SURGICAL THERAPEUTICS

AND

OPERATIVE TECHNIQUE

SURGICAL THERAPEUTICS

AND

OPERATIVE TECHNIQUE

BY

E. DOYEN

ENGLISH EDITION

PREPARED BY THE AUTHOR IN COLLABORATION WITH

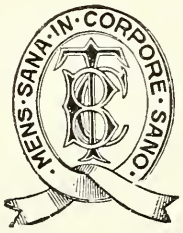
H. SPENCER-BROWNE, M.B. CANTAB., ETC.

ÉLÈVE DE L'INSTITUT PASTEUR ; PHYSICIAN TO AND CHEF DE CLINIQUE DE L'INSTITUT DOYEN

VOL. II.

REGIONAL SURGERY (*Continued*)

OPERATIONS ON THE HEAD (*Continued*), THORAX, UPPER AND LOWER LIMBS



LONDON

BAILLIÈRE, TINDALL AND COX

8, HENRIETTA STREET, COVENT GARDEN

1920 (REPRINTED)

Printed in Great Britain.

CONTENTS OF VOL. II

PART II

REGIONAL SURGERY (*Continued*)

OPERATIONS ON THE HEAD

Operations on the Organs of Mastication and of Deglutition

OPERATIONS ON THE NECK

OPERATIONS ON THE THORAX

OPERATIONS ON THE SHOULDER AND UPPER LIMB

OPERATIONS ON THE SACRUM, ILIUM, AND THE LOWER LIMB

SURGICAL THERAPEUTICS

AND

OPERATIVE TECHNIQUE

Vol. II.

OPERATIONS ON THE HEAD (*Continued*)

OPERATIONS ON THE ORGANS OF MASTICATION AND OF DEGLUTITION.

LIPS AND CHEEKS.

Traumatic Lesions.

Wounds.

Wounds inflicted by cutting instruments may require hæmostasis of the coronary arteries. This is effected by crushing the artery with a short-jawed forceps, which is left in position for two to three minutes. If ligature is necessary, No. 1 silk or No. 0 catgut may be used.

Suture.—When the wound is superficial, we have recourse to intradermic suture with silver wire, or No. 0 Florentine hair. When the section has involved the whole thickness of the tissues, inclusive of the mucous membrane, the mucous edges are first brought together with interrupted fine silk sutures, then those of the cutaneous aspect of the wound.

Inflammatory Lesions.

Acute Inflammatory Lesions.

Furuncle—Anthrax.

These affections, when involving the lips or cheeks, are extremely painful, and, as in all other cases of facial furuncle or anthrax, expose the patient to the complication of phlebitis of the facial vein and intracranial sinuses. Cauterization with the red-hot iron, which till quite recently was the only efficacious remedy in cases complicated with facial phlebitis, is not necessary, if we have timely recourse to injections of antistaphylococcic vaccine and internal administration of mycolysine. Locally we must content ourselves with the application of linseed or starch poultices, frequently renewed. Resolution is the rule. If the antistaphylococcic medication

fails to give the desired result, the thermocautery must be used. I have in many instances obtained rapid subsidence of symptoms and resolution of phlebitis of the cavernous sinus by one or two injections of antistaphylococcic vaccine.

Chronic Inflammatory Lesions.

Tuberculous Ulceration.

The diagnosis is, in general, easy to a practised eye. Histological examination of a small fragment of the altered tissues will remove all doubts. If cauterizations with the galvano-cautery and curettage prove insufficient, it may be desirable to extirpate the foci of ulceration with the bistoury.

Congenital Deformities.

Macrocheilia.

When we have to deal with hypertrophy of either upper or lower lip, whether lymphangiectasis is present or not, the macrocheilia is treated by cuneiform resection of the exuberant tissues.

Operation.—General anæsthesia.

First Stage: Incisions.—Tracing of two semi-elliptical incisions, circumscribing the exuberant structures, and so disposed that the line of reunion will be placed 12 or 15 millimetres behind the junction of skin and mucous membrane—that is to say, at the position least apparent.

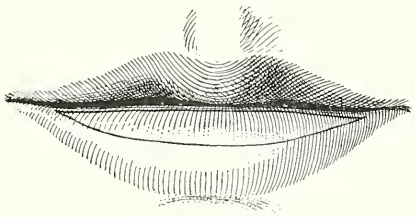


Fig. 1.—Macrocheilia of the Lower Lip.

Tracing of the incisions.

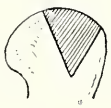


Fig. 2.—Diagrammatic Section of the Mucous Projection of the Lip which has to be extirpated.

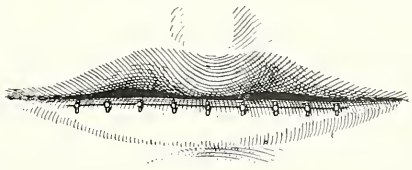


Fig. 3.—Suture of the Wound.

Second Stage: Resection.—Cuneiform resection of the flap thus outlined which will have the form of a segment of an orange.

Third Stage: Hæmostasis and Suture.—Crushing the arterioles with

a short-jawed forceps which is left in position for two or three minutes, usually suffices to secure hæmostasis.

Suture with fine silk, either continuous or interrupted.

Mucous Ectropion.

Simple mucous ectropion may demand either resection of the exuberant tissue, or the extirpation of an elliptical flap of long horizontal diameter from the internal surface of the lip, followed by suture of the wound. This procedure facilitates retraction of the free margin of the lip, which had previously been turned outwards and downwards. The operation is analogous to that for macrocheilia.

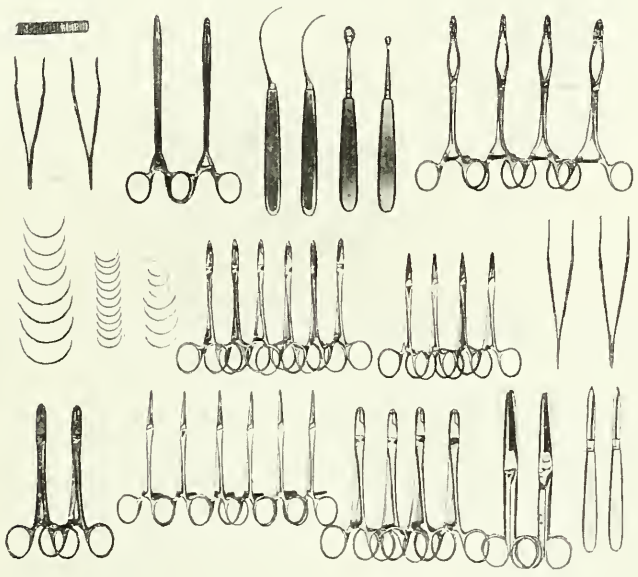


Fig. 4.—Instruments for Operations on the Lips and Jaws.

Below, and from right to left: Two bistouries, two strong curved scissors, four short-jawed artery forceps with claws, six forceps with ringed handles and claws, two short-jawed forceps for veins. Next above: Two artery forceps, four Champonnière's forceps, six needle-holder forceps, four forms of cutting needles, twelve intestinal needles. In uppermost row: Four ringed forceps, two curettes, two needles mounted on handles, two needle-holder forceps with eccentric plates, two clasp-holding forceps, fifty Michel's clasps. (Scale of one-sixth.)

Hare-Lip.

Simple Unilateral Hare-Lip.—Operation for simple unilateral hare-lip should not be performed before the age of eight to ten months, and for complicated hare-lip before twelve to fifteen months. The demands of

parents should be resisted in order to avoid the risk by hasty operation, of either the death of the child or of an unsatisfactory plastic result.

Operation.—Anæsthesia with chloroform.

First Stage : Vivification.—The bistoury penetrates the lip at its border by transfixion, and cuts upwards. A corresponding incision made on the opposite side detaches the mucous membrane completely from the margin of the notch. The vivification should be completed as far as the superior

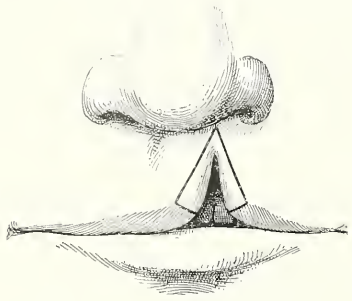


Fig. 5.—Simple Hare-Lip.

Outline of the symmetrical vivification, showing the V-shaped portion of mucous tissue which must be resected.

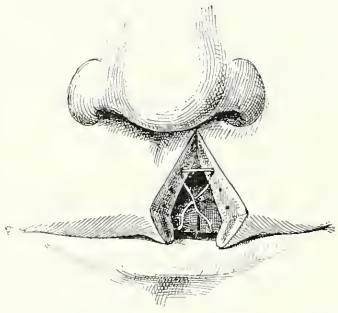


Fig. 6.—Simple Hare-Lip.

The vivification has been completed; position of first muco-mucous suture; two others will be applied below.

angle of the labial cleft; the bistoury should penetrate from the mucous aspect to a depth sufficient to procure a good reunion. The hæmorrhage is insignificant. The mucous V, which is then detached. is excised from right to left.

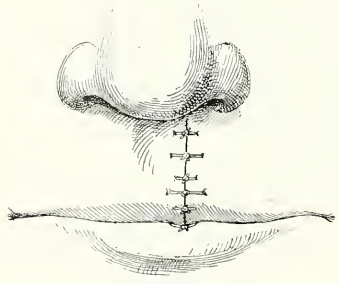


Fig. 7.—Simple Hare-Lip.

The reunion of the vertical portion of the mucous margin of the wound being completed, a point of suture is placed at the angle of union of skin and mucous membrane on the free border of the lip. We then apply on the skin four points of suture, alternately intradermic and subdermic, and finally unite the edges on the free margin of the lip with two points of muco-mucous suture.

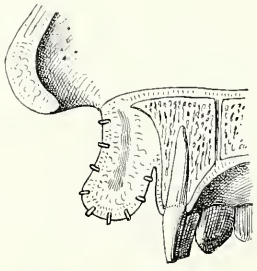


Fig. 8.—Section of the Plane of Reunion showing the Three Intrabuccal Muco-Mucous Sutures, the Four Cutaneous Sutures, the Lowest of which is placed at the Junction of Skin and Mucous Membrane and the Two Muco-Mucous Sutures of the Free Border of the Lip.

Second Stage : Reunion.—We first bring together the mucous tissues on their deep aspect at the level of the gingivo-labial fold. A point of suture is then inserted at the angle of junction of the skin and mucous

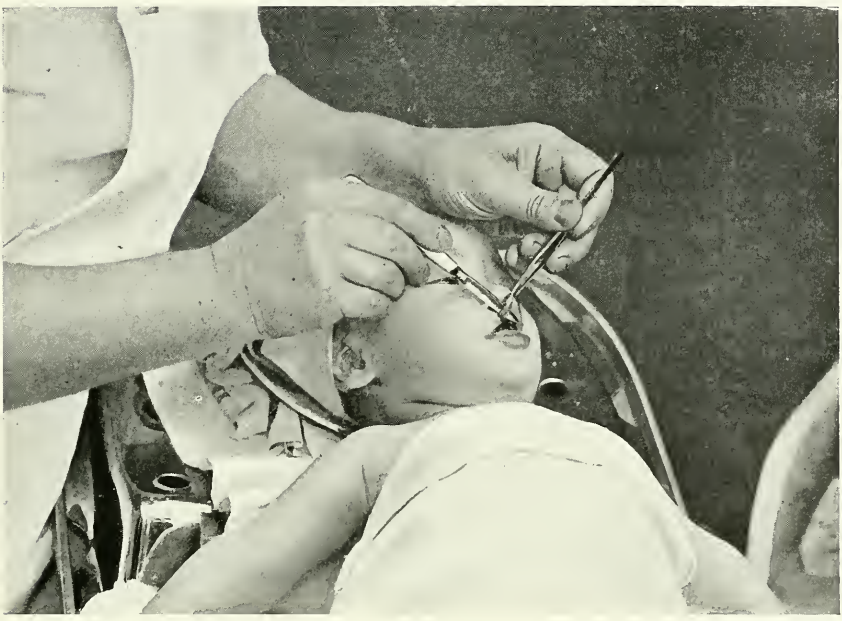


FIG. 9.—SIMPLE UNILATERAL HARE-LIP.

Vivification of left border of notch.

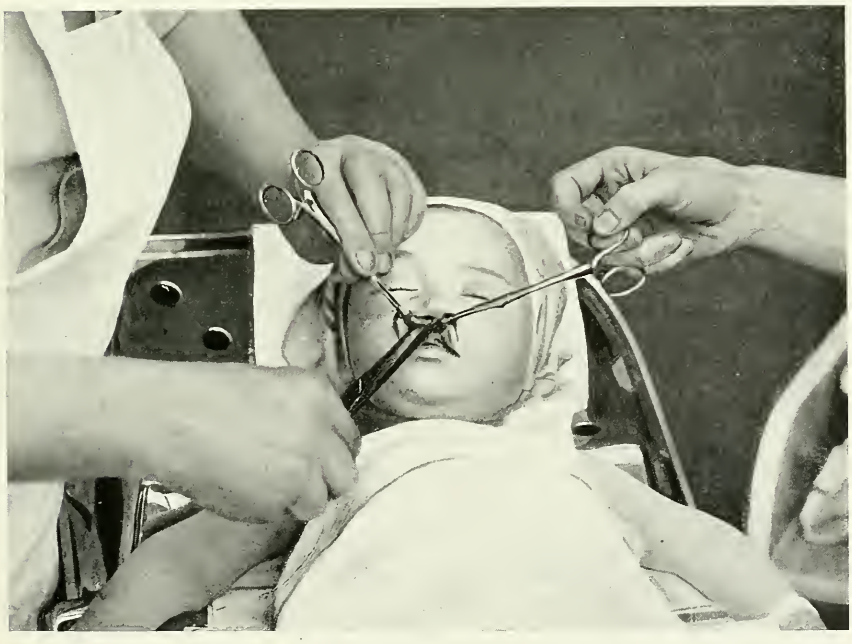


FIG. 10.—SIMPLE UNILATERAL HARE-LIP.

The soft parts are detached with scissors from the superior maxilla so as to facilitate sliding displacement.

FIG. 11.—SIMPLE UNILATERAL HARE-LIP.
First muco-mucous suture.

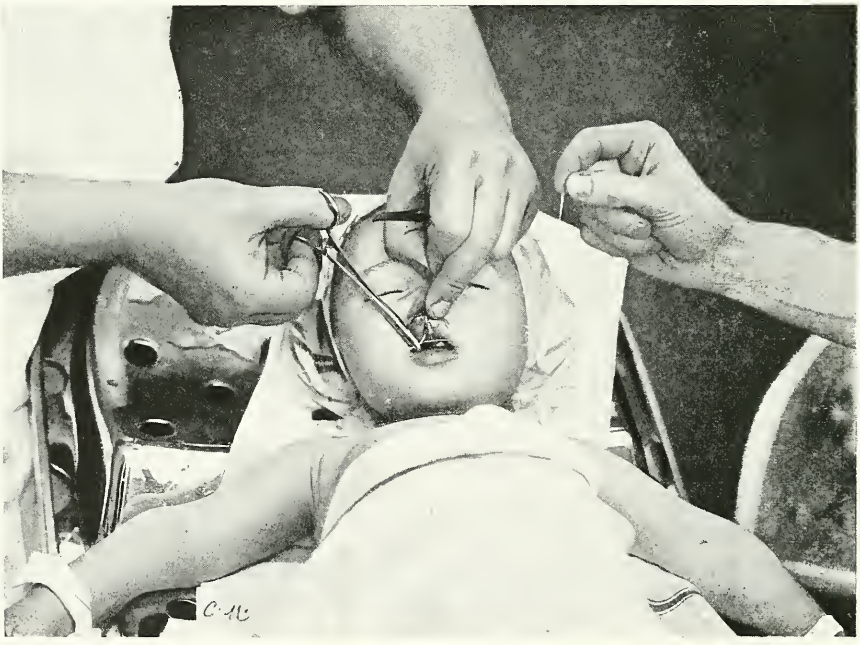


FIG. 12.—SIMPLE UNILATERAL HARE-LIP.
Third muco-mucous suture.

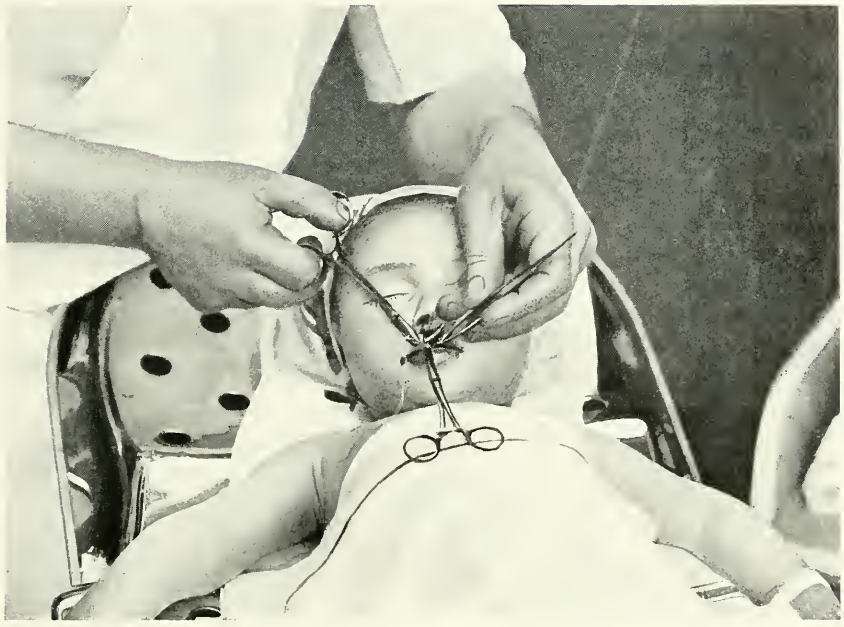


FIG. 13.—SIMPLE UNILATERAL HARE-LIP.

Placing the first cutaneous suture at the junction of skin and mucous membrane.

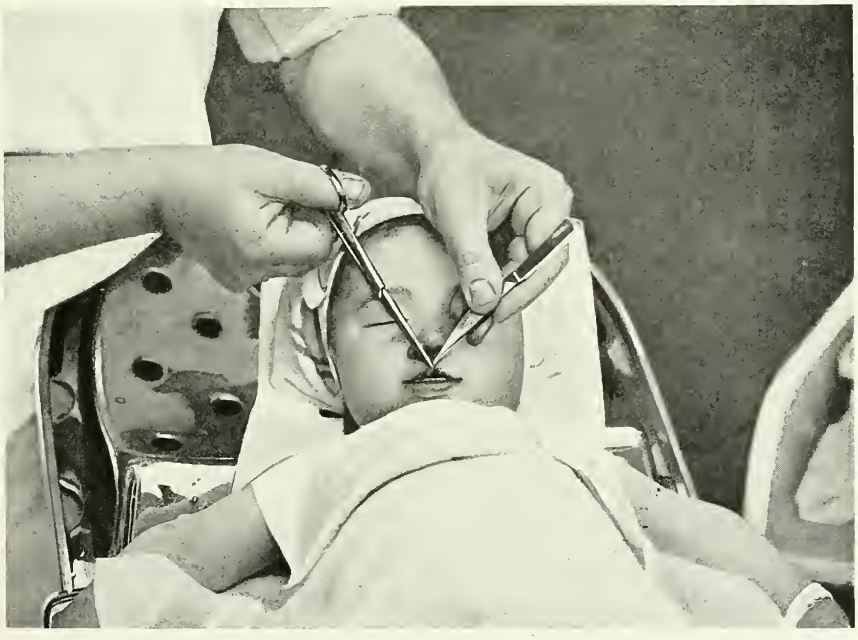


FIG. 14.—SIMPLE UNILATERAL HARE-LIP.

Final resection of a small exuberant portion of the triangular mucous flap before completing the suture of the free border of the lip.

membrane; next the cutaneous sutures are placed, and lastly those on the free mucous border of the lip.

The sutures of the mucous membrane should not penetrate deeper than 3 millimetres in depth. The cutaneous sutures penetrate alternately to a depth, one pair to 3 or 4 millimetres, the others to 2 or 3 millimetres only. The sutures should be of silk or Florentine hair (No. 0), and inserted with a very fine curved needle. The needle should enter and emerge at about 3 millimetres from the line of reunion, in case of the deep sutures, and at 1·5 to 2 millimetres in case of the superficial ones. The coaptation should be exact without tightening the stitches too much.

It will be observed that the reunion is obtained by superficial suture of mucous membrane and skin, and that there are no deep sutures used, as is so wrongly recommended in the classical treatises on the subject. The plastic result obtained in this way is much more satisfactory, and the thickness of the restored lip more considerable.

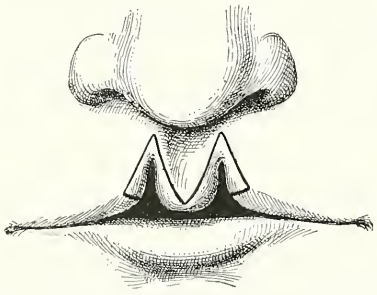


Fig. 15.—Simple Bilateral Hare-Lip. Outline of vivification.

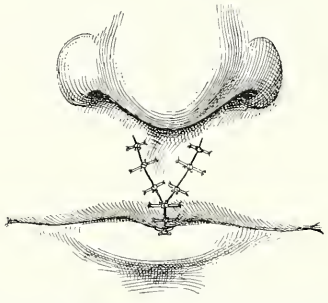


Fig. 16.—Simple Bilateral Hare-Lip. Suture.

Simple Bilateral Hare-Lip—Operation—*First Stage: Vivification.*—Vivification is carried out according to the outline shown in Fig. 15, preserving the skin of the intermediate piece.

Second Stage: Reunion.—The sutures are applied as in case of simple unilateral hare-lip. The vertical mucous margins are first united, then the skin. Care is taken in applying the cutaneous suture at the level of the apex of the median V, to make the loop of thread traverse the inferior extremity of the small intermediate flap in a direction from right to left. This point of suture should be applied exactly at the junction of skin and mucous membrane. We finish the suture, as in case of simple hare-lip, after resection of the exuberant portion of the little mucous V formed in the process of vivification of the free margin of the lip.

When the two notches are very wide, and the vestiges of the upper lip are largely effaced, we must make a curvilinear liberating incision close to the nostril on each side. The suturing is then carried out after sliding displacement of the tissues, as represented in Fig. 18.

When the two notches are very wide (Fig. 17), it may be necessary to add to the curvilinear liberating incision represented in Fig. 17, an

external descending incision of 5 or 6 millimetres, which will provide for the coaptation and reunion represented in Figs. 20 and 21.

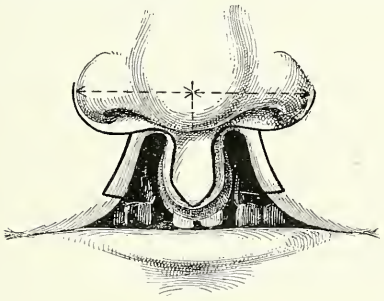


Fig. 17.—Simple Bilateral Hare-Lip.

Very wide notches; liberating incisions necessary for coaptation.

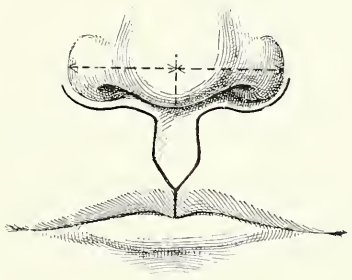


Fig. 18.—Simple Bilateral Hare-Lip.

Sliding displacement of lateral flaps and coaptation.

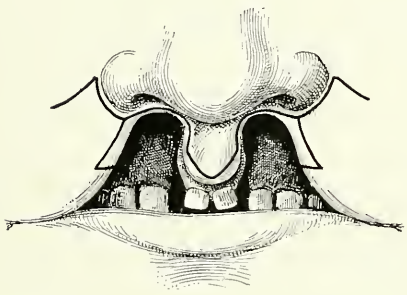


Fig 19.—Simple Bilateral Hare-Lip.

Complementary incisions made in case of excessive shortness of the lateral flaps.

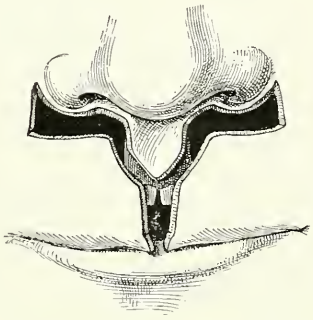


Fig. 20.—Simple Bilateral Hare-Lip.

Vivification completed; reconstruction of the lip.

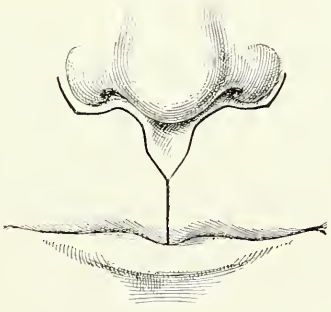


Fig. 21.—Simple Bilateral Hare-Lip.

Coaptation of the flaps.

Complications of Simple Hare-Lip—(*Asymmetry of the Nostrils. Excessive shortness of the Integuments*).—When the nostril on the side of the fissure is very widely open, or when the reunion is rendered difficult by the short-

ness of the two lateral flaps, the lip is detached from its connections with the superior maxilla, with scissors, or spatula. This decollation should be carried out subcutaneously in the wound of vivification, and without extending the wound of the mucous membrane which will be united in the ordinary way.

If the vertical measurement of the repaired lip proves insufficient, this defect can be remedied several months later by adopting the following procedure after the result of the original operation has been finally established.

Operation—*First Stage.*—Resection of the cicatrix of the first operation by a procedure of vivification similar to that of Fig. 15.

Second Stage.—Separate reunion of mucous membrane and then of skin, as in case of simple unilateral hare-lip.

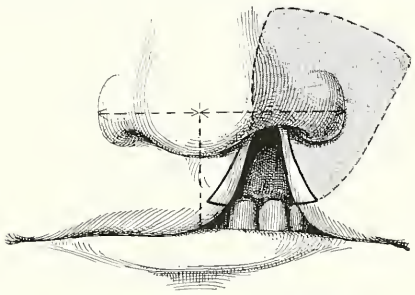


Fig. 22.—Hare-Lip complicated with Unilateral Fissure of Palate.

Outline of vivification. The shaded area indicates the extent of detachment of the soft parts from the maxillæ.

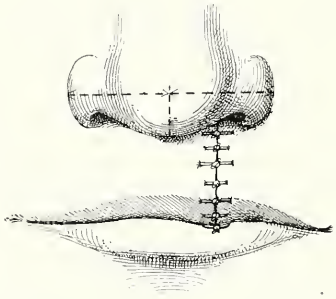


Fig. 23.—Hare-Lip complicated with Unilateral Fissure of Palate.

The suturing is completed, the points being all in position. We can see that the left ala nasi has been brought nearer the middle line, and now occupies a position symmetrical with regard to the right.

Complicated Hare-Lip.—Complicated hare-lip is specially characterized by deviation of the alveolar border, and excessive projection of the incisor tubercle. The deviation and over-riding of the alveolar border, which habitually accompany a cleft palate, should be neglected in the first operation, which, if performed at about the age of eight or ten months, should be limited to restoration of the lip. The procedure of reparation of the alveolar border and of the exuberant projection of the median osseous tubercle of complicated hare-lip should not be undertaken before the age of twelve or fifteen months, except in the case of an extremely vigorous infant.

1. Simple Deviation of the Alveolar Margin.—Deviation of the alveolar border when but slightly pronounced requires no operative interference. When greatly accentuated (Figs. 25 and 26), we can mobilize the projecting osseous tubercle by a vertical cut made with mallet and chisel, and depress it with a brusque shock, after resection of a small quadrilateral from the nasal septum. Care must be taken, in resecting

the exuberant portion of the nasal septum, not to remove a simple triangle (Fig. 26), which would expose the patient to a danger of directing the incisor teeth backwards (Fig. 27). The resection should be carried out (Fig. 28) in such a way that the reduction of the median tubercle will restore the incisor teeth to the normal position (Fig. 29).

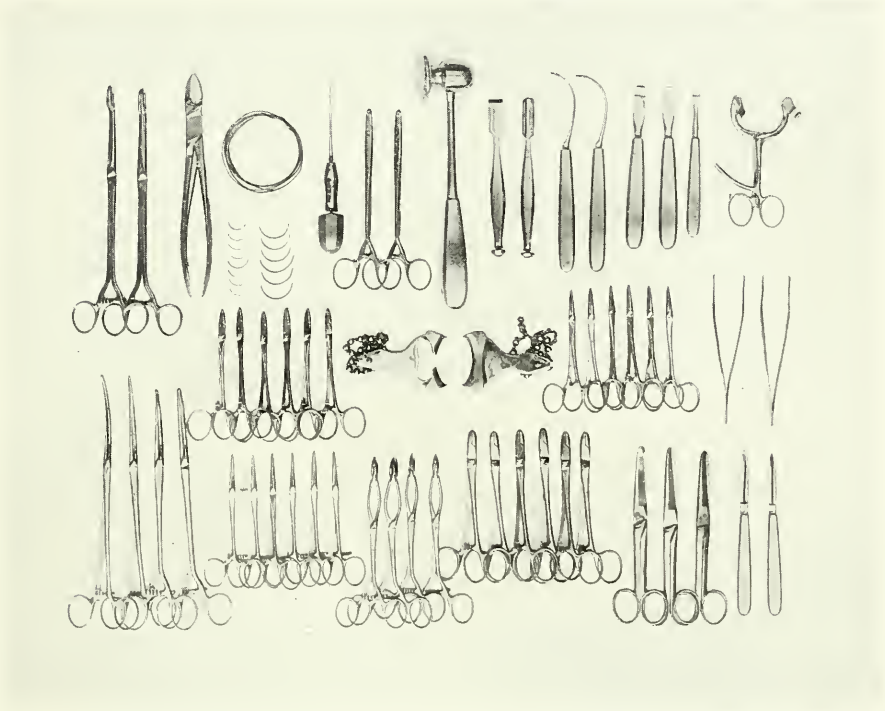


FIG. 24.—INSTRUMENTS FOR OPERATION ON COMPLICATED HARE-LIP AND OSSEOUS SUTURE OF INFERIOR MAXILLA.

Below, from right to left: Two bistouries, two straight scissors, one curved scissors, six short-jawed artery forceps with claws, four ringed forceps with oval jaws, six ringed and clawed forceps, four long forceps with curved jaws. Next above: Two clawed forceps, six Champonnière's forceps, one bicommissural retractor, six needle-holder forceps with excavated jaws. In highest row: One gag for separation of molar teeth, one spatula with cutting edge, two raspatories, two needles with handles, one gouge, one chisel, one mallet, two needle-holder forceps with eccentric plate, one perforator, one roll of gilt, six assorted needles, one Liston's shears, two ringed forceps with eccentric oval jaws. (Reduced scale of one-sixth.)

The mucous membrane is vivified on each side of the osseous tubercle, and on the corresponding points of the fissure of the palate; we then pass the sutures with fine curved needles. Fixation of the mobilized osseous tubercle is assured by tying together the neighbouring teeth on each side with Florentine hair, or even with silver wire.

2. EXUBERANCE OF THE INCISIVE TUBERCLE.—When the forward projection of the incisive tubercle is very considerable, it is not always possible

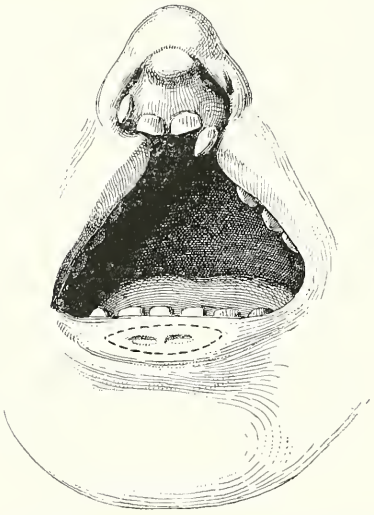


FIG. 25.—BILATERAL HARE-LIP.

With projection of median tubercle, without fissure of palate; congenital fistulæ of lower lip.

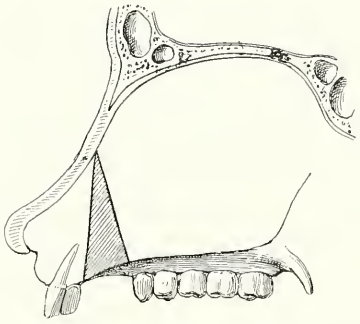


FIG. 26.—BILATERAL HARE-LIP.

Exaggerated projection of incisive tubercle; defective resection of nasal septum.

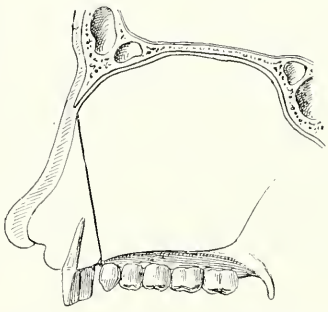


FIG. 27.—BILATERAL HARE-LIP.

Backward deviation of incisor teeth after triangular resection of nasal septum.

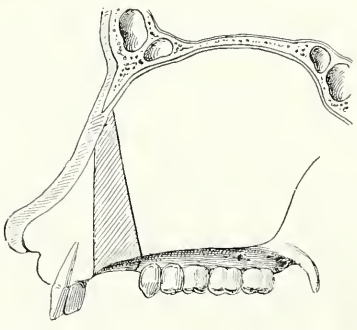


FIG. 28.—BILATERAL HARE-LIP.

Outline of the quadrangular resection of the nasal septum, which is suitable for reduction of the incisive tubercle.

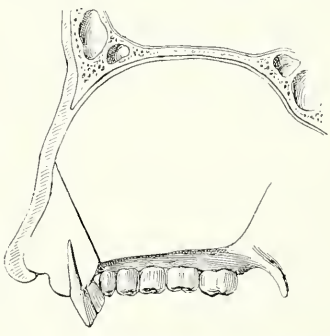


FIG. 29.—BILATERAL HARE-LIP.

Reduction of incisive tubercle to normal position after resection of nasal septum.

FIG. 30.—BILATERAL HARE-LIP.

With projection of incisive tubercle, without fissure of palate, and complicated with congenital fistula of the lower lip.

FIG. 31.—BILATERAL HARE-LIP.

The incisive tubercle has been restored to its place with complete preservation of the teeth.

to reduce it, as the reduction involves too great a depression of the lobule of the nose. We then carry out a partial resection of the tubercle, disposing the skin so as to reconstitute the lower margin of the septum, and adjusting the mucous membrane folded round the osseous tubercle to the anterior

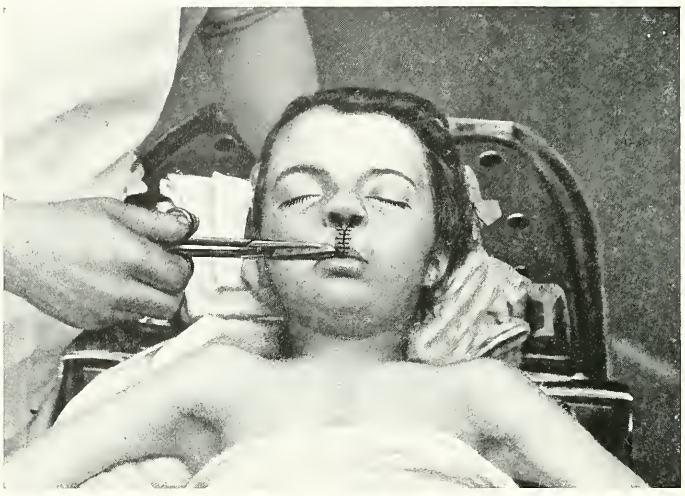


FIG. 32.—BILATERAL HARE-LIP.

The suturing of the lip has been completed. Note the perfect symmetry of the nostrils.

part of the palatine fissure. The mucous covering of the median tubercle is united on each side to that of the adjacent gum, after vivification of the neighbouring surfaces, and the suture is strengthened by adjustment of two dental ligatures. The reparation of the palatine fissure is preferably postponed till after the sixth year.

Commissural Fissure.

The reparation of commissural fissure is easy, and is carried out in the following way:

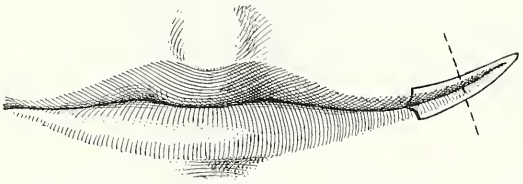


FIG. 33.—FISSURE OF LABIAL COMMISSURE.

Outline of vivification.

FIG. 34.—FISSURE OF LABIAL COMMISSURE.

Section of this fissure in the direction of the dotted line of Fig.

Operation—FIRST STAGE: VIVIFICATION.—Oblique section of the lower border of the lip, and resection of the exuberant mucous membrane.

Second Stage.—Separate reunion, first of the mucous membrane, then of the skin, followed by suture of the new commissure (Figs. 35 and 36).

Fissure of the Lower Lip.

Fissure of the lower lip is very rare, and is found only in the middle line. It is repaired in the same way as the commissural fissure.

Fig. 35.—Fissure of Labial Commissure.

Interrupted suture of mucous membrane and of skin.

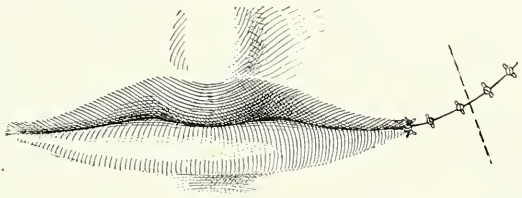


Fig. 36.—Fissure of Labial Commissure.

Appearance of finished suture.

Congenital Fistulæ of Lower Lip.

These fistulæ are usually bilateral, and present the appearance of two little mucous infundibula, situated near the junction of skin and mucous membrane, and ending in the vicinity of the frænum. They habitually coexist with hare-lip deformity above. Such was the case of the infant, the operation on whom is represented in Figs. 25, 30, 31, 32, and 37.

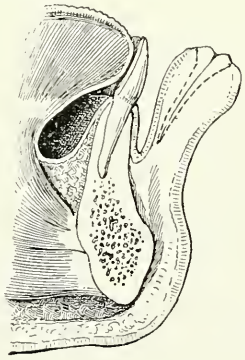


Fig. 37.—Congenital Fistulæ of Lower Lip (see Fig. 25).

Operation—First Stage.—Cuneiform resection of little transverse flap at the junction of skin and mucous membrane, including the two mucous infundibula, the deep tract of each of which is extirpated as completely as possible.

Second Stage.—Suture with very fine silk.

Acquired Deformities.

Cicatrices of Burns.

The cicatrices of burns are retractile, and should be extirpated throughout their whole depth. They habitually present the consistence of true fibrous nodules, of very resistant structure. The great point to be observed

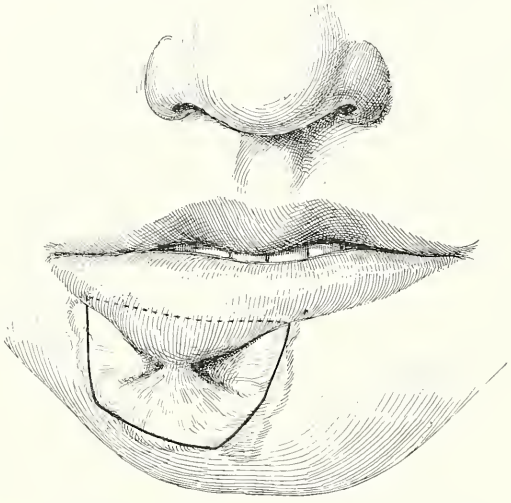


FIG. 38.—ECTROPION OF LOWER LIP RESULTING FROM A BURN OF THE FOURTH DEGREE.

in the extirpation of a cicatrix is to preserve every portion of existing healthy, or almost healthy, skin, and in general, all supple tissues which have not

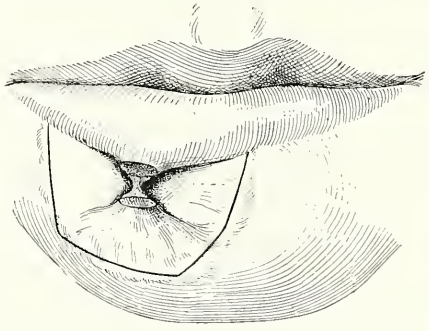


FIG. 39.—ECTROPION OF LOWER LIP RESULTING FROM A BURN OF THE FOURTH DEGREE.

Section of the principal cicatricial band; outline of area of resection of the pathological tissues.

undergone cicatricial retraction. It is better to obtain a satisfactory result by two or three successive autoplastic restorations, separated by periods of five or six months each, than to try to effect too much at a single séance.

Cicatricial Ectropion of the Lower Lip.

In most cases of burn the mucous membrane of the lower lip escapes, but we meet with a partial or complete ectropion produced by the retractility of the cutaneous cicatrix, which has the effect of drawing the mucous

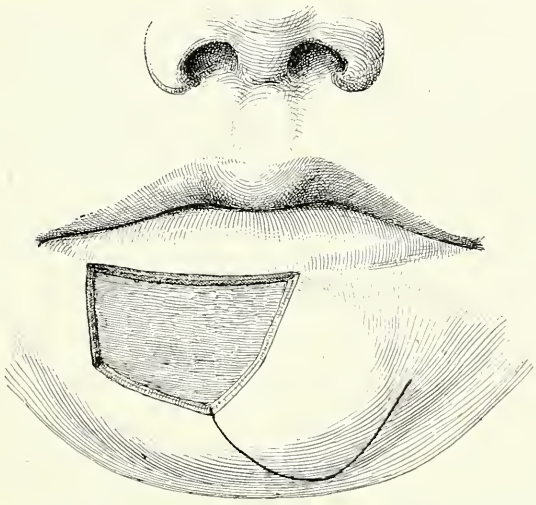


FIG. 40.—ECTROPION OF LOWER LIP RESULTING FROM A BURN OF THE FOURTH DEGREE.

Extirpation of the retractile tissues; outline of autoplastic flap.

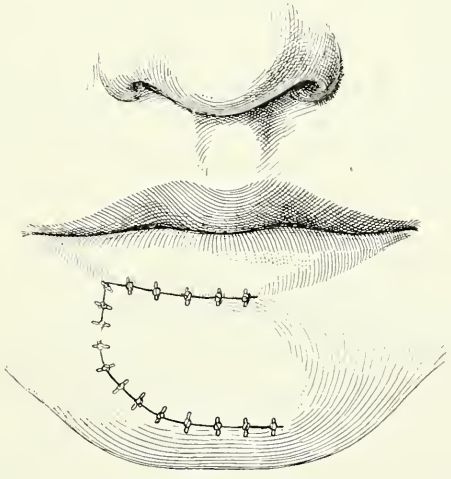


FIG. 41.—ECTROPION OF LOWER LIP RESULTING FROM A BURN OF THE FOURTH DEGREE.

Sliding displacement and suture of autoplastic flap.

surface towards the level of the chin. The cicatrix having been resected and the mucous membrane completely freed, we obtain a very extensive

wound, which corresponds pretty exactly to the area of the tissues which have been destroyed by the action of the heat. The repair of the same must be carried out according to the degree of integrity of the surrounding tissues, by mobilization of a cutaneous flap. In this we follow the indications above given for cheiloplasty in general.

Ectropion and Cicatricial Bands of the Upper Lip.

On the upper lip, if the nose has escaped, we rarely meet with more than a partial ectropion, and of limited extent, produced by retraction of one or more narrow cicatricial bands. I have obtained excellent results from complete extirpation of these retractile bands. They are never reproduced if care is taken to leave none of the deep traces of their tissue. As soon as the non-reproduction of the cicatricial band is certain—that is to say, after the lapse of five or six months—we complete the autoplasty of the lip, if necessary, by the sliding displacement of a small cutaneous flap raised near the ala nasi.

Cicatricial Ectropion.

The operation consists of three stages:

First Stage.—Incision of cicatrix and complete freedom of the lip.

Second Stage.—Excision of the retractile cicatricial tissues throughout their whole extent.

Third Stage.—Autoplasty by one of the modes of procedure already indicated, according to the form and extent of the loss of substance of the integument.

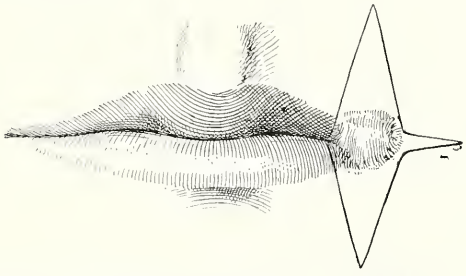


Fig. 42.—Atresia of Labial Commissure resulting from a Burn of the Fourth Degree.

Outline of autoplastic incisions.

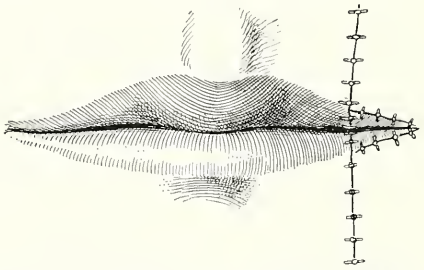


Fig. 43.—Atresia of Labial Commissure resulting from a Burn of the Fourth Degree.

Resection of pathological tissues, and reconstitution of the buccal commissure. The sutures are completed.

Adhesions and Atresia of the Buccal Orifice.

Simple Atresia.

Simple atresia is treated by an operation analogous to that of external canthoplasty. The skin and mucous membrane are divided horizontally, to the necessary extent, on one or both sides. A portion of skin sufficient

to secure the normal folding of the mucous membrane outwards is then excised from either lip, and the mucous membrane is united to the skin by interrupted sutures.

Cicatricial Atresia.

Cicatricial atresia of a labial commissure resulting from a burn requires the resection of the pathological tissues throughout their whole thickness. This resection is carried out by a double V-incision, circumscribing a lozenge, with its long axis vertical. In order to establish the normal extent of the commissure a small V-incision, represented in Fig. 42, is then made; the intermediate tissues are then resected and the two small mucous flaps are sutured to the skin. Vertical reunion of the two V-incisions, superior and inferior, is then carried out by interrupted suture of skin and mucous membrane.

Tumours.

Benign Tumours.

Lipomata—Fibromata—Myxomata.

These tumours are preferably extirpated through a transverse buccal incision. The operation is simple, and varies in details with the individual case.

Cysts—Adenomata.

These tumours must also be extirpated with the bistoury. If local anæsthesia be sufficient, the region to be anæsthetized is circumscribed by

Fig. 44.—Cirsoid Angioma of Lower Lip.

Showing by translucency of integuments the two afferent arterial trunks and their ramifying branchlets.

application of two long forceps with elastic jaws. Interstitial injections of a 1 in 50 solution of cocaine are used, taking care to anæsthetize the skin by application of ethyl chloride.

Angiomata.

Angiomata of very limited extent should be extirpated with the bistoury. Little blood escapes if incision is made at a distance of 2 to 3 millimetres beyond the margin of the cavernous tissue.

Diffuse angiomata can be cured only by complicated operations. In cases in which extirpation is impossible, either at once or in a number of stages, good results are obtained by *dilaceration of the cavernous tissues*, which

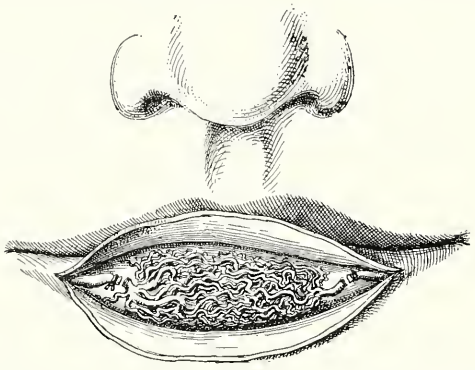


Fig. 45.—Cirsoid Angioma of Lower Lip.

Dissection of mucous membrane, and ligature of the two afferent arteries. Section of arteries beyond the ligature, and extirpation of angioma.

is effected by small incisions with a blunt instrument, or even with the finger. The operation is followed by antiseptic tamponing. It is repeated a number of times at intervals of several weeks. The inflammatory processes finally obliterate the cavernous spaces.

I have met with a curious case of cirsoid angioma of the lower lip, which is represented in Figs. 44 and 45.

Malignant Tumours.

Epithelioma.

Epithelioma is in most cases so characteristic in appearance that it is unpardonable to neglect it. I must, however, mention the occasional occurrence of apparently simple ulceration of the lips in persons affected with buccal psoriasis, which prove histologically to be formed of pavement epithelioma containing epidermic globular nests. Early diagnosis of this small epithelioma requires great clinical experience.

Epithelioma affects the lower lip more frequently than the upper. Infection of the lymphatic glands—submaxillary, median suprahyoid, and even carotid—is sometimes very rapid. These tumours require early and complete extirpation. The operations for labial epithelioma will be described in the section on cheiloplasty.

Cheiloplasty—Longitudinal Excision of the Free Border.—Superficial excision of the free border of either lip is indicated in cases of superficial epitheliomata of considerable transverse diameter. It is carried out as in the operation for macrocheilia.

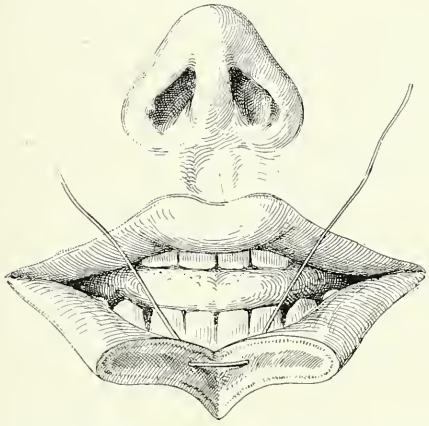


FIG. 46.—V-RESECTION OF LOWER LIP FOR A SMALL CANCROID.

Position of first muco-mucous suture.

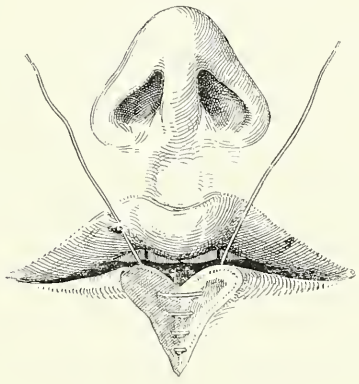


FIG. 47.—V-RESECTION OF LOWER LIP FOR A SMALL CANCROID.

Suture of vertical portion of mucous membrane is almost completed; position of fourth suture.

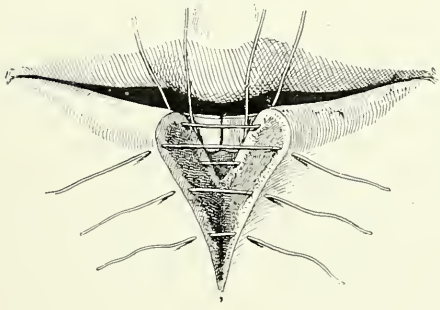


FIG. 48.—V-RESECTION OF LOWER LIP FOR A SMALL CANCROID.

Diagram showing the position of the last mucous and first cutaneous sutures.

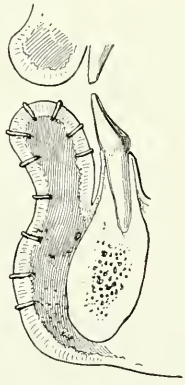


FIG. 49.—V-RESECTION OF LOWER LIP FOR A SMALL CANCROID.

Section of plane of reunion, showing the position of the mucous and cutaneous sutures.

OPERATION—*First Stage.*—Resection of a transverse cuneiform flap, circumscribed by two semi-elliptical incisions.

Second Stage.—Interrupted suture with fine silk.

Cuneiform or V-Shaped Resection.—When the epithelioma, while of small dimensions, engages the whole thickness of the lip, the best procedure

is cuneiform resection, carried at a distance of 3 or 4 millimetres beyond the limits of the neoplasm.

Operation.—Local anæsthesia, with stovaïne, after application of two forceps with elastic jaws, or general anæsthesia.

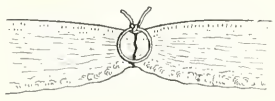


Fig. 50.—Suture of Lip.

Defective coaptation obtained by deep cutaneous sutures made to penetrate nearly to the mucous membrane.

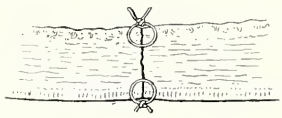


Fig. 51.—Suture of Lip.

Perfect coaptation obtained by separate reunion of mucous membrane and of skin.

First Stage.—Cuneiform resection of the lip, taking care to keep at a distance of 3 to 4 millimetres beyond the outermost limits of the neoplasm.

In order to avoid shortening the vertical diameter of the lip, we curve the branches of the V-incision in giving one or both a certain degree of concavity or convexity, according as the free border of the lip, or its median portion only, displays greater exuberance of tissue. The lower extremity of the V should be formed at a very acute angle. The resection of the mucous membrane varies with the extent of the neoplasm towards that side.

Second Stage.—Hæmostasis, where necessary, with short-jawed forceps. Leave forceps in position for three or four minutes, then suture.

We begin by interrupted suture of the mucous membrane. Three or four points are applied, according to the extent of the resection (Figs. 46 and 47). The skin is then sutured, the first point being placed at its junction with the mucous membrane. As in operation for hare-lip, the reunion is completed with the free border of the lip. For the sutures we use No. 1 silk or fine Florentine hair, and small curved needles.

It will be noticed that the skin and mucous membrane are to be reunited separately. We must reject absolutely the mode of suture still recommended in some of the classical treatises, which consists (Fig. 50) of the insertion of deep sutures from the cutaneous surface only, the thread passing down to a depth of but 1 or 2 millimetres from the mucous membrane. This procedure is very defective, as it narrows the surfaces of coaptation; which, on the other hand, attains its maximum width when the sutures are applied, as I have described, in separate reunion of mucous membrane and skin.

Resection of more than One-Third of the Lower Lip.—Resection in form of a plain V is suitable only in cases in which the extent of the excision is not greater than one-fourth of the lower lip. Extirpation of more than one-third demands an immediate autoplastic reparation. This should be carried out by the procedure of triangulation described below. Coaptation is obtained by sliding displacement of the facial integument, lined by the normal mucous membrane. I devised this procedure in 1886.

1. Restoration of One-Half of the Lower Lip, and, if necessary, of a Commissure (Procedure of Two Triangles)—*First Stage: Tracing of the Cutaneous Incisions.*—A series of rectilinear incisions circumscribing two isosceles triangles is made, as sketched in Fig. 52. The apices of these triangles meet at the labial commissure.

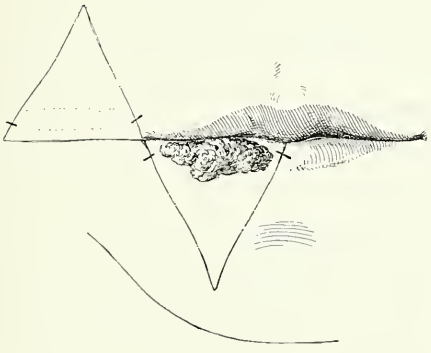


Fig. 52.—Resection of One-Half the Lower Lip by the Method of Triangles Meeting at their Apices.

Outline of incisions.

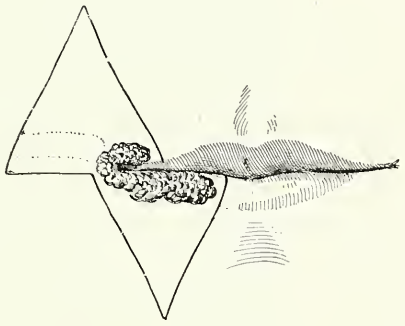


Fig. 53.—Resection of One-Half of Lower Lip, with Adjacent Commissure, and a Portion of Upper Lip

Outline of incisions.

When the commissure has been invaded by the cancer, the outline of the incisions is modified, as represented in Fig. 53.

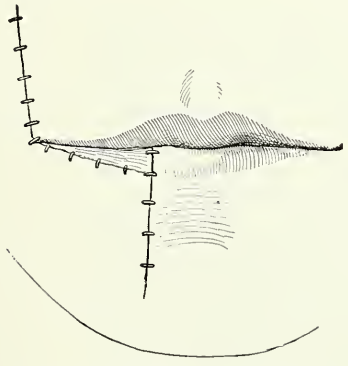


Fig. 54.—Resection of One-Half of Lower Lip.

Appearance of finished suture.

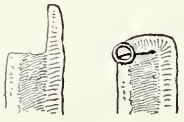


Fig. 55.—Section of the Small Buccal Mucous Flap which is to be sutured to the Skin, so as to reconstruct the Free Border of the Lip.

When the commissure has been invaded by the cancer, we modify the outline of the incisions, as represented in Fig. 53.

Second Stage: Extirpation of Neoplasm and of the Upper Cutaneous Triangles.—The cancer is extirpated outside its limits, and with the corresponding cutaneous triangle. The superior or genial cutaneous triangle is then excised, preserving the mucous membrane, which is in turn cut out in the form of a small horizontal flap of 18 to 20 millimetres in height.

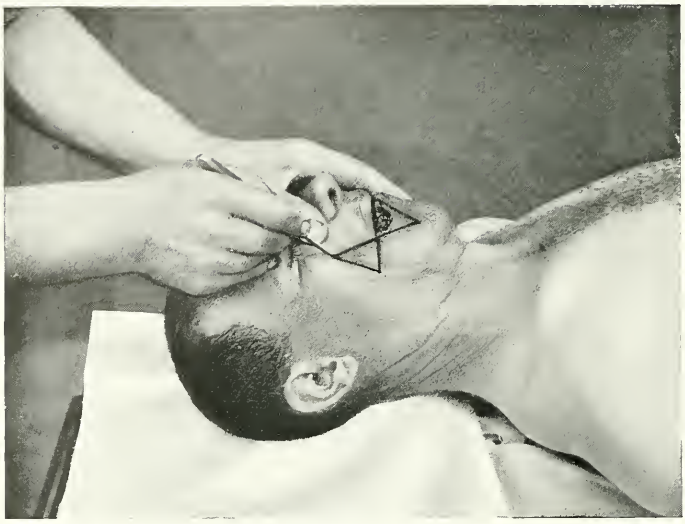


FIG. 56.—RESECTION OF ONE-HALF OF LOWER LIP.
Procedure of triangles meeting at their apices.

FIG. 57.—THE SAME.
The buccal mucous membrane has been sutured to the skin so as to reconstruct the lip.

FIG. 58.—THE SAME.
Median reunion of skin.

FIG. 59.—THE SAME.
Appearance of finished suture.

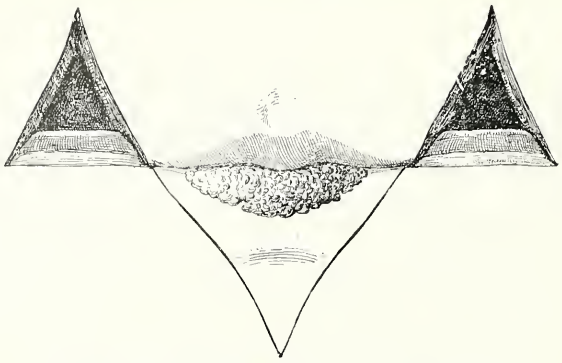


FIG. 60.—TOTAL RESECTION OF LOWER LIP.

Diagrammatic outline of incisions. At the bases of the lateral triangles where the skin has been removed, are seen the flaps of buccal mucous membrane which are to be sutured to the skin so as to reconstruct the free border of the lip.

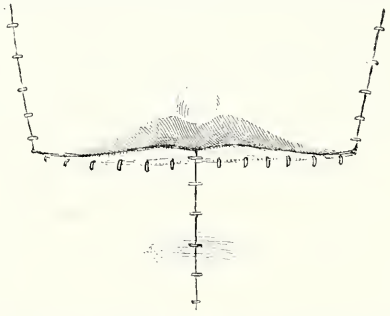


FIG. 61.—TOTAL RESECTION OF LOWER LIP.
Appearance of completed suture.

FIG. 62.—TOTAL RESECTION OF LOWER LIP BY THE PROCEDURE OF THREE TRIANGLES.
Outline of incisions.

FIG. 63.—TOTAL RESECTION OF LOWER LIP.

Appearance of wounds after extirpation of the lip and cutaneous triangles.

FIG. 64.—TOTAL RESECTION OF LOWER LIP.

Sutures have been completed. On comparing this figure with the preceding, we observe that the lower lip has been widened by the vertical reunion of the right and left artificial wounds.

Third Stage : Hæmostasis and Reunion.—The small mucous flap which is to reconstitute the free border of the lip (Fig. 55) is sutured to the skin. We then carry out the vertical suturing of the mucous membrane of the lower lip, as in the case of simple V-resection (Fig. 46). The skin is then sutured to the free border of the lower lip, and the vertical suture of the mucous membrane of the cheek is then completed; and after this, that of the upper lip to the skin of the cheek, taking care to reconstruct the labial commissure.

2. Restoration of the Totality of the Lower Lip (Procedure of Three Triangles).—Restoration of the whole lower lip is effected by the procedure of three triangles.

First Stage : Tracing the Cutaneous Incisions.—We make in succession, and each by a single stroke, the incisions represented in Figs. 62 and 63.

Second Stage.—Resection of the neoplasm and corresponding cutaneous triangle, then of the two lateral cutaneous triangles, preserving the mucous membrane in case of each of the latter. This is divided and shaped in form of two small rectangular flaps which are to serve for reconstruction of the free border of the lip (Fig. 60).

Third Stage : Hæmostasis and Reunion.—We first suture to the skin the two small mucous flaps which are to reconstitute the free border of the lip, then reunite the mucous membrane of the lower lip from below upwards in the middle line ; after that the skin at the free border of the lip. We have then but to carry out the reunion of the mucous membrane of the cheek on each side; and, lastly, the skin of the lower lip to that of the cheek, taking care to reconstruct the labial commissures.

In cases in which the cancer is exactly median in position, and the commissures have remained intact, it may happen that the extent of the V-resection does not permit sufficient reconstruction of the lower lip. We then trace two compensatory triangles, one on either cheek, and carry out the repair by preserving the two outer segments of the lip, as represented in Fig. 64. I have never had occasion, in repair of the lower lip, to have recourse to any other procedure than this of the two triangles.

Post-Operative Median Notch.—If the extent of the loss of substance leaves an ungraceful median notch after cicatrization, the repair can be carried out by V-shaped incision of the integuments, as in ectropion of the lower lip, and suturing the wound in Y-outline, so as to produce elevation of the median portion of the lip, which had previously been depressed.

Pontine Cheiloplasty.—When the loss of substance is so extensive that the procedure by three triangles cannot be applied, we may, after extirpation of the neoplasm, fashion a mental flap in bridge form. But this procedure is applicable only to those cases in which the mucous membrane can be preserved in nearly its whole height. The mental wound is then repaired by gliding displacement of a cervical flap mobilized by two curvilinear incisions.

Restoration of the Upper Lip—1. Unilateral Restoration.—Unilateral restoration of the upper lip is effected by gliding displacement of a cutaneous genial flap, which must include on its deep aspect the extent of mucous membrane necessary for the repair of that resected with the neoplasm.

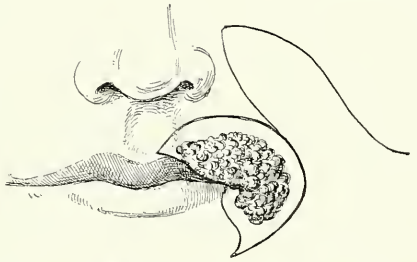


Fig. 65.—Epithelioma of Upper Lip and Commissures.
Outline of incisions combined for extirpation and autoplasty.

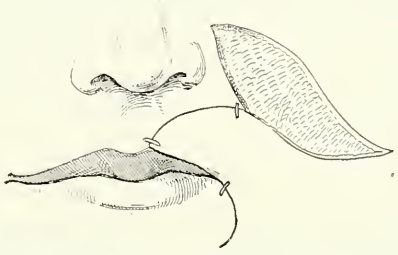


Fig. 66.—Epithelioma of Upper Lip and Commissure.
Mobilization and coaptation of autoplastic flap.

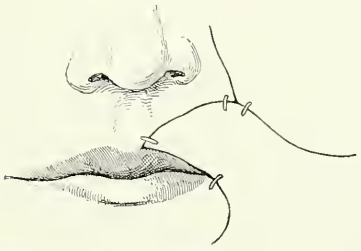


Fig. 67.—Epithelioma of Upper Lip and Commissure.
Suture of wound resulting from displacement of autoplastic flap.

Operation—*First Stage.*—Extirpation of neoplasm.

Second Stage.—Mapping out of autoplastic flap (Fig. 65).

Third Stage.—The autoplastic flap cut from the inner part of the cheek, will or will not include the subjacent mucous membrane, according as the mucous membrane of the lower lip has or has not been resected.

A small triangle of healthy skin is resected at the lower part of the wound, in order to facilitate the coaptation of the autoplastic flap. The

FIG. 68.—EPITHELIOMA OF UPPER LIP AND COMMISSURE.

FIG. 69.—EPITHELIOMA OF UPPER LIP AND COMMISSURE.
Extirpation of tumour and a small triangle of healthy skin near the mental region.

FIG. 70.—EPITHELIOMA OF UPPER LIP AND COMMISSURE.

Autoplasty. Tracing of cutaneous flap destined for reparation of upper lip.

FIG. 71.—EPITHELIOMA OF UPPER LIP AND COMMISSURE.

The lip has been reconstructed. Above the left labial commissure we recognize the suture of the incision made to facilitate coaptation of the autoplastic flap.

cutaneous flap is fixed by some points of suture. The free border of the lip is then reconstructed by suturing the mucous margins to the lower margin of the flap, and the cutaneous sutures are completed in the way represented in Figs. 66 and 67

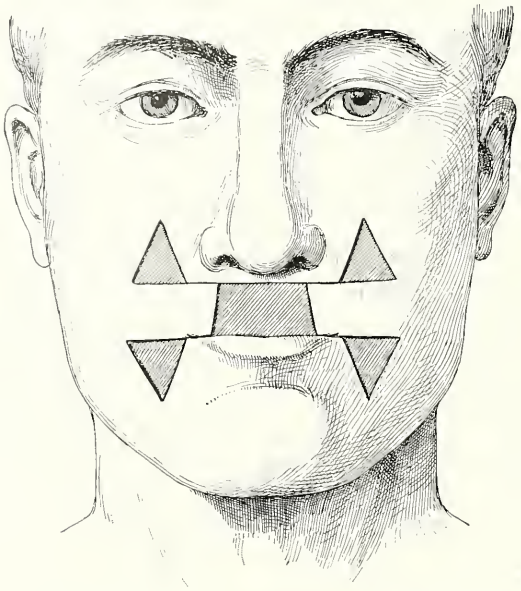


FIG. 72.—RESTORATION OF NEARLY THE WHOLE UPPER LIP.

Outline of autoplastic incisions which circumscribe two symmetrical muco-cutaneous triangles on each side.

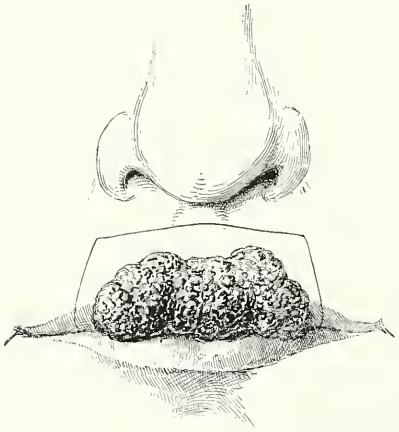


FIG. 73.—EXTIRPATION OF CANCROID INVOLVING NEARLY THE WHOLE SUBSTANCE OF THE UPPER LIP.

Outline of the necessary incisions.

2. TOTAL RESTORATION.—The complete, or approximately complete, resection of the upper lip can be repaired by the procedure of four triangles.

The operation is derivable from the restoration of the lower lip by the procedure of three triangles, above described. We must remember that the autoplastic flaps, which comprise the whole thickness of the tissues of the cheek, contain numerous arterioles derived from the facial artery.

Fig. 74.—The Same.

Wound resulting from the extirpation.

Operation—*First Stage.*—Resection of tumour with subjacent mucous membrane (Fig. 74). Then, arterial hæmostasis by application of short-jawed forceps. These can be removed at the end of four to five minutes. The crushing suffices for arrest of bleeding in most cases.

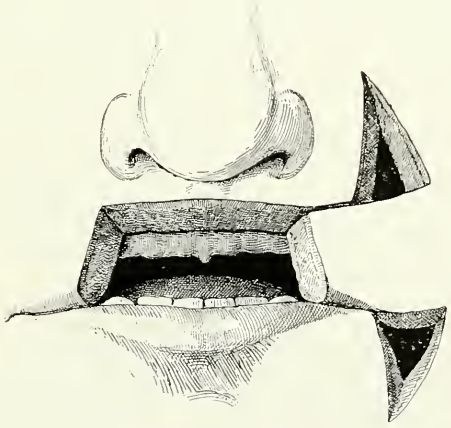


Fig. 75.—The Same.

Mobilization of the horizontal muco-cutaneous flap of left side after resection of two lateral triangles.

Second Stage.—Mobilization of autoplastic flap on left side after resection of two muco-cutaneous triangles—a superior and an inferior. The

resection of those two flaps permits displacement of the horizontal muco-cutaneous flap towards the middle line, for reconstitution of the corresponding half of the upper lip (Fig. 76).

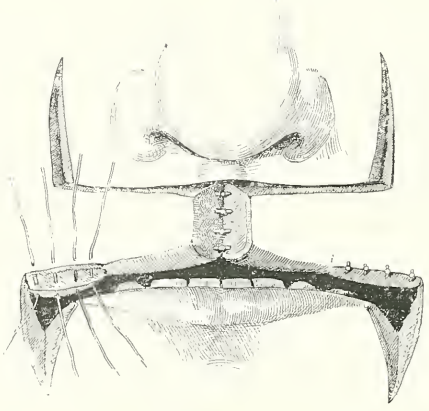


Fig. 76.—The Same.

Mobilization of symmetrical flap on right side; muco-mucous reunion of the two flaps in the middle line; reconstruction of the mucous margin of the free border of the lip.

Third Stage.—Mobilization of a symmetrical muco-cutaneous flap on the right side, and hæmostasis.

Fourth Stage.—Muco-mucous sutures, superior and inferior, at the level of the two resected triangles, and a horizontal one at the position of the superior gingivo-labial groove.

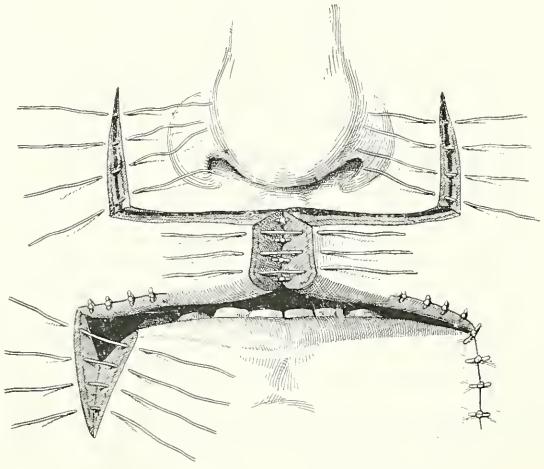


Fig. 77.—The Same.

Cutaneous reunion of the two flaps in the middle line; suture of margins of the four artificial wounds resulting from resection of the four lateral triangles.

Fifth Stage.—Muco-mucous reunion of the two antoplastic flaps in the middle line, and reconstruction of the mucous margin of the free border of the lip (Fig. 78).

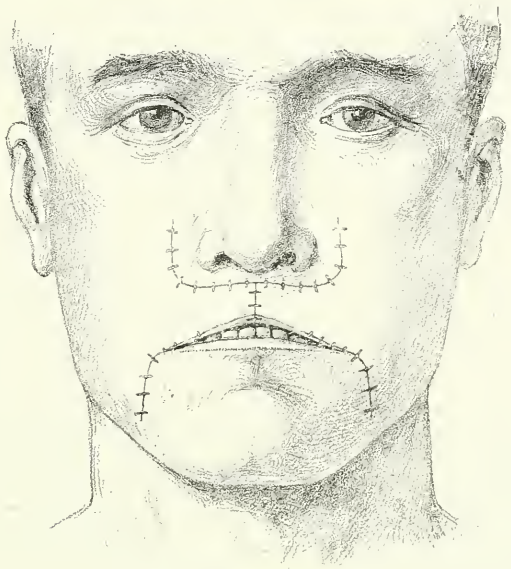


FIG. 78.—THE SAME.

Autoplasty by the procedure of four triangles. The operation has been completed; appearance of the sutures.

Sixth Stage.—Cutaneous reunion of the two autoplastic flaps in the middle line, and vertical suture of the four wounds left by resection of the four lateral muco-cutaneous triangles.

The plastic result of this operation is very satisfactory.

PAROTID REGION.

Traumatic Lesions.

Superficial Wounds.

Suture of superficial wounds is carried out without difficulty after disinfection of the field of operation. Clips or intradermic sutures may be employed.

Wounds of the Extremity of Steno's Duct.

When the terminal portion of Steno's duct is involved, there is danger of fistula, especially when the wound is not a perforating one. In wounds of the posterior portion of the cheek we should look carefully for flow of saliva during mastication. The lumen of Steno's duct is easy to recognize.

Operation.—The genial mucous membrane, if not perforated by the instrument which inflicted the wound, is incised transversely, and the main trunk of Steno's duct is fixed to the lips of this incision with a double silk thread which traverses each corresponding wall.

Inflammatory Disorders.

Furuncle and Anthrax.

Furuncle and anthrax involve a danger of facial phlebitis. Antistaphylococcic treatment, combined with mycolysine.

Parotiditis.

Suppurative parotiditis is a frequent complication of many acute diseases. The infection is propagated along Steno's duct. Accordingly,

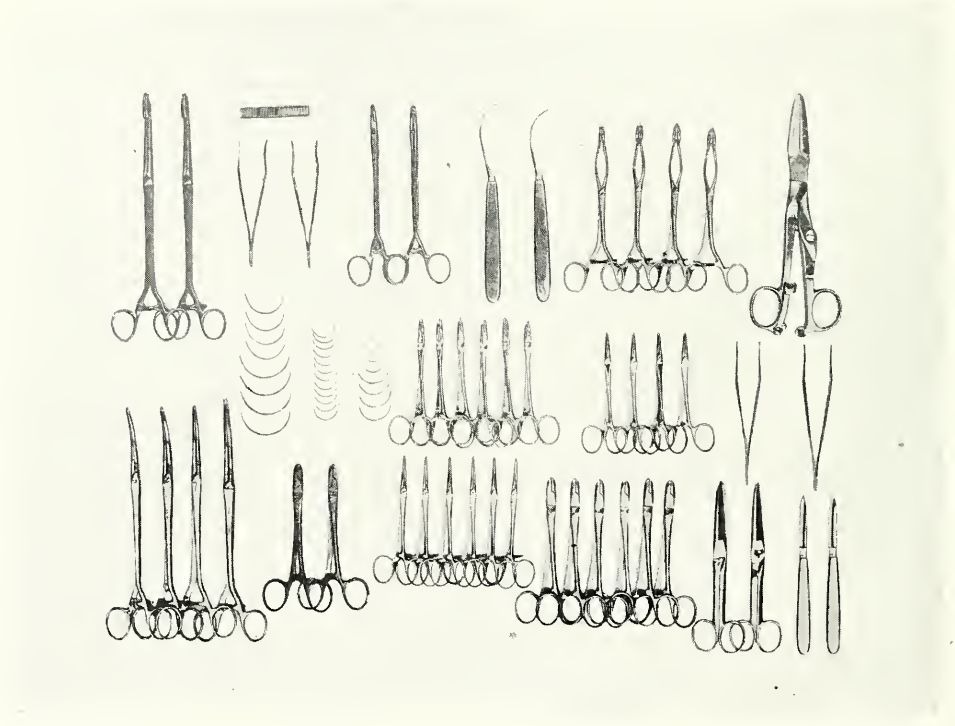


FIG. 79.—INSTRUMENTS FOR OPERATION ON SALIVARY FISTULA AND CALCULUS OF STENO'S DUCT.

Below, from right to left: Two bistouries, two straight scissors, six short-jawed and clawed artery forceps, six ringed and clawed forceps, two short-jawed forceps for veins, four large forceps with curved jaws. Next above: Two clawed forceps, four Champonnière's forceps, six needle-holder forceps with hollowed jaws, four forms of assorted needles. In highest row: One écraseur (small model), four ringed forceps with oval jaws, two mounted needles, two needle-holders with eccentric jaws, two clasp-holder forceps, thirty Michel's hooks, two ringed forceps with oval eccentric jaws. (Scale of one-sixth.)

we cannot insist too strongly on buccal disinfection in acute fevers. I have seen two suppurative cases of parotiditis, which presented the *micrococcus tetragenus* in a pure state. The suppuration is readily recognized.

Operation.—A small vertical cutaneous incision is made at the most fluctuating point, the purulent focus is penetrated by *divulsion* of the extremities of blunt scissors, the blades of which are then withdrawn while open. We thus obtain an opening of 10 to 12 millimetres, without risk of hæmorrhage or of wounding any branches of the facial nerve. Tamponing with a wick of gauze and insertion of glass drainage-tube.

Actinomycosis.

The actinomycosis infection is displayed at the inferior and anterior portion of the cheek by a slow process of suppuration, such as we meet in cold abscesses. The detached skin is reddened and thinned, but may remain long without perforation.

Fig. 80.—Extirpation of an Epithelioma of Upper Part of Cheek which has invaded the Margin of the Orbit.

Operation.—Incision gives exit to a reddish fluid studded with actinomycotic granules which are easily recognizable under the microscope. The purulent focus is curetted, and flat dressing is applied. These cases heal very well. Autoplastic extirpation of the cicatrix is carried out several months after the cicatrization.

FIG. 81.—EXTIRPATION OF AN EPITHELIOMA OF UPPER PART OF CHEEK WHICH HAS INVADED THE MARGIN OF THE ORBIT.

Formation of autoplastic flap destined to fill the space left by loss of substance. We avoid wounding the branches of the facial nerve which lie rather deeply in the subcutaneous cellulo-adipose tissue.

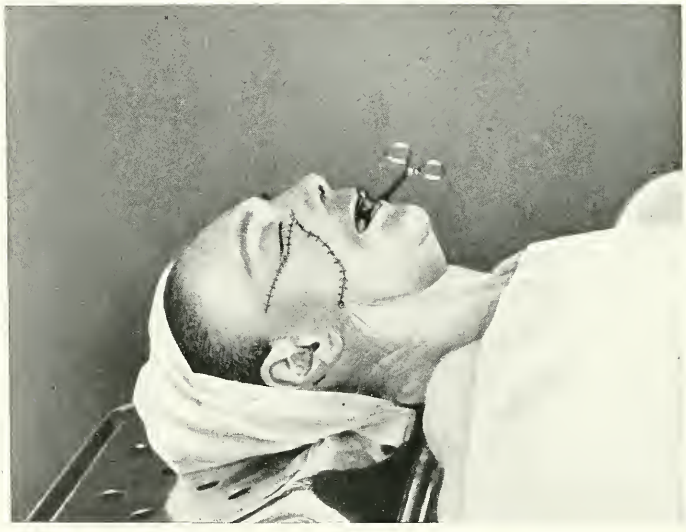


FIG. 82.—EXTIRPATION OF AN EPITHELIOMA OF UPPER PART OF CHEEK WHICH HAS INVADED THE MARGIN OF THE ORBIT.

Coaptation of autoplastic flap which is reunited with interrupted suture of Florentine hairs. The motor nerve fibres of the orbicularis palpebrarum have been preserved.

Deformities: Congenital and Acquired.

Commissural Fissures.

Wide commissural fissures of the lips may correspond to absence of part of the tissues of the cheek. Repair is carried out as in cases of simple commissural fissure without much loss of substance. It is rarely necessary to have recourse to autoplasty by gliding displacement.

Deforming Cicatrices.

Deforming cicatrices should be extirpated throughout their whole thickness, taking care to preserve the mucous membrane.

1. **Genioplasty by Sliding Displacement**—Operation—*First Stage.*—Complete and exact resection of the ungraceful portion of the cicatrix which is capable of being repaired.

Second Stage.—Autoplasty by sliding displacement of one or of two suitable cutaneous flaps. In the section of the cutaneous flaps, care should be taken to avoid division of branches of the facial nerve.

2. **Genioplasty by the Italian Method.**—When we are concerned with the repair of a cutaneous wound without loss of substance of the mucous membrane, this operation is carried out with a technique analogous to that of blepharoplasty.

Salivary Fistulæ.

1. **Fistula of Steno's Duct.**—Traumatic fistula of Steno's duct is often complicated with intermediate salivary cyst, which can be emptied by pressure with the finger. The orifice is usually situated on the buccinator muscle, in front of the masseter.

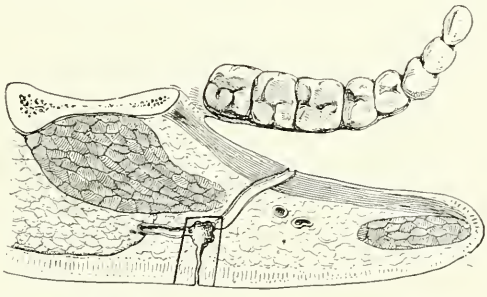


Fig. 83.—Fistula of Steno's Duct with Salivary Cyst.

Diagram of Extirpation of the Fistula.

Operation—*First Stage: Extirpation of the Fistulous Tract.*—The opening of the cutaneous fistulous tract is circumscribed by the curvilinear incisions, and the tract is extirpated throughout its totality. The interstitial salivary cyst is scraped with the curette, and the extremity of Steno's duct is exposed.

Second Stage : Buccal Opening of Steno's Duct.—Two cases are met with:

1. *The Terminal trunk of the Duct is recognized in the Wound.*—A bundle of three or four Florentine hairs is introduced into the terminal opening of the canal; the external ends are passed with a curved needle through the

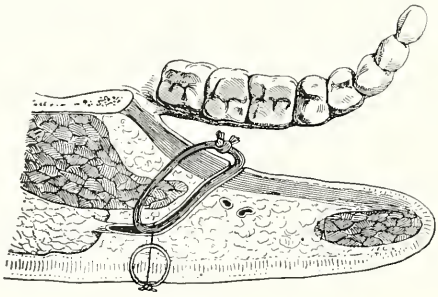


FIG. 84.—REUNION OF THE TWO SEGMENTS OF STENO'S DUCT BY A LOOP OF FLORENTINE HAIRS

The anterior head passes through the terminal segment of the duct, while the posterior head passes through the inner wall of the central segment of the duct and the tissues of the cheek. Beneath is seen a section of Steno's duct, containing a bundle of four Florentine hairs, which secure drainage by capillarity.

internal wall of the central end of the canal; then into the buccal cavity, where the two ends of the bundle of hairs are tied over the mucous surface. The skin is then reunited with points of interrupted suture (Fig. 83). The bundle of Florentine hairs is left in place for ten to fifteen days, and is not to be removed till after complete cicatrization of the cutaneous wound.

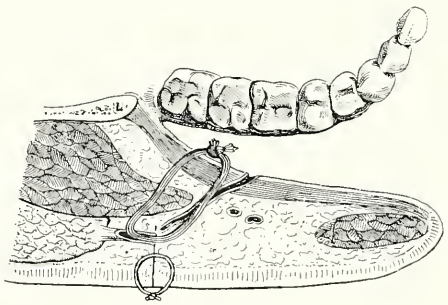


FIG. 85.—REUNION OF THE TWO SEGMENTS OF STENO'S DUCT BY A LOOP OF FLORENTINE HAIRS.

The peripheral segment of Steno's duct has remained undiscoverable. The posterior head of the bundle of Florentine hairs has been passed into the central segment of the canal, then through the tissues of the cheek as far as the mucous membrane. The anterior head is also passed through the same tissues at a point 8 or 10 millimetres anterior, and the two heads are then knotted on the surface of the mucous membrane.

2. *The Terminal Segment of the Trunk of the Duct cannot be discovered.*—In this case the bundle of Florentine hairs is passed through the inner

wall of the central segment of Steno's duct, and thence into the buccal cavity; the other end of the bundle should also be passed through the tissues of the cheek without regard to the central end of the canal. The loop is then left till after cicatrization of the cutaneous wound (Fig. 85).

2. **Parotid Fistulæ.**—These fistulæ usually correspond to the position of a superficial acinus of the gland which has been wounded, either in the process of extirpating a parotid lymph gland, or by an accidental traumatism. If post-operative in origin, the fistula closes spontaneously after five or six weeks.

Operation.—We extirpate the fistulous tract and its orifice, then practise immediate reunion. When this procedure fails, we have recourse to the actual cautery, or even to extirpation of a portion of the parotid gland.

Foreign Bodies.

Foreign bodies are seldom found in Steno's duct; when present, they may cause evolution of a local phlegmon.

Calculus.

Calculi have been met with in the gland, and also in Steno's duct. The first are extracted by making a small cutaneous incision into which the points of blunt scissors are then introduced, closed. The wound is then enlarged by their divulsion.

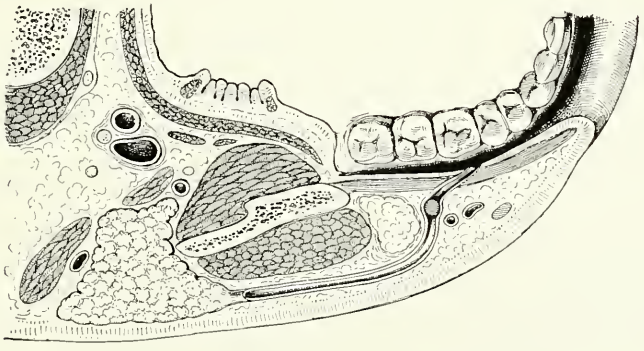


Fig. 86.—Calculus of Steno's Duct arrested on the Outer Aspect of the Buccinator Muscle.

Calculi of Steno's duct are preferably extracted by the buccal route. Extirpation through a cutaneous opening requires tubage of that canal with the help of a double loop of Florentine hairs passing from behind through the wall of the duct and the mucous membrane, and knotted on the inner surface of the cheek with the other end which has been made to follow the lumen of the canal to be restored (Fig. 86).

Tumours.

Tumours of the Cheek.

Cysts—Lipomata—Fibromata.

Sebaceous and glandular cysts, lipoma of Bichot's packet of fat which I have seen acquire the dimensions and consistence of a veritable neoplasm—fibromata, and encapsuled myxomata are treated by extirpation.

Operation—First Stage.—Transverse superficial cutaneous incision made parallel to the direction of the branches of facial nerve.

Second Stage.—Exposure of the tumour with the aid of the blunt extremity of scissors, made to act as a spatula, and then to enlarge the deep wound by divulsion.

Third Stage.—Penetration of the end of blunt scissors beneath the tumour, and isolation of deep surface of the latter by divulsion.

Fourth Stage.—Enucleation of tumour which is luxated through the wound to the outside.

Fifth Stage.—Reunion of the skin and drainage.

To prevent bleeding from the depths of the wound, and the production of an interstitial hæmatoma, we have recourse to antiseptic tamponing, and unite the edges of the skin-wound over the tampon with hooks and without drainage. The wound is then reopened after twenty-four to forty-eight hours for removal of the plug, after which the clasps are replaced and a drainage-tube is inserted.

Epithelioma.

Cutaneous Epithelioma.—Cutaneous epithelioma is extirpated within a limit of at least 3 or 4 millimetres outside the margin of the growth. Reparation is carried out in the *median portion* of the cheek by sliding displacement of a cutaneous flap circumscribed by two curvilinear incisions.

Operation—*First Stage : Extirpation of the Tumour.*—The epithelioma is circumscribed by a curvilinear incision. In the extirpation we should include the subjacent tissues to a certain depth.

Second Stage.—Formation of the autoplastic flap at the upper or lower aspect of the wound.

Third Stage.—Adaptation of flap to loss of substance and cutaneous suture.

Terebrating Epithelioma.—Terebrating epithelioma requires resection of the whole thickness of the cheek, inclusive of the mucous membrane. The repair is difficult enough when the extent of the neoplasm demands ablation of the mucous membrane of the cheek from superior to inferior gingivo-genial groove. This vast loss of substance may be repaired by the folding over of a cutaneous flap which will be doubled by the sliding displacement of a neighbouring flap. The inconvenience of this procedure is, that it exposes the patient to discomfort from the presence of hairs that

may grow from the buccal surface of the skin, which has been made to replace the mucous membrane. The hair follicles can, however, be previously destroyed by the action of X rays.

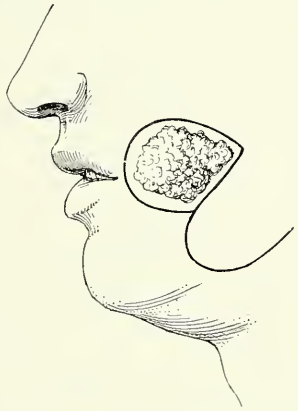


FIG. 87.—SUPERFICIAL CUTANEOUS EPITHELIOMA OF THE CHEEK.

Outline of incisions for extirpation and formation of autoplastic flap.

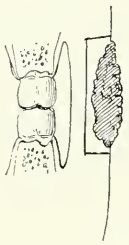


FIG. 88.—SUPERFICIAL CUTANEOUS EPITHELIOMA OF THE CHEEK.

Vertical and transverse section showing how the mucous membrane has been preserved.

FIG. 89.—SUPERFICIAL CUTANEOUS EPITHELIOMA OF THE CHEEK.

Coaptation of autoplastic flap.

OPERATION—*First Stage.*—Resection of tumour and of subjacent mucous membrane.

Second Stage.—Formation of cutaneous flap to be folded back so as to replace the mucous membrane, and suture of the margins of this flap to the buccal mucous membrane (Figs. 87 and 88).

Third Stage.—Formation of autoplastic flaps destined to fill the wound, and subsequent reaction of two small cutaneous triangles, in order to facilitate the coaptation (Fig. 89).

Fourth Stage.—Coaptation and suture of autoplastic flap.

Cutaneous epithelioma of the internal and superior portion of the cheek, when involving the naso-genial groove, requires for the repair

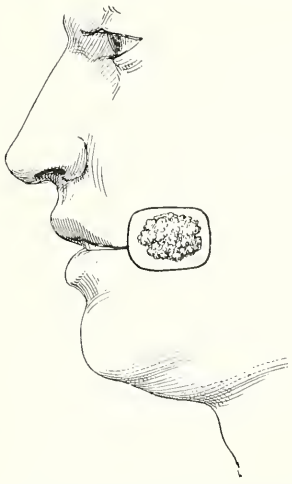


Fig. 90.—Terebrating Epithelioma of Cheek which has invaded the Mucous Membrane.

Outline of incision investing the neoplasm.

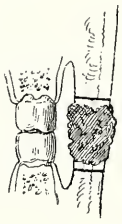


Fig. 91.—Terebrating Epithelioma of Cheek which has invaded the Mucous Membrane.

Vertical and transverse sections showing the total resection of the tissues of the cheek.

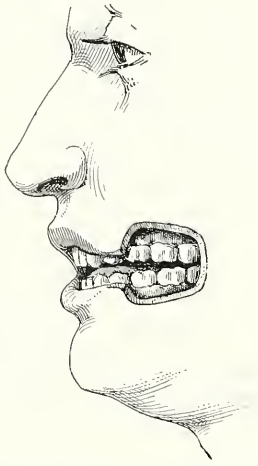


Fig. 92.—Terebrating Epithelioma of Cheek which has invaded the Mucous Membrane.

Resection of whole thickness of tissues of cheek.

Fig. 93.—Terebrating Epithelioma of Cheek which has invaded the Mucous Membrane.

Section showing the outline of the small cutaneous flap which is to be folded back so as to replace the mucous membrane.

of the loss of substance due to its excision the sliding displacement of an elongated trapezoid flap, as represented in Fig. 94.

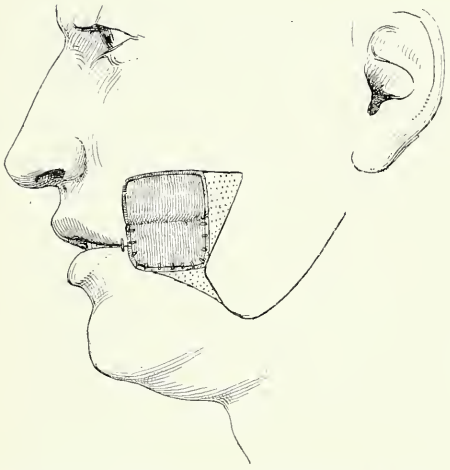


FIG. 94.—TEREBRATING EPITHELIOMA OF CHEEK WHICH HAS INVADED THE MUCOUS MEMBRANE.

Formation of small cutaneous flap which is folded back to replace the mucous membrane. Outline of superficial autoplastic flap. The dotted areas represent the two small cutaneous triangles that are to be resected for coaptation.

FIG. 95.—TEREBRATING EPITHELIOMA OF CHEEK WHICH HAS INVADED THE MUCOUS MEMBRANE.

Transverse section. The small superior cutaneous flap has been folded down, and sutured to the mucous membrane of the inferior gingival groove.

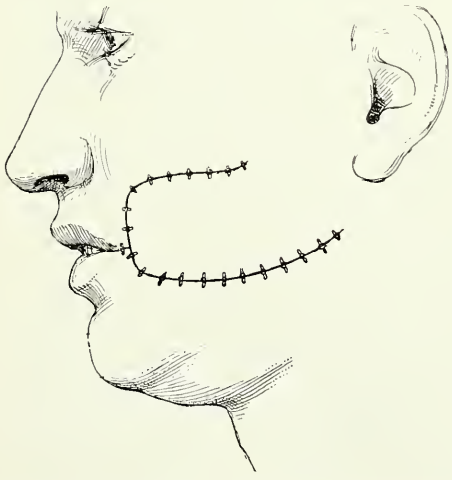


FIG. 96.—TEREBRATING EPITHELIOMA OF CHEEK WHICH HAS INVADED THE MUCOUS MEMBRANE.

Coaptation and suture of superficial autoplastic flap.

FIG. 97.—TEREBRATING EPITHELIOMA OF CHEEK WHICH HAS INVADED THE MUCOUS MEMBRANE.

Transverse sections. The superficial wound has been closed by coaptation of the external flap.

Fig. 98.—Wound formed by Extirpation of Terebrating Epithelioma of Buccal Commissure.

Fig. 99.—Wound formed by Extirpation of Terebrating Epithelioma of Buccal Commissure.

Formation of cutaneous flap to be folded down to replace the mucous membrane.

Fig. 100.—Wound formed by Extirpation of Terebrating Epithelioma of Buccal Commissure.

The upper flap has been folded down and sutured. Mobilization of autoplastic external flap.

Fig. 101.—Wound formed by Extirpation of Terebrating Epithelioma of Buccal Commissure.

Coaptation of large external autoplastic flap.

Epithelioma adherent to the Margin of the Orbit.

When the tumour is adherent to the periosteum of the orbital margin, or has involved the adherent bone, we must include the osseous tissue in our resection.

Operation—First Stage: Incision of the Skin.—The tumour is circumscribed as an elliptical incision involving the periosteum, and the subjacent superior maxilla is exposed with a raspatory.

Fig. 102.—Wound formed by Extirpation of Terebrating Epithelioma of Buccal Commissure.

Terebrating epithelioma of cheek. Immediate autoplasty. Operation is completed. Appearance of sutures.

Second Stage.—We extirpate, as nearly as possible in a single mass, the tumour with affected bone, the section of the latter being made with a strong Liston's forceps.

Third Stage.—Formation of a suitable autoplastic flap.

Fourth Stage.—Reunion of the skin with interrupted suture.

When the tumour is of irregular outlines, it may be advantageous to prepare two or three small cutaneous flaps in stellate form.

Epithelioma of the Mucous Membrane.

Epithelioma of the mucous membrane should be removed with a liberal margin, and preferably with the help of a cutaneous incision, which gives more light. The mucous membrane and the skin are sutured separately. The latter, in a case of infiltrating and recurring epithelioma, should be resected over a wide area.

Operation—First Stage: Cutaneous Incision.—The skin is divided horizontally, beginning at the labial commissure, and care being taken to preserve the subcutaneous tissue by divulsion, so as to preserve the branches of the facial nerve.

Second Stage: Extirpation of the Tumour.—The left index-finger is introduced into the buccal cavity, and the tumour is extirpated taking care to keep widely outside its limits.

Third Stage.—Hæmostasis and interrupted suture of the mucous membrane, the ends of the threads being left in the buccal cavity.

Fourth Stage.—Reunion of the skin.

If the loss of mucous membrane is too considerable to permit suture of the superior flap to the inferior one, we perform the autoplasty by folding over a cutaneous flap (see Fig. 98 *et seq*).

Cutaneous Epithelioma adherent to the Malar Bone.

Cutaneous epithelioma developed on the prominence of the cheek may grow towards the deep structures. In such a case partial or total extirpation of the malar bone must necessarily be carried out.

Operation—First Stage.—Incision of the soft parts at some distance beyond the circumference of the neoplasm.

Second Stage.—Resection of malar bone, as extensively as is necessary, with the Liston forceps and gouge-forceps.

Third Stage.—Formation of autoplastic flap.

Fourth Stage.—Coaptation and suture of this flap to the periphery of the wound.

Sarcoma.

Sarcoma of the cheek which is nearly always due to extension of an osteo-sarcoma of the maxilla, is usually diffuse and inoperable. I have, however, extirpated, with permanent success, a fibro-sarcoma of the jaw, which had eroded the inferior maxilla by compression, and had formed an extensive hollow in its substance, but without adhesion.

Tumours of the Parotid Region.

The tumours of most frequent occurrence in the parotid region are tuberculous adenopathies. Among the tumours of the lymphatic glands are also found lymphadenoma, which in such cases has become generalized in the lymphatic glands. Tumours of the parotid gland are sometimes

FIG. 103.—EPITHELIOMA OF CENTRAL PORTION OF CHEEK WHICH HAS EXTENSIVELY INVADED THE SKIN, AND IS ADHERENT TO THE MALAR BONE.

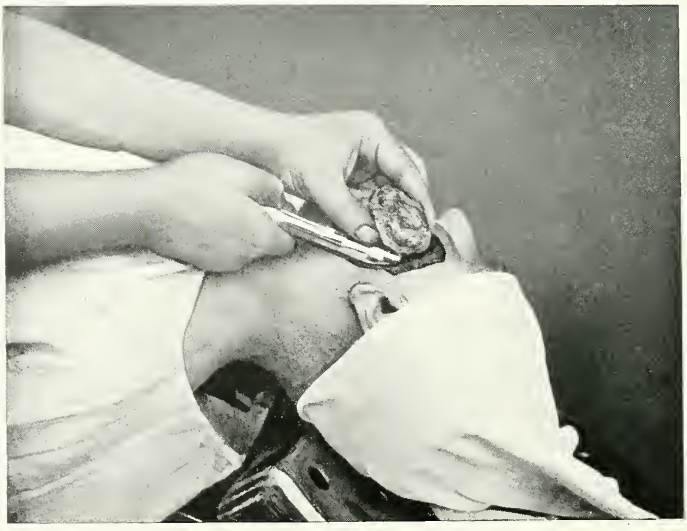


FIG. 104.—EPITHELIOMA OF CENTRAL PORTION OF CHEEK WHICH HAS EXTENSIVELY INVADED THE SKIN, AND IS ADHERENT TO THE MALAR BONE.

Extirpation of tumour and of malar bone. Division of zygomatic arch with Liston's forceps.

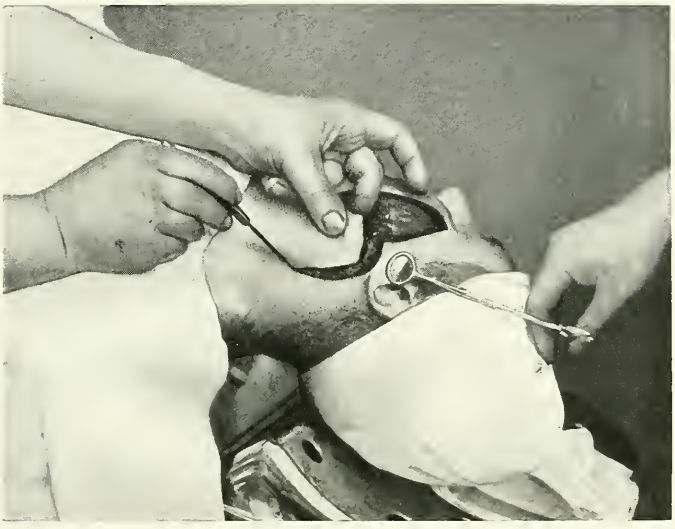


FIG. 105.—EPITHELIOMA OF CENTRAL PORTION OF CHEEK WHICH HAS EXTENSIVELY INVADED THE SKIN, AND IS ADHERENT TO THE MALAR BONE.

Formation of autoplastic flap to fill the wound. The outline of the flap is seen to differ sensibly from that represented in Fig. 92.

FIG. 106.—EPITHELIOMA OF CENTRAL PORTION OF CHEEK WHICH HAS EXTENSIVELY INVADED THE SKIN, AND IS ADHERENT TO THE MALAR BONE.

Appearance of finished suture after resection of the exuberant cutaneous triangle seen below the jaws of the ringed forceps in Fig. 105.

encapsuled and movable, at least, at the beginning; and among those we find pretty frequently branching chondroma or myxochondroma, and sometimes infiltrated and diffuse tumours of a malignant nature.

The diagrammatic figures (Figs. 107 to 110) are meant to elucidate the relations of adenopathies and tumours of the parotid gland with the facial nerve, external jugular vein, and external carotid artery, and also with the region of the styloid apophysis.

Adenopathies.

Extirpation is indicated whenever it can be carried out without difficulty, especially when the glands can be enucleated from their cellular lodging.

Operation—First Stage.—Vertical cutaneous incision as limited as possible, and exposure of the most accessible pole of the gland.

Second Stage.—Introduction through this incision of forceps or blunt scissors, and widening of the wound by divulsion.

Third Stage.—Same manœuvre at the deep face of the glandular tumour.

Fourth Stage.—Luxation of tumour to outer side of wound, and enucleation. This luxation may require the use of a curette of appropriate diameter. We must avoid laceration of the gland by traction with clawed forceps.

Fifth Stage.—Aseptic tamponing or immediate suture.

When the most accessible gland has been extirpated, I have often been able to extract the neighbouring glands, without making a new incision, by penetrating into their enclosure with the extremity of blunt scissors, the ends of which are forcibly opened in order to enlarge the orifice.

In the figures we distinguish between the internal jugular vein and internal carotid artery: (1) From before backwards, the glossopharyngeal, pneumogastric, and spinal accessory nerves; (2) inside the carotid artery, the hypoglossal nerve; and (3) outside the carotid, and covered by the prevertebral aponeurosis, the trunk of the sympathetic chain.

We thus proceed to remove each lymphatic gland, already partly isolated by its fibro-cellular sheath with a curette, taking care not to tear it.

Tumours of the Parotid Gland.

Extirpation of tumours of the parotid glands necessitates a precise anatomical knowledge of that region. Fig. 112 represents a section of the parotid region, passing through the external auditory canal. We there recognize the deep and anterior limits of the parotid region which are formed by the reunion of an aponeurosis that passes from the styloid process to the os hyoides with a horizontal septum placed between the submaxillary and parotid glands. We distinguish in the substance of the parotid gland the trunk of the facial nerve, the external jugular vein which receives the lingual vein below in the submaxillary space; and, finally, the external carotid artery as it emerges from the depths of the region. The

digastric muscle is divided near its intermediate tendon. We see the submaxillary gland at its posterior pole. More deeply, the styloid process is seen in relation with the internal jugular vein; more deeply still, the glosso-pharyngeal nerve and internal carotid artery. Below, we recognize the lingual artery; and, beneath it, the hypoglossal nerve.

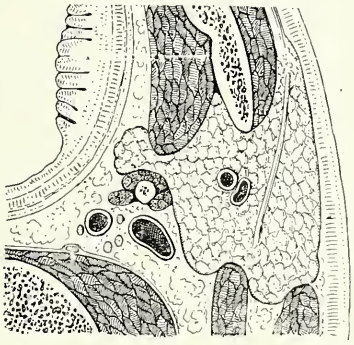


FIG. 107.—HORIZONTAL SECTION OF THE PAROTID REGION.

Showing facial nerve, external jugular vein, external carotid artery, and the deep process of the gland which passes between the internal pharyngeal muscle and the styloid apophysis.

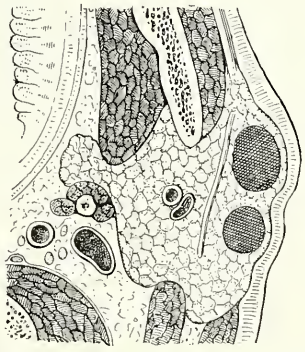


FIG. 108.—HORIZONTAL SECTION OF THE PAROTID REGION.

Showing the usual position of tuberculous glands which are in a position superficial to the trunk of the facial nerve. The trunk of the sympathetic chain is seen behind the hypoglossal nerve and internal carotid artery.

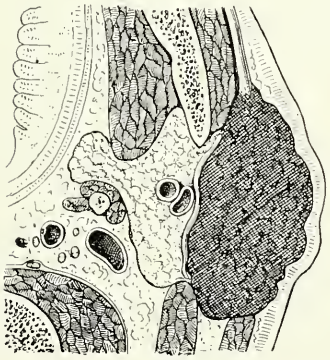


FIG. 109.—HORIZONTAL SECTION OF THE PAROTID REGION.

Showing development of an enchondroma of the parotid gland which remains superficial, and compresses the facial nerve This nerve can be preserved in extirpation of the tumour.

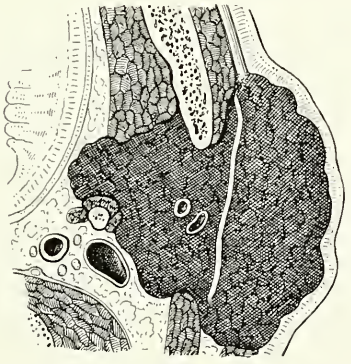


FIG. 110.—HORIZONTAL SECTION OF THE PAROTID REGION.

Showing a diffuse cancerous tumour of the parotid gland, extirpation of which would require resection of the facial nerve, external jugular vein, and external carotid artery.

1. **Encapsuled Tumours.**—I carry out the extirpation of encapsuled tumours of the parotid gland with a technique similar to that of extirpation of movable tuberculous glands.

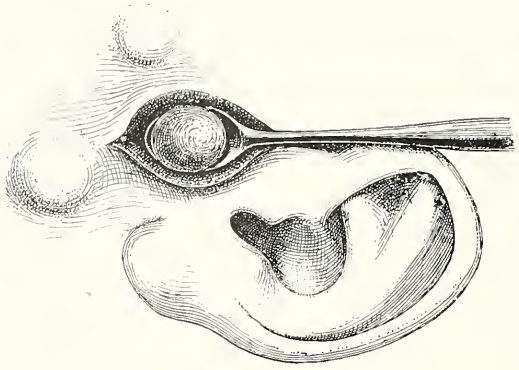


Fig. 111.—Enucleation of a Lymphatic Gland of the Parotid Region with a Volkmann's Spoon.

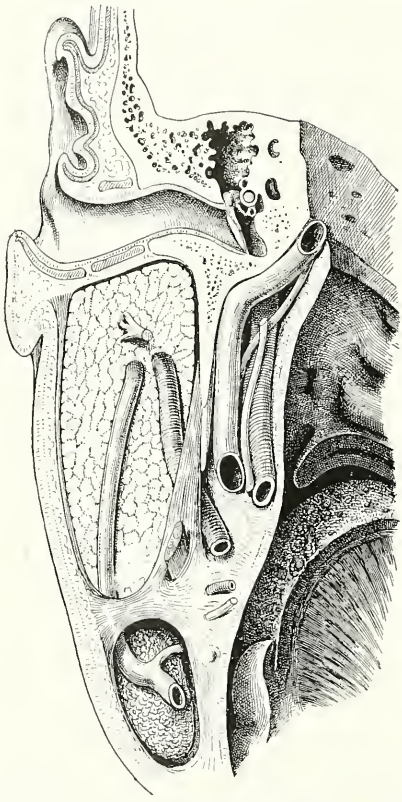


Fig. 112.—Oblique Vertical Section of the Parotid Region, parallel to the Axis of the External Auditory Canal.

Anterior segment.

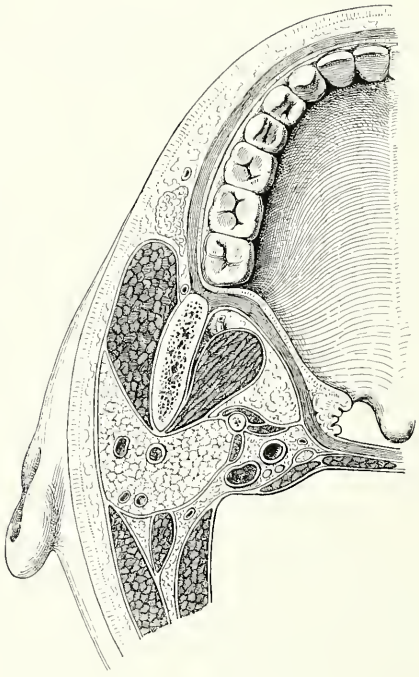


Fig. 113.—Horizontal Section of the Parotid Region at the Level of the Upper Pole of the Tonsil.

Superior segment.

Operation—*First Stage.*—Vertical incision along the posterior border of ascending ramus of the inferior maxilla.

Second Stage.—Exposure of the tumour with the aid of clawed forceps and scissors, and isolation of its anterior aspect by divulsion with the extremities of the blades of blunt scissors.

Third Stage.—The posterior border of the tumour is made out with the finger. We then plunge in the scissors on that side, and isolate the posterior border of the neoplasm by divulsion. The index-finger is then plunged in deeply, and the whole posterior surface is isolated in the same way. The connections of the tumour with its fibro-cellular capsule are broken down over the largest possible area, so that one of the extremities can be luxated

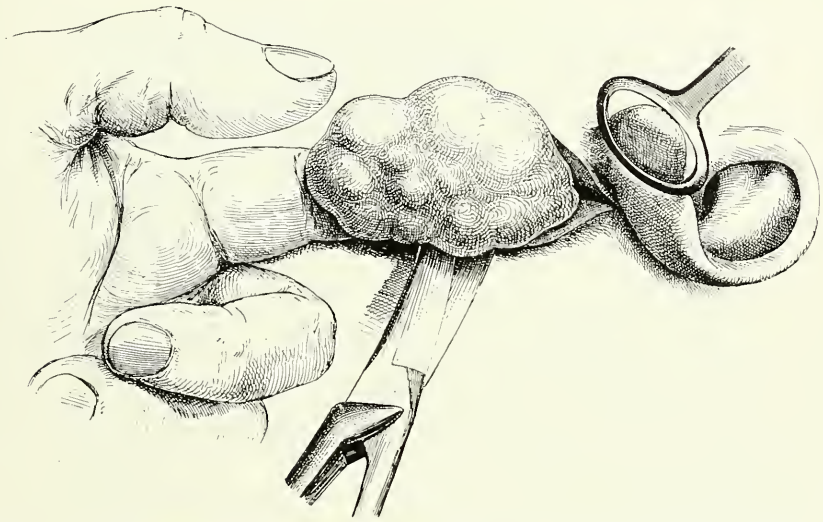


Fig. 114.—Extirpation of an Enchondroma of the Parotid Gland.

The patient is placed in the dorsal decubitus. Luxation of tumour without the wound with index-finger and blunt scissors, acting by divulsion.

from its position. We then draw it out between the jaws of a ringed forceps, and complete the detachment of the opposite extremity. This technique enables us to limit the hæmostasis to the proper vessels of the tumour.

Fourth Stage.—Tamponing of wound and verification of condition of field of operation. Bleeding vessels are seized with forceps, and ligatured.

Fifth Stage.—Provisional antiseptic tamponing and suture of the skin; or even, when no oozing of blood is anticipated, immediate reunion with drainage.

By this technique we can extirpate, without difficulty, parotid tumours which have multiple prolongations. Those prolongations are found on the inner side towards the styloid process, or in front, beneath the ascending ramus of the inferior maxilla, which, in a recent case, was found excavated and thinned as a result of the development of the tumour.

2. **Complete Extirpation of the Parotid Gland.**—Complete extirpation of the parotid gland is carried out with the same technique. The principal point, when the surface of the tumour has been exposed, is to free its periphery at the most accessible point, and to penetrate beneath its deep surface in order to isolate it with the finger and the extremity of blunt scissors, which act, in the first movement, as a spatula, and then by divulsion. If bleeding occurs, we must hasten to complete the procedure as rapidly as possible.

Wound of the external jugular vein or external carotid artery is of no gravity. Temporary hæmostasis is secured by pressing into the wound a compress which is retained with the finger. When the tumour has been

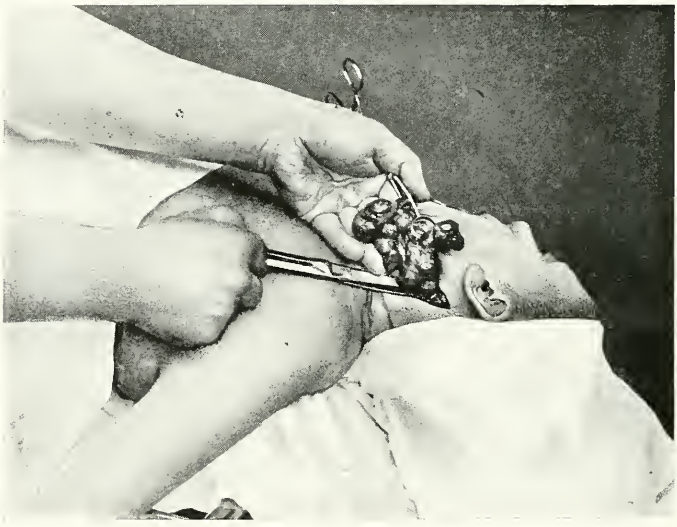


Fig. 115.—Extirpation of a Voluminous Tumour of the Parotid Gland.
Luxation of tumour out of wound, and section of its upper adhesions.

luxated to the outside of the wound, we complete the section of its last remaining attachments, and verify the condition of the field of operation. It is easy to recognize the calibre of the vessels divided by everting the capsule of the tumour between the jaws of a ringed forceps. We fix a short-jawed clawed forceps on the wounded vessel, and tie it with No. 5 silk. If the hæmorrhage seems to be serious, we can increase the cutaneous incision downwards with scissors so as to give more light.

We then apply aseptic tamponing with drainage, and effect a temporary reunion with clasps. These are removed on the second or third day, the tamponing is dispensed with, and a new reunion is effected with drainage.

Total extirpation of the parotid gland requires section of the facial nerve. The patient should be warned beforehand that the operation will be followed by facial paralysis on that side.

AFFECTIONS OF THE JAWS AND THEIR ADNEXÆ.

Traumatic Lesions.

Fracture and Luxation of the Teeth.

Intra-alveolar fractures and luxation of the teeth are usually the result of violent traumatism, directly applied. Fracture of the incisor teeth is often produced in the alveolus simultaneously with fracture of the alveolar margin of the maxilla. We should endeavour to preserve the teeth by tying them to the neighbouring ones, and secure buccal antisepsis.

Fractures of the Maxillæ.

Fractures of the superior maxilla are accidental, or may occur in extraction of the teeth. They unite spontaneously.

On the other hand, fractures of the inferior maxilla, and especially of the horizontal portion, are very often accompanied by considerable displacement, and require either metallic ligature of the teeth which have remained solid near the seat of fracture, or the application of osseous suture.

Osseous Suture—Operation—*First Stage.*—When the skin is whole, a transverse incision of the gingivo-labial fold at the seat of fracture, and exposure of the mental region with a raspatory.

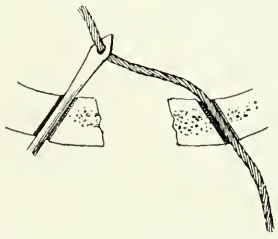


Fig. 116.—Fracture of Inferior Maxilla.

Osseous suture. Passage of metallic threads from right side, and from behind forwards. Horizontal section.

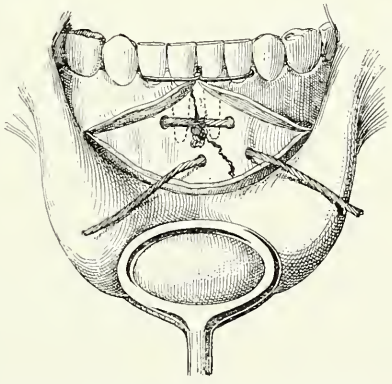


Fig. 117.—Fracture of Inferior Maxilla.

Double osseous suture. The first loop passes between the roots of the incisors. The second is inserted in the basilar portion of the bone.

Second Stage.—Perforation of the bone at the level of the junction of the lower third with upper two-thirds of its vertical measurement, either with a perforator worked by the hand, or with Collin's mechanical perforator.

Third Stage.—Passage of a bundle of twisted threads of gilt nickel wire from behind forwards, and fixation of the two fragments by torsion of the extremities of the metallic thread. Section of the two twisted loops at 3 or 4 millimetres from their crossing, and burial of the twisted portion in the depth of the wound with a blunt instrument. A double osseous suture may be necessary. In that case the upper thread should pass between the roots of the teeth in the neighbourhood of the seat of fracture.

Fourth Stage : Reunion.—The mucous membrane may be united with a continuous suture if the buccal cavity—and more particularly the dental alveoli—be sufficiently aseptic. Glass drainage-tube passing through an orifice made at the antero-inferior margin of the chin.

Inflammatory Lesions.

Dental Abscesses—Suppurative Periostitis.

1. **Dental Abscesses of Superior Maxilla.**—The complications of dental caries, although now more rare than formerly, cannot be neglected by the surgeon. Periosteal dental abscess of the upper jaw may extend to the

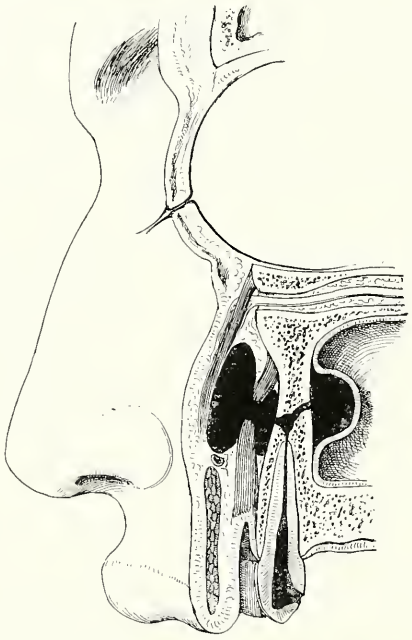


Fig. 118.—Caries of Canine Tooth.

Infra-orbital abscess of shirt-button form which has perforated the canine muscle. The abscess is deeply seated, and has detached the mucous membrane of the sinus.

vicinity of the orbit, and open on the surface of the inflamed and thinned integument, thus producing an ugly cicatrix. These abscesses should be recognized in time, and incised freely through the mouth. If the patient

demands an anæsthetic, we should profit by the opportunity, and remove at once the carious teeth or fangs which had provoked the suppuration.

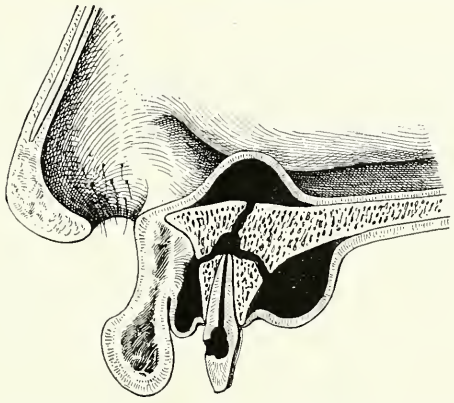


Fig. 119.—Caries of an Incisor Tooth.

Abscess of the labio-gingival groove. Palatine abscess. Abscess of the floor of the nasal fossa.

2. **Dental Abscesses of Inferior Maxilla.**—Inferior dental abscesses have a great tendency to point downwards and to open on the cutaneous surface.

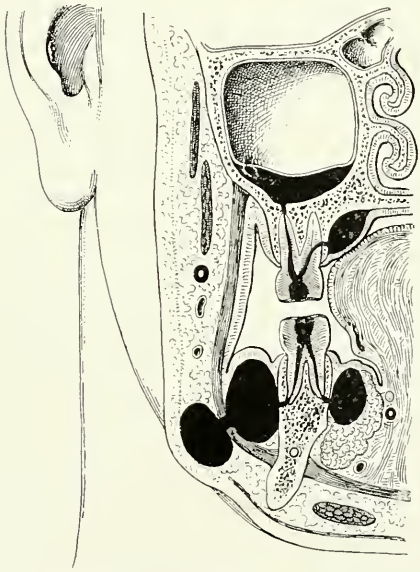


Fig. 120.—Caries of Molars, Superior and Inferior.

Above: abscess of maxillary sinus; palatine abscess. Below: abscess of gingivo-lingual fold; external abscess of shirt-button form which has perforated the buccinator, and is ready to perforate the skin.

Perforation of the skin is always to be feared when it has become red and thinned. A wide opening should be made in the buccal mucous membrane.

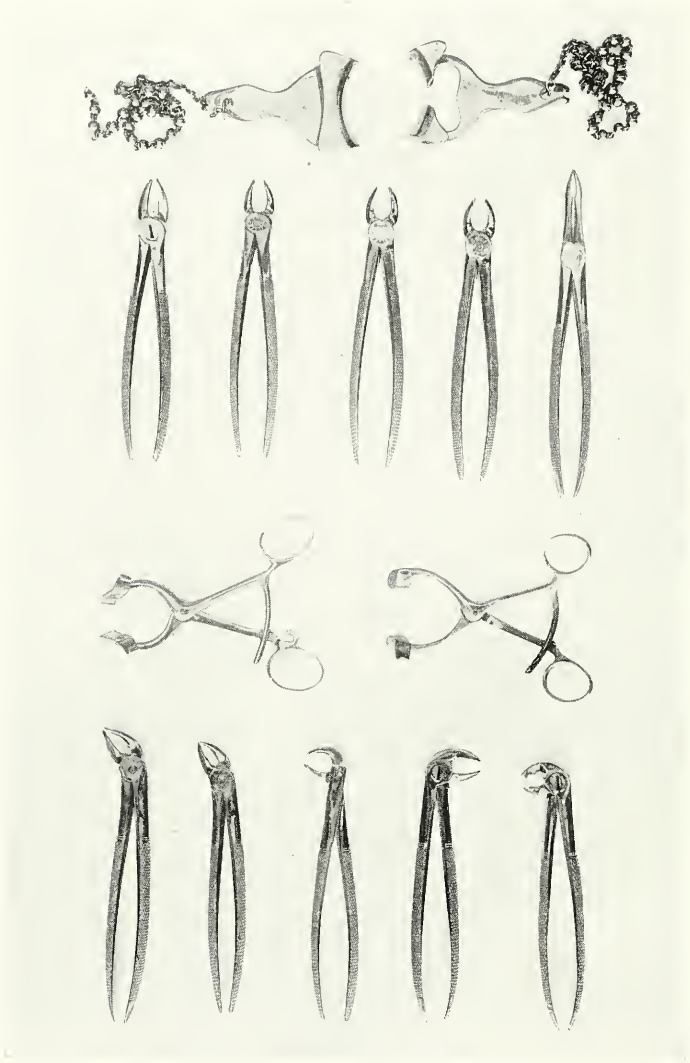


FIG. 121.—INSTRUMENTS FOR AVULSION OF TEETH.

Above: bicommissural retractor. Next below, from left to right: forceps for upper jaw—No. 1, forceps for incisors, canines, and premolars; Nos. 2 and 3, forceps for molars, left and right; No. 4, forceps for wisdom teeth; No. 5, forceps for fangs of the upper jaw. Intermedial row: retractor of molars and retractor of incisors. Beneath: forceps for lower jaws: Nos. 6 and 7, forceps for incisors, canines, premolars, and fangs; No. 8, forceps for first molars, right and left; No. 9, forceps for second molars and left wisdom tooth; No. 10, same forceps for right side.

(Scale reduced to one-fourth.)

When the focus of suppuration is very extensive, we have recourse, after disinfection, to tamponing with a wick of gauze soaked in oxygenated water diluted to 25 per cent., a gargle of a 4 per cent. boric solution, 1 per cent. chloral solution, or a 2 per cent. dilution of Labarraque's fluid. The wide opening and tamponing may avert the perforation of the skin. When perforation of the skin is imminent, a small incision of 6 or 8 millimetres is made for the passage of a drainage-tube.

Extraction of Teeth.

We should remove a tooth only when serious complications result, or are likely to result, from its presence in the mouth, or when all means of conservative therapeusis have failed. It is important to make sure, before extraction of a tooth, that it is the genuine cause of the accidents for which

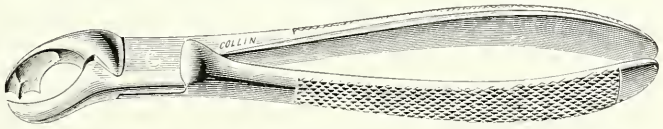


FIG. 122.—COLLIN'S ARTICULATED FORCEPS FOR RIGHT UPPER MOLARS (No. 3).

FIGS. 123 AND 124.—COLLIN'S ARTICULATED FORCEPS FOR RIGHT UPPER MOLARS (No. 3) SHOWING THE DETAILS OF EACH OF THE TWO BLADES OF THE FORCEPS SEPARATED.

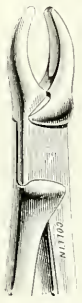
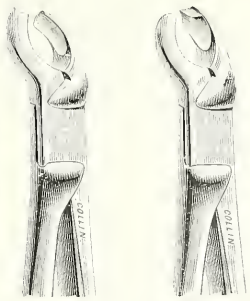


FIG. 125.—STRAIGHT FORCEPS FOR INCISORS, CANINES, AND UPPER PRE-MOLARS (No. 1).

FIG. 126.—STRAIGHT FORCEPS WITH LONG SLENDER JAWS FOR FANGS IN THE UPPER JAW (No. 5).

its extraction is thought to be desirable. When the procedure has been decided on, we must study the degree of solidity of the tooth, the direction of its fangs, and the various anatomical peculiarities that may be met with.

Operative Manipulation—General Anæsthesia.—General anæsthesia is indicated in dental surgery only when we have to extract a number



Figs. 127 and 128.—Curved Forceps of Upper Molars, Left and Right.

The jaw with pointed tip should be on the outer side (Nos. 2 and 3).

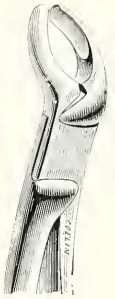


Fig. 129.—Forceps with Double Curve for Wisdom Teeth of Both Sides (No. 4).

Fig. 130.—Forceps bent on the Flat for Lower Incisors, Canines, and Premolars.

One of similar form, and more tender, is used for avulsion of the fangs (Nos. 6 and 7).

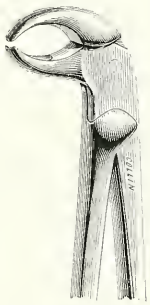
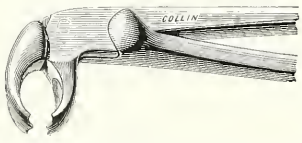
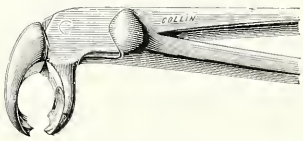


Fig. 131.—Forceps bent at Right Angle, for Lower Molars, Right and Left (No. 8).





Figs. 132 and 133.—Forceps bent at a Right Angle, and with Incurved Jaws for Last Lower Molars and Wisdom Teeth of Both Sides (Nos. 9 and 10).

of teeth at one sitting, or fangs which are continuous with the structure of the alveolus. We also employ it in case of extremely timid patients. The anæsthesia is preferably carried out with ethyl chloride.

The best method of obtaining local insensibility in case of the molars is by submucous injection of a solution of cocaine. The use of cocaine requires certain precautions: a solution of 1 or 2 per cent. may be employed, but for perfect anæsthesia we prefer a 5 per cent. solution, about 1 c.c. of which is injected. The needle is introduced into the gum, which has previously been anæsthetized with ethyl chloride so as to save the patient the pain of the puncture; it is directed parallel to the alveolar margin. The cocaine is slowly injected till a bulla is formed on the gum. This bulla should be formed all around the tooth to secure complete anæsthesia. The cocaine may produce a momentary malaise which will be dissipated by the administration of a cup of coffee.

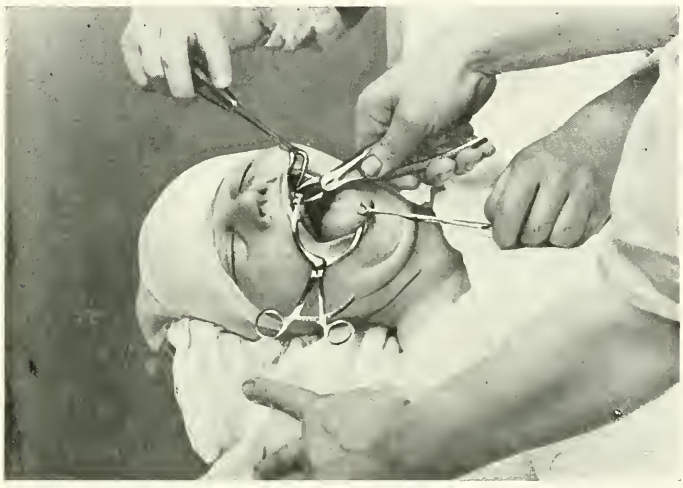


Fig. 134.—Removal of an Upper Canine with the Straight Forceps.

The preparatory material for operation requires ten forceps in all:

Upper Jaw.—A straight forceps (No. 1) for incisors, canines, and premolars; a forceps with double curve (No. 2) for right molars, and a symmetrical forceps (No. 3) for left molars, each of those forceps having its inner jaw curvilinear, and its outer jaw furnished with a median point, to be insinuated between the two outer fangs of the tooth. A forceps with more pronounced double curve (No. 4) for the wisdom tooth. A straight forceps with narrow jaws (No. 5) for extraction of fangs.

Lower Jaw.—A forceps bent at an obtuse angle (No. 6), for incisors, canines, and premolars. A more slender forceps for children, and for extraction of fangs (No. 7). A forceps bent at a right angle for the first molars (No. 8). Two similar forceps with symmetrical curves for left second molars and wisdom tooth (No. 9), and for right second molar and wisdom tooth (No. 10).

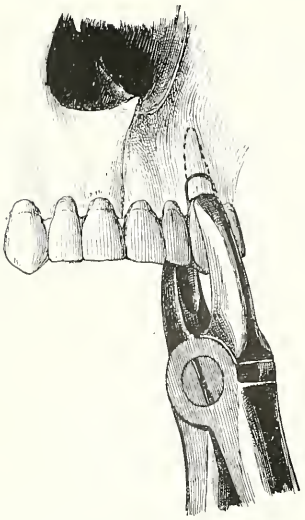


FIG. 135.—EXTRACTION OF AN UPPER CANINE.

The dark line indicated the first grip of the tooth, which should mobilize it. This first seizure prepares for the extraction.

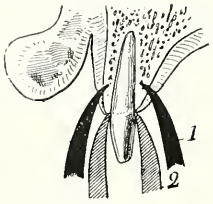


FIG. 136.—EXTRACTION OF AN UPPER CANINE.

Diagrammatic sketch showing at 1 the first grip of the tooth, by which it is luxated. The forceps is then raised to the level of the neck of the mobilized tooth which it seizes there, and extracts without difficulty.

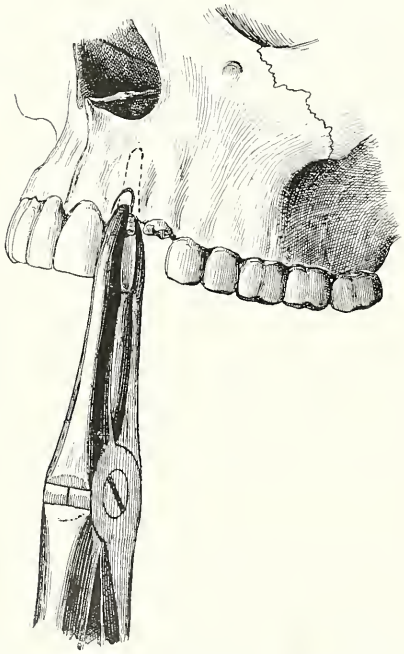


FIG. 137.—ABLATION OF ROOT OF SECOND INCISOR.

The dark line shows the position of the first grip with the fang forceps.

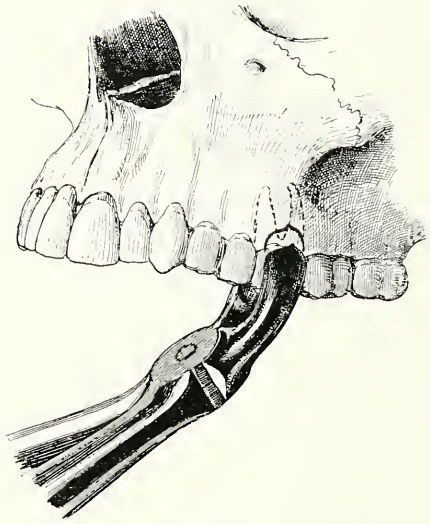


FIG. 138.—EXTRACTION OF A LEFT UPPER MOLAR.

The forceps bears the inscription, "Left upper molars." The outer branch presents a point which should penetrate between the outer fangs. The dark line indicates the position of first grip.

Position of the Surgeon.—For avulsion of all teeth removed without an anæsthetic, or even with local anæsthesia, the surgeon places himself upright before the patient, who is seated on a chair. The operator turns

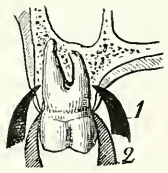


Fig. 139.—Extraction of a Left Upper Molar.

Diagrammatic sketch showing at 1 first grip of the tooth by which it is luxated; and at 2 the second grip for extraction.

a little to left or right in case of the first molars, and places himself wholly on the left or right of the patient in case of the lower molar and wisdom

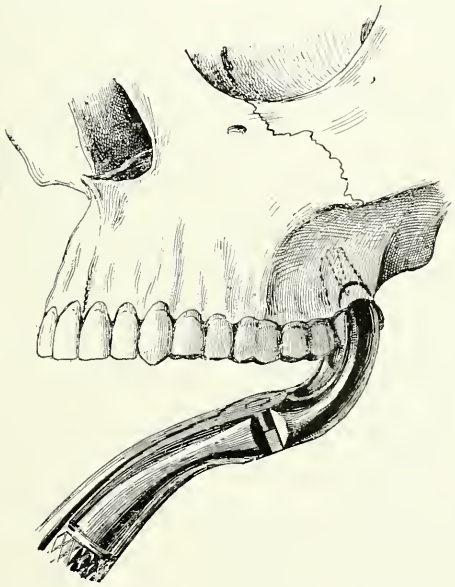


Fig. 140.—Removal of Upper Wisdom Tooth.

The same forceps serves for both sides. The dark line indicates the position of first grip.

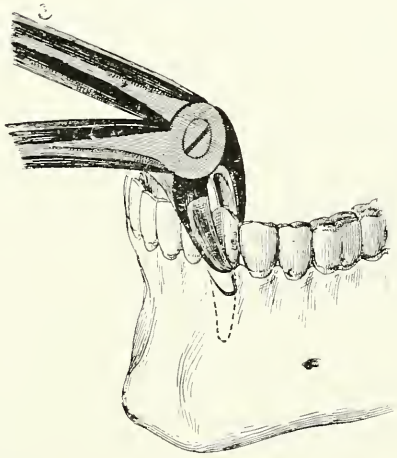


Fig. 141.—Removal of Lower Canine.

The dark line indicates the position of first grip of the tooth. A similar forceps, a little more slender, is used for removal of the fangs of the other teeth of the lower jaw.

teeth of both sides. When general anæsthesia is adopted, we prefer to place the patient in the position of dorsal decubitus, or in the Rose position. The upper jaw then becomes the lower, and *vice versa*.

How the Forceps should be held.—The forceps for the upper jaw is held vertically; the jaws of the instrument should be held, one external

and the other internal, in relation to the tooth by which they are made to penetrate—that is to say, one anterior and the other posterior with respect to the operator. The forceps for the lower jaw is held horizontally; and so that, with respect to the operator, one jaw of the instrument is superior

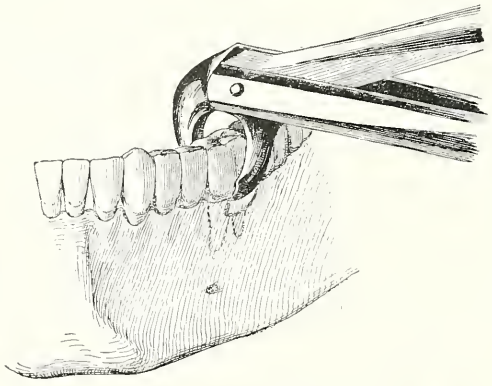


Fig. 142.—Removal of First Lower Molar.

The same forceps is used for both sides. The dark line indicates the first grip.

and the other inferior. In case of the No. 9 forceps (lower left second molar and wisdom tooth), and No. 10 (corresponding teeth of right side), the upper blade, in prehension of the tooth, is on a plane somewhat anterior to the left.

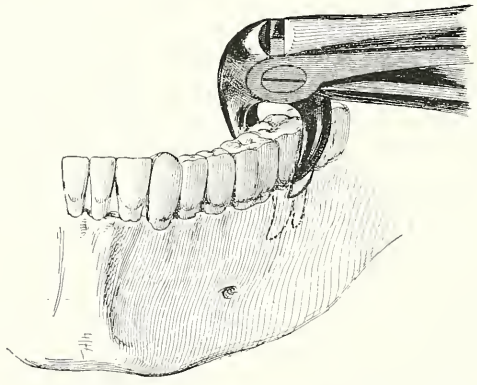


Fig. 143.—Removal of Last Lower Molar of Left Side.

The dark line indicates the first grip for luxation of the tooth.

If we operate in the Rose position with the head turned back, the lower teeth may be removed with the forceps for the upper jaw, and *vice versa*. When we operate on a patient placed in the dorsal decubitus, we use the forceps that is used for the sitting posture in the case of each jaw; but the surgeon should place himself on the right of the patient when dealing with

teeth of the right side in case of the left incision and upper and lower canines, and on his left in case of the left, upper, and lower molar and wisdom teeth.

First Stage: Prehension and Luxation of the Tooth.—Whether the tooth be whole or discrowned, the best way to secure a hold is to seize it very high above the gum; we then compress it moderately, taking care not to risk shaking the other teeth, and luxate it by two or three gentle movements from side to side.

Second Stage: Extraction of the Tooth.—The forceps thus quits its first grip to penetrate between the gum and tooth, which is then seized above the neck and extracted without difficulty. If the tooth has already completely lost its crown, this procedure enables us to mobilize by a single movement the three roots of a molar tooth, which are then seized directly with a fang forceps. The momentary pressure of the forceps on the gum leaves no trace, but we must remember that this first grip of the forceps should serve but to mobilize the tooth, and should be made without lacerating the gum. It may be necessary in exceptional cases to detach the gum from the maxilla, and seize the tooth below the level of the former; but this practice has no advantage, and those who persist in adopting it only succeed, in most cases, in breaking the neck or fangs of the tooth. The method of prehension which I recommend is based on the anatomy of the teeth, which tend, on the whole, to a conical form, with the apex towards the fang.

In extraction of the molars we may meet with a tricuspid tooth which has fangs either extremely divergent or abruptly incurved at the extremity. In such cases a small fragment of this extremity, of 2 to 3 millimetres in length, may break off and remain in the alveolus. But no other technique can securely prevent the fracture of the extremity of an abruptly curved fang, especially when the latter is adherent to the maxilla as the result of inflammatory changes in the tooth. It is unnecessary to add that extraction of teeth should be effected without violence or precipitation in order to avoid shaking of the neighbouring ones. Levers or elevators, "hind's foot," or "carp's tongue," are instruments of which the use, for extraction of fangs or of wisdom teeth, was indicated only in the epoch of Garangeot's key. The use of those levers always involves danger of neighbouring lesions, which can never be produced when an appropriate forceps is employed.

The Milk Teeth.—Extraction of the milk teeth is usually effected without the use of an instrument, and in the majority of cases it is the children themselves who tear them out. When the use of a forceps becomes necessary, we employ a straight No. 1 or No. 5 for the incisors and canines of the upper jaw, and a No. 6 or No. 7, bent on the flat, for the teeth of the lower jaw. The extraction should present no complications; pain is avoided by anæsthesia, general or local; the bleeding is usually insignificant. Antiseptic lavage of the mouth should be practised for some days. Osseous scales, which may have been mobilized in the extraction of a tooth which was very firmly implanted, should be removed immediately after the extraction.

Dental Fistula.—These succeed to phlegmonous affections, to adenitis, and to necrosis of the maxillæ. They are usually situated at the level of the alveolus, sometimes in the submaxillary region; we also meet them in the parotid region, and more rarely in the infraorbital area. Cutaneous fistulæ of dental origin give a purulent discharge which causes the formation of a crust of greater or less thickness at the seat of the external opening of the fistulous tract. In some cases the surrounding skin is reddish or bluish, and thinned.

The formation of dental fistulæ is due to the presence of a carious tooth —a fang or an alveolar sequestrum. The sole treatment consists in the extraction of the same. When the cause has been removed, the fistula heals spontaneously and very rapidly. It is sometimes necessary to have recourse to a small autoplastic operation to remedy the vicious cicatrix which may result from the cure of a cutaneous dental fistula.

Caries and Necrosis of the Outer Aspect of the Superior Maxillary and Malar Bones.

The superior maxilla, especially in case of infants, is often enough the seat of suppuration which seeks a vent beneath the lower eyelid. I have seen the whole inferior orbital margin escape this route in a state of necrosis which had occurred as a sequel of scarlatina. The suppuration may extend towards the zygomatic arch and the malar bone.

The incision should be preferably in the horizontal direction, and parallel to the branches of the facial nerve. The bistoury should divide the skin only; the subcutaneous stratum in which the branches of the facial nerve ramify is perforated with blunt scissors, and lacerated by separating their rings forcibly. The blunt ends of the blades separate the tissues without wounding the branches of the facial nerve. The wound is tamponed after clearing out the focus, and the cicatrix is removed at a later date—after the process of cicatrization has been completed—by an autoplastic operation.

Caries and Necrosis of the Alveolar Border of the Superior Maxilla.

The operation is carried out through the buccal route. The patient is placed in the Rose position. The dental arches are separated on the side opposite the lesion with Heister's gag or with my ring gag. The teeth and fangs are removed with forceps or with gouge-forceps, and the diseased bone is exposed by turning back the investing mucous membrane with a raspatory, straight or curved. The sequestra are then removed, and the containing cavity curetted and tamponed. Phosphorus necrosis which was formerly very frequent, is now very rare.

Caries and Necrosis of the Horizontal Portion of the Inferior Maxilla.

Caries and necrosis of the alveolar border of the inferior maxilla should be operated on by the buccal route. But it frequently happens that the lesion reaches the basilar portion of the bone, into which it extends by

reason of its inferior position, and the stagnation of the pus. After some time one or more fistulæ are produced.

The operation should be carried out in such a way as to leave the cicatrix as little apparent as possible. We should content ourselves then, when the fistula is situated at the most dependent position, to enlarge the existing opening. When there is no fistula, we make the incision at the junction of the cheek and submaxillary region parallel to the lower border of the bone. No important vessel is to be met with except the facial artery and vein, the course of which, along the anterior border of the masseter, is familiar to everybody. No ligature will be required if we take care, on exposure of the bone to a slight extent, to enlarge the wound with a raspatory. The sequestra are removed, and the wound is curetted and tamponed. The cutaneous opening often communicates with the buccal cavity, and the external escape of saliva persists for some weeks.

After healing of the wound, the cicatrix is removed if unsightly.

Caries and Necrosis of the Ascending Ramus of the Inferior Maxilla.

Inflammation of the ascending ramus of the inferior maxilla is habitually of traumatic origin. The lesion frequently reaches the condyle. I have removed many sequestra from this region, even including the condyle. Their ablation is effected through an incision made parallel to the posterior border of the bone. The wound is curetted and then tamponed.

Accidents connected with the Wisdom Teeth.

Tardy evolution of the wisdom tooth may produce osseous lesions of a certain extent. I have seen such accidents appear, even up to the age of fifty. Absence of the tooth which is the source of the mischief—not

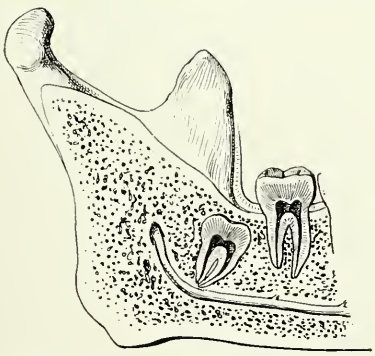


FIG. 144.—LEFT LOWER WISDOM TOOTH ENCYSTED IN THE THICKNESS OF THE MAXILLA, AND TOO LITTLE DEVELOPED TO EFFECT EMERGENCE.

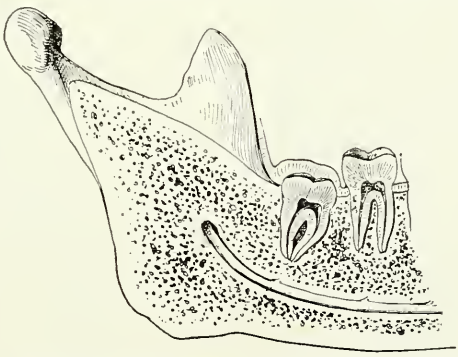


FIG. 145.—LABORIOUS ERUPTION OF LEFT LOWER WISDOM TOOTH, BOUND DOWN BY PERIOSTEUM AND GUM, WHICH MAY RETAIN IT FOR MANY MONTHS.

having emerged from the alveolus, and the special position of the swelling and pain—leave little doubt as to the diagnosis, which may, however, be difficult enough if the masseters are spasmodically contracted. Avulsion

of the tooth can usually be effected through the buccal route. In two patients, of fifty years each, who presented a fistula at the lower border of the cheek, I was obliged to enlarge the opening and then perforate the bone with a burr, in order to expose the osseous cavity, in which was enclosed the dental sequestrum, which was then extracted without difficulty. The wound was treated by tamponing.

Deformities : Congenital and Acquired.

Dental Cysts.

Dental cysts should be treated by widely opening and tamponing after ablation of the parietal membrane.

Complete resection of the osseous wall should be effected, when possible, with the gouge-forceps, or even with the trepan *à cliquet* and the cylindro-spherical burr of 8 millimetres.

Osteotomy of Neck of Jaw and Resection of Condyle.

This operation, which is necessitated by ankylosis of the temporo-maxillary articulation, requires but a very small vertical incision. The skin

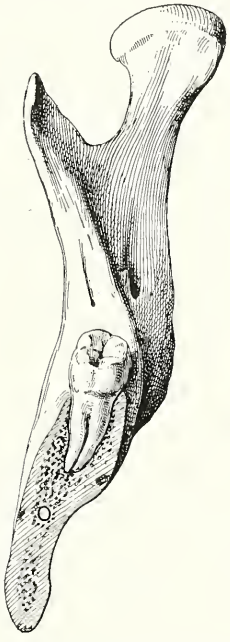


FIG. 146.—NORMAL POSITION OF RIGHT LOWER WISDOM TOOTH.

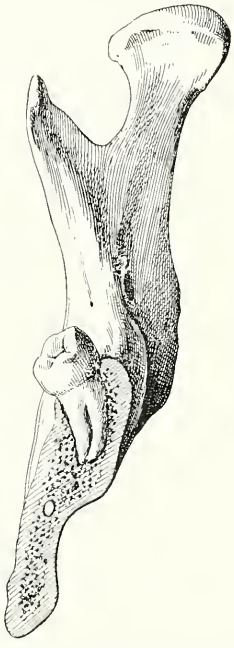


FIG. 147.—OBLIQUITY OF RIGHT LOWER WISDOM TOOTH TOWARDS OUTER SIDE.

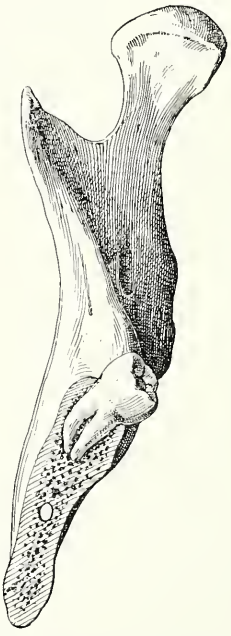


FIG. 148.—OBLIQUITY OF RIGHT LOWER WISDOM TOOTH TOWARDS INNER SIDE.

is divided with the bistoury for a length of 12 to 15 millimetres, and the bone is exposed with a small raspatory to the required extent. In this

way we incur no risk of wounding the upper branches of the facial nerve. The neck of the condyle is easily fractured with a mallet and chisel (Fig. 149). Removal of the upper fragment is necessary, for we cannot calculate very

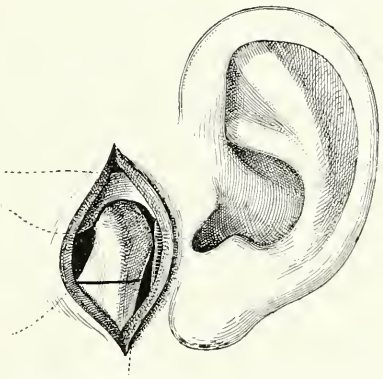


Fig. 149.—Osteotomy of Neck of Jaw and Extirpation of Condyle for Temporo-Maxillary Ankylosis.

much on the movements of the jaw in effecting the formation of a satisfactory pseudarthrosis at the seat of the fracture. The operation must be bilateral when ankylosis exists on both sides.

Tumours of the Superior Maxilla.

Benign Tumours.

Tumours of the Alveolar Border—Epulis.

Tumours of the alveolar margin, which bear the name of "epulis," have nearly always an inflammatory origin. Histologically they are usually osteo-sarcomata, simple, or myeloid; more rarely epitheliomata. Simple or inflammatory epulis is more rare in the upper jaw than in the lower. As any epulis is susceptible of development into a malignant infiltrating tumour, the extirpation should be early and complete.

Operation.—Resection of alveolar margin and affected gum with cutting forceps and gouge-forceps. The neighbouring teeth are removed if mobile so as to reach the limit of the diseased tissues more surely.

Malignant Tumours.

Epithelioma—Osteo-Sarcoma.

These tumours are sometimes epitheliomata springing from the mucous membrane of the alveolar margin of the floor of the mouth, or the frænum linguæ; sometimes tumours with myeloplaxes, osteo-sarcomata more or less ossified, or enchondromata. They require early intervention, and on a large scale. Those with myeloplaxes being less malignant, we can, in doubtful cases, before deciding on total or partial resection, have repeated

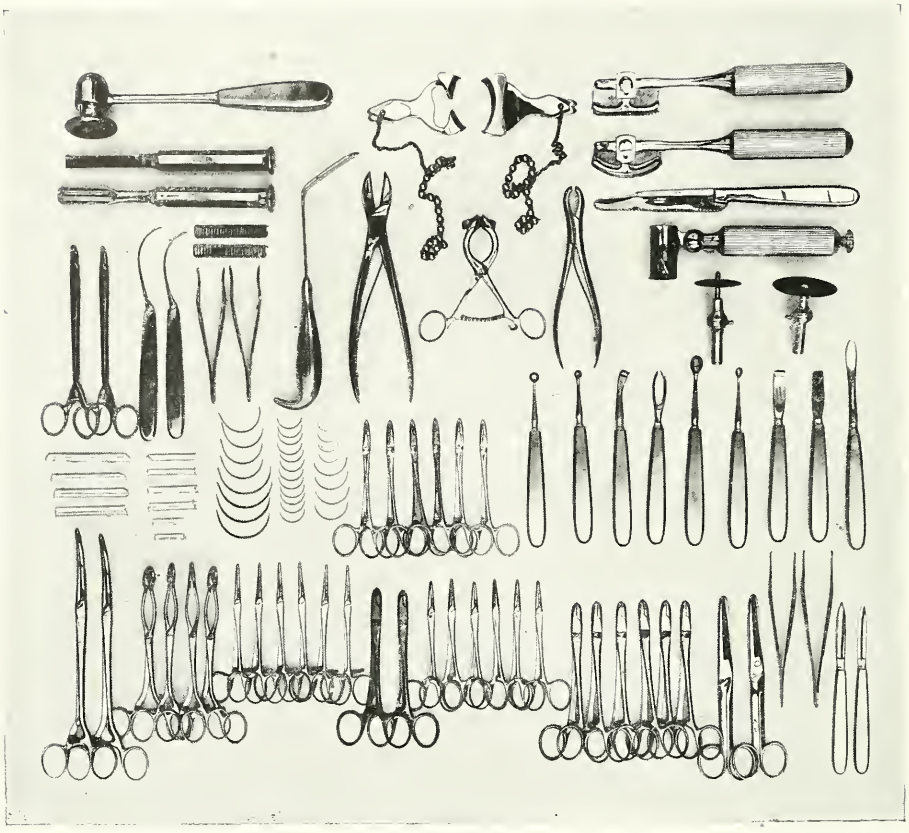


FIG. 150.—INSTRUMENTS FOR RESECTION OF THE MAXILLÆ.

From below upwards and right to left: Two bistouries; two clawed forceps; two strong straight scissors; six artery forceps with short jaws and claws ; six Champonnière's forceps; two forceps with short jaws for veins; six ringed forceps with nine oblique claws; four ringed forceps with oval jaws; two long forceps with curved jaws. Above these: One spatula; two raspatories, straight and curved; two curettes; four fenestrated raspatories ; six needle-holder forceps; sorted needles; glass drainage-tubes. In highest row: Two mounted circular saws, and handle with variable inclination for section of the bone by electric instrumentation; one small saw with movable back; two saws with movable backs, a right and left; one gouge-forceps; one gag ; (*a*) two retractors of the labial commissures; one Liston forceps; one oblique retractor; thirty clasps and two clasp-holders; two needles with handles; two needle-holders with eccentric jaws; one chisel; one gouge; one mallet of soft copper.

Reduced to one-sixth.

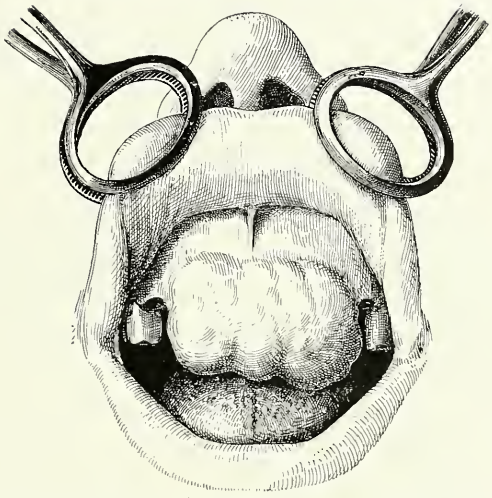


FIG. 151.—SARCOMA OF ALVEOLAR BORDER OF SUPERIOR MAXILLA INVADING THE PALATINE ARCH.

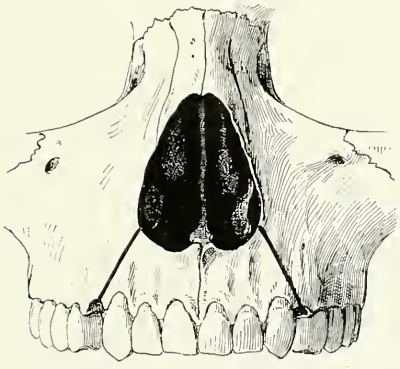


FIG. 152.—SARCOMA OF ALVEOLAR BORDER OF SUPERIOR MAXILLA INVADING THE PALATINE ARCH.

Diagram of the osseous resection seen from the front.

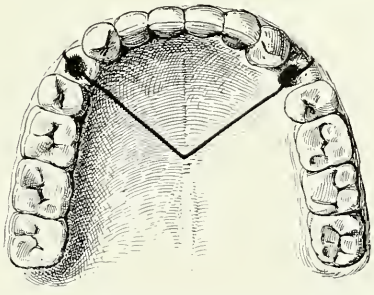


FIG. 153.—SARCOMA OF ALVEOLAR BORDER OF SUPERIOR MAXILLA INVADING THE PALATINE ARCH.

Diagram of the V-shaped palatine incision, which should pass through the sockets of the two first premolars.

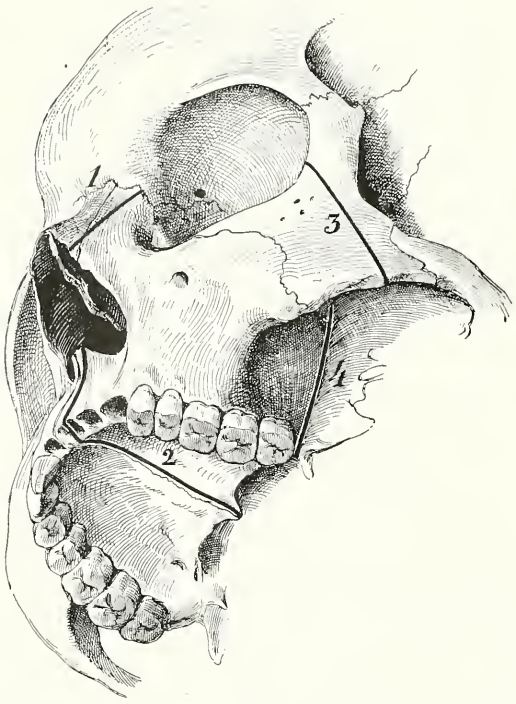


FIG. 154.—DIAGRAM OF THE FOUR OSSEOUS SECTIONS NECESSARY FOR TOTAL EXTIRPATION OF THE SUPERIOR MAXILLA.

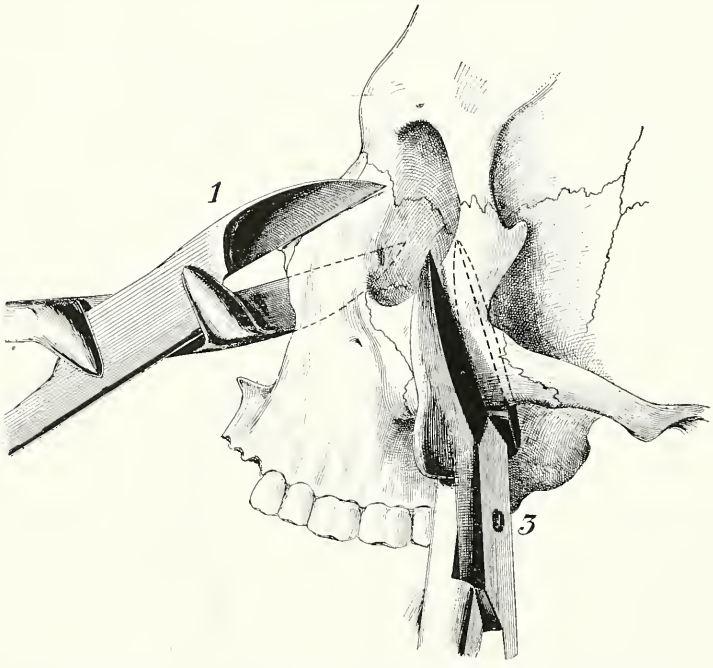


FIG. 155.—POSITION OF THE FORCEPS IN SECTION OF THE ASCENDING PROCESS OF THE MAXILLA (1), AND IN SECTION OF THE MALAR BONE (3).

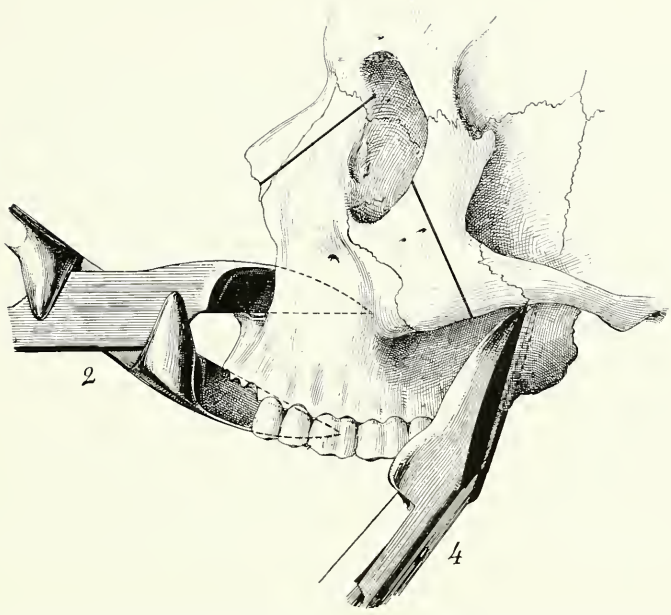


Fig. 156.—Position of the Forceps for Section of the Palatine Vault (2), and for Pterygo-Maxillary Disjunction (4).

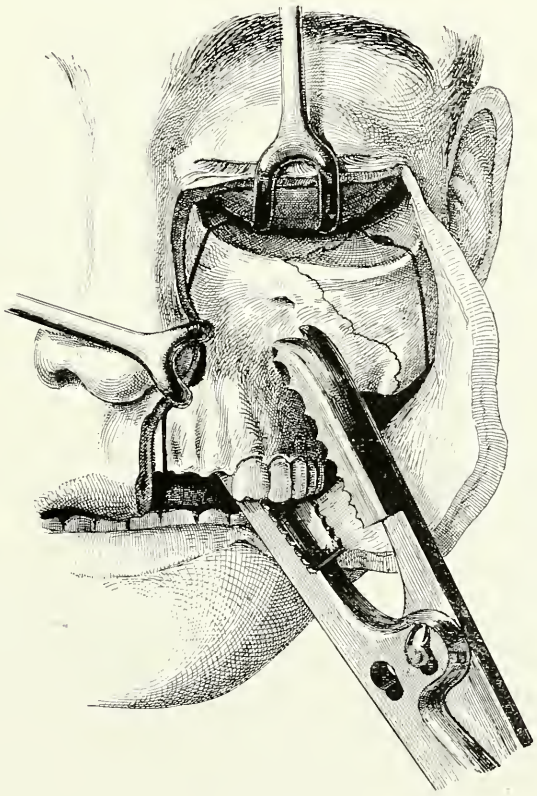


Fig. 157.

The superior maxilla, freed from its attachments, is removed with Farabœuf's forceps.

recourse to radiographic examination, which reveals the smaller prolongations of the neoplasm, and especially the distant foci; and make a microscopic examination of a characteristic fragment, removed at a suitable point after local anæsthesia with cocaine.

Partial Resection of the Superior Maxilla.

This operation is carried out, either for the treatment of an affection of the bone itself, or of the maxillary sinus, or in order to reach the base of the skull by the transmaxillary route.

1. **Removal of the Anterior Wall of the Maxillary Sinus.**—This operation is carried out with the same incision as that used in total extirpation of the bone, but taking care to preserve the lip, palatine vault, and dental arcade. The object is to reach tumours situated on the outer wall of the nasal fossa on that side. Resection of the whole anterior wall of the sinus, then of its internal and posterior walls permits us to reach the base of the skull between the basilar apophysis and the foramen ovale. The trunk of the middle meningeal artery, when it bleeds repeatedly, should be obliterated in the foramen rotundum itself, either by folding back the vessel with the extremity of a forceps, or by introducing into the foramen a splinter of bone removed from the vicinity.

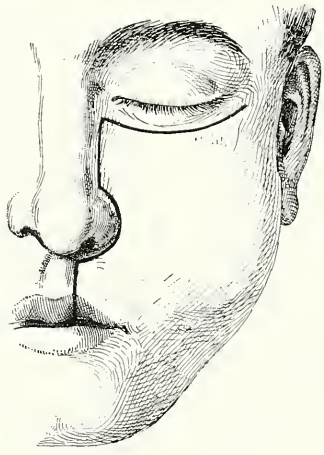


Fig. 158.—Nélaton's Cutaneous Incision for Total Extirpation of the Superior Maxilla.

2. **Resection of the Alveolar Process.**—This operation, which is necessitated by the presence of small tumours of the alveolar margin of the bone, differs from the operation on foci of caries and of necrosis, because the soft parts, notably the gum, which is habitually invaded by the neoplasm, must be extensively extirpated with the latter. The operation should extend widely beyond the limits of the tumour.

FIG. 159.—NÉLATON'S CUTANEOUS INCISION FOR TOTAL EXTIRPATION OF THE SUPERIOR MAXILLA.

Resection of the superior maxilla: division of the ascending process.

FIG. 160.—NÉLATON'S CUTANEOUS INCISION FOR TOTAL EXTIRPATION OF THE SUPERIOR MAXILLA.

Resection of superior maxilla: section of the palatine vault.

FIG. 161.—NÉLATON'S CUTANEOUS INCISION FOR TOTAL EXTIRPATION OF THE SUPERIOR MAXILLA.

Resection of superior maxilla: ligature of the internal maxillary artery.

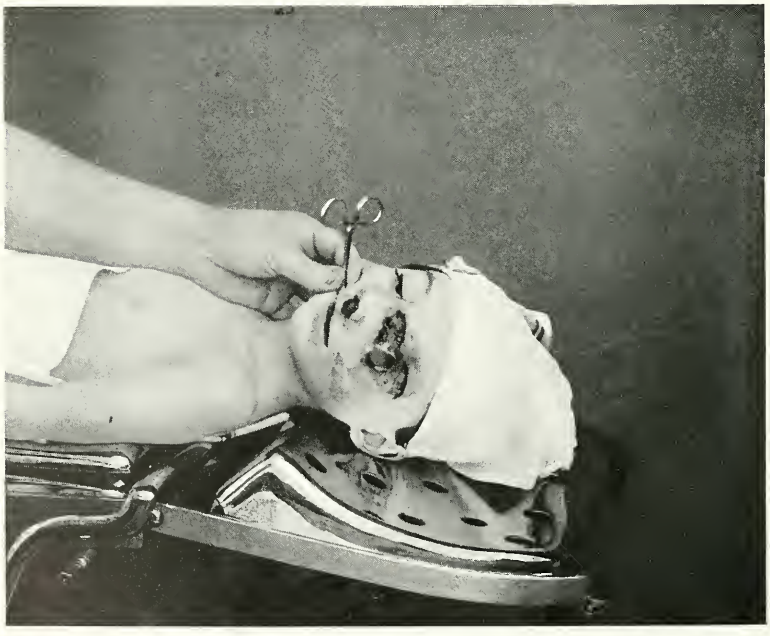


FIG. 162.—SARCOMA OF THE SUPERIOR MAXILLA INVOLVING THE WHOLE CONTENTS OF THE ORBIT AND THE EXTERNAL ORBITAL APOPHYSIS.

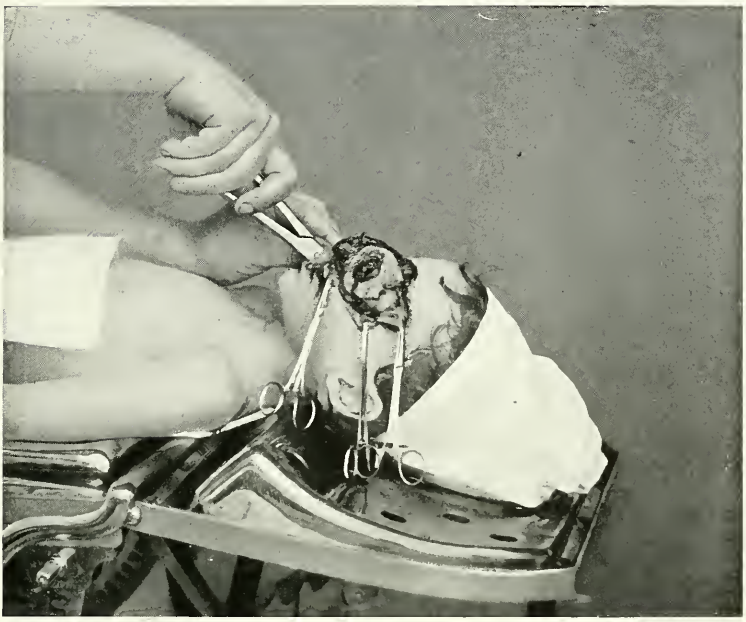


FIG. 163.—SARCOMA OF THE SUPERIOR MAXILLA INVOLVING THE WHOLE CONTENTS OF THE ORBIT AND THE EXTERNAL ORBITAL APOPHYSIS.

Resection of superior maxilla and palati bone. Section of the palatine vault.

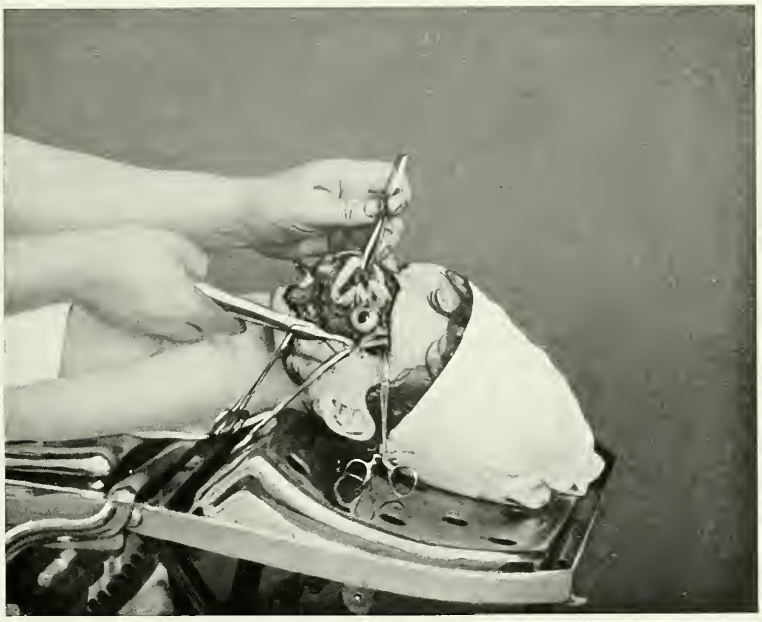


FIG. 164.—SARCOMA OF THE SUPERIOR MAXILLA INVOLVING THE WHOLE CONTENTS OF THE ORBIT AND THE EXTERNAL ORBITAL APOPHYSIS.

Pterygo-maxillary disjunction.

Complete Resection of the Superior Maxilla.

Tumours of the superior maxilla are frequently malignant: osteo-sarcoma or epithelioma. The ablation should be carried out within the widest possible limits. The patient, anæsthetized, is placed in the ordinary position of dorsal decubitus; the surgeon stands on his right side.

Operation—First Stage: Incision of the Integuments.—The best incision is that of Nélaton. It follows the lower border of the orbit, the naso-genial and naso-labial grooves, and descends vertically on the lower lip in the middle line. The incision is carried out with a single movement, beginning at the external orbital apophysis, and following the inferior border of the orbit and the naso-genial groove as far as the median plane of the upper lip, which is incised without involving the mucous membrane (Fig. 158).

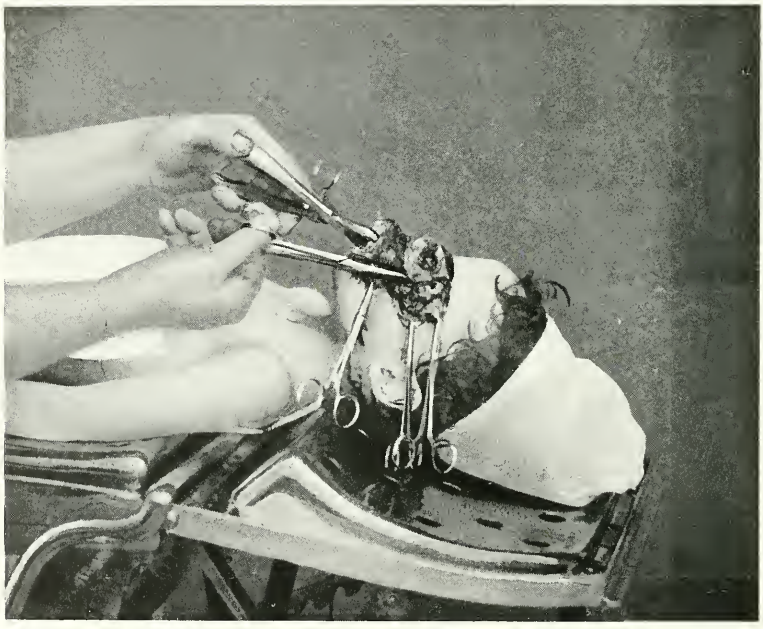


Fig. 165.—Sarcoma of the Superior Maxilla involving the Whole Contents of the Orbit and the External Orbital Apophysis.

The maxilla is completely freed from its last attachments.

Second Stage: Mobilization of the Cutaneous Flap.—The cutaneous flap is rapidly detached from the maxilla with a bistoury taking care to keep outside the limits of the neoplasm. We then divide the fibrous band of attachment of the lower eyelid to the adjacent border of the orbit, the infraorbital nerve inside the orbit, and the fibro-muscular attachments of the anterior portion of the zygomatic apophysis. The bistoury is then plunged, along the interval border of the bone, into the nostril, and the

section of the upper lip is completed, so that we can fold back the whole substance of the musculo-cutaneous flap on the ear.

Third Stage: Removal of Incisor Teeth and Isolation of the Bone.—One or two incisors are removed with the forceps, or even with the gouge-forceps, and the bone is mobilized by four sections with the shears. The first divides the ascending process of the maxilla; the second, after division of the velum palati with a bistoury, divides the whole length of the palatine arch; the third, the zygomatic arch; finally, the fourth, penetrating behind the tuberosity of the maxilla, effects the disjunction of the spheno-maxillary suture.

Fourth Stage: Extirpation of the Bone.—The bone is seized with the jaws of a suitable forceps, and removed like an ordinary molar, taking care to divide the last remaining fibro-muscular attachments with scissors, and also the infraorbital nerve, if not previously divided. The internal maxillary artery is usually the only one which is met with in the depth of the wound. It is seized with a forceps with short jaws and claws, and tied with silk.

Fifth Stage: Reunion of the Wound.—After tamponing the wound, the skin is sutured with silk or Florentine hair. The tampon is removed after three or four days. A prothetic piece of covering is finally applied.

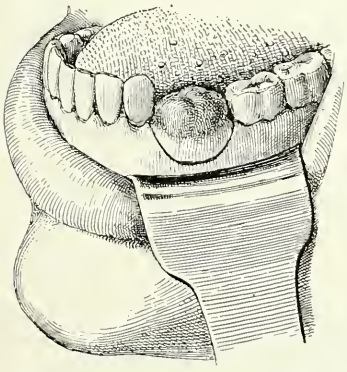


Fig. 166.—Epulis of Alveolar Margin of Inferior Maxilla in the Plane of the Two Left Premolars.

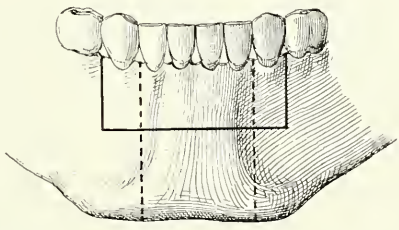


Fig. 167.—Partial Resection of Alveolar Process of Lower Jaw in a Case of Epulis.

The dotted lines indicate a complete resection of the median portion of the inferior maxilla.

By this procedure the superior maxilla can be removed with a portion of the malar bone and the whole of the palate. I have obtained excellent results from this broad operation—notably in case of a man aged fifty-five, who had an enormous tumour which had ulcerated the skin. He survived five years without any recurrence, and died from an accidental pneumonia. Figs. 162 to 165 illustrate the same operation on a still more extensive scale, which was completed by ablation of the eye and resection of the external orbital apophysis. The case was one of an enormous sarcoma which had commenced in the superior maxilla.

Atypical Resections of the Skeleton of the Face.

The topography of tumours may require the resection of either both superior maxillæ, in part or totally; or one maxilla, with the entire skeleton of the nose. These operations are carried out when there are special indications, and do not call for special description.

Tumours of the Inferior Maxilla.

Benign Tumours.

Tumours of the Alveolar Border—Epulis.

The tumours of the alveolar process and gum of the lower jaw which are described under the common name of "epulis," includes various types of neoplasm, ranging from benign inflammatory papilloma to epithelioma and osteo-sarcoma. Ablation of inflammatory epulis is effected with clawed forceps and scissors; the seat of implantation is then resected with the gouge-forceps. When recurrence takes place, the intervention must be on a wider scale, and we must not hesitate to sacrifice the neighbouring teeth.

Malignant Tumours.

Tumours of the Body of the Bone.

The tumours which attack the deep parts of the superior maxilla are either *primary* (osteo-sarcomata), or *secondary* (epitheliomata).

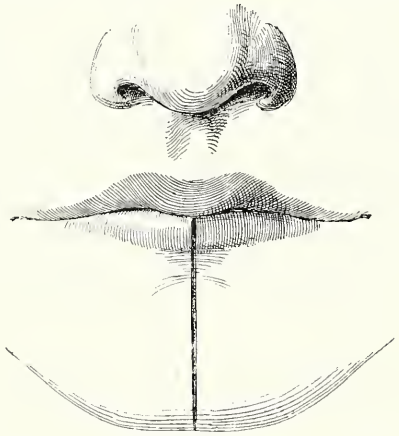


Fig. 168.—Partial Resection of Median Portion of Lower Jaw.

Incision of the skin.

Partial Resection of Inferior Maxilla, by Anterior Vertical Incision.

Resection of the median portion of the inferior maxilla may be necessitated by a sarcomatous epulis. This operation is also indicated in case of osseous epithelioma, secondary to cancer of the lip or tongue.

Operation—First Stage: Incision of Integuments.—The lip and skin of the median plane of the chin are incised till the neoplasm is reached.

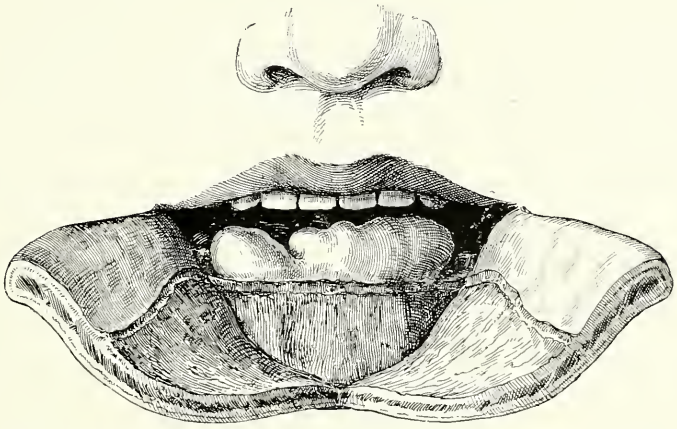


Fig. 169.—Partial Resection of Median Portion of Lower Jaw.

The soft parts are detached from the bone, exposing the sarcomatous epulis, which has invested the whole vertical extent of the median portion of the inferior maxilla.

Second Stage: Section of the Maxilla.—The bone is exposed with the bistoury, which we take care to keep sufficiently far from the neoplastic

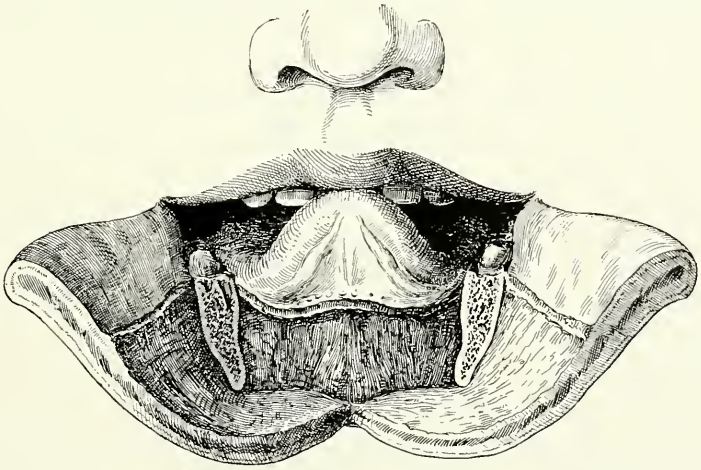


Fig. 170.—Partial Resection of Median Portion of Lower Jaw.

The median portion of the inferior maxilla has been resected. The divided surface of the bone is shown on each side. We also see the lines of section of the lingual and gingival mucous membranes.

tissues. We then divide it, either with a saw with movable back, or with a circular saw—in exceptional cases with a chain saw—after having completely freed its surface from its muscular and mucous attachments. I divide

the body of the lower jaw habitually with either a small saw with movable back, or with a circular saw worked by electricity. We take care to protect the soft parts with a long curved forceps introduced beneath the bone at

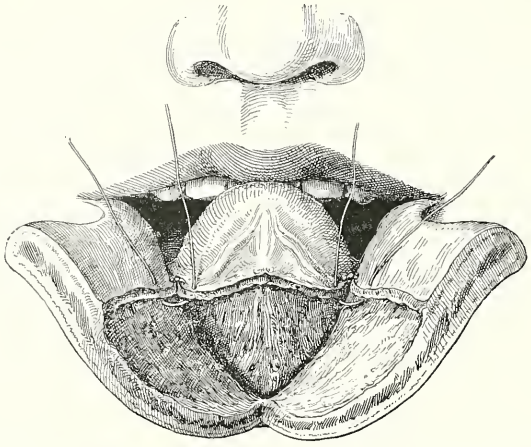


Fig. 171.—Partial Resection of Median Portion of Lower Jaw.

Suture of lingual to gingival mucous membrane. The divided surface of the maxilla has already been covered by the suture.

the chin, and made to emerge between the dental arches (Figs. 177 and 181). The bone is held by the left hand with a gouge-forceps, while we saw through it with the right. Division of the bone with the circular electric

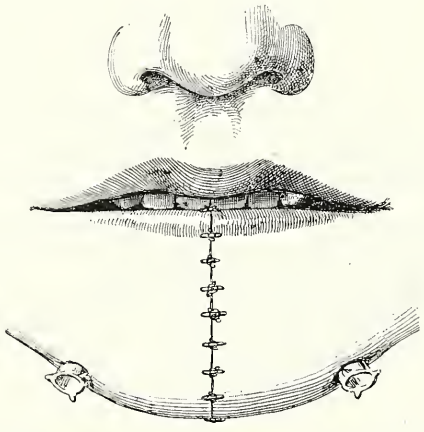


Fig. 172.—Partial Resection of Median Portion of Lower Jaw.

Suture of mucous membrane and skin in the middle line. Drainage.

saw is still more simple when we know how to work this instrument. When we choose to employ the chain saw, the dentated band should be passed under the inferior maxilla with a long curved forceps.

Third Stage: Reunion of the Mucous Membrane.—After the osseous resection we apply the necessary ligature, and proceed to operation of the mucous membrane by suturing the mucous margin of the lower aspect of the tongue to that of the gingival surface.

Fourth Stage: Suture of the Wound.—The skin is sutured with Florentine hair, and the field of operation is drained with glass drainage-tubes.

Partial Resection of the Median Portion of the Inferior Maxilla through the Submaxillary Route.

In the case of a primary tumour of the basilar portion of the bone, the incision is made along the lower border of the maxilla.

Operation—First Stage: Incision of Integuments.—Section of skin along the lower border of the inferior maxilla for a distance of 8 or 10 centimetres.

Second Stage: Exposure of the Tumour.—Dissection of both lips of the incision and exposure of the neoplasm. The healthy bone is laid bare with the raspatory to an extent reaching beyond the limits of the tumour.

Third Stage.—Resection of median portion of maxilla.

Fourth Stage.—Reunion of lingual and gingival mucous membrane.

Fifth Stage: Suture of Skin and Drainage.—The skin is united by interrupted suture, and the drainage-tubes are placed in position.

Unilateral Resection of the Inferior Maxilla.

First Stage: Incision of the Skin.—The incision required for extirpation of one half of the lower jaw should be made along the lower margin of the bone from the symphysis menti, and carried up behind to a point 15 to 20 millimetres above the posterior angle of the jaw.

Second Stage: Isolation of the Maxilla.—The bone is separated from its musculo-aponeurotic attachments with the bistoury, after ligature or simple forcipressure of the upper and lower ends of the facial artery and vein. It is then detached from the mucous membrane of the floor of the mouth.

Third Stage: Division and Extraction of the Maxilla.—The maxilla is then divided in the middle line. The half to be removed is drawn outwards with the gouge-forceps or between the jaws of an Ollier's forceps. We then divide with scissors the lower attachment of the internal pterygoid muscle, the spheno-maxillary, and stylo-maxillary ligaments, and the inferior dental nerve; and, passing upwards to the coronoid apophysis, the tendon of the temporal muscle; after which we have but to enucleate the condyle by twisting the whole mass two or three times round its axis.

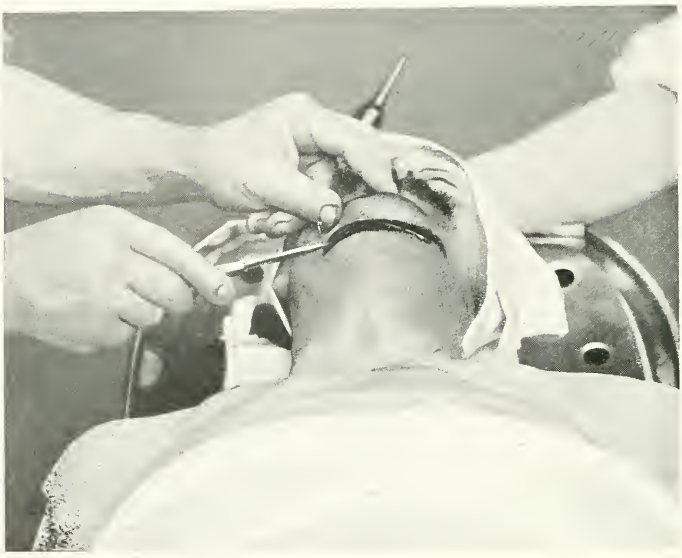


FIG. 173.—RESECTION OF MEDIAN PORTION OF INFERIOR MAXILLA BY HORIZONTAL SUBMAXILLARY INCISION.

First stage: Section of integuments.

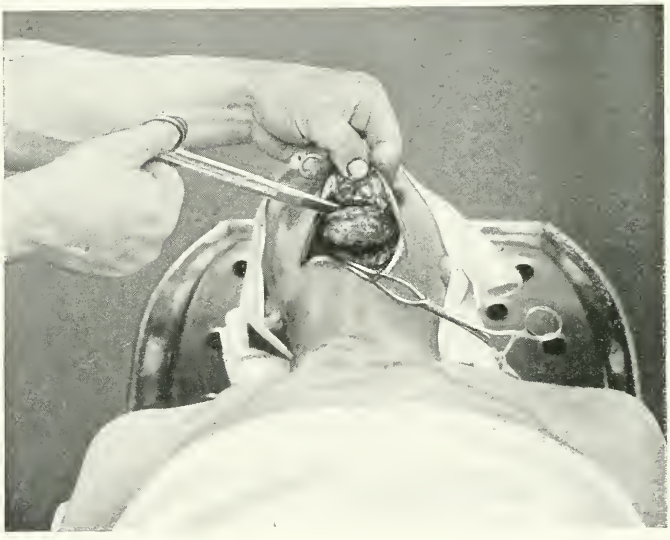


FIG. 174.—RESECTION OF MEDIAN PORTION OF INFERIOR MAXILLA BY HORIZONTAL SUBMAXILLARY INCISION.

Second stage: Dissection of anterior flap of wound, and exposure of tumour.

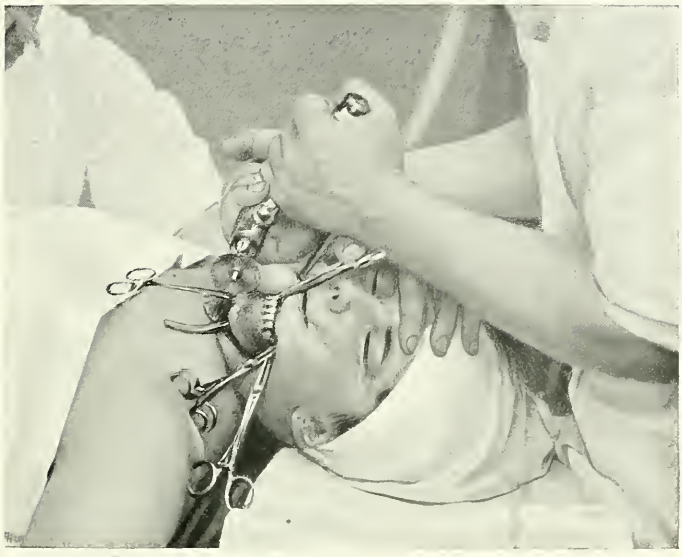


FIG. 175.—RESECTION OF MEDIAN PORTION OF INFERIOR MAXILLA BY HORIZONTAL SUBMAXILLARY INCISION.

Division of bone with circular saw.

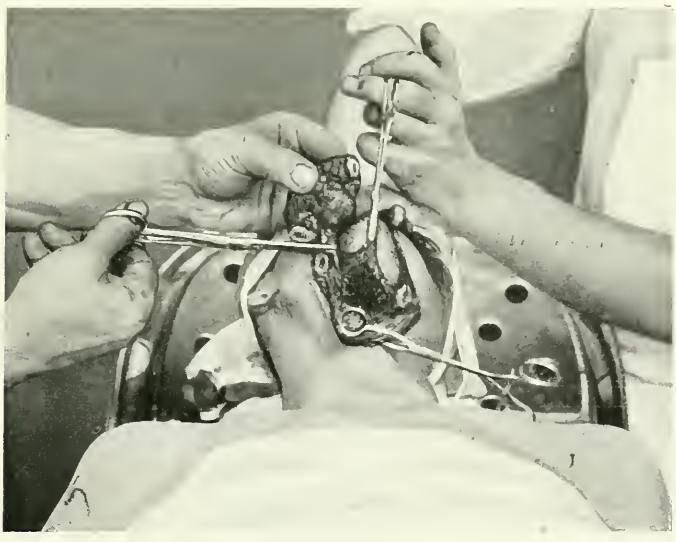


FIG. 176.—RESECTION OF MEDIAN PORTION OF INFERIOR MAXILLA BY HORIZONTAL SUBMAXILLARY INCISION.

Third stage : Extirpation of tumour. Division of last bridge of mucous membrane.

Fourth Stage: Toilet of Wound.—We secure hæmostasis and carry out the toilet of the wound.

Fifth Stage.—Suture of mucous membrane and of skin; drainage.

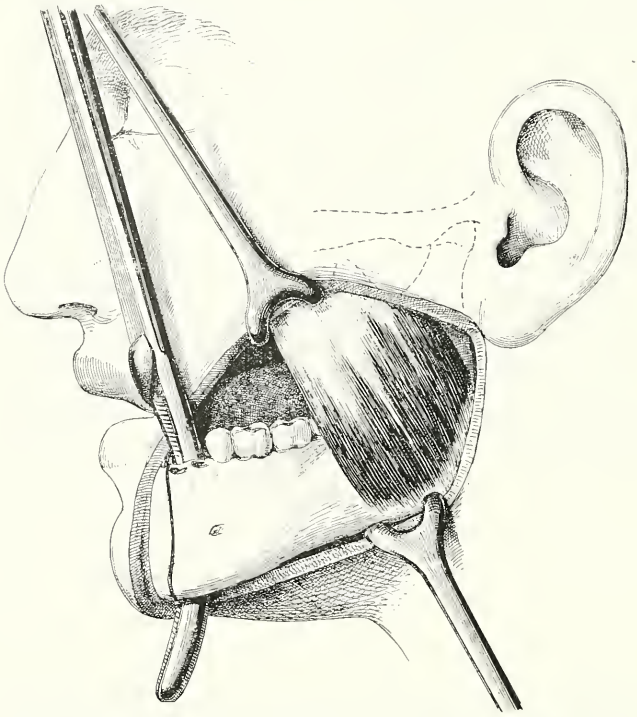


Fig. 177.—Unilateral Resection of Inferior Maxilla.

A curved forceps is passed behind the bone to protect the soft parts from the saw.

Total Resection of the Inferior Maxilla.

I have had to remove the whole lower maxilla for an osteo-sarcoma which involved nearly the whole of the horizontal portion of the bone in a girl aged twenty. The operation was decided on after curettage, and histological examination of the principal neoplastic focus. The incision, made as described above, enabled me to free the bone at its median part. The maxilla, of which the tissues were profoundly altered, was divided without difficulty with a single movement of the cutting forceps, and each half was extirpated in the way above indicated. This operation, which was performed many years ago, has not been followed by recurrence. The patient's sister was operated on some months later for the same affection. By this procedure the lower lip is left intact.

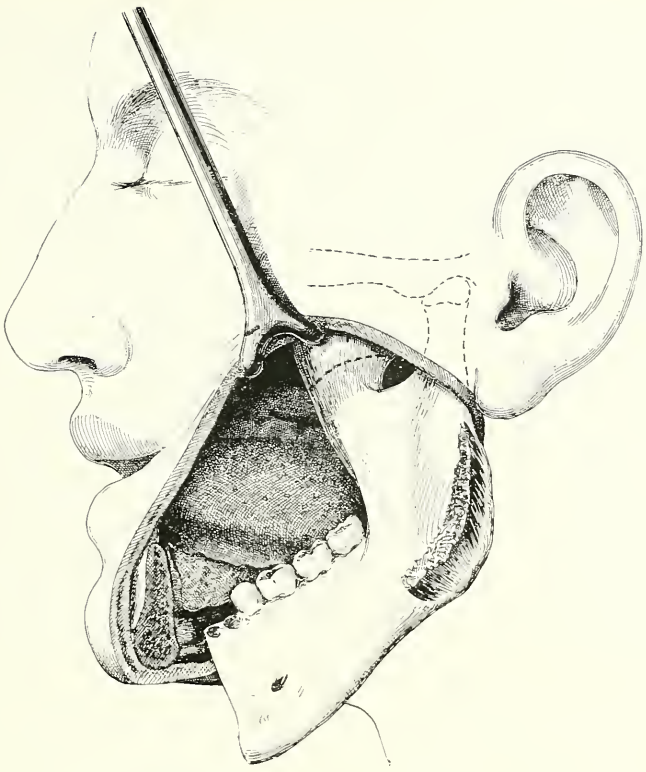


Fig. 178.—Unilateral Resection of Inferior Maxilla.

The bone, divided in the middle, is now almost detached. The tendon of the temporal muscle is seen.

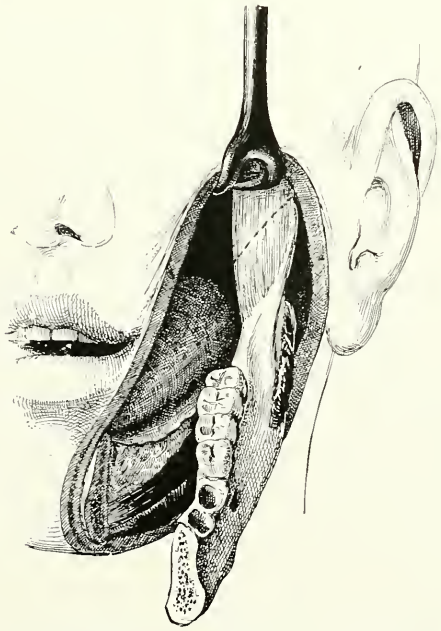


Fig 179.—Unilateral Resection of Inferior Maxilla.

Same stage of operation viewed from the front.

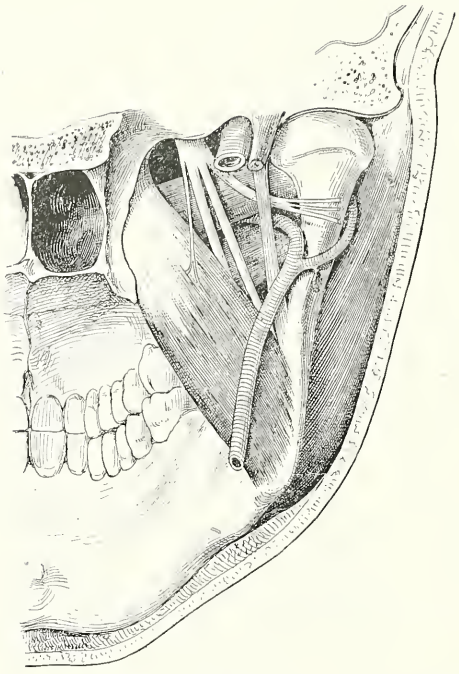


FIG. 180.—RELATIONS OF THE INTERNAL SURFACE OF THE INFERIOR MAXILLA.

We see here the auriculo-temporal, inferior dental, and lingual nerves; also the nerve to the internal pterygoid muscle; the divided end of the styloid apophysis; the stylo-maxillary ligament; and the external carotid artery, which divides into internal maxillary and superficial temporal.

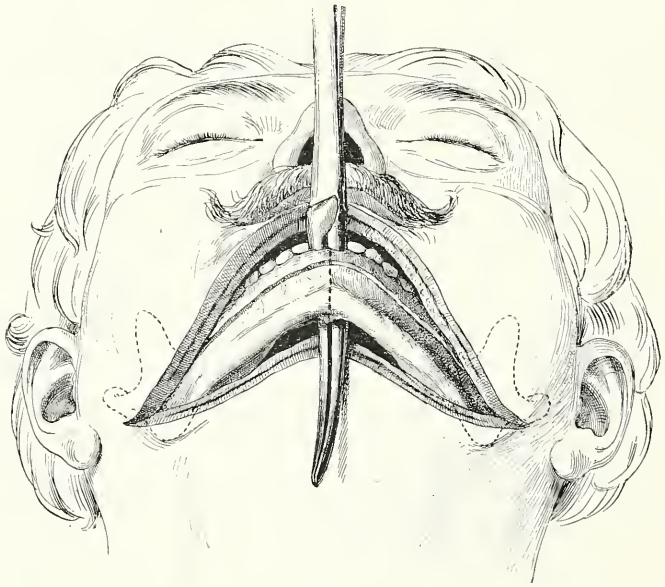


FIG. 181.—TOTAL RESECTION OF INFERIOR MAXILLA.

We prepare for division of the median portion of the bone by the introduction of a curved forceps under the maxilla.

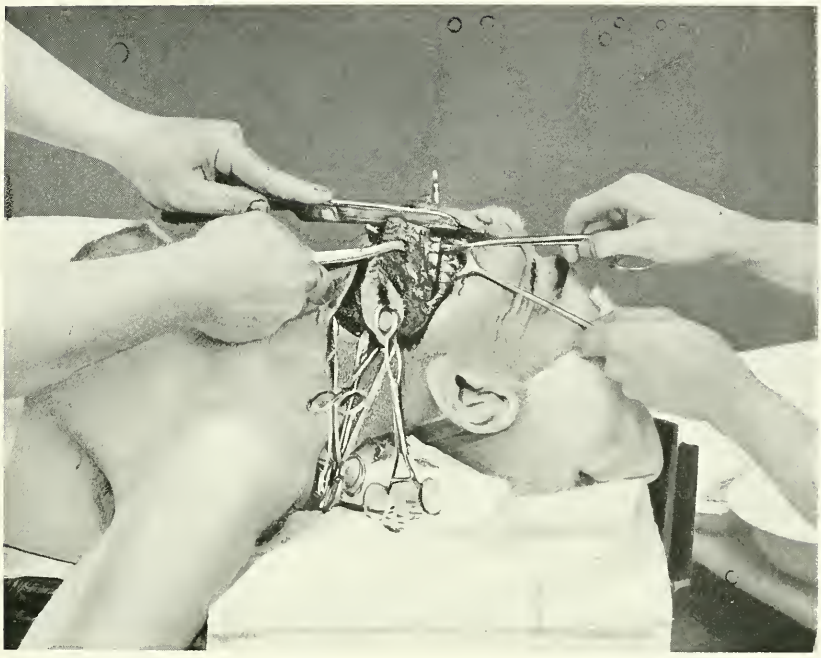


FIG. 182.—RESECTION OF RIGHT HALF OF INFERIOR MAXILLA WITH ADHERING SUBMAXILLARY EPITHELIOMATOUS MASS.

Division of bone in middle line.

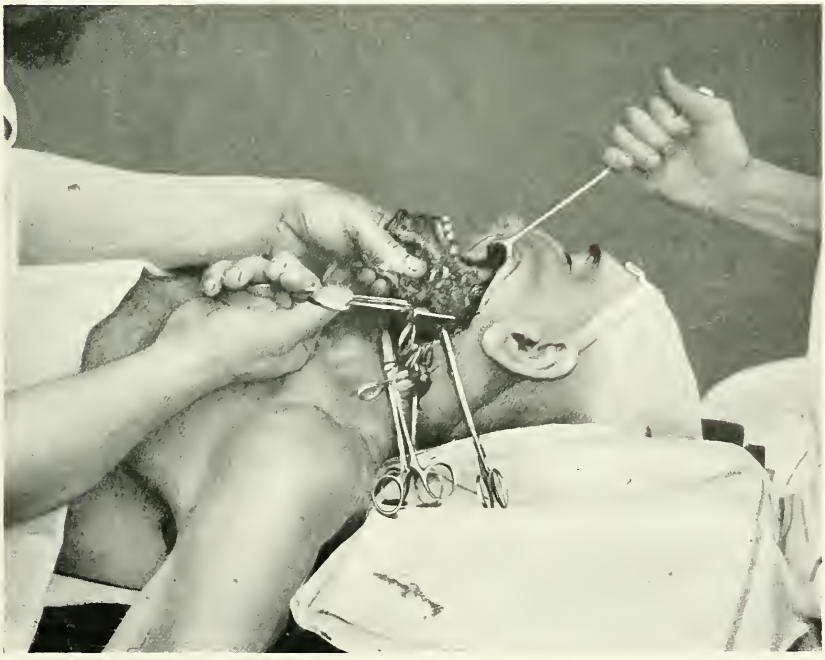


FIG. 183.—RESECTION OF RIGHT HALF OF INFERIOR MAXILLA WITH ADHERING SUBMAXILLARY EPITHELIOMATOUS MASS.

Division of internal pterygoid muscle.

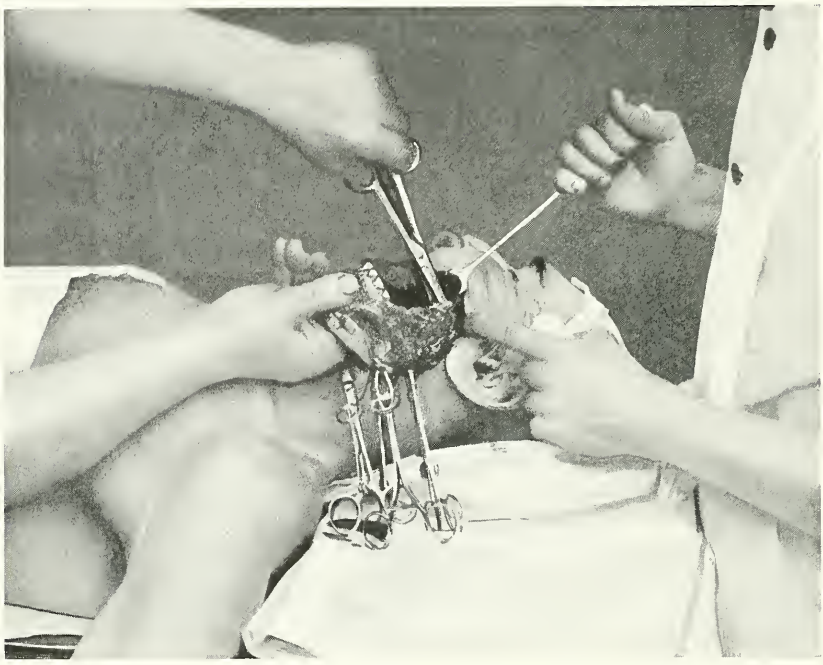


FIG. 184.—RESECTION OF RIGHT HALF OF INFERIOR MAXILLA WITH ADHERING SUBMAXILLARY EPITHELIOMATOUS MASS.

Division of tendon of temporal muscle above the coronoid apophysis.

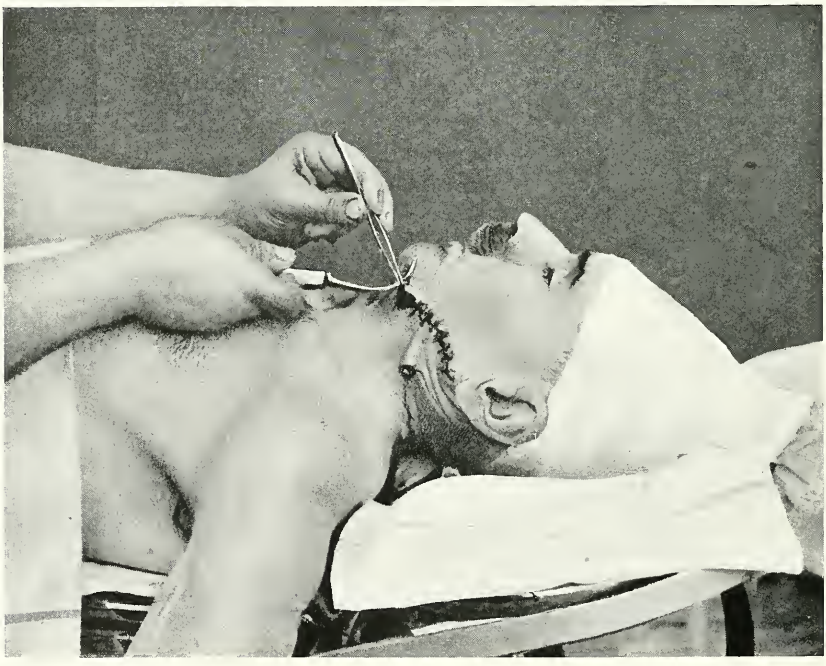


FIG. 185 —RESECTION OF RIGHT HALF OF INFERIOR MAXILLA WITH ADHERING SUBMAXILLARY EPITHELIOMATOUS MASS.

Suture of skin. Drainage.

Repair of Extensive Loss of Substance from the Cheek by the Italian Method.

In cases in which the operation necessitates sacrifice of the greater portion of the soft tissues of the face, and also of the subjacent skeleton, the process of reparation can be carried out only by the Italian method. The mucous membrane and the skin must be reconstituted at the same time.

Fig. 186.—Loss of Substance produced in Ablation of an Epithelioma of the Face which had involved the Superior Maxilla.

The operation is carried out in a series of successive séances. When the loss of substance has been very extensive, reconstitution of the inner wall of the cheek is necessary. I will describe the operation as suited to the case represented in Fig. 186.

Reconstitution of Inner Aspect of the Cheek—First Intervention—*First Stage.*—Mobilization of a cutaneous flap of suitable form and dimensions raised from the antero-internal aspect of the arm of the same side; the epidermal surface is made to form the wall of the buccal cavity.

Second Stage.—Suture of this flap to the mucous membrane, the margins of which have been vivified, and reconstitution of the free border of the lip (Fig. 187).

Fig. 187.—Reconstitution of Inner Wall of Cheek by Suture of a Brachial Cutaneous Flap, the Epidermis of which is turned towards the Buccal Cavity.

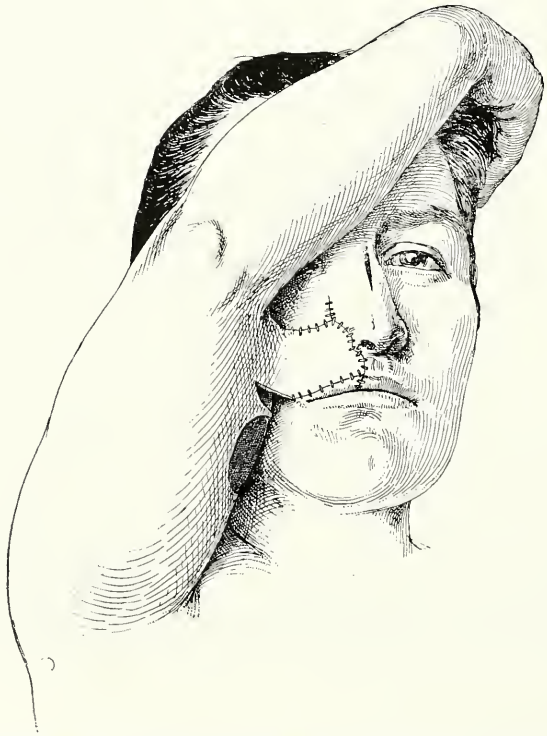


Fig. 188.—Reconstitution of Skin of Cheek by Suture of a Brachial Cutaneous Flap, the New Surface of which is turned towards the Loss of Substance.

Third Stage.—Application of dressing, and fixation of arm to head.

The bandage is left in position for eight days.

Second Intervention.—The bandage is completely removed. We detach the brachial flap as far as is necessary for completion of the autoplasty of the mucous membrane, but taking care to preserve a pedicle of several centimetres in width.

Third Intervention—*First Stage.*—Removal of the bandage and toilet of the region.

Second Stage.—Section ot pedicle of brachial flap.

Third Stage.—Adaptation and suture of flap to posterior margin of area of loss of substance.

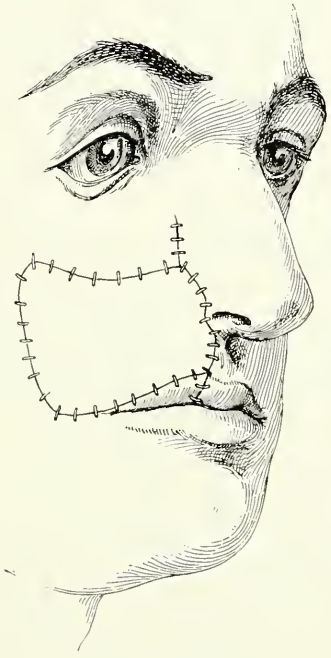


Fig. 189.—Reconstitution of the Inner Wall and Skin of Cheek.

Appearance of suture after third intervention.

The autoplastic flap should be extensive enough to permit separation of the dental arches. When cicatrization is completed, we have to deal with reconstitution of the region.

Reconstitution of the Cutaneous Surface—First Intervention—*First Stage.*—Formation of a brachial flap in a position near that of the first, but disposed in such a manner that it is applied to the area of the loss of substance by its raw surface (Fig. 188).

Second Stage.—Curettage of the wound, vivification of its margin, and suture of the margin of the brachial flap to three-quarters of the periphery of the wound.

Third Stage.—Application of dressing and of immovable bandage.

Second and Third Interventions.—The second and third interventions are carried out as above described for the reconstitution of the internal wall of the cheek. Fig. 189 represents the close of the final stage of the third intervention. The free border of the lip has been reconstituted by a fold of the first brachial flap. The second cutaneous flap has re-established the configuration of the integument of the region.

Reconstitution of Inner Wall and Skin of Cheek with a Single Brachial Flap.—In some cases we may endeavour to reconstitute the skin and mucous membrane simultaneously by the same brachial cutaneous flap, instead of with two flaps, as just described.

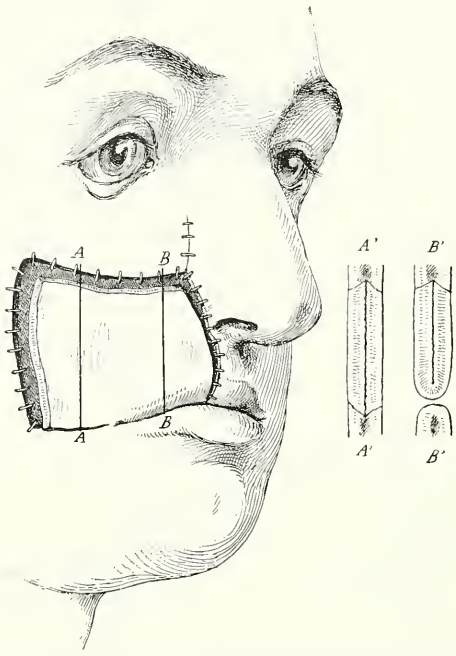


Fig. 190.—Reconstitution of the Inner Wall and Skin of Cheek with a Single Cutaneous Flap.

Beside the figure are seen sections of both aspects of that area along the lines *AA* and *BB*.

First and Second Interventions.—The first two interventions are carried out with the same technique as that described for reconstitution of the inner wall of the cheek, but a much larger flap is required.

Third Intervention—*First Stage.*—Removal of bandage and toilet of the region.

Second Stage.—Adaptation and suture of flap to periphery of area of loss of substance, with care to reconstitute the labial commissure.

Resection of the Inferior Dental Nerve.

This operation is preferably carried out through the facial route.

Operation—First Stage: Incision of the Skin.—A small oblique incision is made parallel to the basilar border of the bone, and equally distant from that border and the alveolar border. This incision avoids the branches of the facial nerve.

Second Stage: Perforation of the Bone.—The maxilla is exposed by divulsion so as to preserve the nerve filaments effectively, and is attacked with the trepan *à cliquet* and flat drill, and then with the cylindro-spherical burr of 12 millimetres. The dental canal is soon laid open.

Third Stage: Section of the Mental Nerve.—The mental nerve, exposed in the gingivo-labial groove by scratching the bone with a raspatory, is divided at its point of exit from the mental foramen.

Fourth Stage.—The trunk of the dental nerve is raised with a small crotchet, and is drawn out with a small hæmostatic forceps. It is they divided above the forceps, and its terminal end is extracted by a rotatorn movement which rolls it around the jaws of the instrument.

Fifth Stage.—Suture of mucous membrane and of skin.

PALATINE ARCH AND SOFT PALATE.

Traumatic Lesions.

Wounds with cutting instruments which involve the velum palati, require immediate union with interrupted suture. When a fistula has been produced, staphylorrhaphy is carried out as in cases of congenital fistula. The thinned velum palati may be torn through in the course of rapid extirpation of large pharyngeal polypi. Union is carried out with points of interrupted suture made with fine silk.

Inflammatory Lesions.

Abscesses of dental origin may form at the level of the palatine arcade. These should be incised. The persistence of a fistula leads to a point of necrosis from which the sequestrum should be removed.

Hypertrophy of the Uvula.

Simple hypertrophy and neoplasm of the uvula are both treated by excision.

Operation.—Local anæsthesia with cocaine. The patient is placed in a chair and the bicommissural retractor is applied. The extremity of the uvula is firmly seized with a clawed forceps, and cut off at the desired level with strong scissors. The artery of the uvula often emits a small jet of blood. Cicatrization is completed in ten to twelve days, after an interval

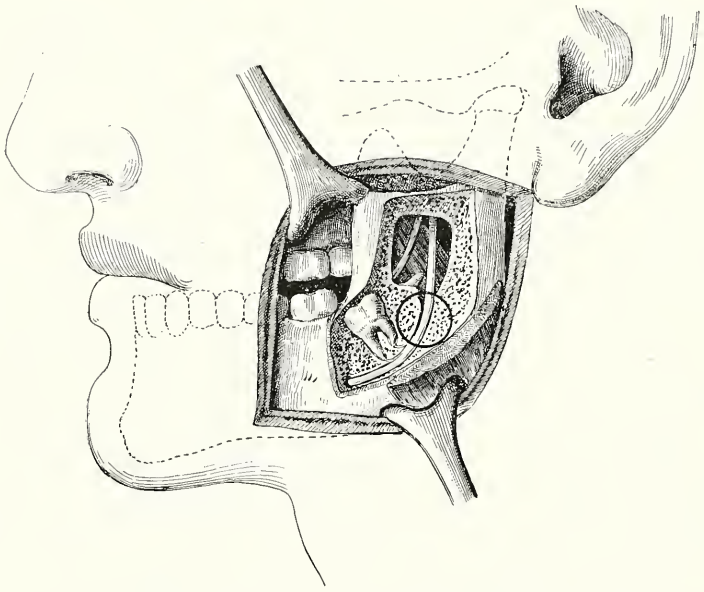


FIG. 191.—RESECTION OF THE INFERIOR DENTAL NERVE.

Anatomy of the region of Spix's spine, showing the lingual and inferior dental nerves, between the bone and internal pterygoid muscle. The black circle indicates the position at which the burr is applied. The wisdom tooth has not emerged.

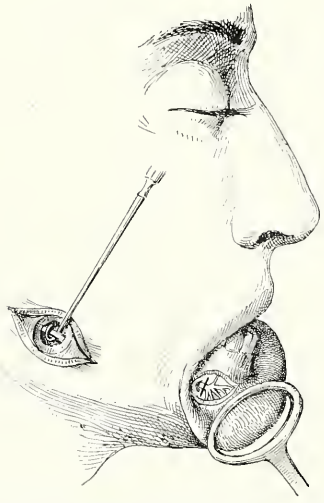


FIG. 192.—RESECTION OF THE INFERIOR DENTAL NERVE.

Exposure of the dental nerve in the dental canal, and division of its mental branch.

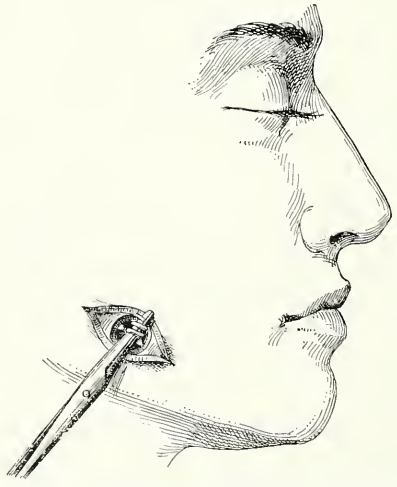


FIG. 193.—RESECTION OF THE INFERIOR DENTAL NERVE.

Rolling of the inferior dental nerve on the hæmostatic forceps.

of inflammatory tumefaction which is sometimes painful. The hæmorrhage is arrested, when this is necessary, by application of a bullet forceps for some minutes, or with the galvano-cautery.

Malformations : Congenital and Acquired.

Perforation of Median Portion of the Palatine Vault.

All perforations and median divisions of the palate are repaired by a similar method. Vivification of the edges is carried out with folding, and the lateral flaps are completely mobilized so as to facilitate their union.

Operation.—General anæsthesia. The Rose position.

First Stage : Liberating Incisions.—Two deep incisions are made parallel to the alveolar borders of the palatine arch, each beginning on the soft

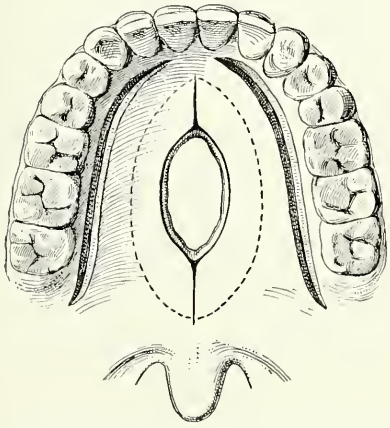


Fig. 194.—Median Perforation of Palate.

Liberating incision, and vivification by folding.

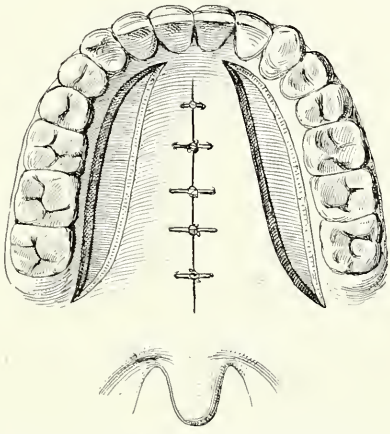


Fig. 195.—Median Perforation of Palate.

Staphylorrhaphy. Reunion of mucous membrane.

palate, a little behind and outside the last molar tooth, and ending in front of the canine (Fig. 194). Those incisions should avoid the palatine arteries, which are placed in the thickness of the submucous tissues (Fig. 198).

Second Stage : Mobilization of the Mucous Bridges.—The mucous membrane of the palate is detached on the right and left side in succession with angular raspatories, respectively adapted to the corresponding sides. The decollation is prolonged as far as possible in front, taking care not to tear the anterior median pedicle which insures the vitality of the flaps on either side.

Third Stage : Vivification.—We vivify the edges of the perforation by folding, after making two small longitudinal incisions, in front and behind, for the purpose of facilitating the coaptation (see Figs. 194 and 195).

Fourth Stage : Suture.—Suture is carried out with small curved needles, and needle-holder with eccentric plate, taking care to turn downwards the

margin of each flap, and to insure the meeting over a range of 4 to 5 millimetres (Fig. 195).

Juxta-Alveolar Perforation.—If autoplasty by folding is impossible, we can secure the closure of the orifice by sliding displacement of a rectangular mucous flap, which is cut out tangentially to the orifice. Or, again, we can, after the example of Delorme, fix to the margins of the perforation

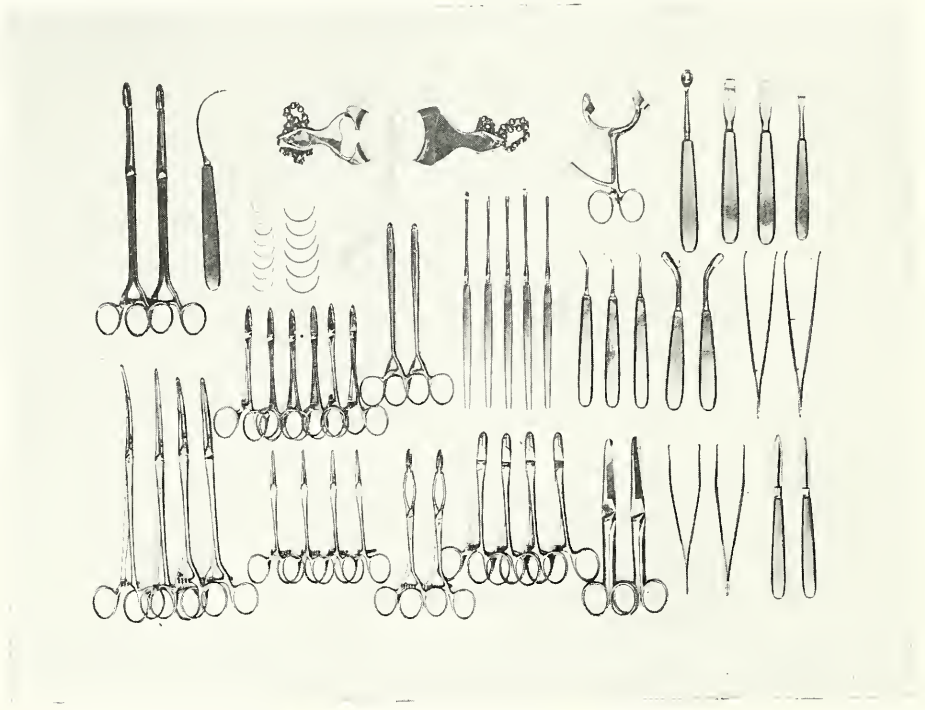


FIG. 196.—INSTRUMENTS FOR STAPHYLORRHAPHY AND URANOPLASTY.

Below, from right to left: Two bistouries; two mouse-toothed forceps; two straight scissors ; four short-jawed artery forceps; two ring-handled forceps with oval jaws; four ring-handled forceps with nine oblique teeth; four large curved forceps. Next above: Two clawed forceps with curved jaws; two Trelat's raspatories, right and left; three small raspatories for staphylorrhaphy; five author's angular bistouries for vivification; two needle-holder forceps with eccentric jaws ; six small needle-holder forceps with short jaws; assorted needles. In highest row : One small cutting spatula; two raspatories, straight and curved; one curette; one gag; two retractors for the labial commissures; one needle, mounted; two forceps with eccentric jaws. [Reduced to one-sixth.]

a pedunculated mucous flap taken from the inner surface of the cheek, and left adhering at the place of its implantation for an interval of six or eight days. In a second operation the pedicle is divided, and the palatine suture completed.

Syphilitic Perforations.—Syphilitic perforations can be repaired only after complete removal of necrosed bony tissues. They are often very exten-

sive. Absence of the subjacent skeleton renders more difficult the vivification of the margins of the orifice by folding. The lateral incisions and the decollation of the two mucous flaps must be carried very far back.

Congenital Division of the Palatine Arch and Velum Palati.

Complete Urano-Staphylorrhaphy.—This operation is intended for repair of congenital divisions of the palate and velum palati.

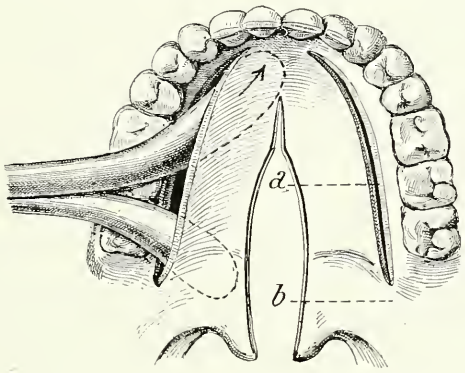


FIG. 197.—URANO-STAPHYLORRHAPHY.

First stage: Liberating incisions. Decollation of the muco-membranous palate with Trelat's raspatory. The decollation should be pursued as far back as *a b*, in order to mobilize the velum palati.

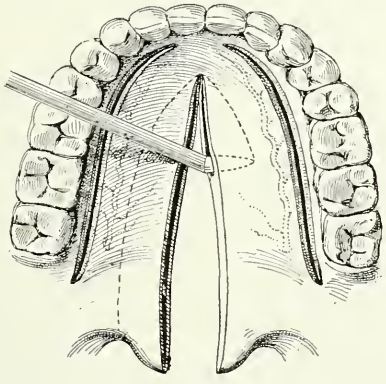


FIG. 198.—URANO-STAPHYLORRHAPHY.

Bilateral vivification unlining.

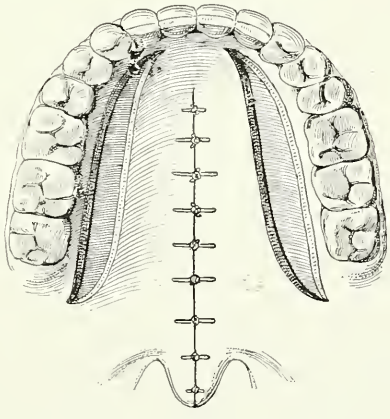


FIG. 199.—URANO-STAPHYLORRHAPHY.

Union of the mucous membrane by interrupted suture.

OPERATION—*First Stage: Liberating Incisions.*—A deep incision with the bistoury, reaching down to the bone, is made on each side along the dental arch from the last molar tooth to the canine. We must keep in close approximation to the alveolus, in order to preserve the trunk of the palatine artery in the mucous flap.

Second Stage : Mobilization of the Two Mucous Bridges.—Same technique is used as in perforation of the palate (see p. 101).

Third Stage : Vivification.—We make in front of the fissure a small incision of 8 to 10 millimetres, reaching to the bone, and then complete the decollation of the mucous membrane of the palatine vault, over a width of 4 to 5 millimetres, with the curved raspatories already described. We then introduce the angular bistoury, first on one side and then on the other,

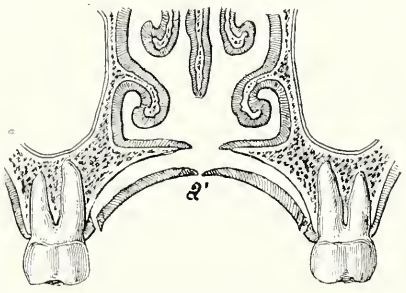


Fig. 200.—Urano-Staphylorrhaphy.

Frontal section, showing the lowering of the muco-membranous palate after use of the raspatory.

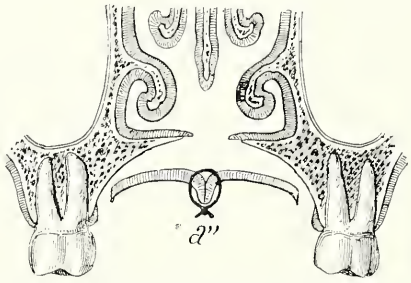


Fig. 201.—Urano-Staphylorrhaphy.

Frontal section, showing the adjustment of the bleeding surfaces after suture.

and detach the mucous membrane from the subjacent bone as far back as the posterior margin of the hard palate. We then split the margins of the fissure along the whole length of the velum palati, and the two halves of the uvula (Fig. 198). We should make sure that the vivification by unlining has been effected on each side, without interruption, along the whole length of the fissure.

Fig. 202.—Frontal Section of Velum Palati, showing the Vivification by Unlining.

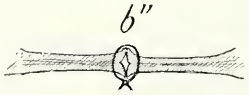


Fig. 203.—Frontal Section of Velum Palati, showing the Coaptation of the Raw Surface after Suture.

Fourth Stage : Suture.—We use interrupted sutures made with Florentine hair, taking care to fold down the palatine mucous membrane, and the two ends of the thread are held in the jaws of a forceps. We then place the deep stitches which unite the posterior portion of the velum palati and the two halves of the uvula; after this we insert the anterior ones. The needles should be made to pentrate and to emerge at about 4 millimetres from the margin of the artificial wound.

On the velum palati the upper mucous flaps are raised towards the nasal fossæ, and thus contribute to increase the thickness of the zone of vivification (Fig. 200).

Congenital Fissure of the Velum Palati

Staphylorrhaphy.—Autoplastic repair of a congenital fissure, limited to the velum palati, is carried out in the same way.

Operation—*First Stage.*—Liberating incisions are made as described above, commencing on the soft palate, behind the last molar tooth, and terminating in front in the plane of the canines.

Second Stage.—Mobilization of the two mucous bridges.

Third Stage : Vivification.—Longitudinal section of 10 millimetres, down to the bone, in front of the fissure; decollation of the mucous membrane, and vivification of the edge of each flap by splitting with the angular bistoury.

Fourth Stage : Suture.—Reunion with interrupted suture as above described.

Fig. 204.—Complete Urano-Staphylorrhaphy.
Result of the operation.

The process of reparation of congenital fistula is not satisfactorily effected till after the age of seven or eight years; at an earlier date we merely expose ourselves to failure, on account of the greater thinness of the flaps, and the unmanageableness of the child. The voice retains its nasal quality for a certain period after the operation. The velum palati remains tense, and half rigid during the first months. The function of phonation does not attain the normal standard till after the lapse of a good many months.

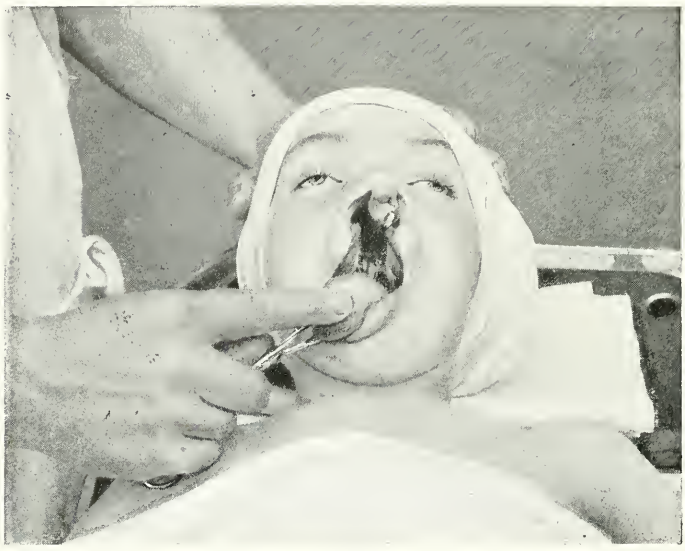


FIG. 205.—COMPLICATED HARE-LIP.

Complete fissure of palate, with projecting premaxillary bone. Aspect of the deformity.

FIG. 206.—COMPLICATED HARE-LIP.

Second stage: The liberating incisions have just been made. Decollation of palatine flap of left side.

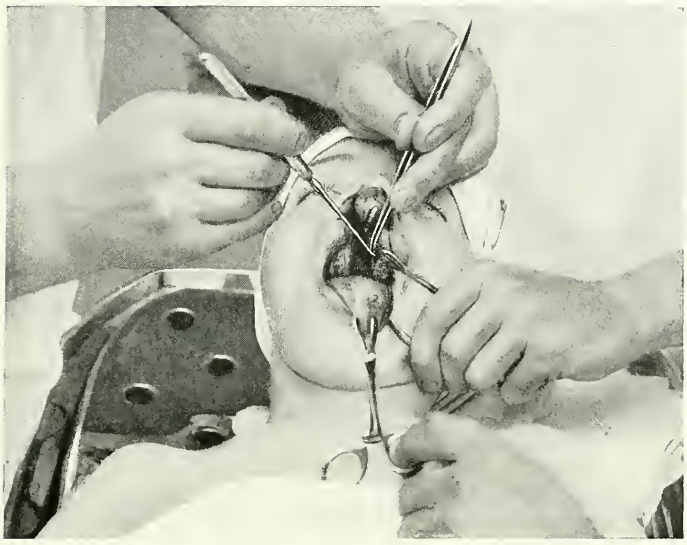


FIG. 207.—COMPLICATED HARE-LIP.

Third stage: Vivification of margin of fissure by splitting with angular double-edged bistoury.

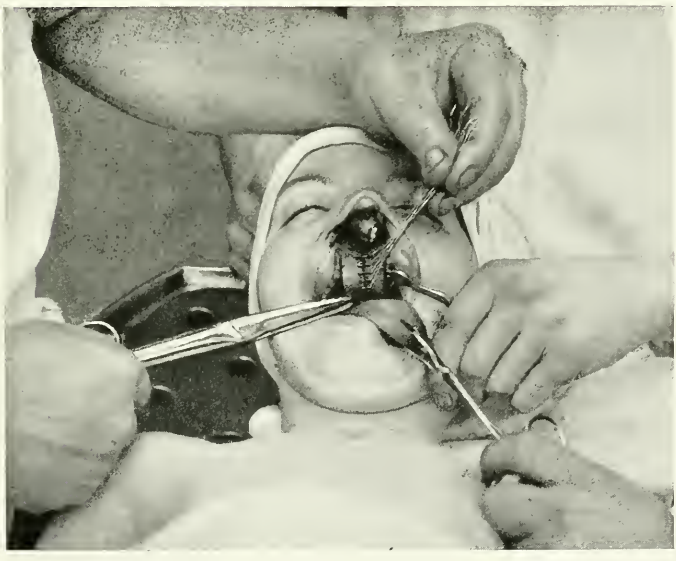


FIG. 208.—COMPLICATED HARE-LIP.

Fourth stage: The palatine suture is complete. Plastic result. The hare-lip will be repaired by a later operation.

Tumours.

Benign Tumours.

Angiomata of the mucous membrane of the palate are extirpated, in some cases with the bistoury, in others with the thermo-cautery.

Fibromata.

I have met with a case of fibroma of oval outline in the submucous tissue of the palate. It was enucleated without difficulty through a longitudinal incision made in the mucous membrane.

Glandular Tumours.

Mixed tumours of the salivary glands take on an infiltrating course, and should be removed at an early date.

Malignant Tumours.

Epithelioma—Osteo-Sarcoma.

Malignant tumour of the palatine arch may rapidly invade the floor of the nasal fossæ, the septum, and the inferior meatus. They are accompanied by acute pain and hæmorrhages. These cases are often inoperable, as it would be necessary to extirpate almost all the bones of the face in order to remove them.

Tumours of the pillars of the fauces are usually epitheliomatous. They may circumscribe, in horseshoe outline, the whole opening of the isthmus faucium. These tumours are inoperable.

THE TONGUE AND FLOOR OF THE MOUTH

Traumatic Lesions.

Wounds.

Wounds of the tongue and of the floor of the mouth may necessitate ligature of one or of many arterioles. When the margins of the wound are clear-cut, it is united with interrupted silk suture. It is well to pass two or three deep stitches, in order to prevent the formation of a cavity beneath the line of reunion. When the wound is contused and deep, we treat it by antiseptic tamponing.

Foreign Bodies.

Foreign bodies in the tongue or floor of mouth are of no importance. They usually produce some painful inflammatory swelling complicated with suppuration. Exploration of the fistula and enlargement of its calibre by

divulsion enable us to recognize and extract the foreign body. To facilitate the cicatrization, it may be worth while to excise the inflammatory tissues, and endeavour to secure immediate reunion, with drainage.

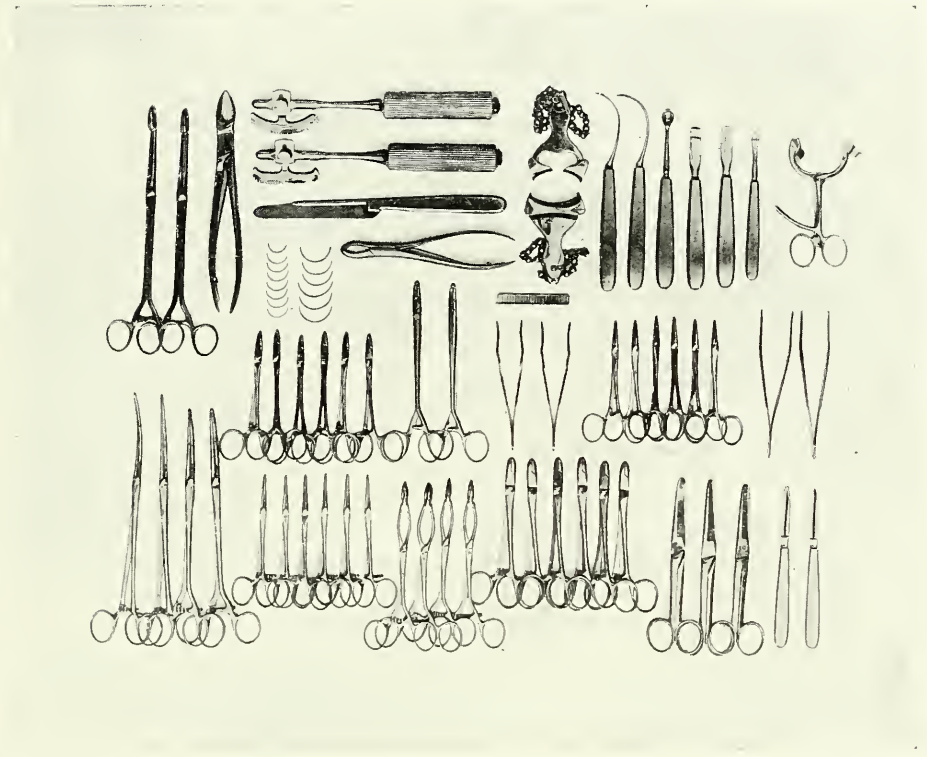


FIG. 209.—INSTRUMENTS FOR OPERATIONS ON THE TONGUE AND FLOOR OF THE MOUTH, AND FOR RESECTION OF THE ALVEOLAR BORDER OF THE LOWER JAW.

Below, from right to left: Two bistouries; two strong straight scissors; one strong curved scissors; six clawed forceps with short jaws; four ring-handled forceps with oval jaws; six ringed forceps with nine oblique claws; four large forceps with curved jaws. In middle: Two clawed forceps; six small artery forceps; thirty nickel clasps, and two clasp-holder forceps; two needle-holder forceps with eccentric plates; six needle-holder forceps with short jaws; assorted needles. Above: One gag for separation of molars; one small cutting spatula; two raspatories, straight and curved; one curette; two needles with handles; two retractors of the labial commissures; two sliding saws, straight and convex; one saw with movable back; one gouge-forceps; one Liston's bone-forceps; two long forceps with eccentric rings. [Reduced to one-sixth.]

Abscess.

Small abscesses of this region are easily recognized. If resolution is not produced by subcutaneous injections of mycolysine, we incise them under local anæsthesia.

Salivary Calculi.

Salivary calculi of the floor of the mouth are usually phosphatic concretions of inflammatory origin. They are found either in the substance of the submaxillary or sublingual glands, or in their excretory ducts. Small calculi of Wharton's duct are sometimes expelled during mastication. The large stones are recognizable on exploration, by their elongated form and stony consistence. Sometimes the extremity can be seen through the buccal orifice of the excretory canal.

Operation.—The incision is made either in the plane of the *ostium umbilicale*, or at the point in the floor of the mouth at which the calculus is most prominent. We make the calculus project internally by pushing up the submaxillary region. Extraction is seldom difficult. Deeply seated and voluminous calculi may require an external incision in the submaxillary region.

Tuberculosis.

Local tuberculosis of the tongue is rare. The affection can be recognized by the yellowish tint and caseous consistence of the ulcerated surface. Inoculation on animals and biopsy may be necessary for decision of the diagnosis. When the tuberculous focus is of small extent, we should extirpate on a wide scale, and carry out immediate reunion.

Actinomycosis.

Primary actinomycosis of the human tongue has often been observed in the form of simple irregular nodosities, sometimes suppurative. Histological examination of the pus and actinomycosic granules are necessary to establish the diagnosis. We must always have recourse to curettage and excision of the nodosities.

Vices of Conformation : Congenital and Acquired.

ADHESIONS AND MALFORMATIONS.

Adhesions of the tongue require liberation of the organ, followed by suture of the wound. Congenital malformations may demand intervention of very various kind and degree. In a case of total inferior ankylo-glossus, the mucous membrane passes directly from the gingival margin to the dorsum of the tongue, which is thus wholly included in the floor of the mouth.

Division of the Frænum.—Division of the frænum is effected without hæmorrhage after crushing for three or four minutes with a short-jawed forceps. Section without preliminary écrasement exposes the patient to some little hæmorrhage from the artery of the frænum.

Macroglossus.

Macroglossus, congenital or acquired, demands, if the hypertrophy of he tongue be very considerable, an autoplastic resection of the exuberant tissues.

Operation—First Stage: Tracing Out the Incisions.—The exuberant portion is circumscribed by two semi-elliptical incisions.

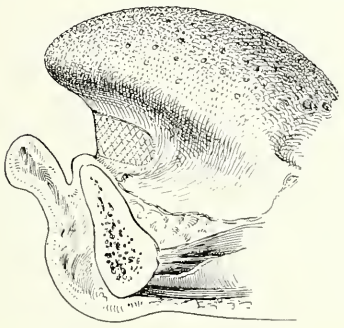


Fig. 210.—Crushing of Frænum with Short-Jawed Forceps.

Division of the crushed structures is effected without hæmorrhage.

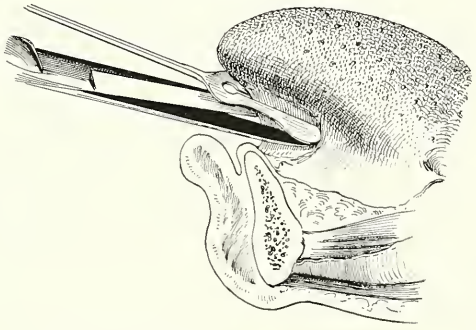


Fig. 211.—Division of Frænum by the Old Method.

The tongue is raised with the cleft handle of a grooved director.

Second Stage: Cuneiform Resection of the Exuberant Part.—This resection is carried out in stages with the bistoury or scissors. The arteries, as they are seen to bleed, are seized with short-jawed forceps, and a catgut ligature is applied to each.

Third Stage: Reunion.—Sutures of silk or Florentine hair are applied, taking care to insert some deep stitches to prevent separation of the deep surfaces beneath the line of reunion.

Tumours of the Tongue and of the Floor of the Mouth.

Benign Tumours.

Parasitic Cysts.

Cysticercus and echinococcus have been met with in the tongue and in the floor of the mouth. An inflamed cyst may simulate an abscess, and its nature is recognized only by the appearance of the sac, which is expelled on evacuation of the focus. These growths may lead to suffocation when seated at the base of the organ. Encapsuled tumours of benign nature are also met with—fibromata, lipomata, etc.

Operation.—Incision and extirpation of the cystic sac, or tumour, by the buccal or the submaxillary route, according to the inherent peculiarities of the individual case.

Angeiomata—Lymphangeiomata.

Erectile tumours and lymphangeiomata should be treated by extirpation at the earliest possible date. The operation is carried out with a cutting instrument, which is applied at a distance of 2 or 3 millimetres outside the limits of the cavernous tissue. Small erectile tumours are readily operable, while cavernous degeneration of nearly the whole of the tongue and floor of the mouth represents a grave affection indeed, and one beyond the resources of surgery.

Angeioma always results in cure if treated by early and complete extirpation.

Ranula.

Ranula is a cyst of salivary origin, situated in the tissues of the floor of the mouth. These growths are distinguished clinically as *sublingual* and *submaxillary*, according to the position in which the salivary cyst bulges—either into the buccal cavity, on one side of the frænum linguæ, or in the submaxillary cutaneous region, between the lower border of the inferior maxilla and the os hyoides.

Buccal or Sublingual Ranula.—The buccal ranula should be operated on in the Rose position. The dental arcades are separated with a ring-handled gag.

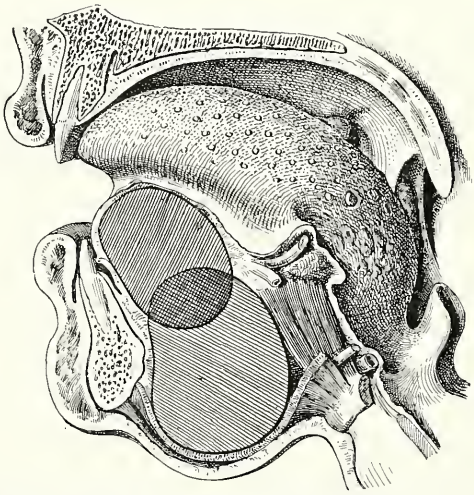


Fig. 212.—Diagrammatic Scheme of the Evolution of a Ranula: Upwards towards the Frænum Linguæ; or Downwards towards the Submaxillary Region.

Operation—1. *Partial Excision.*—When the tumour is of small volume, and when its upper wall is very thin, we can excise that portion which bulges above the floor of the buccal cavity. Its inferior wall is left in the wound after cauterization with nitrate of silver or with the thermo-cautery.

2. *Complete Excision.*—Complete ablation of the cyst is the procedure of election in all cases in which it is possible without extensive destruction

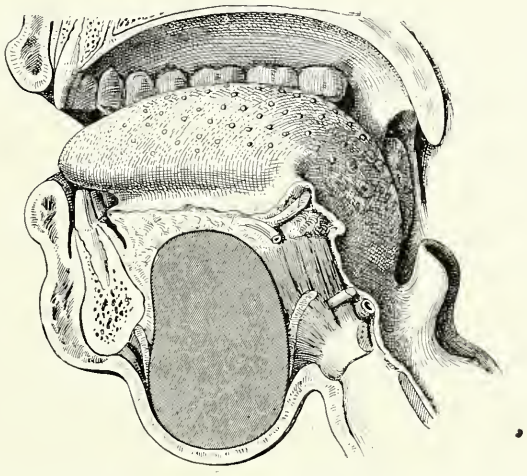


FIG. 213.—RANULA OF SUBMAXILLARY EVOLUTION, WHICH HAS PERFORATED THE MYLO-HYOID MUSCLE.

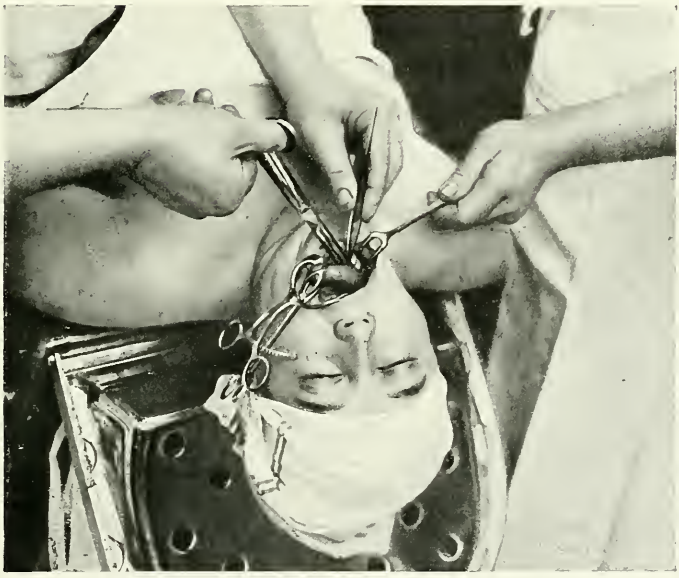


FIG. 214.—RANULA OF SUBMAXILLARY EVOLUTION, WHICH HAS PERFORATED THE MYLO-HYOID MUSCLE.

Operation on sublingual ranula in the Rose position. Resection of the cystic pouch.

of the tissues of the floor of the mouth. The upper wall of the cyst is completely resected with the aid of clawed forceps and scissors. The deep wall is extirpated in its turn, and the mucous membrane of the floor of the

mouth is reunited. Some sutures are inserted in the depth of the wound, in order to prevent re-formation of the cavity by retraction of the walls of the space left on operation. The stitches are partially removed after two

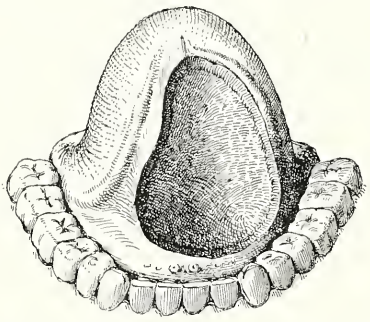


FIG. 215.—RANULA OF SUBMAXILLARY EVOLUTION, WHICH HAS PERFORATED THE MYLO-HYOID MUSCLE.

Diagrammatic figure showing the wound left after partial resection of the pouch.

or three days. If any suppuration has taken place beneath them, the patient should frequently wash out the mouth with boric solution or dilute oxygenated water till the healing process is completed.

Submaxillary Ranula.—Complete extirpation of the cyst is carried out through the submaxillary route. The operation is very simple, and does not require a special description (see Operations on the Submaxillary Region).

MALIGNANT TUMOURS.

If we except some cases of sarcoma and of ill-defined mixed tumours, primary malignant tumours of the tongue and of the buccal floor are almost exclusively epitheliomata. Epithelioma may commence at any point of the buccal mucous membrane. We know the frequency of cancerous degeneration of lingual psoriasis and of ulceration initiated by contact with a carious tooth.

The seat of election is at the middle of the lateral margin of the tongue. It is sometimes observed on the dorsum, notably in case of buccal leucoplasia, complicated with the presence of median villous papillomata; sometimes on the frænum; sometimes at the base of the organ. Diagnosis is made with the aid of sight and, above all, by that of touch. The special induration of a cancroid growth leaves no doubt in the mind of an experienced clinician. If there is any hesitation, histological examination of a fragment of 4 or 5 millimetres in diameter should be carried out, after removal under local anæsthesia produced by interstitial injection of cocaine.

Epitheliomata of the tip, anterior part of dorsum, and lateral margin of the tongue can be attacked through the buccal route. Tumours of the base of the tongue must be reached through the submaxillary.

Epithelioma of Dorsum, Tip, and Margins of the Tongue.

Epithelioma of the dorsal region, the tip, or the lateral margin of the tongue is readily diagnosed. It should be operated on at an early date. Some surgeons still have recourse to the bloody procedure in these cases.

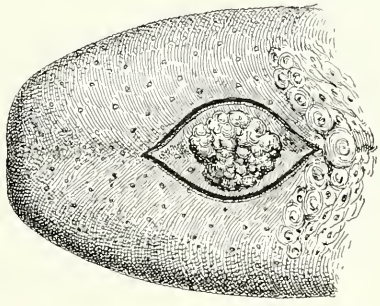


Fig. 216.—Papilloma of Dorsum of Tongue.

Outlines of incision.

Anæsthesia is carried out with ethyl chloride, followed by chloroform; the bicommissural retractor is then applied. In cases in which extensive retraction of the dental arches is necessary the molar gag is applied from the side of the fixed valve of the bicommissural retractor, or the valve is replaced by this gag, between the rings of which we fix the chain of the commissural valve, which is placed on the same side as the papilloma.

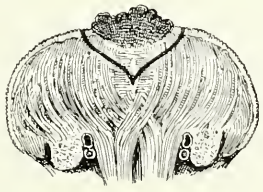


Fig. 217.—Papilloma of Dorsum of Tongue.

Frontal section, showing extent of necessary ablation.

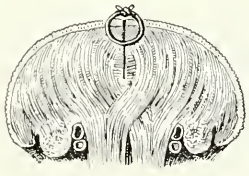


Fig. 218.—Papilloma of Dorsum of Tongue.

Frontal section, showing reunion of wound.

The growth is removed with the bistoury, scissors, and clawed forceps. The edges of the wound are immediately united with interrupted sutures of silk or Florentine hair. The use of cocaine is here shown at great disadvantage, inasmuch as the œdema produced by the injection of that anæsthetic makes the recognition of the limits of the tumour more difficult during the course of the operation. Immediate reunion is the rule when care has been taken

to disinfect the mouth of the patient, and the operation has been carried out with the requisite precautions. We prevent infection of the field of operation by keeping the dental arcades separate, as above indicated, and drawing out the tongue with two or three loops of Florentine hair passed through completely healthy tissues.

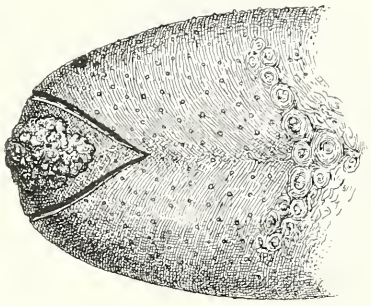


Fig. 219.—Papilloma of Tip of Tongue.

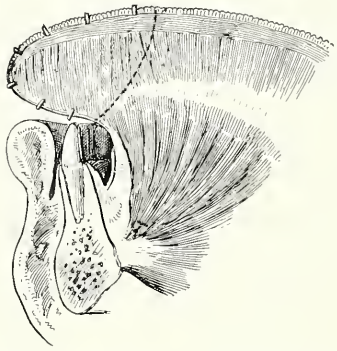


Fig. 220.—Papilloma of Tip of Tongue.

Antero-posterior section, showing arrangement of sutures.

When the lesion is seated on the dorsum of the tongue, it is extirpated with a bistoury and clawed forceps; when at the margin or point, it is removed with scissors, taking care to keep at a distance of 10 or 12 millimetres outside the limits of the pathological tissues.

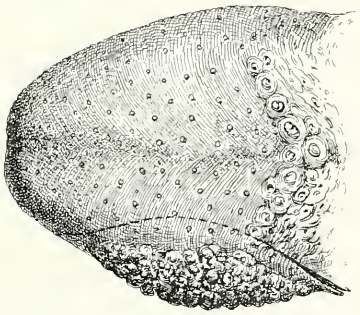


Fig. 221.—Papilloma of Lateral Margin of Tongue.

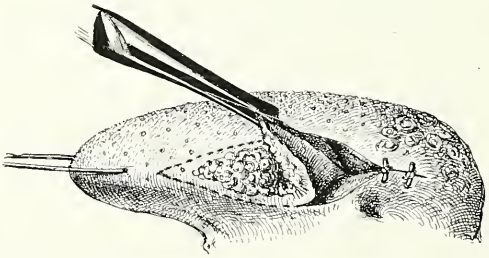


Fig. 222.—Papilloma of Lateral Margin of Tongue.

Extirpation from behind forwards with progressive application of suture.

It is rarely necessary to use forcipressure or ligature in case of an arteriole; and the lingual artery itself, if divided, remains obliterated after the application of a short-jawed forceps for three or four minutes. The suturing is carried out as follows: The first stitch is placed at the furthest limit of the field of operation, when the tumour has been detached at that point. The assistant holds the ends of this first thread outside the mouth, so as to avoid

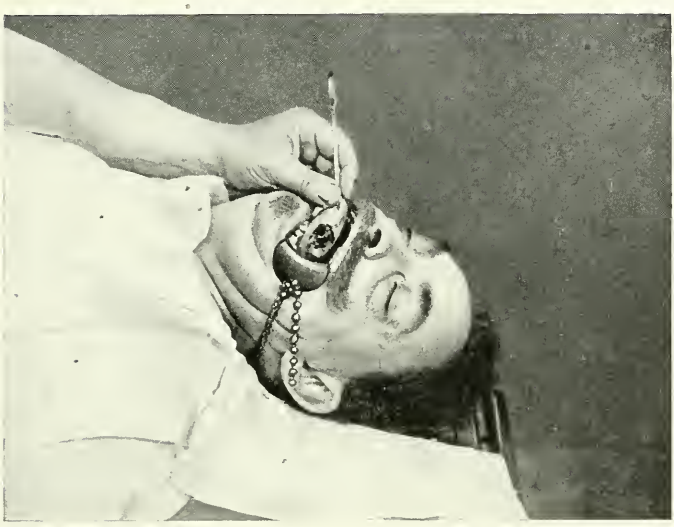


FIG. 223.—ULCERATED EPITHELIOMA OF LEFT MARGIN OF TONGUE.
Application of bicommissural retractor.

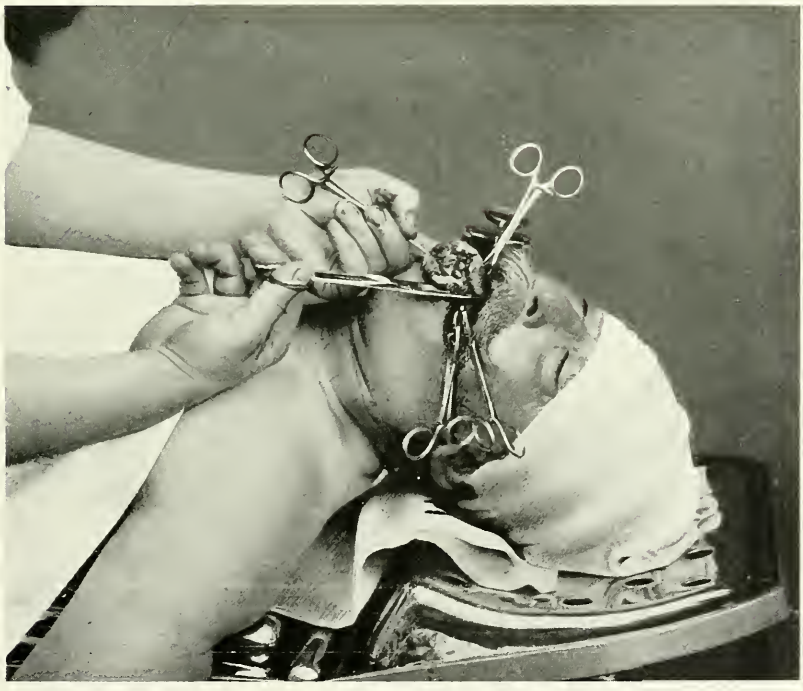


FIG. 224.—LOCALIZED EPITHELIOMA OF ANTERIOR PART OF TONGUE. OPERATION BY THE BLOODY METHOD.
Division of the mucous membrane behind the seat of ulceration.

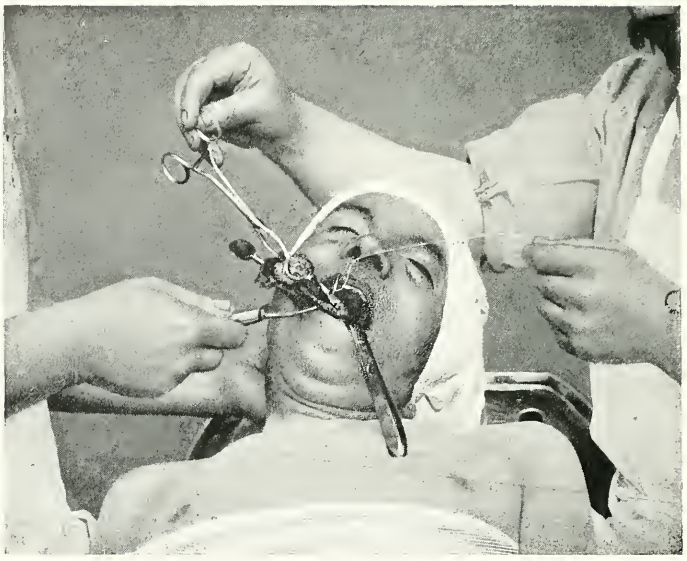


FIG. 225.—EPITHELIOMA OF ANTERIOR PART OF TONGUE.

The posterior part of the tumour has been detached. Immediate suture of wound behind the neoplasm.

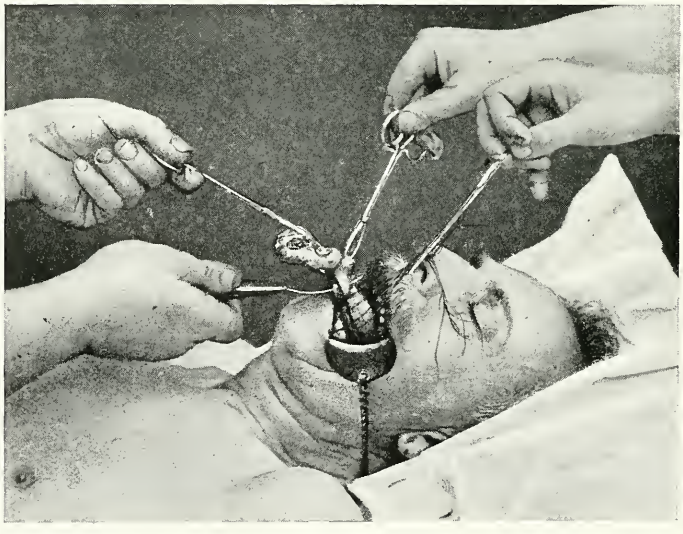


FIG. 226.—EPITHELIOMA OF ANTERIOR PART OF TONGUE.

Sutures should be instantly applied on detachment of the tumour. Insertion of the last points of suture.

contamination of the field of operation by the buccal fluids. The dissection of the tumour is continued, two or three new sutures are applied, and so on, in such a way that the suturing is nearly completed at the moment at which the tumour is fully detached. The suturing is thus actually effected outside the buccal cavity. The points of suture are placed according to the form of the tumours: in some cases from behind forwards, sometimes in an oblique direction, and sometimes in a nearly transverse one; we arrange them in such a way as to restore the tongue as nearly as possible to its normal form.

The operation, when carried out at the beginning of the growth of the epithelioma, and on a broad scale, may give excellent results, but we must keep far beyond the limits of the neoplasm. If the submaxillary, subhyoid, or carotid lymphatic glands have already been infected, they should be extirpated in the course of the same operation.

Thermic Electro-Coagulation.

I have now come to prefer thermic electro-coagulation, in all these cases without exception, to removal with the bistoury, which exposes the patient to too great danger of recurrence.

Epithelioma of the Frænum Linguæ.

Extirpation of an epithelioma of the frænum linguæ which has infiltrated the gingival mucous membrane would necessitate the following technique: The mucous membrane of the labio-gingival groove must be incised in the plane of the necks of the teeth for a distance of about 4 centimetres, and detached with a raspatory as far down as the lower third of the maxilla. The bone must then be divided, both horizontally and transversely, with a saw with movable back; the alveolar portion, thus separated from the basilar, must be resected, after removal of the two premolars, with a Liston's forceps or with the saw with movable back. This resection of the anterior segment of the alveolar margin of the inferior maxilla would provide easy access for extirpation of the neoplasm and reunion of the margins of the field of operation.

If the subhyoid or submaxillary glands are affected, they are carefully sought out and must be thoroughly extirpated.

This technique, so far as regards complete ablation of the tumour, gives a much more extended field than median section of the symphysis while it also presents the advantage of not requiring the application of osseous suture, as the basilar portion of the maxilla insures the solidity of the bone.

Thermic Electro-Coagulation.

I prefer thermic electro-coagulation to the bloody procedure, as it enables me to destroy, at once and thoroughly, the epithelioma while still limited in extent. If thermic electro-coagulation happens to produce necrosis of the alveolar process, this can be remedied by adapting a prothetic apparatus after cicatrization.

Epithelioma of the Frœnum Linguæ and Inferior Maxilla.

When the epithelioma has extensively infiltrated the osseous tissue, resection of the whole median portion of the inferior maxilla is necessary. This operation is carried out in the following manner: The lower lip is incised along the middle line, as far as the tip of the chin, and the two cutaneous flaps thus formed are drawn to the right and left respectively with ring-handled forceps, which, while acting as retractors, simultaneously secure temporary hæmostasis of the inferior coronary arteries. The maxilla is laid bare with a raspatory, down to, and beyond, its inferior border; and two curved forceps are then passed under the bone, one at each of the positions selected for section. These forceps perforate the mucous membrane easily, and emerge between the dental arcades. Two teeth are removed, at the

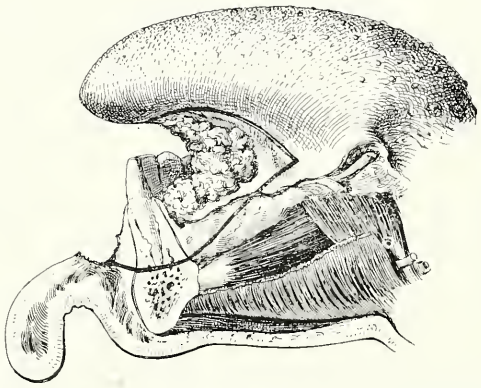


Fig. 227.—Epithelioma of Frænum Linguæ which has invaded the Gum. Outline of the necessary resection.

points at which the saw is to be applied. I sometimes use the saw with movable back, sometimes the electric saw. For a long period I have ceased to use the chain-saw. The chain can be passed with a curved forceps, the jaws of which are made to seize and draw through the dentate ribbon.

In order to make a neat section of the bone, the maxilla should be held firmly with a strong forceps, as the basilar portion is firm and resistant. It is impossible to unite usefully the two halves of the lower jaw if the resected fragment is more than 25 to 30 millimetres in width. An intermediate fibrous cicatrix is formed, which can be made to support a prothetic apparatus.

Epithelioma of Anterior Part of Tongue, involving Floor of Mouth.

These tumours are usually incurable, except in cases in which it is still possible to destroy the whole of the pathological tissues completely by thermic electro-coagulation.

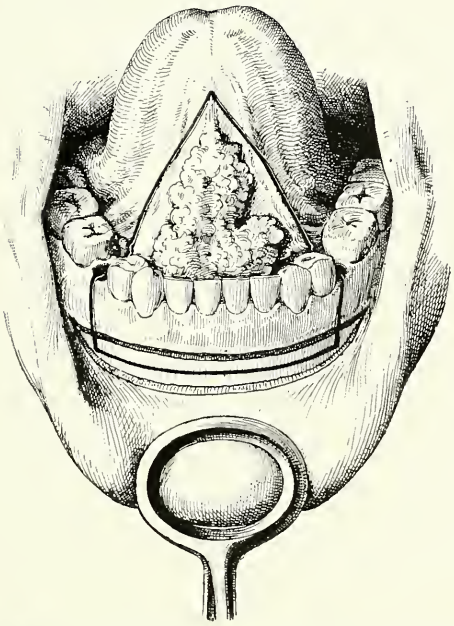


FIG. 228.—EPITHELIOMA OF FRÆNUM LINGUÆ WHICH HAS INVADED THE GUM.

Diagrammatic scheme, showing V-shaped resection of the frænum linguæ, and resection of alveolar border of lower jaw.

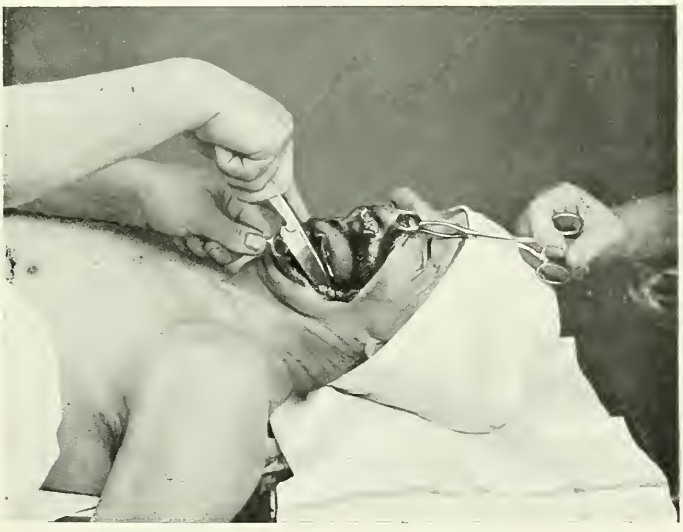


FIG. 229.—EPITHELIOMA OF FRÆNUM LINGUÆ WHICH HAS INVADED THE GUM.

Resection of alveolar border of lower jaw. Section of the bone on the left side with saw with movable back.

Epithelioma of Base of Tongue and of the Latero-Lingual Region.

Epithelioma of the base of the tongue should be operated on at the first stage of its growth—that is to say, before it has attained a large size—and, if at all possible, before any glandular infection has taken place. Diagnosis is easy, and is readily confirmed by sight and touch. This is also the case with tumours of the tonsillar region.

These tumours should be destroyed by thermic electro-coagulation. The intervention is effected through the buccal route.

OPERATIONS ON THE LINGUAL NERVE AND ON THE NERVE TO THE BUCCINATOR MUSCLE.

Resections of the lingual and buccinator nerves are carried out through the mouth. Those nerves pass at a very short distance from the neck of the wisdom tooth—one inside, the other outside.

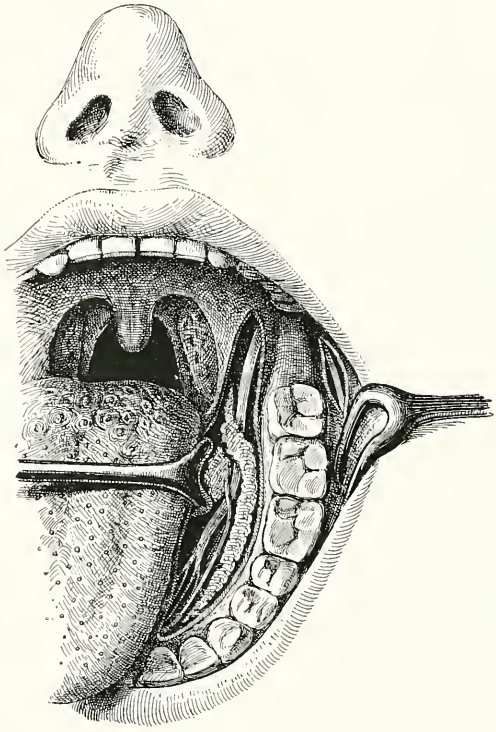


Fig. 230.—Dissection of Left Glosso-Gingival Furrow.

The lingual nerve is seen at the bottom, between the tonsil and last molar. On the outer side is the buccinator nerve. Opposite the last molar tooth the lingual nerve crosses the sublingual gland, and then crosses Wharton's duct.

Resection of the Lingual Nerve.

Operation—First Stage.—Incision of two centimetres long in the glosso-gingival furrow, in contact with the alveolar border, and in the plane of the last molar tooth.

Second Stage.—Decollation of the soft parts with a raspatory to a depth of 8 or 10 millimetres.

Third Stage.—The lingual nerve, which is a large trunk, now appears in the wound. It is raised with a curved forceps, drawn out of the wound, and divided, or resected, through a certain part of its length. When the posterior pole of the sublingual gland is greatly developed, it must be drawn inwards in order to expose the nerve.

Resection of the Buccinator Nerve.

Operation—First Stage.—Incision of two centimetres long at equal distances from the two dental arcades, and directed from the interval between the large molars towards the labial commissure.

Second Stage.—Decollation of both lips of the incision.

Third Stage.—Exposure of the buccinator nerve, which is sensibly horizontal, and is hidden by a little musculo-fibrous tissue.

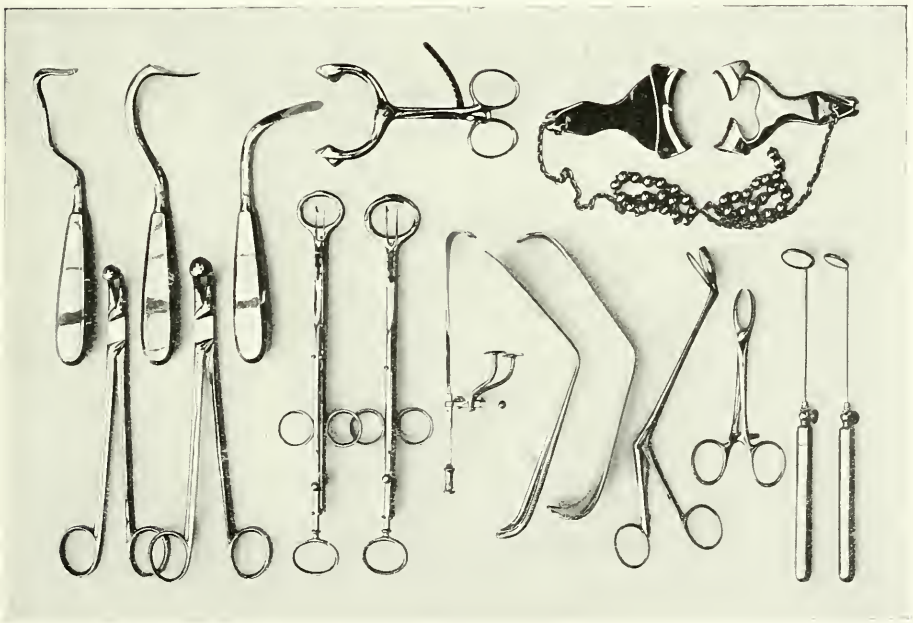


Fig. 231.—Instruments for Ablation of Tonsils and Adenoid Tumours of the Naso-Pharynx, and for Rapid Extirpation of Naso-Pharyngeal Polypi.

Below and to the right: Two pharyngeal mirrors; one tongue forceps; one rotary mirror; two tongue depressors; one retractor of the velum palati; two Collin's amygdalotomes; two forceps for adenoid vegetations. Above: One bicommissural retractor; one gag for separation of the molars; three raspatories for detachment of naso-pharyngeal polypi.

AFFECTIONS OF THE PHARYNX AND TONSILS.

Traumatic Lesions.

Wounds.

Accidental wounds of the tonsils and pharynx are rare, and have no importance except in case of complications with lesions of the great vessels and nerve trunks of the vicinity. Quite recently a case occurred of an infant who fell forwards while holding a glass tube between the lips; the extremity of the tube, after perforating the tonsil, wounded the carotid artery, causing almost instantaneous death.

Foreign Bodies of the Pharynx and Tonsil.

Foreign bodies implanted in the pharynx—pieces of fish-bone, bark, ears of wheat, etc.—produce very painful foci of irritation. We make the diagnosis by local examination, aided, when necessary, by the use of a laryngeal mirror.

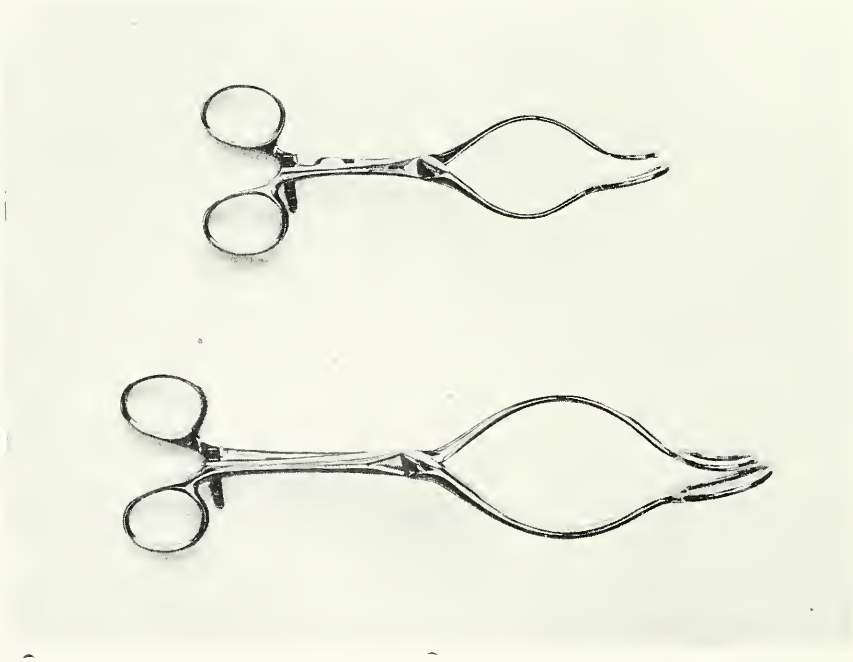


Fig. 232.—Compression Forceps for Arrest of Hæmorrhage in the Tonsillar Region.

The smaller form is intended for use in case of children, the larger for adults

Extraction of the foreign body is easy when its presence has been recognized. We may have to deal with a local infection with *Leptothrix buccalis*

in association with the thrush fungus, and various forms of microbe. The caseous stratum which covers the mucous surface presents an acid reaction. We use lavages of saturated boric solution, or of Labarraque's fluid diluted to 1 in 400.

Inflammatory Lesions.

Phlegmon.

Phlegmonous angina is of frequent occurrence. Whether the focus be tonsillar or paratonsillar, the lesion is nearly always an infection by *Staphylococcus aureus.* These affections yield, in the majority of cases, after some hours to the internal administration of mycolysine or to injection of the preparation of the same made for hypodermic use. The abscess undergoes resolution in two or three days.

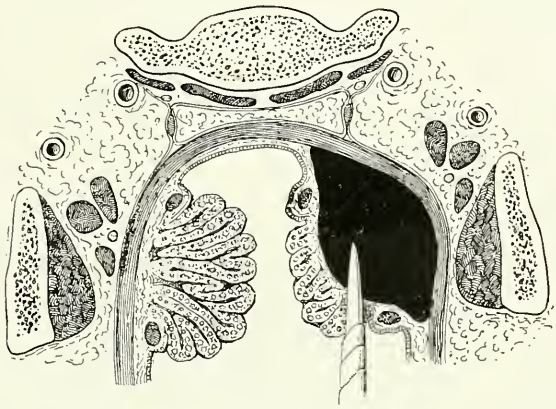


Fig. 233.—Opening an Abscess of the Left Tonsil.

The distance between the posterior wall of the abscess and the internal and external carotid arteries is shown. On the right is a hypertrophied tonsil.

When the suppuration is obvious, and pus has collected, the focus is incised with a straight bistoury the blade of which has been rolled in a spiral band of paper, to a distance of 15 millimetres from the point. The point is plunged into the anterior pillar of the fauces, and thence into the substance of the tonsil. The wound can be enlarged by divulsion with a long curved forceps.

Tuberculous Ulceration.

Tuberculous ulceration of the tonsil is not uncommon. It may require curettage or extirpation of the affected tissues. The general treatment is carried out by administration of phymalose.

Mycosis of the Tonsil—Tonsillar Calculus.

Accumulation in the crypts of the tonsil of semi-solid concretions, which are often formed of agglomerated masses of mycelial elements, or, indeed, of small calculi of calcium carbonate and phosphate, may cause repeated attacks

of angina, and require to be dealt with by tonsillotomy. When this operation has failed to eradicate the deepest crypts of the gland, we have recourse to galvano-cautery; and, for extraction of any remaining calculi, to the bistoury and curette.

Retro-Pharyngeal Abscess.

Retro-pharyngeal abscesses, acute or subacute, are often overlooked in children. They may be recognized by the presence at the back of the pharynx of a distinctly fluctuating and visible swelling. If rapid resolution is not obtained by administration of mycolysine, by the mouth and hypodermically, the pus must be evacuated.

Operation.—The ringed gag is used. The focus is recognized with the finger, and incised with a straight bistoury rolled in a strip of paper. The blade is guided along the left index-finger.

Latero-Pharyngeal Abscess

Hot or subacute latero-pharyngeal abscesses do not point in the cavity of the pharynx, but subcutaneously in the cervical region, in the vicinity of the angle of the jaw. In the buccal cavity we perceive the inflammatory

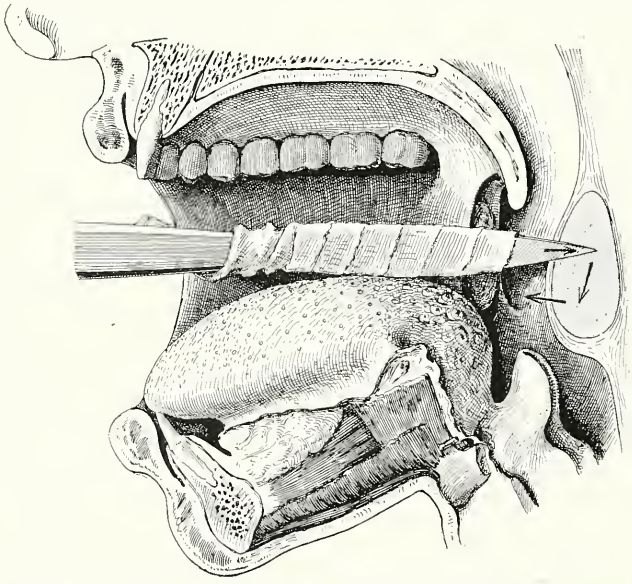


Fig. 234.—Incision of a Retro-Pharyngeal Abscess.

tumefaction on the same side, and behind the tonsil. Bimanual palpation, carried out while the jaws are separated by a gag, will reveal the extent of the purulent focus. The general treatment consists in administration of mycolysine. If resolution does not supervene in some days, local operation must be resorted to.

Operation.—General anæsthesia. Lateral pharyngeal incision, through the point of fluctuation, by the procedure above described. When the

collection is considerable, and points subcutaneously in the lateral cervical region, it should be incised in that position (see Surgery of the Neck).

Hypertrophy of the Tonsils.

Hypertrophy of the tonsils is a result either of repeated inflammations or of a general hypertrophy of the adenoid tissues of the pharynx in the infant. Staphylococci are found in the crypts; sometimes tubercle bacilli.

Simple Tonsillotomy—Operation.—In case of children from twelve to fifteen years old, and of grown-up persons, ablation of the tonsils is carried out with a suitable tonsillotome, after local anæsthesia with a 10 per cent. solution of cocaine. The patient is seated facing the operator. When the tonsil is sessile, and cannot be grasped with the ring of the tonsillotome, it is easy to carry out its ablation with the help of a clawed forceps and a blunt-pointed bistoury. Strong curved scissors, or even a nibbling forceps, are sometimes employed in these cases. If any vestiges of the amputated tonsil remain after the operation, or some pharyngeal mycosis is present, we must have recourse to the aid of the thermo-cautery, or the galvano-cautery.

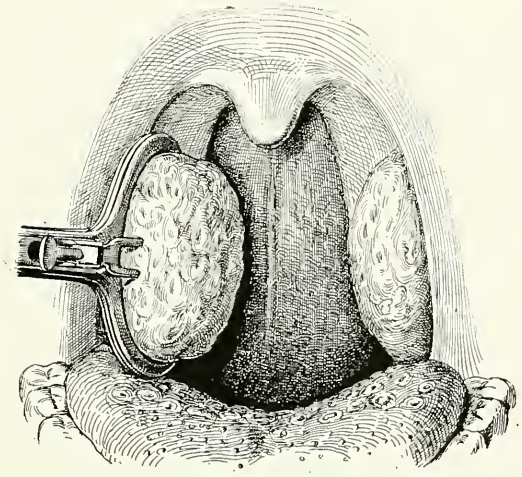


Fig. 235.—Ablation of Right Tonsil with Collin's Amygdalotome.

Envelopment of the Tonsil.—A chronically inflamed tonsil may become encased and partly covered up by the pillars of the fauces. In those cases the whole region projects, and is of a violet-red tint, but the tonsil is almost inaccessible. These chronic inflammations of the tonsil often cause grave accidents. They may be followed after each acute inflammatory crisis by an attack of articular rheumatism.

Operation.—Left side: The patient is seated in a chair in full light, and the region is cocainized.

First Stage: Prehension of the Tonsil.—The tonsil is seized between the jaws of a clawed forceps, which is introduced obliquely into the mouth at the right labial commissure, and directed towards the left tonsillar pocket.

Second Stage : Enucleation of the Tonsil.—The tonsil is drawn outwards with the forceps, which is held in the left hand, while it is attacked vertically behind the anterior pillar of the fauces with strong curved scissors, which penetrate at once to the limit of the tonsillar tissue. A second stroke of the scissors completes the enucleation of the inflamed mass; a third, followed by a fourth, detach it from the posterior pillar.

Right side: Enucleation of the right tonsil is a difficult enough procedure when the surgeon is not ambidextrous. But it may be enucleated in the same way as the left on placing the patient in the Rose position.

Complications of Tonsillotomy.—The hæmorrhage, formerly so much dreaded, is usually insignificant. When the flow of blood persists, in case of a subject of hæmophilia. it is arrested by direct compression with the forceps represented in Fig. 232. The wider jaw should be supported on the skin of the lateral cervical region, while the narrower one, which may be wrapped in a ribbon of gauze, compresses the area from which the blood emerges.

Adenoid Vegetations of the Pharynx.

Adenoid vegetations of the naso-pharynx are of frequent occurrence in infancy. They may develop during the first years, before the child has learned to speak, to the point of producing auricular complications that may lead to the establishment of a condition of deaf mutism. The well-known facies of children affected with adenoid growths—the elongated visage,

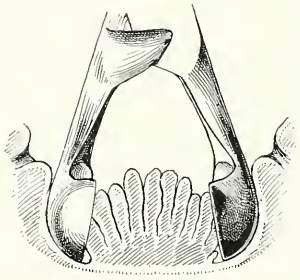


Fig. 236.—Horizontal Section of Pharynx between the Pavilions of the Eustachian Tubes.

Seizure of adenoid vegetations with the gouge-forceps.

hollow cheeks, and ogival palate—are not equally characteristic in all cases. The most constant sign is sleeping with the mouth open. Hypertrophy of the mucous covering of the inferior turbinated bones and hypertrophy of the tonsils often coincide with the presence of adenoid vegetations. The diagnosis, which should be a probable one from the objective signs alone. is confirmed by the digital examination; this can be practised under narcosis at the moment of preparing for operation. I usually remove at one séance

the adenoid vegetations of the naso-pharynx, the tonsils, and, if necessary, the exuberant margin of the inferior turbinated bone.

Operation.—General anæsthesia, at first with ethyl chloride, then with chloroform. At the opportune moment the limbs and the head should be firmly held. The child is then placed in the Rose position. The head should be wrapped in a moist napkin in order to protect the hair.

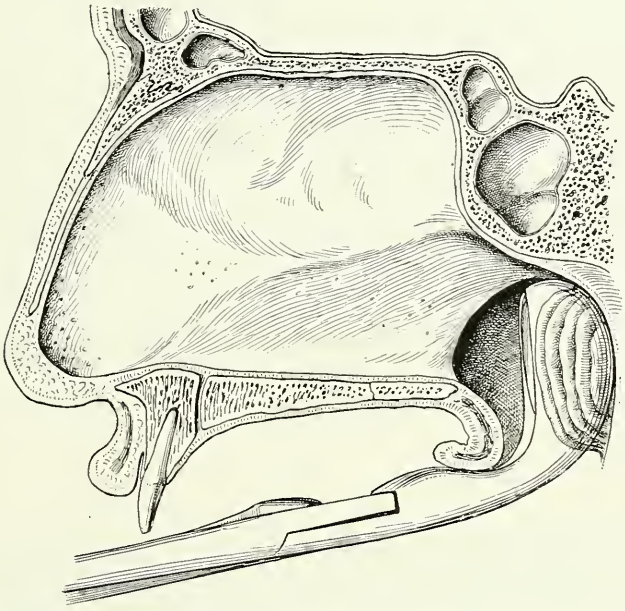


Fig. 237.—Horizontal Section of Pharynx between the Pavilions of the Eustachian Tubes.

Vertical antero-posterior section of left nasal fossa, tangential to the vomer, showing how a gouge-forceps of appropriate curvature extirpates the adenoid mass at a single movement.

Ablation of Adenoid Vegetations—*First Stage: Introduction of the Forceps.*—The ringed gag is placed on the right side, the adenoid vegetations are recognized with the index-finger, and we plunge the closed gouge-forceps above the level of the soft palate, and open its blades when brought into contact with the pharyngeal orifice of the Eustachian tube. The forceps then grasps the whole of the adenoid tissue at a single movement (Figs. 236 and 237).

Second Stage: Removal of the Adenoid Mass.—The proper placing of the forceps is verified by the left index-finger. It is necessary in closure of the blades to expose the pearly fibres of the pharyngeal aponeurosis. We then withdraw the instrument with a slight movement of rotation, while guiding it with the index-finger; and taking care, as is easily done, not to tear off a flap of the mucous membrane. The hæmorrhage is insignificant (Figs. 238 and 239)

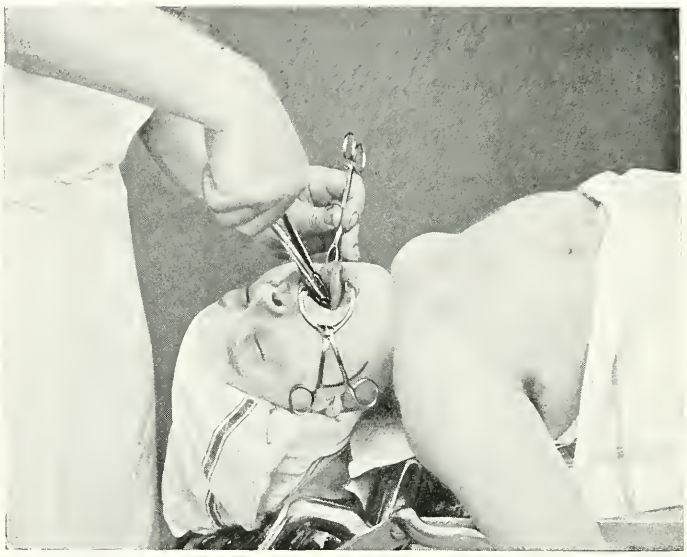


FIG. 238.—ABLATION OF ADENOID VEGETATIONS OF NASO-PHARYNX WITH THE GOUGE-FORCEPS

Introduction of the forceps.

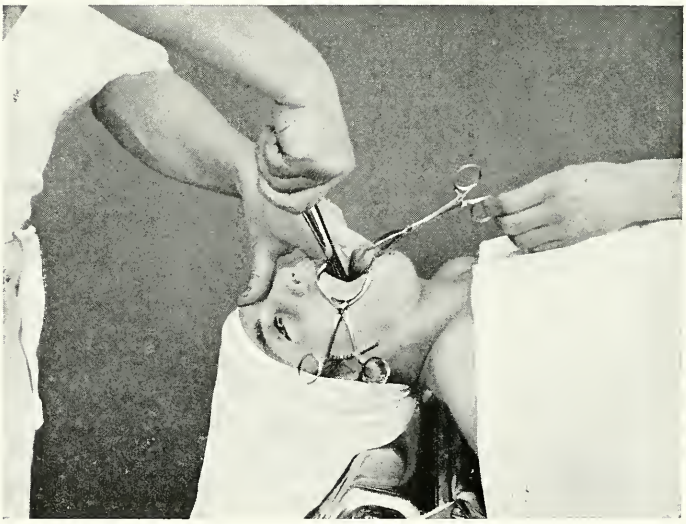


FIG. 239.—ABLATION OF ADENOID VEGETATIONS OF NASO-PHARYNX WITH THE GOUGE-FORCEPS.

Extirpation of the hypertrophied adenoid tissue. The left index-finger prevents any tearing away of the pharyngeal mucous membrane

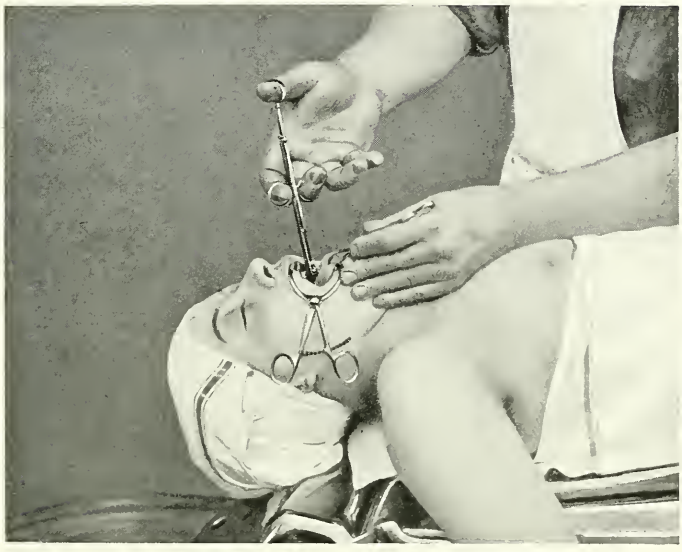


FIG. 240.—EXTIRPATION OF LEFT TONSIL WITH COLLIN'S AMYGDALOTOME, GUIDED ON THE INDEX-FINGER.

FIG. 241.—ABRASION OF EXUBERANT MARGIN OF LEFT INFERIOR TURBINATED BONE, WITH THE GOUGE-FORCEPS USED FOR THE NASAL FOSSÆ.

Complementary Ablation of Tonsils.—The tonsils, when hypertrophied, are at once removed with a tonsillotomy, of which it is necessary to have three assorted models. It is not necessary to see the tonsil. It is recognized with the index-finger, and removed in the way above described.

Abrasion of Exuberant Border of Inferior Turbinated Bone.—Abrasion of the exuberant mucous membrane of the inferior turbinated bone may also be effected by a single movement to either side with the forceps represented in Fig. 241, which is introduced so that one of its branches passes along the inferior meatus. The whole of the exuberant structure of the inferior turbinated bone, both osseous and mucous, is then extirpated at a single stroke by a brusque double movement of rotation, first in one direction, then in the opposite (Fig. 241). We take care to have in readiness some compresses for eventual tamponing of the nasal fossæ, a procedure which I have never found necessary in these cases, and a compressive forceps for the tonsil, to be applied in case of persistent hæmorrhage—a complication which I have never met with.

Tumours of the Pharynx and Tonsil.

Benign Tumours.

Cysts.

Congenital cysts of branchial origin are sometimes met with in the pharynx. They are situated on the lateral aspects, near the subtonsillar fossette of His. Excision is sufficient, which can be effected with clawed forceps and curved scissors.

Naso-Pharyngeal Polypi.

Naso-pharyngeal polypi constitute a special affection of the period of adolescence, especially in the male sex. Those tumours are telangiectasic fibromata, and they are invariably implanted on the periosteum of the basilar apophysis. The root from which they spring is rarely more than some square centimetres in surface extent, but the growths sometimes attain such dimensions as to project at the corresponding nostril, after filling up the whole nasal fossa. Very voluminous polypi sometimes penetrate into the sphenoidal, ethmoidal, and maxillary sinuses; perforate the inferior wall of the orbit, so as to produce exophthalmos, and project prominently under the skin of the cheek. Sometimes the tumour destroys the palate bone, invades the posterior part of the zygomatic fossa, and also the pterygo-maxillary, and the temporal fossa. Having reached that stage of development, those tumours proceed to ulcerate, produce serious hæmorrhages, and often, indeed, give inexperienced surgeons the idea of the presence of a malignant neoplasm.

Many methods have been devised for the ablation of naso-pharyngeal polypi. Some surgeons have even recommended temporary resection of

the superior maxilla or the nasal bones. All indirect methods should be rejected, as they expose to the risk of hæmorrhage of such extent that the patient may succumb in the hands of the operator, even before he has reached the seat of implantation of the tumour. I devised the following technique in 1897:

Instead of attacking the tumour at its periphery, I determined to detach it at the very start from its seat of implantation—that is to say, to anticipate the hæmorrhage which troubled the operators—by beginning with the destruction of the afferent vessels. I had the three raspatories represented in Fig. 231 constructed by M. Collin. The operation must be carried out

Fig. 242.—Naso-Pharyngeal Polypus in an Adolescent.

The growth projects through the left nostril, and fills up the pharynx and maxillary sinus. On the left cheek is seen the cicatrix of an operation which had been attempted for the removal of that polypus, and which had to be abandoned without completion.

in the Rose position. Several gags, commissural retractors, raspatories for the basilar apophysis, forceps for adenoid growths, various types of gouge-forceps (straight and curved), one bistoury, two strong curved scissors, and two long forceps for tamponing the nasal fossæ, are placed within reach of the hand of the operator. The region should not be explored with the index-finger till the last moment, as the slightest touch may determine formidable hæmorrhage.

Operation.—The patient is placed in the Rose position.

First Stage: Exploration and Section of the Pedicle.—The child is completely anæsthetized, and the gag placed firmly in position. The surgeon then introduces the left index-finger above the velum palati, locates the

pedicle, and tears it from the basilar apophysis by an oscillatory movement of the raspatory. This stage of the operation requires very vigorous action. If the first raspatory does not suffice, we complete the detachment of the pedicle with another raspatory of different form. This stage of the operation should occupy hardly ten to fifteen seconds. The blood flows in torrents.

Second Stage: Extraction of the Tumour.—Many cases present themselves:

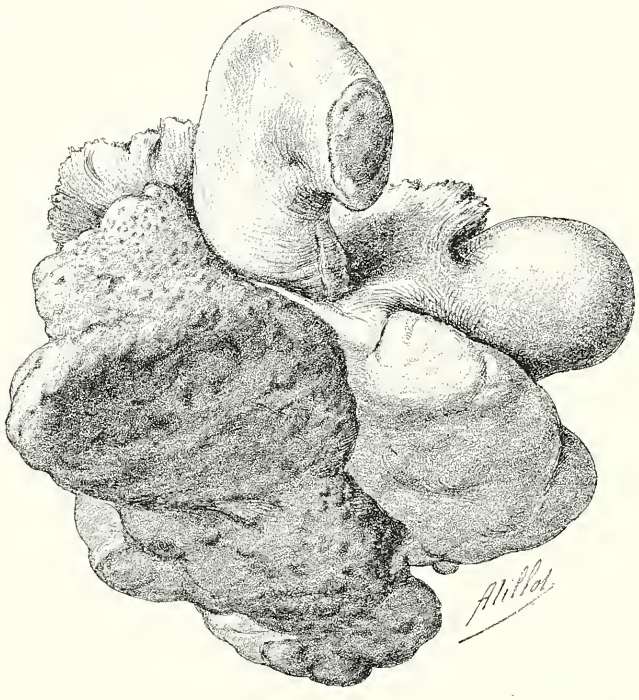


FIG. 243.—NASO-PHARYNGEAL POLYPUS EXTRACTED IN A SINGLE MASS FROM THE YOUNG MAN REPRESENTED IN FIG. 249.

The superior extremity, which resembles a bent finger, corresponds to the process which presented at the left nostril. The figure represents the natural size of the growth.

1. A POLYPUS OF MEDIUM SIZE, WHICH HAS NOT PENETRATED THE SINUSES.—In those cases the mass of the polypus may be grasped above the soft palate with the forceps, and the tumour is extracted in a single piece.

2. A VOLUMINOUS POLYPUS, WITH PROLONGATION INTO THE SINUS.—When the polypus has invaded the maxillary sinus, the prehension of the pharyngeal mass may prove insufficient for extraction of the whole tumour and its prolongations; so we tear off what comes first, and if a large mass remains in the maxillary sinus, we incise the superior jugo-gingival groove, and extirpate the sinusal segment of the tumour through that route. The anterior wall of the sinus is usually thinned; it is even completely destroyed in some cases.

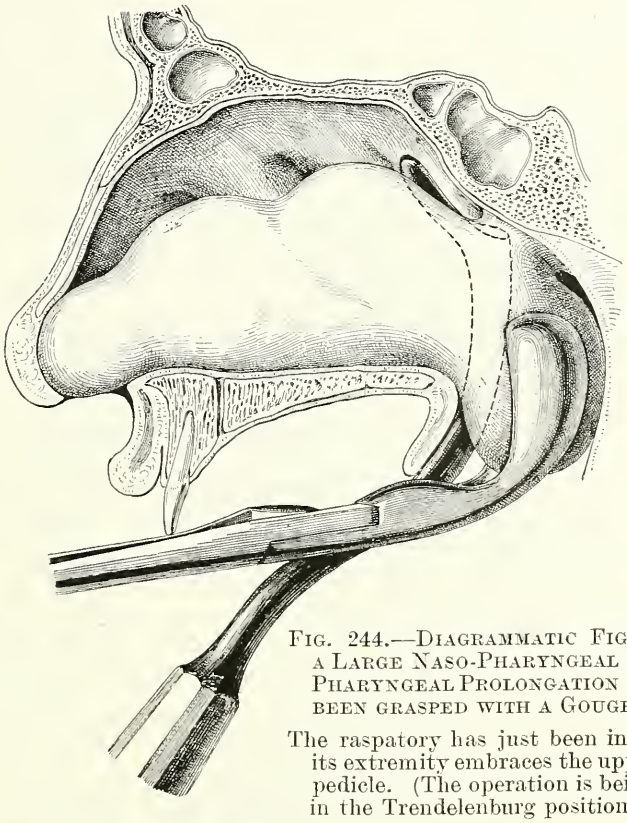


FIG. 244.—DIAGRAMMATIC FIGURE SHOWING A LARGE NASO-PHARYNGEAL POLYPUS, THE PHARYNGEAL PROLONGATION OF WHICH HAS BEEN GRASPED WITH A GOUGE-FORCEPS.

The raspatory has just been introduced, and its extremity embraces the upper part of the pedicle. (The operation is being carried out in the Trendelenburg position.)

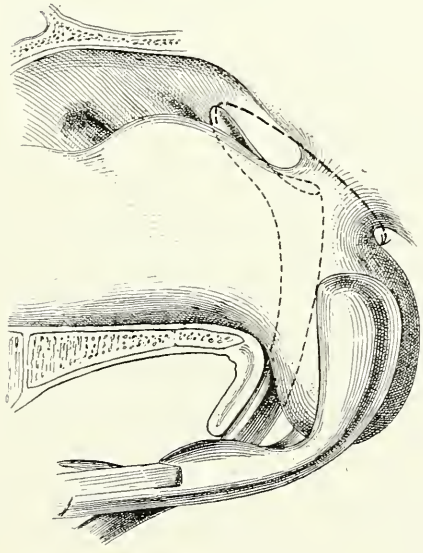


FIG. 245.—DIAGRAMMATIC FIGURE SHOWING THE POSITION OF THE RASPATORY AT THE MOMENT AT WHICH IT DETACHES THE PEDICLE OF THE POLYPUS FROM ITS SEAT OF IMPLANTATION ON THE BASILAR APOPHYSIS.

FIG. 246.—EXTIRPATION OF A NASO-PHARYNGEAL POLYPUS OF MEDIUM SIZE.

Detachment with the raspatory of the pedicle from its seat of implantation on the basilar apophysis.

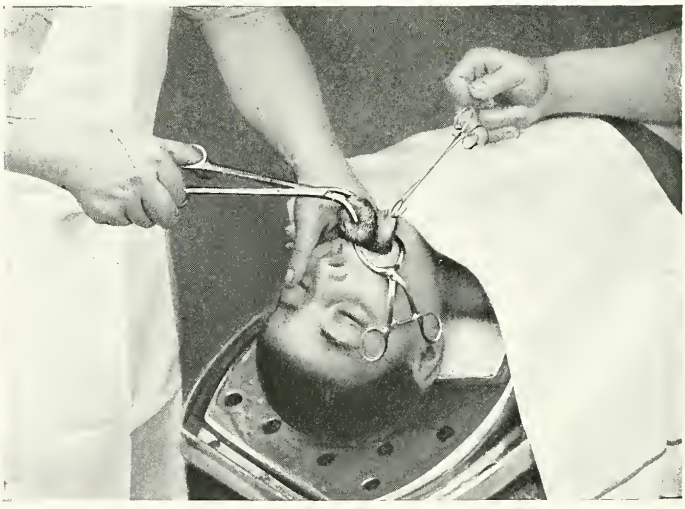


FIG. 247.—EXTIRPATION OF A NASO-PHARYNGEAL POLYPUS OF MEDIUM SIZE.

The pedicle of the growth has just been detached. Extraction of the tumour with the gouge-forceps.

3. *Polypus of the Sphenoidal Sinus.*—In 1913 I operated on two such cases. Not being able to grasp the pedicle with my pharyngeal raspatory, I recognized the implantation in the sphenoidal sinus with the index-finger passed above the level of the soft palate. I then immediately introduced a small straight gouge-forceps of the form used for uterine fibro-myomata, through the nostril of the same side. With this I seized the growth, which I then detached and extracted by torsion.

4. Naso-Pharyngeal Polypus, which has invaded All the Sinuses of the Face.—Some naso-pharyngeal polypi come to acquire a very considerable development. They fill up the pharynx; distend one of the nasal fossæ so far as to push over the septum till it reaches the turbinated bones of the opposite side; invade the maxillary sinus, perforating its anterior

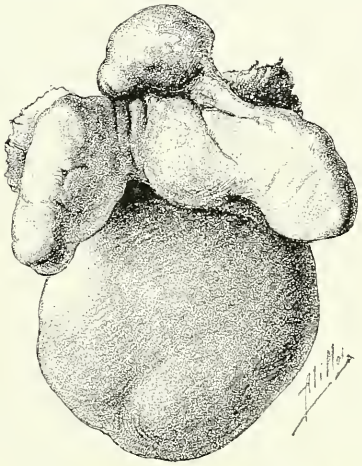


Fig. 248.—Naso-Pharyngeal Polypus extracted from the Child represented in Figs. 246 and 247.

Natural size.

and superior walls, so as to project under the skin of the cheek; displace the eyeball upwards, and also penetrate into the ethmoidal and sphenoidal cells. Those tumours may also invade even the zygomatic and temporal fossæ.

I have just recently met with such a case in a child of fourteen, who had been repeatedly operated on unsuccessfully by other surgeons. The case was a very difficult one. A surgeon had previously failed to extract the tumour after making a large horseshoe cutaneous incision, followed by resection of the anterior wall of the maxillary sinus. The excessive hæmorrhage had compelled interruption of the procedure. The child was now placed in the Rose position, and the pedicle of the growth was torn from the basilar apophysis by a powerful movement of the raspatory; but the pharyngeal forceps could extract only a certain portion of the neoplasm. I then noticed that the sinusal mass had contracted extensive adhesions to the walls of the antrum of Highmore, such as I have never met with in any other case, and which must have resulted from the previous attempts at operation. Swift

incision of the jugo-gingival furrow enabled me to extract the sinusal prolongation of the growth. The superior and posterior processes were then extirpated with a straight gouge-forceps introduced through the corresponding nostril, the orifice of which was considerably dilated. When all the processes of the growth had been extirpated, the cavity was stuffed

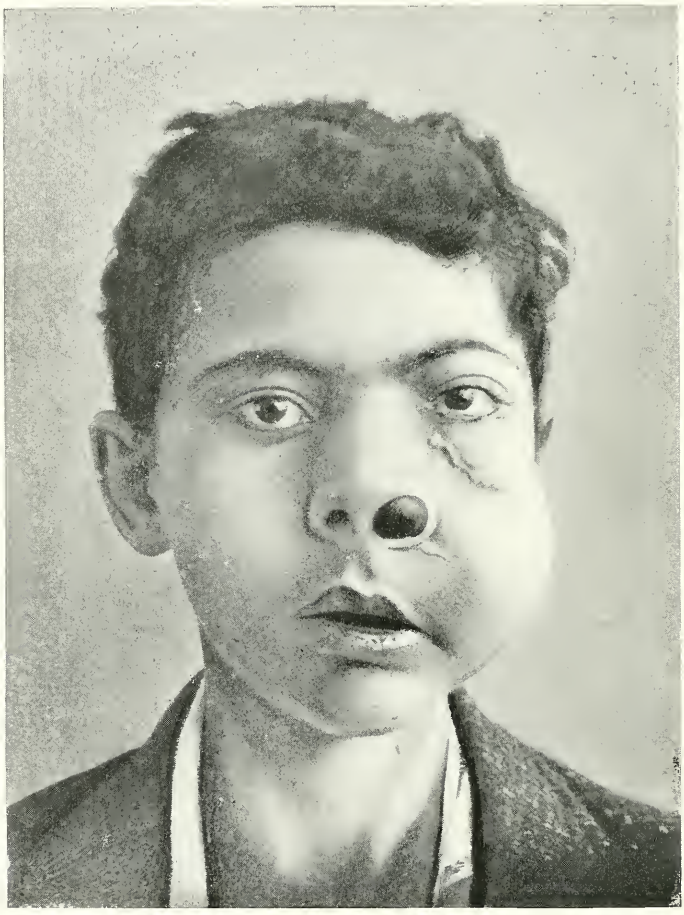


FIG. 249.—NASO-PHARYNGEAL POLYPUS WHICH HAS INVADED ALL THE SINUSES OF THE FACE, AND CONTRACTED DEEP ADHESIONS AS THE RESULT OF A FRUITLESS ATTEMPT AT EXTRACTION BY THE JUGAL ROUTE.

The tumour was extirpated in fifteen seconds by my method.

with compresses, and hæmorrhage ceased. The whole operation lasted hardly a minute. The child could not have borne up had it been prolonged thirty or forty seconds more.

One must have assisted at one of those truly startling interventions to be able to comprehend fully the enormous importance in such cases of knowing how to operate quickly. During the whole time of the operation the flow of blood is torrential, and the patient, livid and blue of aspect, lies

in a state of apparent death; but when the wound has been tamponed, the bleeding ceases, the respiration is re-established, and the countenance regains its ruddy hue, with, however, a certain pallor when the loss of blood has approached a total of 500 grammes.

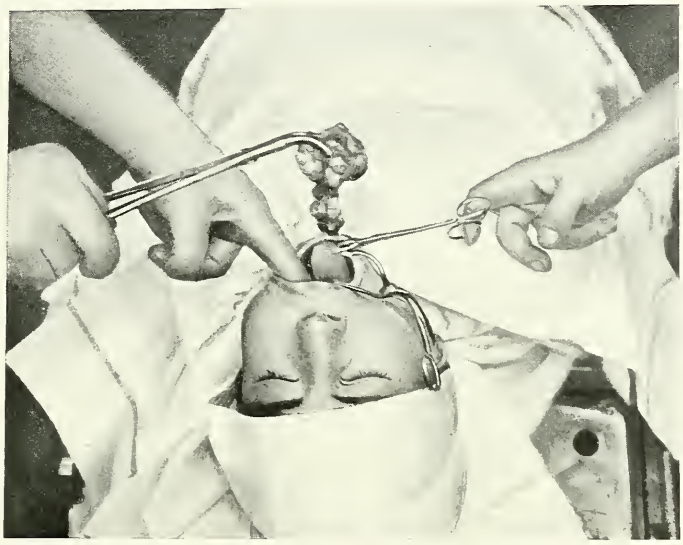


FIG. 250.—NASO-PHARYNGEAL POLYPUS OF CONSIDERABLE VOLUME.

The pedicle has just been detached with the raspatory. Extirpation of the naso-pharyngeal mass, which has separated from a larger mass developed in the maxillary sinus.

MALIGNANT TUMOURS.

Primary tumours of the tonsil are nearly always of malignant nature—sometimes sarcoma, sometimes epithelioma. They rapidly infiltrate the pillars of the fauces, and produce infection of the submaxillary and carotid lymphatic glands at an early date.

Ablation of malignant growths of the tonsil can be effected through the buccal route only in very exceptional instances. The presence of engorged lymphatic glands forces us nearly always to adopt the subangulo-maxillary channel of exit (see subsequent reference). The field of operation should be heated to a temperature of 60° C. (140° F.) by applying the procedure of thermic electro-coagulation, using a spherical electrode, which is moved about over every point of the surface.

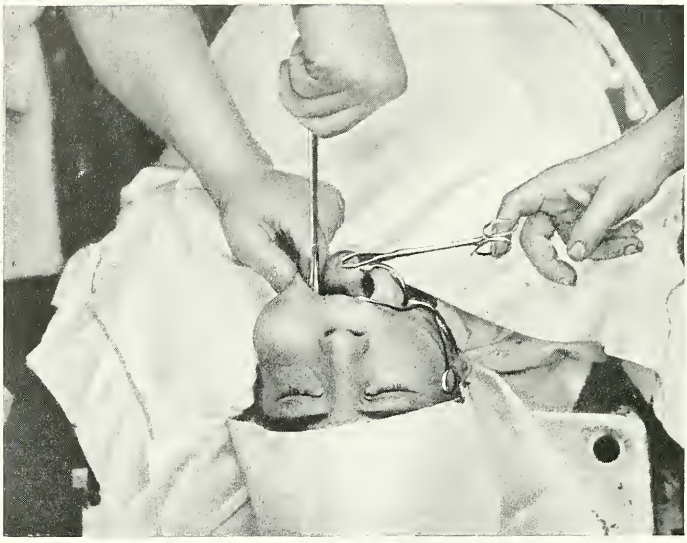


FIG. 251.—NASO-PHARYNGEAL POLYPUS OF CONSIDERABLE VOLUME.

Prehension of the mass located in the sinus, which has destroyed the anterior wall of the antrum of Highmore. The tumour is seen projecting under the skin of the cheek.

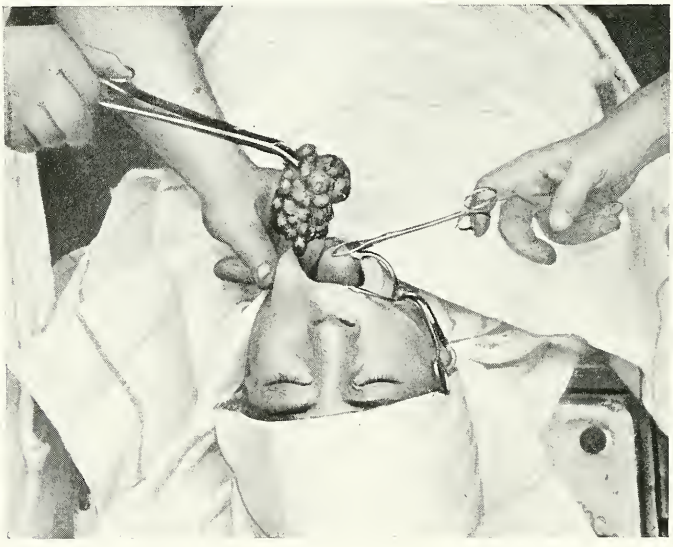


FIG. 252.—NASO-PHARYNGEAL POLYPUS OF CONSIDERABLE VOLUME.

Extirpation of the whole sinusal mass, which is extracted in a single piece with the gouge-forceps, through the jugo-gingival groove.

SUBMAXILLARY REGION.

The submaxillary region is divided anatomically into median and lateral suprahyoid spaces. I will not observe this subdivision, which is but little respected in surgical practice.

Traumatic Lesions.

Wounds with Cutting Instruments.

Lateral wounds of the submaxillary region may be deep enough to involve the facial artery. The hæmorrhage, which is considerable, requires exposure of the facial artery, and adoption of either simple crushing or, for greater security, ligature of both divided ends of the vessel. There are no important arterial branches in the vicinity of the middle line. Hæmorrhage from the submental artery may necessitate ligature in the wound.

Inflammatory Lesions.

Phlegmon.

Phlegmon of the Submaxillary Space.—Phlegmons of the submaxillary region, whatever may have been the cause, are recognizable by the special inflammatory aspect of the region. We have recourse to intensive treatment with mycolysine, both by the mouth and hypodermically. This treatment has produced rapid resolution of many enormous phlegmons of both submaxillary regions, which had extended to the whole of the floor of the mouth, and caused grave symptoms of suffocation. One of those cases was that of an obese and emphysematous woman of fifty years. The volume of the engorged lymphatic glands was considerable, and the origin of the phlegmon was very obscure. Two subcutaneous injections of mycolysine, made with an interval of two days between, determined the cessation of those symptoms and subsidence of the inflammation, followed by complete resolution. This treatment has enabled us to dispense with incision of both submaxillary regions. In cases in which operation is necessary, we can avoid all danger of deep hæmorrhage by having recourse to the process of divulsion in laying open the focus (see Vol. I., p. 427).

Operation—*First Stage.*—Cutaneous incision of 2 to 3 centimetres parallel to the margin of the lower jaw.

Second Stage.—The extremity of closed blunt-pointed scissors is plunged into the purulent focus, and when pus appears on the outside, we withdraw the blades opened, so as to enlarge the orifice by divulsion. This procedure enables us to avoid with certainty the wounding of any deep-seated artery. The operation lasts scarcely one or two minutes, and can be carried out under the anæsthesia of ethyl chloride alone. The wound is treated by a combination of plugging and drainage.

Median Suprahyoid Phlegmon.—Median suprahyoid phlegmon is not rare and originates in the lymphatic glands situated in the space between the anterior bellies of the two digastric muscles. When the focus is superficial,

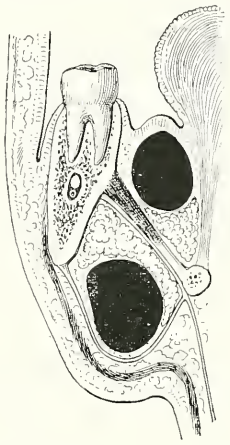


Fig. 253.—Diagram showing Abscess of the Submaxillary Space beneath the Mylohyoid Muscle, and Abscess of the Sublingual Space above the Mylohyoid.

it is opened directly with the bistoury; when deep, we operate in two stages, as above indicated. We first incise the skin, and introduce through the wound the extremity of blunt-pointed scissors, which we push in forcibly. When pus appears, we enlarge the orifice by divulsion.

Actinomycosis.

Median or lateral subhyoid phlegmon caused by actinomycosis is not rare, several cases having come under the author's notice. They have healed well after incision, curettage, and tamponing of the focus. The diagnosis is made by identifying the granules, and bacteriological examination.

Tuberculous Adenopathy.

Isolated tuberculous glands of the submaxillary region are not exceptional in occurrence. They often coincide with considerable adenopathies of the parotid and carotid regions. Originally hard and movable, tuberculous glands soften, perforate their capsules, and may give rise to enormous tuberculous abscesses, which thus have no proper walls, and may extend deeply towards the great vascular trunks. Operation on these cases will differ appreciably when the glands are still firm to the touch, and sufficiently mobile to be extirpated in their entirety, from that which must be adopted in those cases in which they have become adherent, and when their contents have been diffused outside their cellular capsule.

These glands are sometimes so numerous as to occupy the whole submaxillary region, median and lateral. In such cases we make two incisions parallel to the jaw, each of 3 to 4 centimetres in length. The glandular

sacs are opened by divulsion, and the more accessible glands are extirpated. When there are others lying between the two incisions, they are extracted by the same procedure of divulsion by opening the blades of blunt-pointed scissors introduced into the investing pouches, and then dislocating the contents outwards. We must take care not to crush them, as that would involve danger of inoculation of the wound of operation.

Movable Tuberculous Glands.

Operation—First Stage.—Incision parallel to margin of lower jaw of 5 to 6 centimetres in length, and exposure of the superficial cervical aponeurosis.

Second Stage.—Incision of the pouch containing the glands, and enlargement of the orifice by divulsion.

Third Stage.—Extraction of all the lymphatic glands, and, when necessary, of the submaxillary gland, with the help of the index-finger. We must take care, before extracting the gland, to pinch up the two segments, central and peripheral, of the facial artery, on each of which a fine silk ligature is placed. When the artery is healthy, crushing with a short-jawed forceps for three or four minutes will suffice.

Fourth Stage.—Reunion of skin and drainage.

Diffuse Glandular Abscess.

When the capsule of the gland has been perforated by the tuberculous pus, the abscess has no longer any proper walls, and is found to be traversed by the nerves and large vessels of the region.

Operation—First Stage: Opening of Focus.—The skin is incised at the point of greatest fluctuation, and the pus evacuated.

Second Stage.—We extirpate the glands with well-defined borders, if any still exist; then proceed to curettage of the walls of the focus, taking care not to wound the vessels or nerves.

Third Stage.—Toilet of wound, and antiseptic tamponing.

The cicatrization leaves but a single insignificant cutaneous scar. When the healing proceeds slowly, it may be necessary to have recourse to a number of successive curettages. When the resulting cicatrix is disfiguring, it may be extirpated, and the new wound reunited with intradermic sutures.

Malformations: Congenital and Acquired.

Congenital Malformations.

Subhyoid Fistula.

Subhyoid fistula of branchial origin is recognizable by a small opening, from which a mucous discharge issues. The tract must be extirpated.

Operation—First Stage.—The fistulous orifice is circumscribed between two semi-elliptical incisions.

Second Stage.—The small cutaneous area which comprehends that orifice is grasped with clawed forceps, and the fistulous tract is dissected as deeply as possible. We must use every effort to extirpate it completely.

Third Stage.—Suture of skin, drainage.

It may happen that a sero-mucous discharge persists for some time, and that the wound does not close till after several weeks.

Acquired Malformations.

Vicious Cicatrices.

Acquired deformities are usually those of retractile cicatrices resulting from burns.

Operation—First Stage.—The cicatrix should be extirpated in its whole extent and thickness without leaving the smallest trace of the retractile tissue.

Second Stage.—Autoplasty by sliding displacement of a cervical cutaneous flap, the form of which must be adapted to the pathological conditions.

Third Stage.—Union of flap with interrupted suture.

Tumours.

Benign Tumours.

Submaxillary Ranula.

Ranula of the submaxillary origin is not exceptional in occurrence. The cyst may perforate the mylohyoid muscular plane, and project under the skin (see Fig. 213).

Operation—First Stage.—Cutaneous incision parallel to the jaw, passing over the most prominent point of the cyst.

Second Stage.—Exposure of the sac of the cyst, which we should try to extirpate in its totality, and without rupture.

Third Stage.—Suture of skin and drainage.

Tumours of the Submaxillary Gland.

Benign tumours of the submaxillary gland are oftenest of mixed structure, notably adenomata or myxochondromata.

Operation—First Stage.—Incision of skin, as above, and exposure of the superficial cervical aponeurosis.

Second Stage.—Incision of aponeurosis and exposure of the tumour, which is isolated by divulsion of its cellular capsule with the aid of the index-finger and blunt-pointed scissors.

Third Stage.—Exposure of one of the poles of the tumour. We penetrate to the deep aspect of the neoplasm, first with the index-finger and

then with blunt-pointed scissors, which are made to isolate its posterior aspect by divulsion.

Fourth Stage.—Luxation of tumour to outside of wound, forcipressure of facial artery and vein above and below, and division of the last attachments of the neoplasm.

Fifth Stage.—Verification of field of operation, reunion and drainage.

Malignant Tumours.

Primary Cancer of the Submaxillary Gland.

Primary cancer of the submaxillary gland rapidly invades that region and may very soon become inoperable. Extirpation of the tumour, when still limited, is carried out with the technique which has just been described.

Cancerous Glands.

Cancerous glands of the submaxillary region sometimes occupy the median suprahyoid space; sometimes the vicinity of the submaxillary gland. The median cancerous glands remain movable for a rather considerable period, but those of the submaxillary space infiltrate the periosteum and even the maxilla itself at a pretty early date. Whether we are dealing with a primary cancer of the submaxillary gland or with secondary cancerous infection of the lymphatic glands, the operative technique is the same.

Operation—First Stage.—The incision in the skin should be extensive enough to expose the whole of the suspected region.

Second Stage.—Exposure of the capsule which invests the glands, if median; if lateral, opening of the submaxillary space.

Third Stage.—Extensive extirpation of the whole of the suspected tissues. When the cancerous growth adheres to the maxilla, we must carry out partial resection of the bone.

Fourth Stage.—Suture of the skin.

Suppurating and Adherent Cancerous Glands.

Submaxillary cancerous adenopathies often become infected by pyogenic microbes. The glands then become inflamed, and undergo softening. It may become necessary to resect the basilar portion of the bone to a certain extent with the gouge-forceps, or a saw worked by the hand or by electricity.

Extirpation of the Tongue through the Suprahyoid Route: Median or Lateral.

Some neoplasms of the tongue require, in order to effect extensive extirpation, luxation of the organ by the median suprahyoid route or the submaxillary.

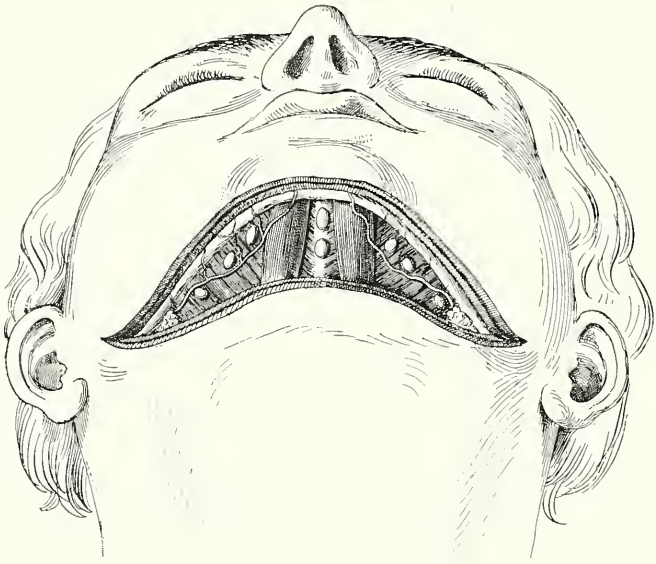


FIG. 254.—ANATOMY OF THE MEDIAN SUPRAHYOID REGION.

First plane: Mylohyoid and digastric muscles, median, and superficial lymphatic glands.

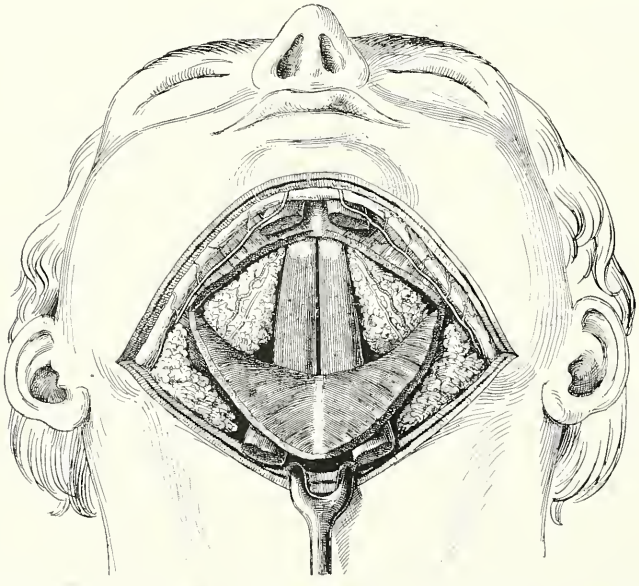


FIG. 255.—ANATOMY OF THE MEDIAN SUPRAHYOID REGION.

Second plane: The geniohyoid muscles and sublingual glands are brought into view as well as the submaxillary glands.

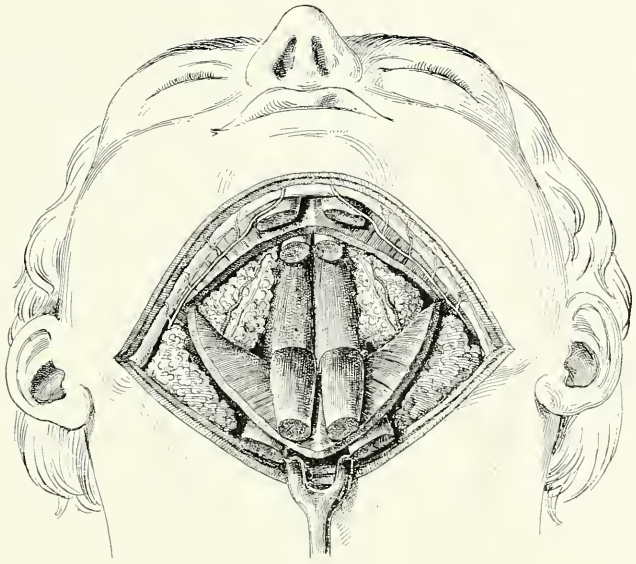


FIG. 256.—ANATOMY OF THE MEDIAN SUPRAHYOID REGION.

Third plane: Section of the genio-hyoid muscles has permitted exposure of the genio-glossi.

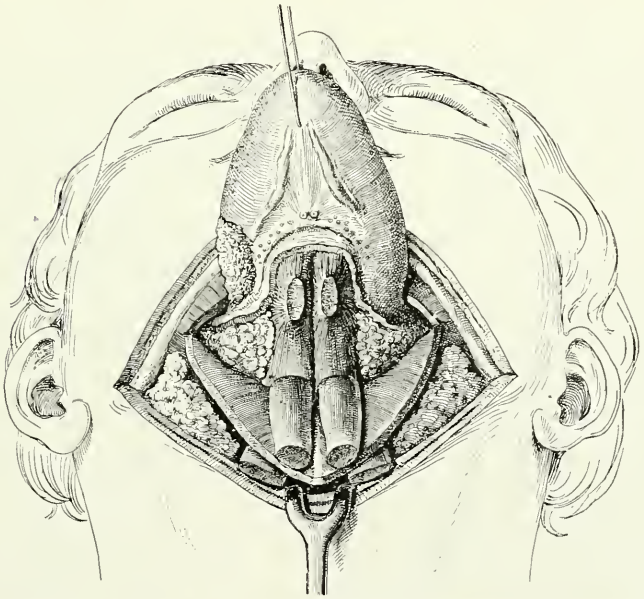


FIG. 257.—ANATOMY OF THE MEDIAN SUPRAHYOID REGION.

The tongue, luxated to the outside of the wound, has been drawn forward; the divided edge of the mucous membrane is seen, and the radiating distribution of the fibres of the genio-glossus in the tongue. On the right border of the tongue is seen a cancroid of small dimensions.

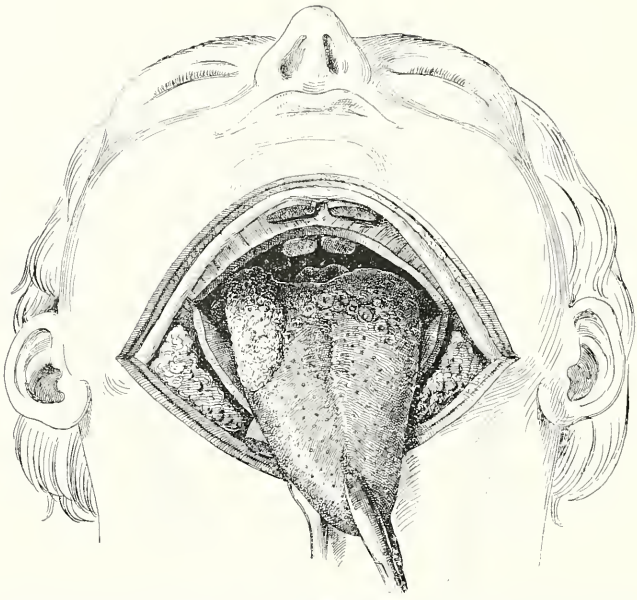


FIG. 258.—ANATOMY OF THE MEDIAN SUPRAHYOID REGION.

The tongue is drawn downwards. The tumour is exposed. The epiglottis is seen in the distance.

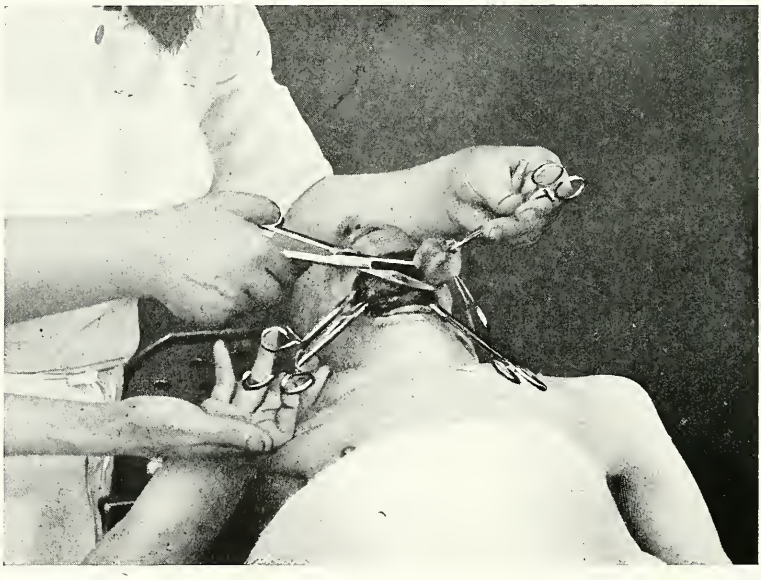


FIG. 259.—PARTIAL EXTIRPATION OF THE TONGUE BY THE SUPRAHYOID ROUTE: FOURTH STAGE.

Dissection of tumour.

Operation through the Median Suprahyoid Route — Anatomy of the Region—*First Plane.*—An incision made parallel to the lower border of the inferior maxilla, and extending from one angle of the jaw to the other, exposes, on division of the platysma, the mylohyoid muscle, on which are found the anterior bellies of the digastric muscles as they approach the middle line. In Fig. 254 we recognize two median suprahyoid lymphatic glands, and at the side the superficial suprahyoid glands which are in relation with the trunk and branches of the submental artery. We also recognize, at the margins of the incision, the anterior pole of either submaxillary gland, exposed by incision of the superficial cervical aponeurosis.

Second Plane.—When we divide, as shown in Fig. 255, the anterior belly of each digastric muscle and the mylohyoid, and draw them backwards, we open the two sublingual pouches, and the genio-hyoid muscles are seen, one on either side of the middle line.

Third Plane.—If we divide, finally, the genio-hyoid muscles close to the maxilla, and draw down their posterior segments, we uncover the juxtaposed fasciculi of the genio-glossi muscles (Fig. 256).

Operation—*First Stage.*—Section of skin and subcutaneous tissue parallel to lower border of jaw for a length of 10 centimetres.

Second Stage.—The median suprahyoid lymphatic glands are removed, when affected, with all the surrounding tissues, and the mylohyoid muscle is liberally incised in the vicinity of its superior attachment. We then resect the attachments of the genio-glossus, which are divided in turn. Hæmostasis is carried out as we proceed.

Third Stage.—Incision of the gingivo-lingual fold now opens into the buccal cavity, and the tongue can be drawn to the outside of the wound below the border of the maxilla.

Fourth Stage.—It is then easy, with the aid of bistoury, scissors, and clawed forceps, to extirpate the whole of the neoplasm, and with it a certain proportion of healthy tissues. The reunion is carried out in such a way as to restore as far as possible the form of the healthy tongue.

Fifth Stage.—Union of mucous membrane of floor of mouth to the gingival mucous membrane.

Sixth Stage.—Suture of skin and drainage.

Operation through the Lateral Suprahyoid Route — Anatomy of the Region. — On dissection of the lateral suprahyoid—that is to say, submaxillary—region, we notice from behind forwards: (1) Sterno-cleido-mastoid muscle, and internal jugular vein, in which the thyro-linguo-facial vein terminates. (2) Below and to right side, the primitive carotid artery and its bifurcation; the hypoglossal nerve and its internal descending branch; the external carotid artery, with its inferior thyroid, lingual, and facial branches; the superior laryngeal nerve; the small external laryngeal nerve, a branch of the hypoglossal. (3) The digastric muscle passing across the tendon of the stylo-mastoid, and the fibrous expansion which fixes its intermediate tendon to the hyoid bone. (4) Below it, the hyo-glossus muscle, which covers the lingual artery, the course of which is indicated by the

dotted line. (5) On the right, the mylohyoid muscle and anterior belly of the digastric. The submaxillary gland, grasped by its anterior pole, has

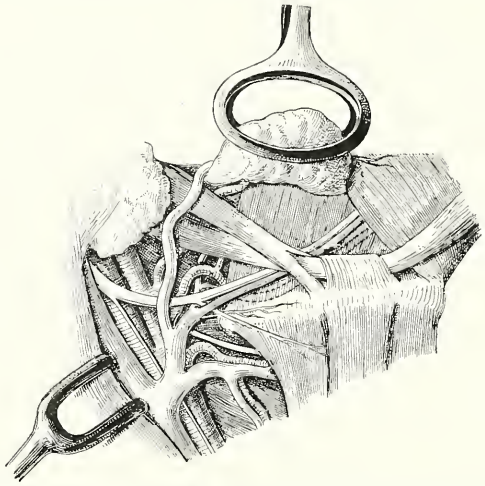


Fig. 260.—Dissection of the Submaxillary Region, showing the Course and Relations of the Lingual Artery.

been drawn upwards in order to expose the deep structures. At the level of the angle of the maxilla we distinguish the inferior extremity of the parotid gland.

Ligature of the Lingual Artery.

We tie the lingual artery either in the hypoglosso-hyoid triangle—that is to say, after the origin of the dorsal artery of the tongue—or near the origin of the vessel, at some millimetres from the external carotid trunk—between the posterior extremity of the great cornu of the hyoid bone and the posterior belly of the digastric. The artery may be tied in either position through the same horizontal submaxillary incision.

When discussing operations on the neck, we will see that the lingual artery can be tied at its origin, as well as the external carotid, superior thyroid, facial, and occipital arteries, through a vertical incision made at the anterior border of the sterno-mastoid muscle. Ligature of the lingual and other branches of the external carotid is, accordingly, but the complement of ligature of the primitive trunks for the purpose of arresting the retrograde collateral circulation which is so active in this region.

1. **Ligature in the Hypoglosso-Hyoid Triangle**—Operation—*First Stage.*—A horizontal incision of 5 centimetres in length in the submaxillary region, at equal distances from the hyoid bone and the lower border of the inferior maxilla.

Second Stage.—Incision of the superficial cervical aponeurosis, and exposure of the submaxillary gland, which is raised with a ring forceps. In the depth of the wound we notice the tendon of the digastric fixed to the hyoid bone by a fibrous expansion; and above it the hypoglossal nerve, along which run the superficial lingual veins. The distance between the hypo-

glossal nerve and the tendon of the digastric muscle is variable enough. We should take care to recognize, first, the tendon of the digastric, and then the nerve as it is about to disappear beneath the mylohyoid muscle. We then expose in the hypoglosso-hyoid triangle the fibres of the hyoglossus muscle, which are directed upwards and forwards.

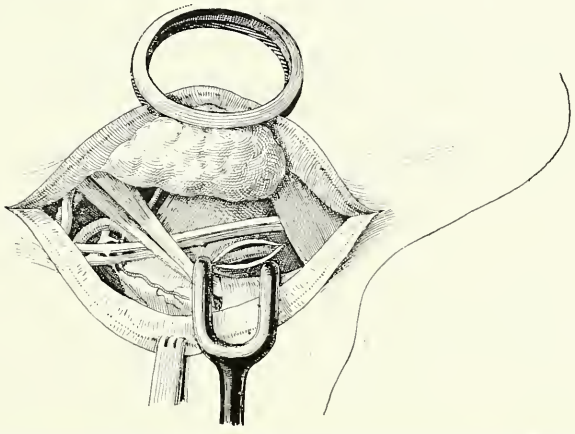


FIG. 261.—LIGATURE OF LINGUAL ARTERY IN THE HYPOGLOSSO-HYOID TRIANGLE. Second stage of the operation.

Third Stage: Exposure of the Artery.—The tendon of the digastric is drawn downwards with a retractor, and we grasp with clawed forceps the fibres of the hyoglossus muscle, which are then incised in a direction

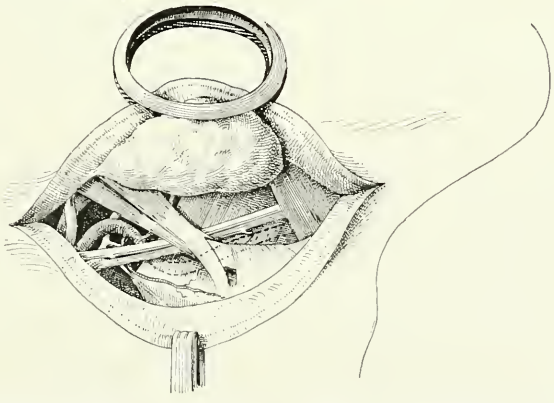


FIG. 262.—LIGATURE OF LINGUAL ARTERY IN THE HYPOGLOSSO-HYOID TRIANGLE. Third stage of the operation. Incision of hyoglossus muscle and exposure of the artery.

parallel to the nerve. The muscle is not very thick. We must take care not to go too deep, and thus pass beyond the artery. A curved and grooved director is passed into the wound from below upwards, and made to raise the vessel, which is then tied with fine silk.

Fourth Stage.—Suture of skin, drainage.

The operation should be carried out rapidly, and with great precision. If we expose the deep aponeurotic lining of the submaxillary pouch by divulsion, the field of operation is bloodless, and we distinguish the relations above enumerated as clearly as in an anatomical preparation.

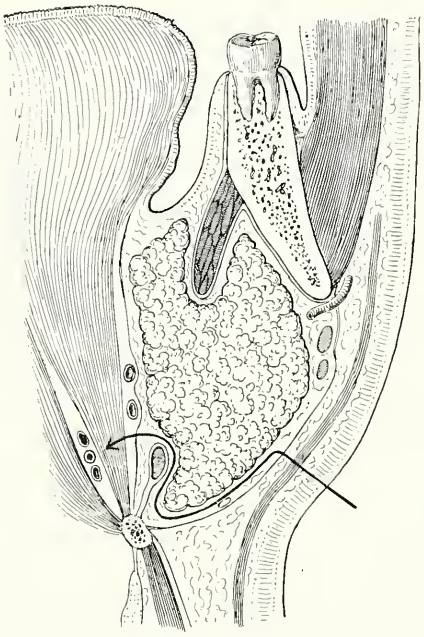


Fig. 263.—Ligature of Lingual Artery in the Hypoglosso-Hyoid Triangle.

Frontal section, passing through the anterior part of the submaxillary pouch, and showing the sublingual process of the submaxillary gland. The arrow indicates the route to be followed in ligature of the lingual artery.

2. **Ligature behind the Hyoglossus Muscle**—Operation—*First Stage.*—The incision is made as above described.

Second Stage.—Incision of superficial cervical aponeurosis, opening of the submaxillary pouch, and exposure of the tendon of the digastric and attachment of the stylo-glossus muscle. We wipe out the depth of the wound with a compress, so as to expose the hypoglossal nerve below, and, above it, the posterior belly of the digastric. The artery lies at a depth of some millimetres.

Third Stage.—The artery is exposed by detaching the investing cellular tissue with a clawed forceps. It is then raised on a grooved director and tied.

Fourth Stage.—Suture of skin and drainage.

Extirpation of the Tongue through the Lateral Suprahyoid Route.

The lateral suprahyoid route permits us to reach the corresponding side of the base of the tongue. The approach to tumours of the base of the tongue in this direction is relatively easy.

Operation—First Stage: Incision of the Integuments.—The incision should start from the angle of the maxilla, traverse the submaxillary region obliquely, and end at the vicinity of the os hyoides. It involves skin and platysma.

Second Stage.—Incision of platysma, of the superficial cervical aponeurosis, extirpation of the submaxillary and infected lymphatic glands,

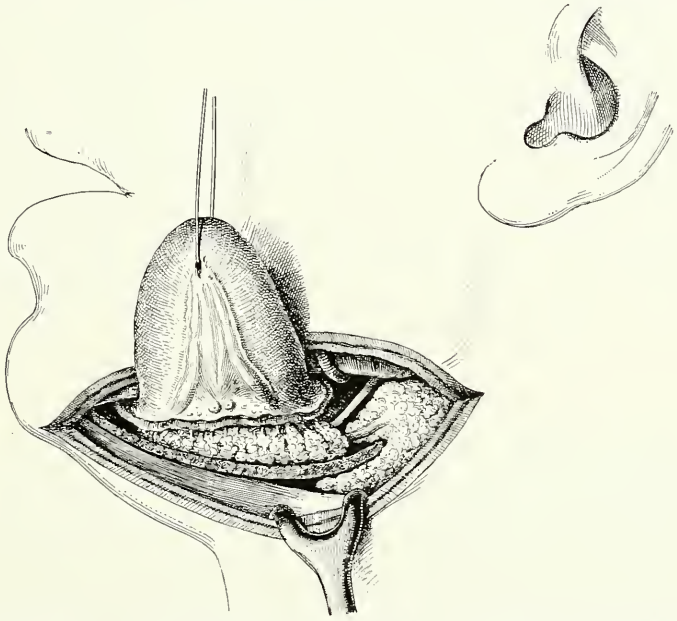


Fig. 264.—Dissection of Sublingual and Submaxillary Space, showing: Below, the Digastric; in the Middle, the Divided Edge of the Mylohyoid; with the Sublingual Gland above it, and the Submaxillary curled around its Posterior Margin.

The tongue has been drawn out through the wound.

double ligature of the lingual artery. It often happens that the carotid glands are also involved. In such a case a further incision of 4 or 5 centimetres should be made from the posterior extremity of the first, as if for exposure of the external carotid artery. The glands are then extirpated, and the external carotid and its principal branches are tied (see p. 291).

Third Stage.—The dental arcades are separated with the ringed gag. The surgeon recognizes the glosso-gingival groove with his left index-finger, while he explores the depths of the wound with his right, separating the various cellular strata till he has reached the mucous membrane. The mylohyoid muscle is found at the anterior part of the field of operation.

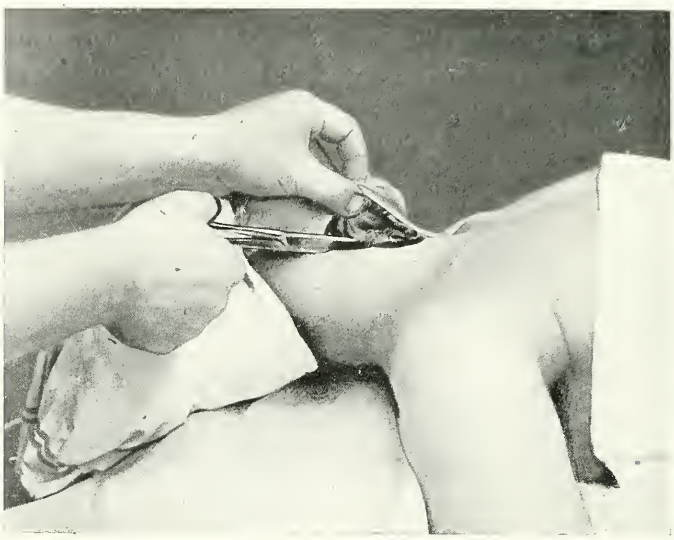


FIG. 265.—ABLATION OF A TUMOUR OF THE BASE OF THE TONGUE BY THE LATERAL SUPRAHYOID ROUTE.

Exposure of the cancerous lymphatic glands.

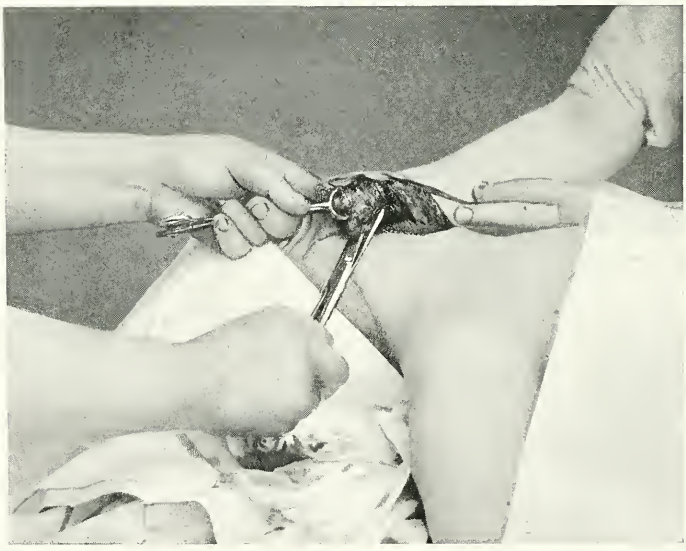


FIG. 266.—ABLATION OF A TUMOUR OF THE BASE OF THE TONGUE BY THE LATERAL SUPRAHYOID ROUTE.

Extirpation of cancerous glands.

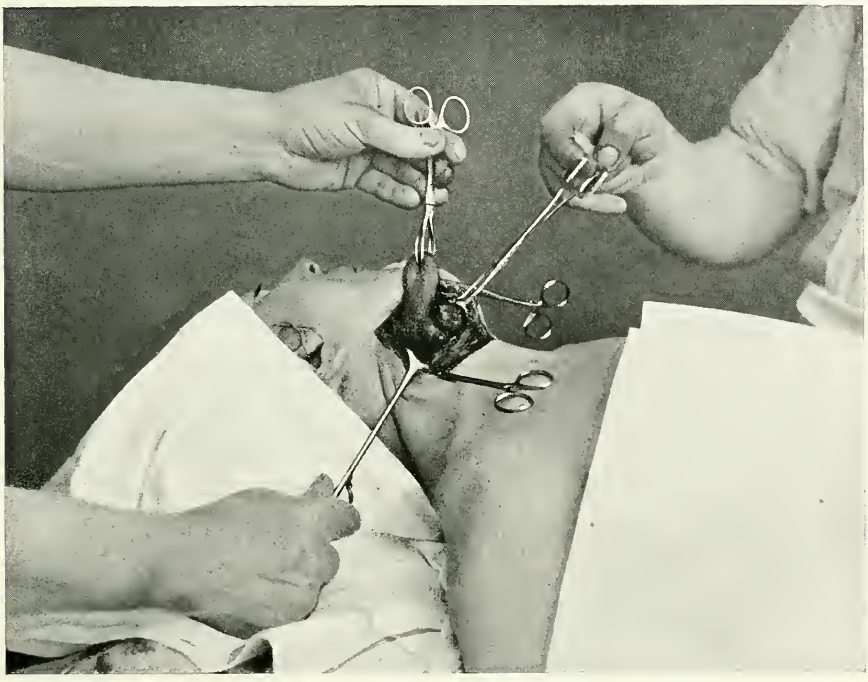


FIG. 267.—ABLATION OF A TUMOUR OF THE BASE OF THE TONGUE BY THE LATERAL SUPRAHYOID ROUTE.

Luxation of the tongue to outside of wound.

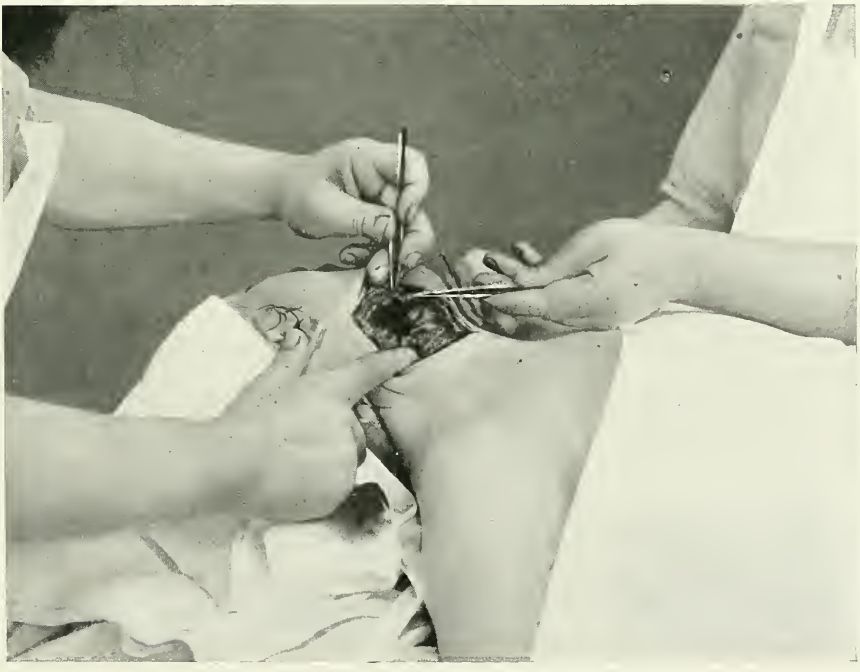


FIG. 268.—WOUND PRODUCED BY EXTIRPATION OF TUMOUR.

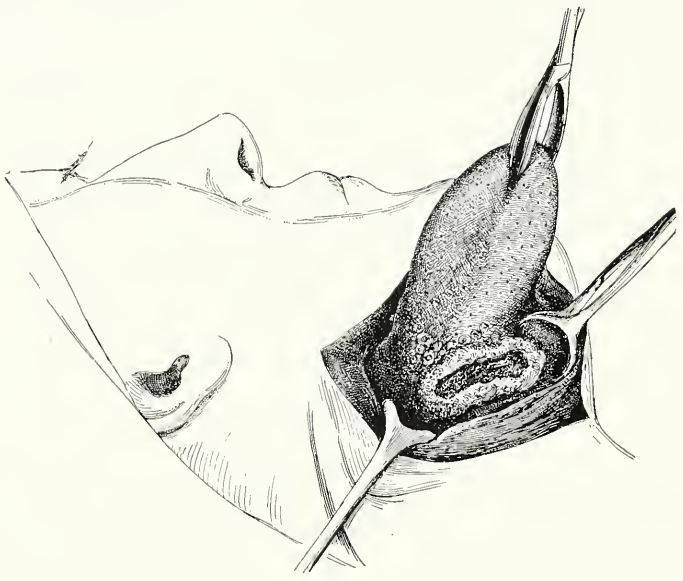


FIG. 269.—WOUND PRODUCED BY EXTIRPATION OF TUMOUR.

The buccal mucous membrane has just been incised. The tongue has been luxated below the maxilla. We recognize the tumour, which is situated at the right side of the base of the tongue.

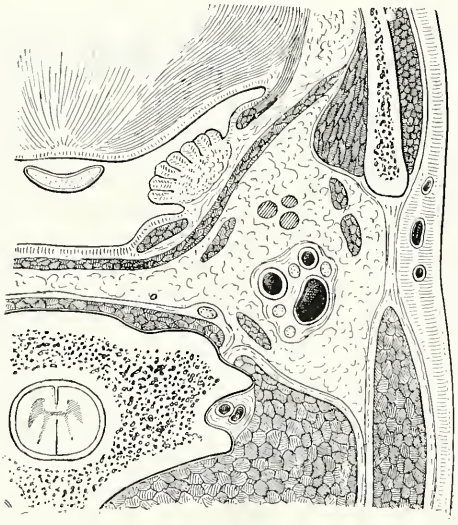


FIG. 270.—HORIZONTAL SECTION OF THE TONSILLAR REGION IN THE PLANE OF THE LOWER PART OF THE TONSIL.

The relations of the organ to the superior constrictor of the pharynx and the neuro-vascular bundle are shown.

This must be divided throughout its whole extent, and after it the attachments of the genio-glossi.

Fourth Stage.—The mucous membrane is perforated with a short forceps from above downwards in the gingivo-lingual groove. It is incised from before backwards as far as is necessary to allow luxation of the tongue to the outside of the wound. The tongue is first drawn upwards, so as to mobilize it thoroughly. The surgeon then luxates it towards the neck, so as to expose the neoplasm, which he then proceeds to remove.

Fifth Stage.—Removal of the neoplasm; progressive suture of the lingual wound.

Sixth Stage.—Reunion of buccal mucous membrane, partial reunion of skin, tamponing of posterior part of wound, and drainage.

Tumours of the Tonsil.

Anatomy of the Region.—Malignant tumours of the tonsil are sometimes of the nature of sarcoma, sometimes that of pavement epithelioma. Cancer may begin either in the gland itself or in the glosso-amygdaloid

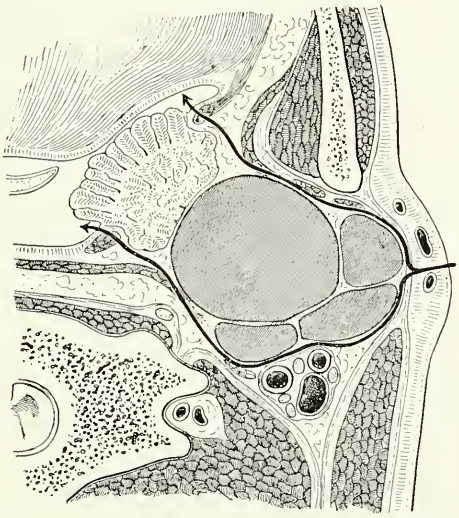


Fig. 271.—Horizontal Section of the Tonsillar Region in the Plane of the Lower Part of the Tonsil.

Showing tumour of tonsil, and the displacement of the neuro-vascular bundle by the cancerous adenopathy. The two arrows indicate the way of access for enucleation of the infected glands and the tumour.

groove at the level of the pillars of the fauces. Ablation of tumours of the tonsil, of the pillars of the fauces, and of the glosso-amygdaloid groove should be effected through the lateral submaxillary route.

If we make a horizontal section passing by the inferior pole of the tonsil, we notice that this gland is placed exactly inside the angle of the lower jaw,

so that a transverse line joining the inferior angles of the two maxilla would pass through each of the tonsillar sockets.

The tonsil is one of the adnexæ of the buccal mucous membrane. It is separated from the carotid region by the musculo-aponeurotic plane of the

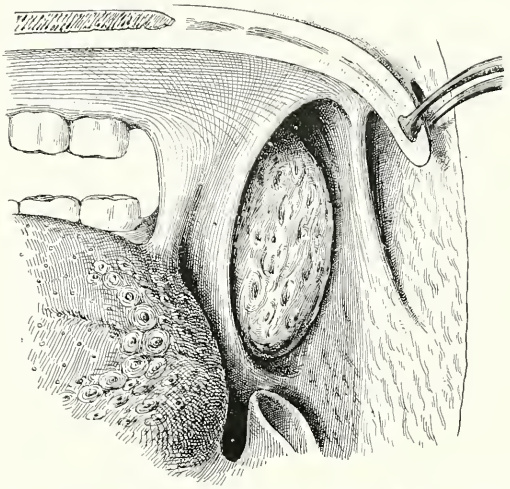


FIG. 272.—RIGHT TONSILLAR FOSSA, SEEN FROM THE INNER SIDE.

The tongue is inclined to the left, and the velum palati is drawn upwards and backwards.

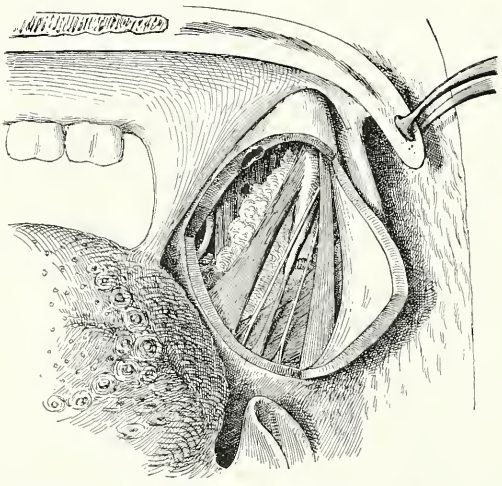


FIG. 273.—RIGHT TONSILLAR FOSSA, SEEN FROM THE INNER SIDE.

The tonsil and the glosso-amygdaloid fold are drawn backwards. Anatomical relations of the outer surface of the tonsil.

superior constrictor of the pharynx. Between the muscle and the neuro-vascular sheaf passes the stylo-pharyngeus muscle. In front we see three lymphatic glands, and in the vicinity of the internal pterygoid muscle the small stylohyoid and styloglossus. The neuro-vascular bundle includes

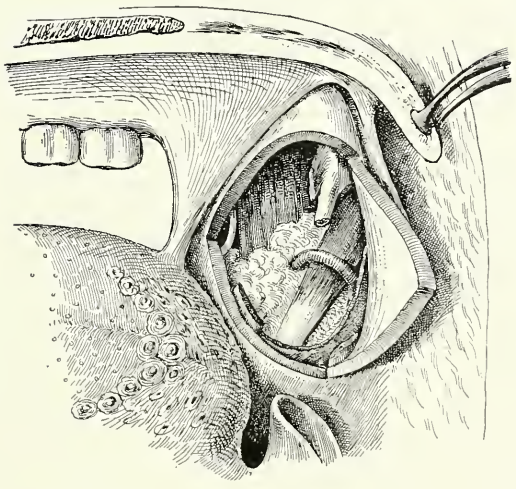


FIG. 274.—RIGHT TONSILLAR FOSSA, SEEN FROM THE INNER SIDE.

The styloid apophysis, styloid muscles, and superior constrictor of pharynx, have been resected. Exposure of lingual nerve, internal pterygoid and digastric muscles, and facial artery, which plunges into the cellulo-adipose tissue of the maxillo-pharyngeal space.

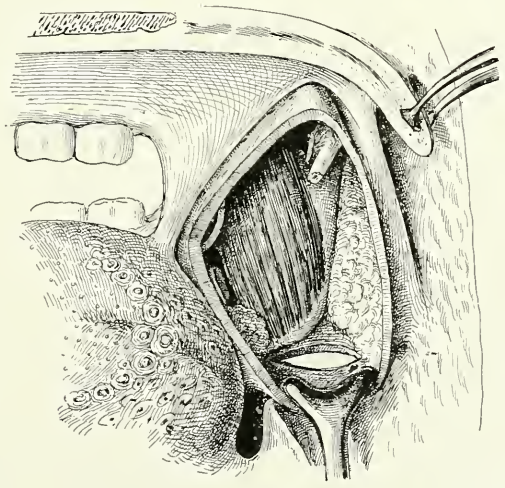


FIG. 275.—RIGHT TONSILLAR FOSSA, SEEN FROM THE INNER SIDE.

A retractor has hooked back the digastric muscle and facial artery, and drawn the inferior angle of the tonsillar wound forcibly downwards. This disposition enables us to see: behind, the anterior aspect of the parotid pouch; in front, the posterior pole of the submaxillary gland; on the outside, the lingual nerve, internal pterygoid muscle, and ascending ramus of inferior maxilla; below, a small cutaneous incision. This is the incision which we use in attacking the tonsil through the subangulo-maxillary region.

the external and internal carotid arteries, the internal jugular vein, and a number of nerves—on the outside, the hypoglossal; between the two carotid arteries, the glosso-pharyngeal; between the internal carotid artery and internal jugular vein, the pneumogastric; and behind the internal jugular vein, the spinal accessory. The posterior belly of the digastric is behind the neuro-vascular sheaf. The sympathetic nerve-chain is covered by the prevertebral aponeurosis.

Cancerous adenopathy due to primary tumours of the tonsil pushes the neuro-vascular sheaf backwards, and projects beneath the angle of the jaw (Fig. 271). The relations of the tonsillar socket to the angle of the lower jaw are very interesting. If we dissect it from within outwards, we expose many strata in succession: (1) Beneath the superior constrictor of the pharynx we find—in front, the lingual nerve; immediately behind and to the outer side, the internal pterygoid muscle, to the inner side of which we find embedded in the adipose tissues the styloid apophysis, styloglossus muscle, stylohyoid ligament, and glosso-pharyngeal nerve; finally, we find posteriorly the lingual branch of the facial and the stylopharyngeus muscle. We should notice that the styloid apophysis was of abnormal length in this specimen. (2) The subjacent stratum is exposed by resection of the styloid apophysis, styloid muscles, and the two nerves just named. We then distinguish beneath the trunk of the styloid apophysis the posterior belly of the digastric muscle, round which the facial artery bends. (3) If we remove the digastric muscle and facial artery, we expose the ascending ramus and the angle of the lower jaw, beneath which a small horizontal cutaneous incision has been made.

This dissection shows that it is easy to reach the tonsil through the lateral suprahyoid region by passing below the angle of the jaw, and between the parotid gland and the submaxillary. The lateral suprahyoid incision also enables us to expose the base of the tongue, the glosso-epiglottic fold, tonsil, and pillars of the fauces without having recourse to resection of any portion of the inferior maxilla.

Operation—First Stage: Cutaneous Incision.—The incision should be made parallel to the angle of the jaw, starting at the inferior extremity of the capsule of the parotid gland, and extending to the vicinity of the body of the os hyoides. If there are voluminous lymphatic glands, it will be necessary to prolong the cutaneous incision downwards and backwards for a distance of 2 to 3 centimetres.

Second Stage: Exposure of the Glands.—When the infected glands are very voluminous, they are exposed almost immediately. We then detach their investing sac by divulsion, and luxate them out of the wound, taking care not to lacerate them. The right index-finger, plunging into the depths of the wound, is made to search for deep-seated glands, which it bends around and detaches till the mucous membrane is reached. With some dexterity we can succeed in liberating the whole periphery of the tumour with the right index-finger; while the left index, which has been introduced into the buccal cavity, continuously follows the progress of this dissection. We then tie the bleeding vessels.

Third Stage: Extirpation of the Tumour.—When the manœuvre thus described has been executed with care, the tumour is completely liberated on its outer, upper, and lower aspects, and now possesses no further connection, except that with the buccal mucous membrane. The surgeon incises this mucous membrane at a short distance from the tumour, guiding himself with the index-finger, which has been introduced through the mouth, and the neoplasm is set free with a few snips of the scissors.

Fourth Stage.—We then carry out partial reunion of the mucous membrane, tamponing of the wound, suture, and drainage.

Cicatrization is obtained at the end of some weeks.

This technique enables us to remove very freely the localized tumours of the tonsillar region. The field of operation can be enlarged by having recourse to oblique resection of the angle of the jaw. I have never had occasion to adopt this artifice.

OPERATIONS ON THE NECK.

Traumatic Lesions.

Superficial Wounds.

Wounds made by pointed instruments, also incised and contused wounds, and even gun-shot wounds *en seton*, are usually of no serious gravity. When the superficial veins are wounded, the hæmorrhage is arrested by compression. Wounds of the lower part of the external jugular vein may involve the entrance of air into the circulating blood-current. We disinfect the wound, ligature the injured vessels with fine silk, and reunite the skin with ordinary suture, or with the aid of clips.

Deep Wounds.

The degree of gravity of these wounds depends on the importance of the organs involved. Wounds of the internal jugular vein, even by a puncture, may cause an immense extravasation of blood. Wounds of large arteries are followed by fulgurating hæmorrhage. Emphysema is likely to follow wounds of the larynx and trachea. The surgeon is summoned only in those cases in which the wounded person has survived—whether by the efforts of of nature or as a result of immediate attention.

Wounds of the soft parts in the posterior cervical region are not of grave character. The muscles of the nucha may be divided down to the vertebræ without any serious complication. We will see afterwards how this section is carried out for the cure of spasmodic torticollis.

Operation.—When the gravity of the case and the extent of the lesions necessitate the intervention of the surgeon, he should be inspired by the respective conditions existing in each individual case. The examination is

conducted with care, and when the patient is very feeble, without anæsthesia, and the toilet of the wound is carried out; forcipressure being applied to all open vessels, veins as well as arteries. When ligature is impracticable, the walls of the injured vessels are sutured with the extra fine needles made for

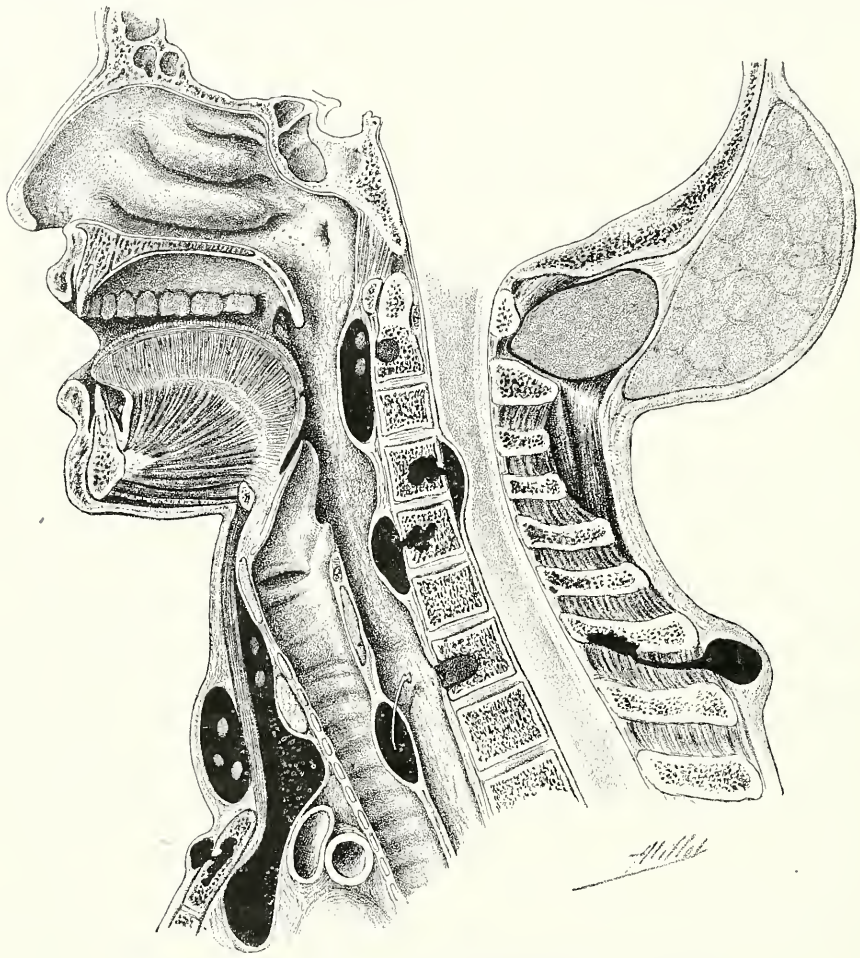


Fig. 276.—Suprasternal Phlegmonous Adenitis.

Ossifluent abscess, *en bouton de chemise*, of the manubrium sterni; pretracheal adeno-phlegmon, burrowing into the interior mediastinum; abscess of the intertracheo-œsophageal space produced by the presence of a foreign body; retro-pharyngeal adeno-phlegmon; bullet of 6 millimetres in diameter, lodged in the body of the axis; tuberculous abscess of fifth cervical vertebra projecting towards the œsophagus; revolver bullet of 8 millimetres embedded in the body of the seventh cervical vertebra; subcutaneous lipoma of the nucha; deep-seated lipoma of the nucha; ossifluent abscess of the spinous process of the seventh cervical vertebra.

arteriorrhaphy. Whenever necessary, the suturing of the pharynx, larynx, or trachea, is then proceeded with, and the wound is treated by antiseptic tamponing, with or without partial reunion of the skin. The surgeon must hold himself in readiness to perform tracheotomy on the slightest warning.

Gunshot Wounds.

Revolver bullets, of small or medium size, are often arrested in their course by the spinal column. Fig. 276 represents two such. I extracted one of these from the axis, the other from the body of the seventh cervical vertebra. The former was a spherical bullet, of 6 millimetres in diameter, which had been fired in the mouth from a small pistol. A probe could readily be introduced through the opening in the pharyngeal mucous membrane, but the projectile was deeply embedded in the bone. It was necessary to approach the prevertebral region by an incision made along the posterior border of the sterno-cleido-mastoid muscle. The projectile was extracted with the help of a small curved raspatory.

The bullet which is figured in the seventh cervical vertebra had penetrated by the side of the trachea, without wounding the vasculo-nervous bundle. It also was extracted through a lateral incision. That represented in Fig. 277 is a revolver bullet, which was fired from behind the patient, and was flattened out against a vertebral lamina. The removal of such a projectile is not difficult if we have a radiographic installation at our disposal.

Inflammatory Lesions.

Acute Inflammatory Lesions.

Phlegmons of the Neck.

The neck is one of the regions in which the suppurative process produces the greatest variety of effects. Fig. 276 shows an adeno-phlegmon located superficially in the suprasternal fossa. Situated more deeply between the middle cervical aponeurosis and the laryngo-tracheal tree is an abscess which is burrowing into the anterior mediastinum. At the surface of the manubrium sterni is seen a small osseous abscess of the "dumb-bell" form. In the retro-tracheal cellular space is figured an abscess resulting from the perforation of the œsophagus by a pin. Such abscesses burrow rapidly into the posterior mediastinum. Above is seen, in the prevertebral region, a retro-pharyngeal adeno-phlegmon; lower down is seen a retro-œsophageal cold abscess emerging from the body of a tuberculous vertebra. A similar abscess projects from the surface of the fourth cervical vertebra into the spinal canal. Behind is a cold abscess of the spinous process, which has come to point under the skin.

Fig. 277 represents, in horizontal section, the detachment produced by a subcutaneous and a subaponeurotic abscess of the neck respectively. More deeply will be observed the course of a tuberculous osteitis of the body and lateral portions of a vertebra which has established an opening into the œsophagus.

In this section the position of the principal groups of glands can be recognized—the external, anterior, and posterior groups of the carotid chain; and the nuchal group of glands—the so-called Ricord's gland—from

the importance of examination of the retro-mastoid region in which they are situated, in order to confirm the diagnosis of secondary or tertiary syphilis.

All phlegmons of the neck should be treated by early incision, in order to prevent purulent infiltration. Administration of mycolysine, both by the mouth and hypodermically, should also be resorted to, as this remedy can by itself secure resolution in some cases.

Operation.—Median and lateral subhyoid phlegmon must be dealt with by vertical incision. We operate as follows:

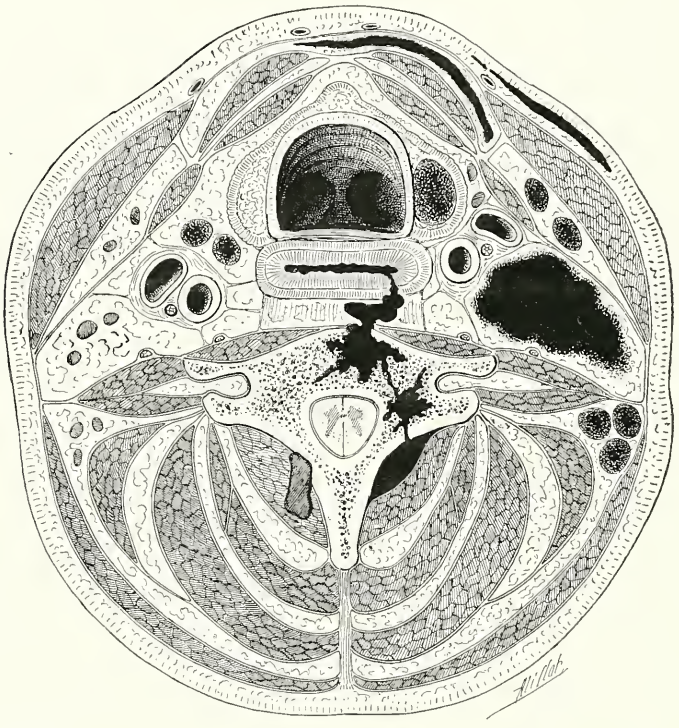


Fig. 277.—Subcutaneous Phlegmon: Median and Right Lateral, Subaponeurotic Phlegmon.

Focus of thyroid suppuration; adenitis of anterior carotid glands on left side, and of external carotid glands on the right. Also on this side: Phlegmon of posterior carotid glands, displacing the vasculo-nervous bundle. Behind: Adenitis of posterior cervical glands; ossifluent abscess of a vertebral opening in front of the œsophagus; revolver bullet flattened against a vertebral lamina.

First Stage: Incision of the Skin.—Subcutaneous phlegmons are attacked at the most projecting point. Wound of a superficial vein is rare; when it occurs a ligature is applied. Phlegmons situated beneath the middle aponeurosis are also opened at the most projecting point. Phlegmons of the carotid glands should be attacked according to the group involved—from before, or behind, the sterno-mastoid muscle; sometimes even through its substance, when the muscular fasciculi have been separated by the purulent focus. The incision must be vertical in nearly all cases, especially when an

extent of several centimetres is required. In certain cases, and especially in females, small horizontal incisions may be made along the natural grooves of the skin of the neck, if such seem probably sufficient to lead to a cure of the condition present.

Second Stage: Incision of Superficial Cervical Aponeurosis, and Exploration of the Depths of the Wounds with the Index-Finger.—We penetrate the purulent focus by following the known cellular interstices, and then plunging into it the extremity of blunt-pointed scissors, closed. When pus appears, we open the blades and enlarge the wound by divulsion.

Third Stage.—Evacuation of the pus and tamponing of the suppurating focus with a wick of sterilized gauze.

Phlegmon of the Thyroid Space.

The collection of pus may form either in the perithyroid space or within the substance of the gland (Fig. 277). These deep-seated phlegmons of the anterior region of the neck have a great tendency to burrow towards the mediastinum and produce a fatal septicæmia if not incised at an early stage and very freely. Tamponing of the focus, when this is extensive, is far better than simple drainage. We can place a glass drainage-tube beside the compress, which should be left for three or four days, and renewed every twenty-four hours till the walls have granulated. Small abscesses should be treated by simple drainage.

Chronic Inflammatory Lesions.

Cold Abscess.

Among those are found subcutaneous tuberculous gummata, cold abscess of glandular origin, and ossifluent abscess. The general treatment should be carried out by combined administration of phymalose and mycolysine (see Vol. I.).

Circumscribed Subcutaneous Cold Abscess—Fistulous Cold Abscess.

The sac should be extirpated if of small size.

Operation—First Stage.—Incision of the focus by the same technique as used for hot abscesses; followed by curettage of the walls.

Second Stage.—Thorough examination of the sac and exploration of the smallest sinus which might lead to a more deeply placed primary osseous or glandular focus. If such focus is found to exist, the incision is enlarged and the deep lesion treated by extirpation, if localized; by curettage, if diffuse. Aero-cauterization is then applied.

Third Stage.—Tamponing of the focus with sterilized gauze. Cicatrization is allowed to proceed over the whole surface involved. The cicatrix is ultimately extirpated if very ungraceful.

Tuberculous Adenopathies.

We first endeavour to produce resolution by the action of phymalose. When the glands soften the contents are evacuated by a small incision, and the general treatment by phymalose is still continued; this frequently

enables us to secure permanent cicatrization. When these palliative modes of procedure fail, we must have recourse to a surgical operation.

Extirpation of massive tuberculous adenopathies will be described simultaneously with that of enlarged lymphadenomatous or cancerous glands.

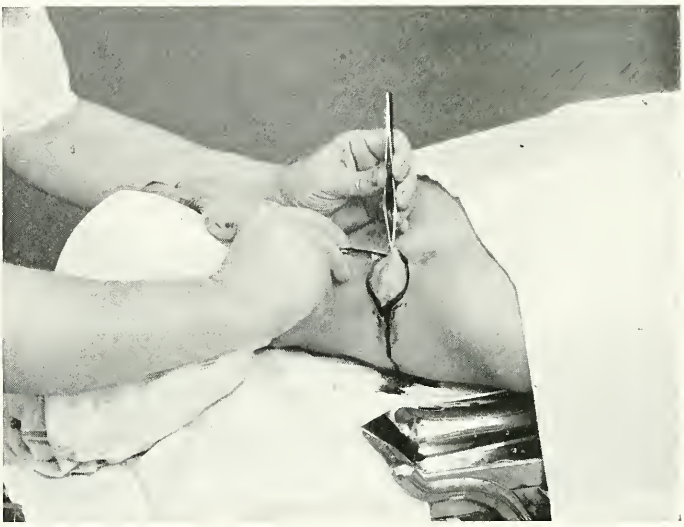


FIG. 278.—EXTIRPATION OF A CIRCUMSCRIBED SUBCUTANEOUS TUBERCULOUS GUMMA.

Benign Lymphadenomata.

These multiple adenopathies of the cervical region, which pass through a benign course of evolution, constitute the group of benign lymphadenomata. They usually disappear under the influence of the X rays, which exercise a selective action on the pathological tissue of these growths, as they do on the splenomegaly which often accompanies them.

Congenital Malformations.

BRANCHIAL FISTULA.

Primary Branchial Fistulæ.

Branchial fistulæ are found opening either on the middle line, near the os hyoides, or laterally, at the inner border of the sterno-mastoid muscle, and 2 to 3 centimetres from the sterno-clavicular articulation. The fistula is usually single; sometimes it is bilateral.

Secondary Branchial Fistulæ.

Sometimes the fistula is formed after birth, as the sequel of the opening of a congenital branchial cyst externally. The internal orifice, when such exists, is situated near the tonsil and base of the tongue. The blind external fistula ends in a cul-de-sac, not far from the hyoid bone. The tract has a

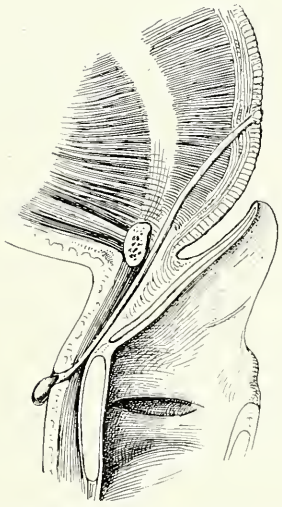


FIG. 279.—MEDIAN PARAHYOID BRANCHIAL FISTULÆ, CONNECTED WITH THE FORAMEN CÆCUM OF THE LINGUAL V.

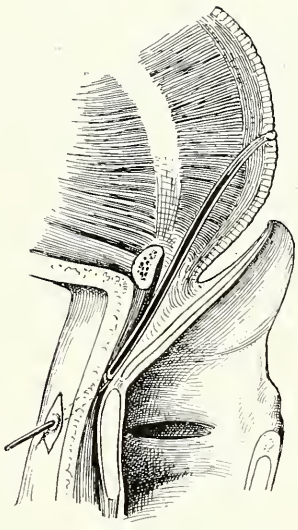


FIG. 280.—MEDIAN PARAHYOID BRANCHIAL FISTULA, CONNECTED WITH THE FORAMEN CÆCUM OF THE LINGUAL V.: EXPLORATION OF THE FISTULOUS TRACT WITH A FILIFORM BOUGIE.

Tracing of the lozenge-shaped incision around the external orifice.

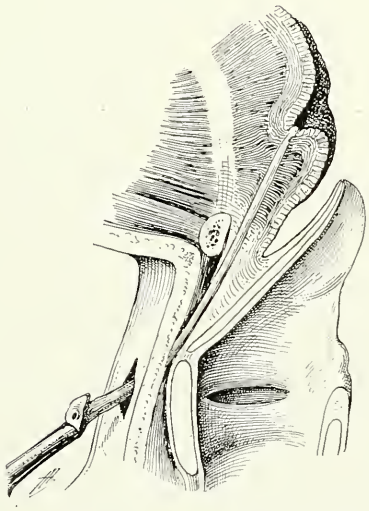


FIG. 281.—MEDIAN PARAHYOID BRANCHIAL FISTULA, CONNECTED WITH THE FORAMEN CÆCUM OF THE LINGUAL V.

The cutaneous orifice has been detached; dissection of the fistulous canal, which is progressively drawn outwards.

mucous lining with an outer coating of fibro-cellular tissue. In the lower portion we find squamous epithelium; in the upper segment the lining is of ciliated cylindrical epithelium. The outer coat of the mucous membrane often presents an adenoid structure. The orifice is usually very small, and is found closed by an epithelial operculum, or with a small yellowish crust. A small quantity of liquid mucous fluid escapes, either clear or turbid. The tract is recognizable on palpation as a hard cord directed towards the great cornu of the os hyoides.

Operation—First Stage.—Vertical elliptical incision around the orifice of the fistula, and liberation of the lower portion of the tract.

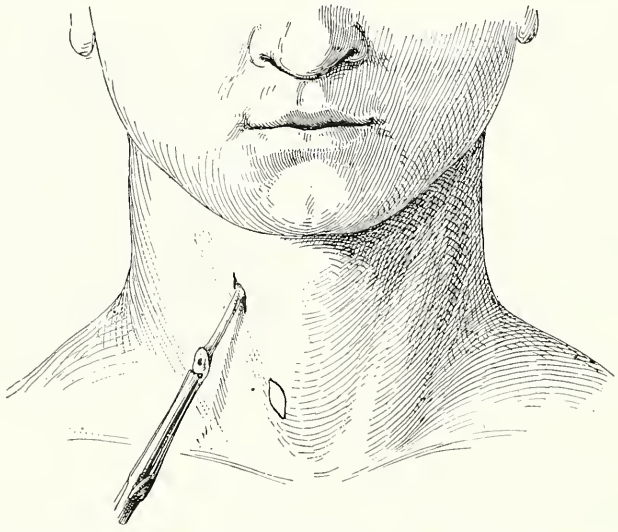


Fig. 282.—Lateral Suprasternal Branchial Fistula.

The fistulous tract, which has been detached by a primary incision over its lower portion, is drawn outwards through a small cutaneous button-hole opening, in order to allow dissection of its upper part.

Second Stage.—Introduction of a blunt stylet into the fistula and dissection of the tract. In case of a blind external fistula, we endeavour to extirpate the whole of the tract; if not, we may neglect the deeper portion. In a case of inferior lateral fistula, in a girl of eighteen, I have had recourse to the following artifice: The lower half of the tract had been dissected out by a small elliptical incision carried around the cutaneous orifice. As the wall of the fistulous tract, which was rather thin, here threatened to break, I made a small counter-opening on the end of a curved forceps, at the upper end of the detached portion. The lower half of the tract was drawn out through that orifice, and I was fortunate enough to be able to extract the upper half, and obtain immediate reunion of the wound, without any recurrence of the trouble.

Third Stage.—Antiseptic tamponing. Suture on fourth or fifth day.

I have carried out this operation in many cases with success and without subsequent recurrence.

Branchial Cysts.

Median branchial cysts of the thyroid region are in most cases lined with cylindrical ciliated epithelium. The lateral cysts are usually adherent to the great cornu of the os hyoides, and frequently to the walls of the vessels, especially of the internal jugular vein.

Dermoid Cysts.

Dermoid cysts are more rare in this region than in the floor of the mouth. They have been met with in front of the trachea, and also in the anterior mediastinum.

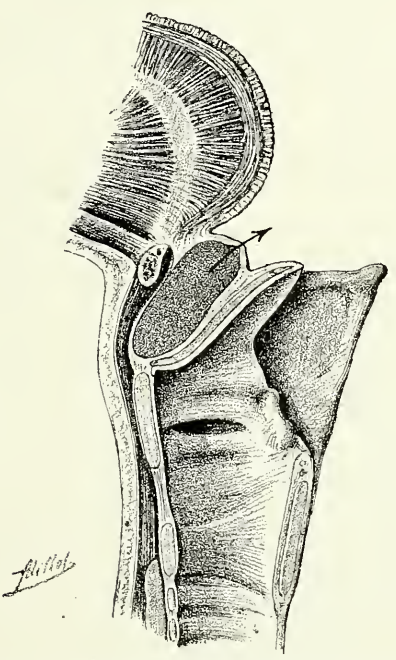


Fig. 283.—Serous Adthyroid Branchial Cyst, projecting into the Glosso-Epiglottic Groove.

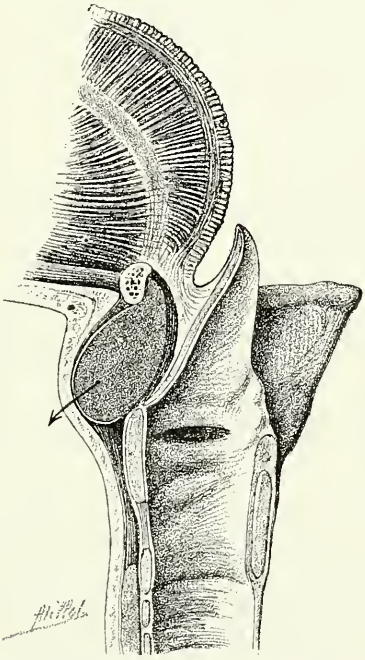


Fig. 284.—Serous Adthyroid Branchial Cyst, the Thyro-Hyoid Membrane.

Operation.—The sac is completely extirpated. In some cases of dermoid cyst it is necessary to resect the portion of the os hyoides to which it is adherent. The fully completed operation is rarely followed by any recurrence.

First Stage.—Transverse incision of the skin over the cyst, close to the os hyoides.

Second Stage.—Exposure and isolation of the sac. The cutaneous incision is increased, if necessary.

Third Stage.—Complete extirpation of the sac and of the hyoid attachment.

Fourth Stage.—Aseptic tamponing or immediate reunion.

Congenital Serous Cysts.

These cysts, whether unilocular or multilocular, are usually of congenital origin; they have been observed even in a five-month fœtus. They are sometimes of considerable size. When the infant is very young, and the cyst voluminous, the procedure of ablation is a serious one.

Operation—First Stage.—Transverse cutaneous incision and exposure of the capsule of the cyst.

Second Stage.—Isolation of the cyst from the fibro-cellular capsule to which it adheres. The dissection must be carried out with minute care on account of the deep-seated off-shoots of these cysts, and their adhesions to the great vessels and nerves of the neck. It is judicious, in most cases, to leave the operation incomplete. Those portions of the cyst wall which are left behind after incision and evacuation undergo spontaneous atrophy.

Prethyroid Cysts.

We meet with serous cysts and prethyroid hygroma of Boyer's bursa; the latter sometimes undergo inflammation and suppuration. Those reputed hygromata are, however, no other than branchial cysts in many instances. The diagnosis can be decided only by histological examination of the capsule and cyst wall.

Operation.—Immediate extirpation, when the cyst is not inflamed. simple incision and tamponing in case of abscess. Secondary extirpation of the tract and sac in case of the formation of a fistula.

Hydatid Cysts.

The diagnosis is made only by puncture, or during operation. Radiography sometimes demonstrates the presence of the daughter cysts.

Operation—First Stage.—Transverse incision and exposure of the cyst wall.

Second Stage.—Incision and evacuation of the hydatid membranes.

Third Stage.—Extirpation of the cellular pouch, followed by reunion and drainage, or by aseptic tamponing and secondary suture.

Sanguineous Tumours.

We sometimes meet with serous cysts with very vascular walls; also true angiomata.

Operation—First Stage.—Exposure of the tumour.

Second Stage.—Dissection of the cyst and extirpation of the sac and hæmostasis of all bleeding vessels.

Third Stage.—Antiseptic tamponing and secondary suture.

Gaseous Tumours.

The gaseous tumours of the neck—*aeroceles, laryngoceles, tracheoceles bronchoceles*—are formed by effusions of air into cavities, either natural or adventitious. They are clearly distinguishable from diffuse gaseous infiltration or emphysema. When such gaseous tumours resist compression, or if they increase in volume, they should be treated by operation.

Operation—First Stage.—Exposure of the tumour and incision of the gaseous sac.

Second Stage.—Dissection of the sac when there is a veritable cyst, and, if possible, suture of the orifice of communication with the respiratory tree.

Third Stage.—Suture, immediate or secondary, after antiseptic tamponing.

Torticollis.

Simple Torticollis.

Retraction of the sterno-mastoid muscle, whether congenital or acquired, always coexists with partial degeneration of its fibres. Sterno-mastoid

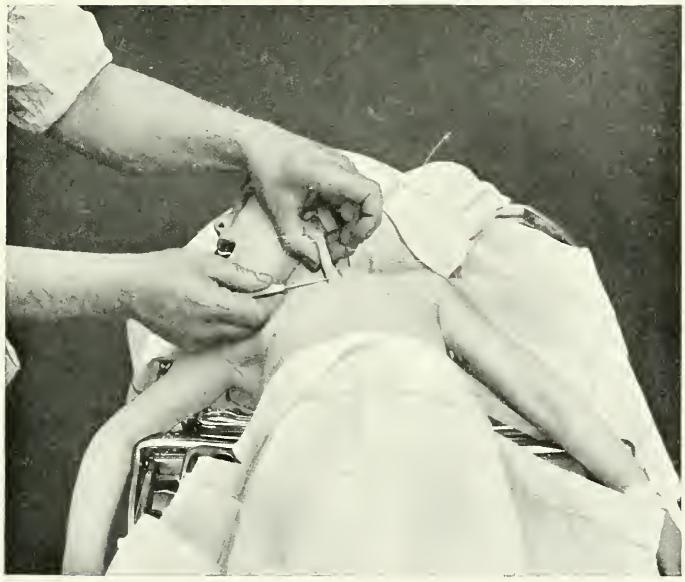


Fig. 285.—Congenital Torticollis: Subcutaneous Tenotomy of Sternal Head of Left Sterno-Mastoid.

torticollis may be complicated by contraction of the platysma. When the deviation of the head resists the application of adjusting apparatus and courses of appropriate exercise, we must have recourse to operation.

Operation.—The patient is anæsthetized, and the head is firmly held inclined in the opposite direction, so as to bring the contracted tendon of the sternal head into prominence.

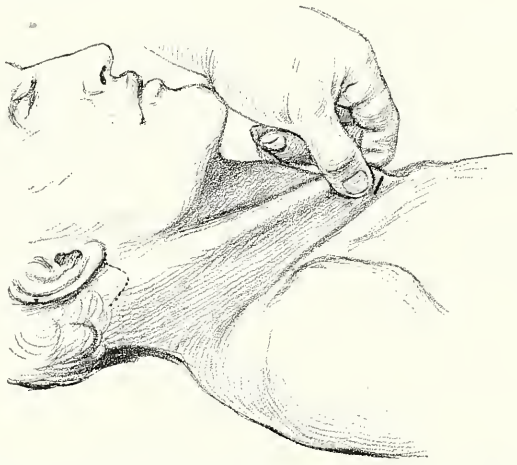


FIG. 286.—CONGENITAL TORTICOLLIS: SUBCUTANEOUS TENOTOMY OF STERNAL HEAD OF LEFT STERNO-MASTOID.

Diagrammatic sketch showing the tendon raised by the finger, so as to permit its division, either from behind forwards, or from before backwards, without danger to the subjacent vessels.

Subcutaneous Tenotomy of the Sternal Head—OPERATION—*First Stage.*—Puncture of the skin on the outer side of the contracted tendon.

Second Stage.—Introduction of a blunt-pointed concave tenotome beneath the tendon, which is then divided from behind forwards.

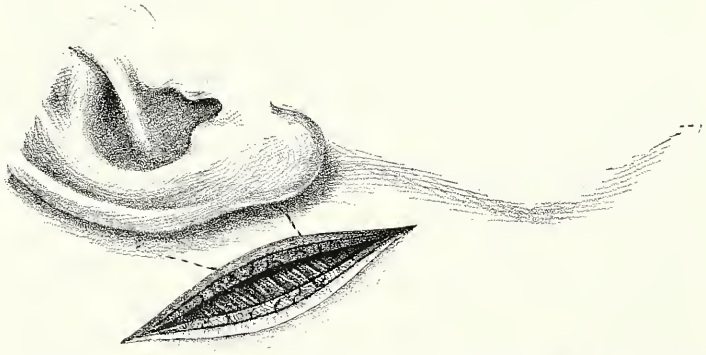


FIG. 287.—SUPERIOR OPEN MYOTOMY OF THE STERNO-MASTOID MUSCLE.

The incision has been made at a finger's breadth from the mastoid process.

Third Stage.—Brusque retraction of the patient's head in the direction opposite to that of rotation produced by the torticollis, so as to tear the last fibres of the muscular attachment. The anterior and external jugular veins can be easily recognized and isolated.

Tenotomy of the Clavicular Head.—The section is in this case more safely carried out *from before backwards.*

Operation—*First Stage.*—Puncture of skin on the outer side of the contracted muscle.

Second Stage.—Introduction of a blunt-pointed convex tenotome to the surface of the tendon, which is then divided by slight strokes, from its cutaneous to its deep surface.

Third Stage.—Re-adjustment of head, as above.

Open tenotomy requires a horizontal incision, 10 millimetres above the clavicle.

Complementary Tenotomy of the Upper Extremity of the Muscle.—When the tenotomy of the two inferior attachments of the muscle has proved insufficient, and the upper part still remains contracted, this is divided 2 centimetres from the mastoid process, either by the subcutaneous or open method. It is easy to avoid injury to the spinal accessory nerve and vessels of the neck by dividing the contracted fibres from without inwards till relaxation of the muscle has been obtained.

Extirpation of the Sterno-Mastoid Muscle.—This operation, which was invented by Mickuliez in 1895, is carried out in the following way:

Operation—*First Stage.*—Longitudinal incision between the two heads of the muscle, from 3 to 4 centimetres above the clavicle.

Second Stage.—Isolation of both muscular bundles with a spatula, and section of both sternal and clavicular attachments, taking care to safeguard the external jugular vein.

Third Stage.—Traction on the two heads, while each is separately held in the jaws of a ring-handled forceps, and progressive withdrawal of the muscle through the wound, while forcibly bending the head towards the side of the operation.

Fourth Stage.—Resection of the muscle, while taking care to preserve the spinal accessory nerve.

Fifth Stage.—Suture of the skin, with or without drainage.

Consecutive Treatment.—Massage and appropriate exercises can be carried out, with elastic traction in the direction of the sterno-mastoid of the opposite side.

Spasmodic Torticollis.

Painful spasmodic torticollis is an affection quite as painful as tic douloureux of the face, with the superadded inconvenience of almost complete impossibility of eating or drinking without having the head firmly held by an attendant, or with an appropriate apparatus. For the cure of spasmodic torticollis, operations have been suggested on the spinal accessory nerve, suboccipital nerve, or posterior branches of the cervical plexus; also section of the contracted muscles. Such interventions involving the nerves are necessarily productive of paralysis and muscular atrophy. Total transverse division of the muscles of the neck—Kocher's operation—has given me excellent results in two cases.

Resection of the Spinal Accessory Nerve—Operation—*First Stage.*—Vertical incision of integument at the posterior border of the sterno-mastoid, extending from the angle of the jaw to the level of the superior border of the thyroid cartilage.

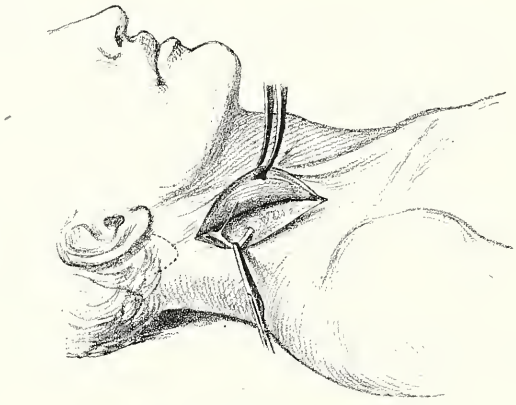


Fig. 288.—Exposure and Section of Mastoid Branches of the Spinal Nerve: General Sketch.

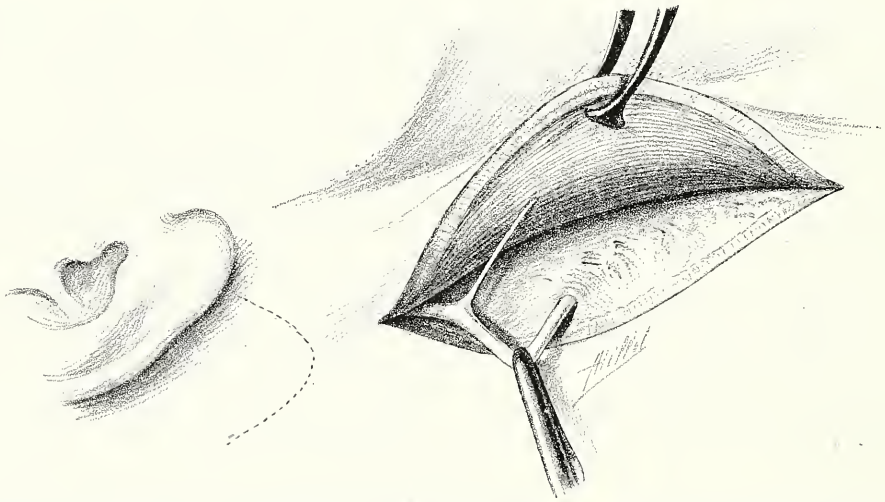


Fig. 289.—Exposure and Section of Mastoid Branches of the Spinal Nerve: View of Field of Operation.

Dissection of the posterior aspect of the sterno-cleido-mastoid muscle, the posterior border of which is raised, together with the skin, by the forceps. The branch of the spinal accessory nerve is held in the jaws of the forceps.

Second Stage.—Dissection of the posterior border of the muscle, which is firmly drawn forwards with one or two forceps. This artifice places the mastoid branches of the spinal accessory nerve on the stretch.

Third Stage.—The posterior surface of the muscle is laid bare in passing upwards towards the origin of the spinal accessory nerve, the external

branches of which are divided in succession, from below upwards, at their entrance into the substance of the sterno-mastoid muscle. We can then dissect the trunk of the nerve very high up in the neck, and remove a certain portion of its length with the mastoid branches.

Fourth Stage.—Toilet of the wound, reunion, drainage.

Resection of the Greater and Lesser Occipital Nerves.—This operation, which is specially indicated in spasmodic torticollis, will be described in connection with the operations on the nuchal region.

Multiple Myotomy of the Nuchal Muscles.—This procedure, also known as Kocher's operation, will afterwards be described with the operations on the nuchal region.

Cicatrices.

Cicatrices on the neck may be simply *disfiguring*, in which case we can have recourse to intervention with a plastic result in view; or they may be *retractile* and productive of a permanent vicious attitude.

Disfiguring Cicatrices.

Operation—First Stage.—Pericicatricial incision of the healthy skin and complete extirpation of the cicatrix. When the cicatrix has been the result of a tuberculous adenitis, it is necessary to resect the subjacent glandular débris in addition to the cicatricial tissue.

Second Stage.—Mobilization of the skin and tracing of the incisions intended to provide for autoplastic reparation.

Third Stage.—Reunion with intradermic suture, or with the aid of clasps.

The outlines of the incision will vary with the individual case (see Vol. I., Autoplastic Surgery).

Vicious and Retractile Cicatrices.

Retractile and vicious cicatrices, especially those of burns, may be productive of repulsive deformity, and of producing, at the same time, a vicious attitude of the head and dragging on the labial commissures. The only rational treatment is that by total extirpation of the pathological tissues over the whole area, and throughout their whole thickness, followed by autoplastic reparation.

Operation—First Stage.—Extirpation of the whole extent of the vicious cicatrix and of the subjacent pathological tissue.

Second Stage.—Autoplasty by sliding displacement, following the topography of the loss of substance when this is on a small scale; by approach from a distance, according to the Italian method, when it is considerable. Any loss of substance afterwards persisting may be filled with the aid of dermo-epidermic grafts, according to the method of Reverdin or of Thiersch. We may also try complete transplantation of cutaneous flaps, which are then secured in position by continued suture, made with fine silk, to the edges of the surrounding healthy skin, which have been carefully vivified beforehand. An elastic compressive dressing can then be applied.

Tumours.

Malignant Tumours.

Papillomata.

We meet in the cervical region with papillomata, either simple or pigmented, which are liable to undergo malignant transformation; more especially that of degeneration into melanotic sarcoma. These little tumours, when they have become the seat of chronic inflammation, should be destroyed by thermic electro-coagulation.

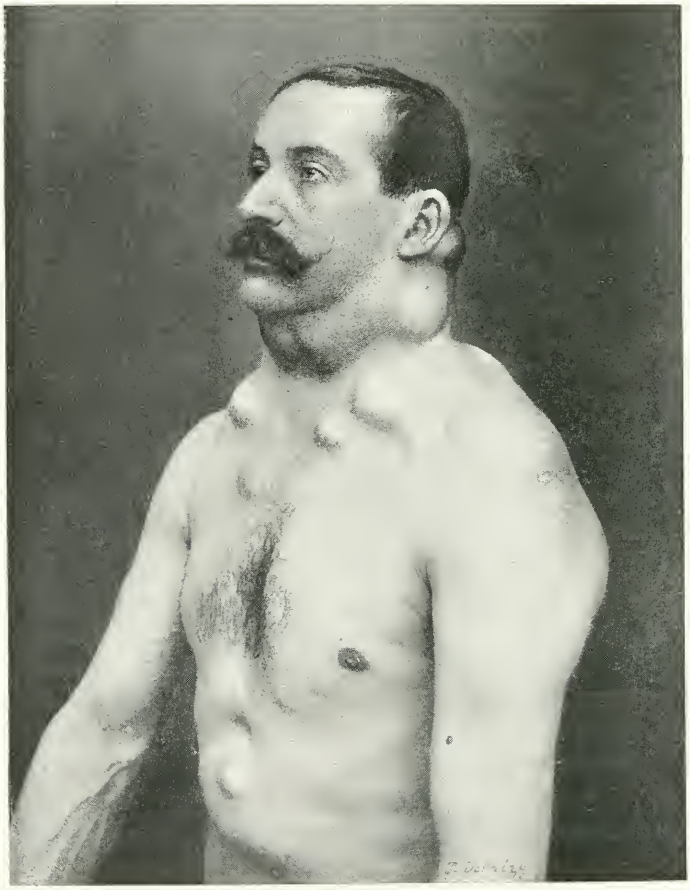


Fig. 290.—Multiple Lipomata of Nucha, Neck, and Trunk.

Subcutaneous Lipomata.

Lipomata of the neck may be of small size. Multiple lipomata are also met with. They develop symmetrically, and may grow to a considerable volume. I have observed in many of these cases six large lipomatous masses, two anterior, situated in the lateral suprahyoid regions; and four posterior,

the upper pair of which were situated on the nucha, and the lower astride the cervico-dorsal region. Operation on such lipomata is not a grave procedure. It is easy when the tumours are encapsuled. It may be a delicate one when they are multiple, as it is very difficult to recognize the dividing limit of the neoplastic and non-pathological adipose tissue.

FIG. 291.—MULTIPLE LIPOMATA OF NUCHA, NECK, AND TRUNK.
Three-quarter view, showing the extent of the tumours.

Superficial Lipomata.

Operation—FIRST STAGE.—Transverse incision of the skin
SECOND STAGE.—Discovery and isolation of the tumour.
THIRD STAGE.—Enucleation and hæmostasis.
FOURTH STAGE.—Reunion and drainage.

Deeply Seated Lipomata.

I have met with a case of deep-seated lipoma of the nucha of the size of an orange, which had developed under the complexus minor, in contact with the obliquus capitis inferior.

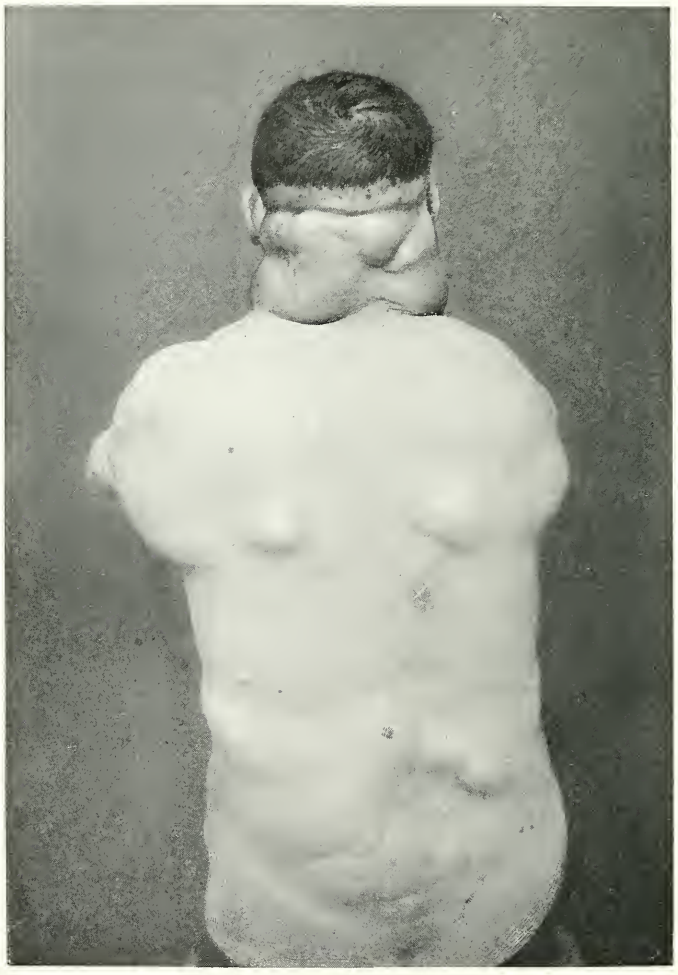


FIG. 292.—MULTIPLE LIPOMATA OF NUCHA, NECK, AND TRUNK.

Dorsal view, showing the symmetrical development of the tumours.

Operation—FIRST STAGE.—Transverse incision of the skin.

SECOND STAGE.—Section of the superficial muscles and exposure of the tumour.

THIRD STAGE.—Isolation of the lipoma with the index-finger and blunt-pointed scissors used for divulsion.

Fourth Stage.—Luxation of tumour to outside of wound; section of its last attachments and hæmostasis.

Fifth Stage.—Temporary aseptic tamponing, when there is a sanguineous oozing; reunion, and drainage.

Fibromata.

These tumours, which are of rather rare occurrence, may originate at the expense of the nuchal aponeurosis. Adhesion to the bone complicates the procedure of extirpation, which requires an extensive cutaneous incision.

Malignant Tumours.

Malignant Tumours of the Skin and Subcutaneous Connective Tissue.

Epithelioma of the skin of the neck is not very rare, and may develop, as in case of melanotic sarcoma, at the expense of an old-standing papilloma or a pigmentary stain. These tumours tend to invade the deep tissues. Thermic electro-coagulation should be adopted. This procedure gives remarkably successful results, on the condition of total destruction of all the pathological tissues present. Accordingly, it will be necessary to intervene before the extension of the neoplasm to the deeper structures.

Extirpation of Cervical Adenopathies.

The nature of cervical adenopathies is very variable. They may, however, be classified in two categories—infective and neoplastic. The infective include all glands enlarged as the result of simple inflammation which have not proceeded to suppuration, and tuberculous glands. Neoplastic adenopathies are sometimes, too, of infective origin; but we have here to deal with another form of infection—hyperplasia of normal cells due to a specific microbe. In the former class we have a reaction of the lymphoid elements against the pathogenic germs; in the latter, a symbiosis of the parasiticized cells and specific microbes; which, reproducing themselves *ad infinitum*, destroy the healthy tissues and substitute themselves for them. I have already pointed out the therapeutic action of mycolysine in cases of ordinary infective adenitis, that of phymalose in those of tuberculous adenitis, and that of the X rays and other radio-therapeutic agents in benign lymphadenoma.

I will describe in the same chapter the interventions for all cervical adenopathies, as the technique does not differ sensibly, whether we have to deal with hypertrophied tuberculous or neoplastic glands.

Inflammatory Hypertrophied Glands.

Benign Lymphadenoma.

In this first section I will describe the extirpation of hypertrophied glands and of benign lymphadenoma, inasmuch as it may serve as a model of the technique to be adopted in extirpation of all such glands when movable and easily enucleated. Extirpation of all affected glands gives excellent results in those cases in which radio-therapy has failed to produce their complete disappearance.

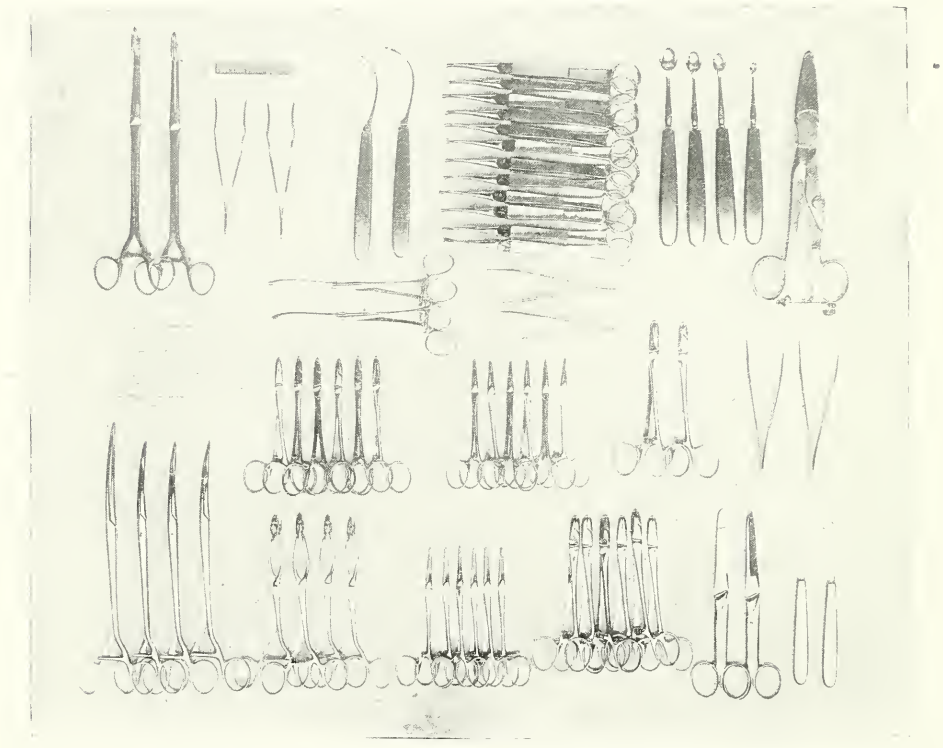


Fig. 293.—Instruments for Use in Operations on the Neck for Cervical Adenitis and in Suture of Veins.

From right to left, and from below upwards: Two bistouries; two strong straight scissors; six short-jawed clawed forceps; six ring-handled forceps with nine oblique claws; four forceps with oval jaws; four long curved forceps. Above: Two clawed forceps; two short-jawed forceps for veins; six Champonnière's hæmostatic forceps; six Doyen's needle-holder forceps with hollowed jaws; two slender forceps; two elastic forceps for veins; six round needles for suture of veins; five assorted glass drainage-tubes. In uppermost row: Écraseur (the small model); four curettes; twelve hooked forceps; two needles mounted on handles; two clip-holder forceps and twenty-five metallic clips; two forceps with oval eccentric jaws.

Operation—First Stage.—Incision along the anterior border of the sterno-mastoid muscle and exposure of the most accessible group of glands.

Second Stage.—Isolation of these glands by divulsion with blunt-pointed scissors, and detachment of each with the index-finger or a curette of suitable dimensions.

Third Stage.—When the superficial group has been extirpated, we retract the edges of the wound, and expose the deeply seated glands. These are isolated by the same procedure, and enucleated in their turn. We then proceed to the exposure and extirpation of the retro-carotidean glands.

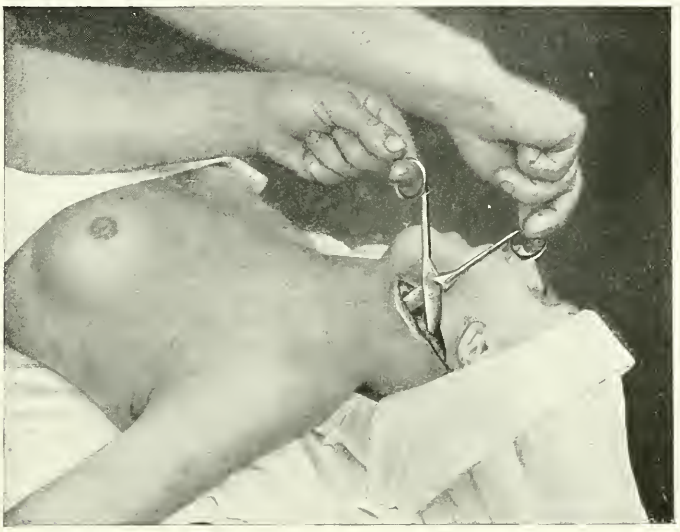


Fig. 294.—Increase by Divulsion of an Incision destined for Extirpation of a Mass of Carotid Glands.

It is rare not to find a coexisting group of retro-scalenic glands. Accordingly, the blunt-pointed scissors is plunged from this side, across the outer border of the scaleni muscles; the wound is expanded by divulsion, and we proceed to extirpation of the whole of those glands without making a new cutaneous incision (Fig. 294).

Fourth Stage.—Treatment of the irregular wound, by tamponing, when there is an appreciable oozing; when there is not, by drainage through two or three counter-openings with glass drainage-tubes, and reunion of the skin with clips. It is sometimes necessary to tie one or two arterioles or venules; among the last must be mentioned the thyro-lingual—facial venous trunk—in the vicinity of its termination in the internal jugular vein.

Procedure of Divulsion.—I will now return to a consideration of some points of this technique. Every encapsuled gland can be enucleated by the method of divulsion (see Vol. I., p. 427). The different stages of the process of enucleation are represented in Figs. 296 to 300. Fig. 296 represents a large gland exposed by a vertical incision. When the cellular periglandular

zone has been exposed, the blunt-pointed scissors are introduced with closed blades through the upper part of the incision, and withdrawn after forcibly

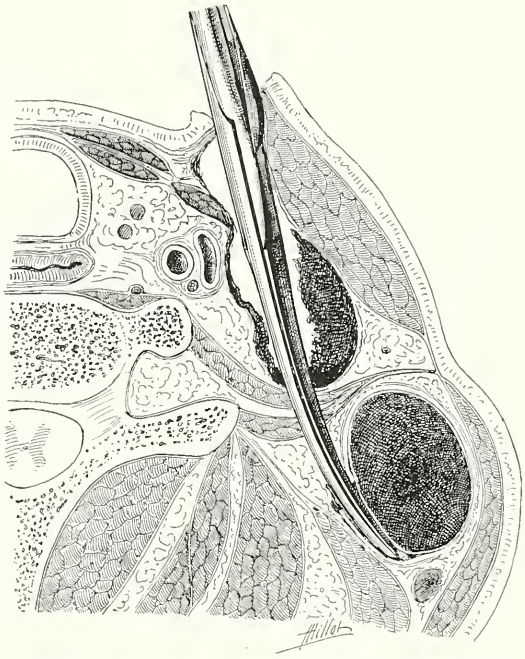


FIG. 295.—PERFORATION OF THE SCALENI IN ORDER TO REACH A GLAND OF THE SUPRACLAVICULAR FOSSA BY DIVULSION.

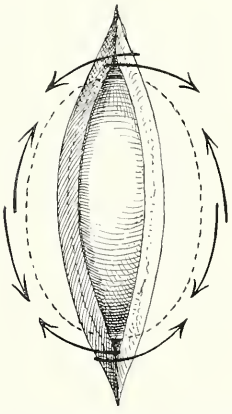


FIG. 296.—DIAGRAMMATIC SKETCH OF THE DENUDATION OF THE SURFACE OF A LARGE CERVICAL GLAND BY THE PROCEDURE OF DIVULSION.

Seen from the front.

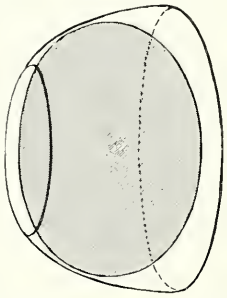


FIG. 297.—DIAGRAMMATIC SKETCH OF THE DENUDATION OF THE SURFACE OF A LARGE CERVICAL GLAND BY THE PROCEDURE OF DIVULSION.

Diagrammatic figure representing the ellipsoidal area of decollation which has been realized in the four first stages of the procedure. Viewed from the side.

opening them. This process is then repeated below, and also on each side. We thus detach the whole cellular capsule of the gland over an area repre-

senting in form a segment of an ellipsoid, as shown in Fig. 297. The scissors are then introduced beneath the gland (Fig. 298) in order to

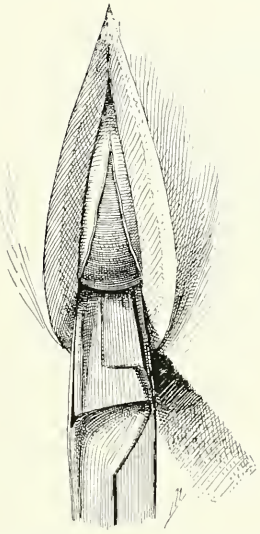


FIG. 298.—MANŒUVRE OF DIVULSION.

The scissors have been introduced behind the gland.

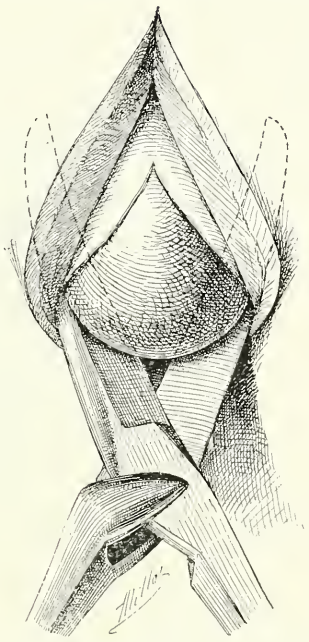


FIG. 299.—MANŒUVRE OF DIVULSION: LACERATION OF THE POSTERIOR AND INFERIOR CELLULAR ADHESIONS.

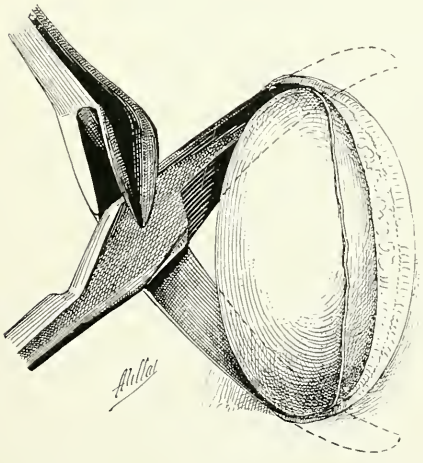


FIG. 300.—DEEP DIVULSION, FROM BELOW UPWARDS, AT THE LEFT LATERAL ASPECT OF THE GLAND.

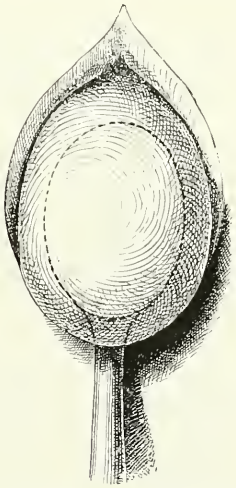


FIG. 301.—ENUCLEATION OF THE GLAND WITH A CURETTE, WHICH IS NOW ALMOST WHOLLY FREED FROM ITS ATTACHMENTS.

separate the posterior surface by divulsion (Fig. 299). The same manœuvre is used on the left side (Fig. 300); and if the gland does not then emerge

of its own accord, it is luxated through the wound with the help of a curette of suitable dimensions, which has been passed beneath it.

Some glands can be enucleated without exposure of any important vessels. We learn to extirpate them by this technique, when we have

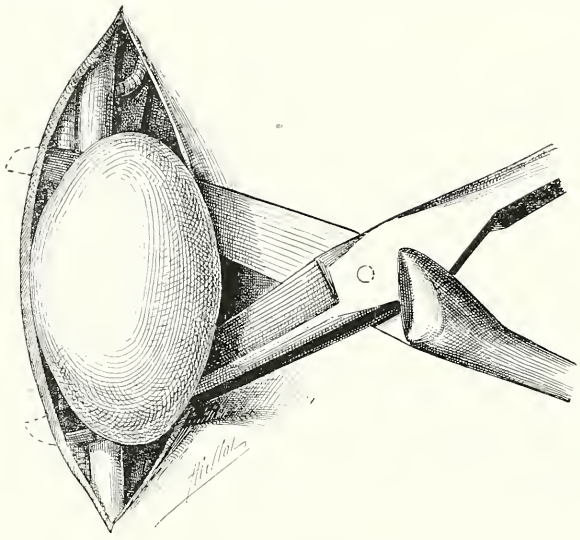


FIG. 302.—ISOLATION OF A LARGE GLAND WHICH RESTS ON THE CELLULAR SHEATH OF THE LARGE VESSELS OF THE NECK, BY THE PROCESS OF DIVULSION.

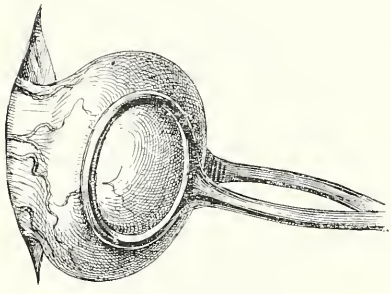


FIG. 303.—VASCULAR PEDICLE OF A DEGENERATED GLAND.

It is greatly elongated in its vertical measurement.

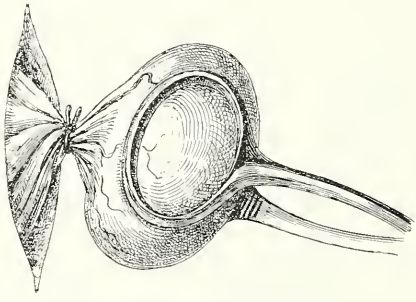


FIG. 304.—VASCULAR PEDICLE OF A DEGENERATED GLAND.

The pedicle, previously flattened by the jaws of the écraseur, has been rotated through 180 degrees before application of the ligature.

acquired sufficient experience of the vasculo-nervous sheath of the neck (Fig. 302). When there is an important vascular pedicle, it is usually of flattened outline (Fig. 303), and is best treated by immediate crushing with the smaller form of écraseur; it is then reduced to a circular outline by twisting through 180 degrees, and a silk ligature is applied (Fig. 304).

Tuberculous Glands.

These glands, which are very often adherent, may be met with as specmens of massive adenitis, and susceptible of removal *en bloc*, as in case of lymphadenoma; glandular abscess, encysted or diffuse; or fistulous adenitis.

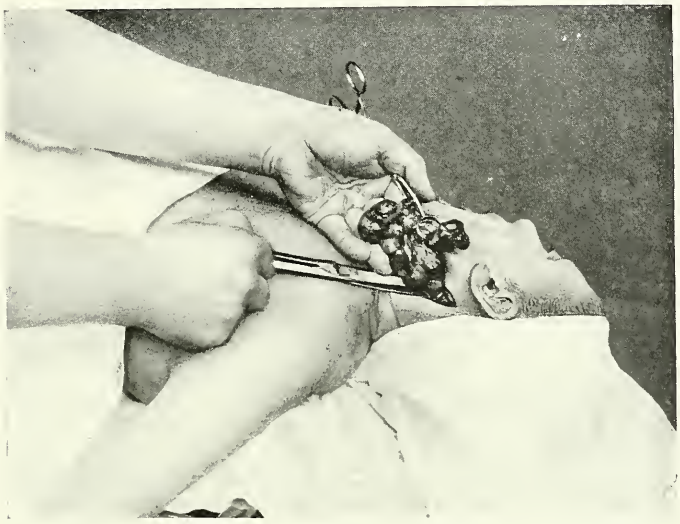


Fig. 305.—Extirpation of a Bunch of the Tuberculous Carotid Glands.

Fig 306.—Extirpation of Tuberculous Supraclavicular Glands.

Tuberculosis frequently involves nearly the whole of the following groups of glands: Carotid, posterior cervical, parotidean, submaxillary, median supra-

hyoid, and supraclavicular. Operation is nearly always more difficult than in cases of lymphadenoma, on account of the inflammatory adhesions which tuberculous glands are prone to contract with the sheaths of the great vessels, and notably with that of the internal jugular vein. I have in many cases extirpated this vein throughout nearly its whole length, between two ligatures. The technique of the operation is that above described. The procedure may extend into the supraclavicular fossa.

I make two incisions along the anterior border of the sterno-mastoid muscle, a superior and an inferior, separated by an interval of 5 or 6 centimetres, through which the glands can easily be enucleated by divulsion. It is sometimes necessary to dissect off the whole of the vasculo-nervous bundle with care; the surrounding glands then separate progressively, little by little,

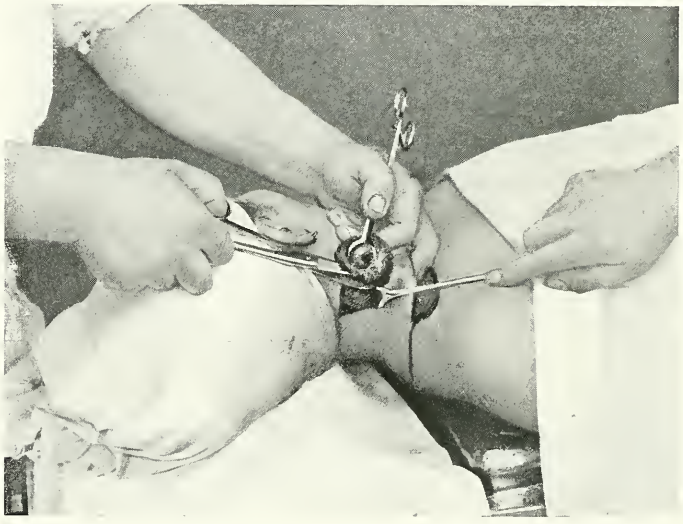


Fig. 307.—Extirpation of Subcutaneous Tuberculous Gummata and the Subjacent Glands.

and drop into the hand. It is necessary to avoid traction on the glands, which are frequently softened and tear readily. The operation, although tedious and difficult, is carried out under favourable conditions when the extent of the glandular affection is still fairly limited; but it is no longer so when they are completely destroyed. We then find diffuse tuberculous abscesses, the walls of which are formed by the muscles and the vasculo-nervous sheath, and a prudent and minutely careful process of curettage must be adopted. The wound is then treated by aero-cauterization, and tamponing.

Whatever may be the number of glands engaged, we should, as in extirpation of lymphadenomata, avoid multiplication of cutaneous incisions, and the subcutaneous route should be preferred, each gland being enucleated from its cellular shell by divulsion.

Cancerous Glands.

The cervical glands are sometimes attacked by epithelial cancer, sometimes by sarcoma. These may be either primary or secondary. Among the cases of primary neoplastic adenitis, malignant lympho-sarcoma may be cited in the foremost five; it may become generalized throughout the whole of the glands of the system. A generalized lympho-sarcoma cannot be operated on. Some cases of lympho-sarcoma are limited to the cervical glands. Localized malignant lympho-sarcoma is easily distinguished from the benign form, by the special feature of the rapid fusion of the glandular masses, and the resulting presentation of the character of an infiltrating tumour.

FIGS. 308.—EXTIRPATION OF SUBCUTANEOUS TUBERCULOUS GUMMATA AND THE SUBJACENT GLANDS.

I have operated on many cases of primary epithelioma of lymphatic glands. I have thoroughly satisfied myself that there existed no other analogous lesion in those cases that could have produced a secondary infection. In like manner, cancerous nodules of the metastatic type may be formed in the liver without the existence of an originating cancerous focus.

My observations tend to show that it is inaccurate to attribute primary epithelioma of the cervical glands to the malignant degeneration of the vestiges of the branchial arches. The cases which I have seen were evidently cases of primary cancerous adenitis. The pathogenesis seems to me to be identical with that of cases of tuberculous adenitis of the neck: Koch's bacillus passes through the tonsil and the lymphatic vessels without leaving any traces there. An epithelial cell of the tonsil or intestine, which has been parasiticized by the specific microbe, may also pass into the lymphatic

vessels without multiplication on the line of transit, and then originate a glandular or visceral cancer of the metastatic type.

FIG. 309.—THE SAME.

FIG. 310.—TAMPONING OF THE WOUND; INTRODUCTION OF AN ŒSOPHAGEAL SOUND THROUGH THE NOSTRIL, TO BE LEFT IN POSITION.

The secondary cancerous glands are more usually of the type of epithelial cancer. Sarcomatous glands are more rarely observed. Cancerous carotid glands are associated with neoplasms of the tongue, tonsillar region, and

deep part of the nasal fossa. I have, in my own practice, had to extirpate a bunch of cancerous carotid glands in order to attain a primary tumour of the tonsil. Thermic electro-coagulation is inapplicable in many of these cases, because it may be quite impossible to destroy the deep-seated cancerous glands without destroying the vasculo-nervous bundle of the neck at the same time. Accordingly, the process of extirpation must be carried out with the bistoury, after completion of which all the more suspected points of the field of operation are cautiously subjected to thermic electro-coagulation.

Operation—First Stage.—Incision of the skin of requisite extent along the anterior border of the sterno-mastoid muscle, and exposure of the glandular mass.

Second Stage.—Isolation of the posterior margin of the neoplastic mass by divulsion with blunt-pointed scissors, so as to be able to pass the index-finger beneath it, and recognize the vasculo-nervous sheath. If the finger is able to penetrate beneath the glands so as to break down the cellular adhesions which separate the neoplastic masses from the sheath of the vessels, the operation is easily completed.

Third Stage.—The blunt scissors, passed along the left index-finger, detaches the mass of glands from their cellular adhesions and raises them at the same time, thus commencing to luxate them outwards through the wound.

Fourth Stage.—The neoplastic mass is grasped with a ring-handled forceps, and separated below from its last attachments by some snips of the scissors. When the inferior pole has thus been liberated, the tumour is adherent only at its upper end, below the external auditory canal, where we have only to detach it deliberately with scissors and clawed forceps.

Fifth Stage.—Verification of the field of operation; hæmostasis, thermic electro-coagulation of suspected points, tamponing, and partial suture of the skin. If a capillary oozing persists, a wick of sterilized gauze is left in the wound and the skin is sutured above it. This should be removed after twenty-four to forty-eight hours and replaced with clips, preserving an orifice for drainage.

Suppurating Cancerous Glands.

Cancerous cervical glands are often infected by pyogenic microbes, and suppurate. The fistulæ formed by these abscesses often present neoplastic fungosities. When extirpation is impossible, we have recourse to curettage, followed by cautious heating of the walls of the field of operation, in accordance with the technique of thermic electro-coagulation. We can then adopt the specific treatment by antineoplastic injections.

OPERATIONS ON THE THYROID BODY.

Traumatic Lesions.

Accidental wounds of the thyroid are likely to produce considerable hæmorrhage. When no large artery has been wounded, tamponing will suffice for its arrest; in other cases, suitable incision and ligature must be adopted.

Acute Inflammatory Lesions.

Suppurative thyroiditis is not exceptional; we occasionally observe, also, the suppuration of a pre-existing thyroid cyst as a complication of certain infectious diseases. Large doses of mycolysine should be administered, both by the mouth and hypodermically; the purulent focus should be opened by the method of divulsion; and, when necessary, we ultimately carry out intraglandular enucleation of the sac.

Chronic Inflammatory Lesions.

Actinomycosis.

Actinomycosis of the thyroid body is accompanied by a sero-purulent discharge, with evacuation of the characteristic granules. It is treated by extirpation and tamponing.

Tuberculosis.

Tuberculosis of the thyroid body may lead to local formation of cold abscess. Such complications are treated by partial thyroidectomy, which should be supplemented by the internal administration of phymalose.

Malformations: Congenital and Acquired.

Congenital Malformations.

Absence of the thyroid body, or, to speak more accurately, atrophy of its structure, is not exceptional. We may endeavour to remedy the condition by aseptic grafting of the thyroid body taken but some minutes before from a live sheep, or by the grafting of a portion of human thyroid which has been just removed from a healthy individual, or even one affected with a partial exophthalmic goitre.

Acquired Malformations.

The diffuse thyroid hypertrophy which constitutes endemic goitre must be specially mentioned here. We know that the thyroid function disappears in cases of this affection, and that such condition must be remedied by opotherapy. The reader must be referred to the medical textbooks for a description of the accompanying cachexia.

Tumours.

Benign Tumours.

The thyroid body may be affected with any one of a considerable variety of benign neoplasms, ranging from the endemic goitre to the thyroid cyst. I have met with a thyroid cyst the wall of which was ossified and furnished with osteoblasts.

Malignant Tumours.

Cancer of the thyroid body is fairly common, and is very often complicated with adhesions to the sheaths of the vessels, and deep-seated cervical adenopathy. When it has attained this stage, cancer of the thyroid is usually incurable.

Indications for Operation.—Tumours of the thyroid gland are, almost without exception, amenable to the procedure of thyroidectomy. The characteristic feature common to all, of ascension at the moment of swallowing, enables us, as a general rule, to make a true diagnosis of the seat of those neoplasms. Endemic goitre is rare in Paris. The simple forms of cystic and of parenchymatous goitre are those usually met with, while cancer of the thyroid body is fairly frequent. The syndrome of exophthalmic goitre is not exclusively limited to a special type of thyroid tumour. I have observed it in some cases of parenchymatous goitre which had become partially septic, and even in cases of cancer of the thyroid body. In all cases of exophthalmic goitre we find nodules formed of young thyroid tissue, in which the closed vesicles are very small, and do not yet contain any colloid substance.

Thyroid tumours may be median, unilateral, bilateral, or retrosternal; when of malignant nature, they are accompanied with adenopathy of the neighbouring lymphatic glands.

Technique of Thyroidectomy.—Thyroidectomy was long regarded as a dangerous operation. The vascular and nervous connections of tumours of the thyroid body, and the occurrence of asphyxia during the course of operation, were justly dreaded by most surgeons. Extirpation of goitre came to be recognized in surgical practice with the brilliant operations of A. and J. Reverdin, and of Th. Kocher. But their technique was long and laborious. The tumour was always extirpated slowly, whatever its nature, and after being circumscribed by many dozens of double ligatures. They divided the small cellular structures little by little; the isolation of the trachea was long and difficult in most cases, and sometimes important nerves, such as the superior or recurrent laryngeal, were wounded in the course of the operation.

I have completely modified the operative manipulation of thyroidectomy. Whatever the volume or the topography of the tumour, the operation can be carried out according to a well-defined technique, of which the following are the different stages:

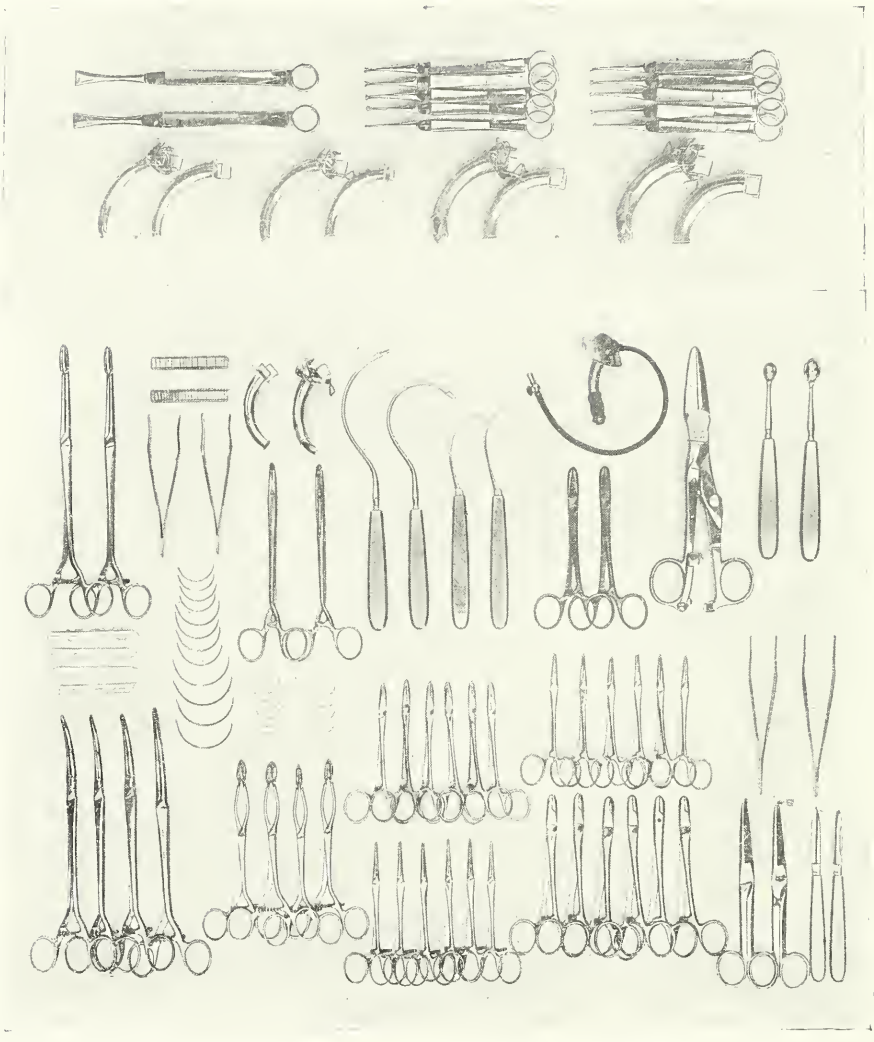


Fig. 311.—Instruments for Thyroidectomy.

From right to left, and from below upwards: Two bistouries; two strong straight scissors; six short-jawed clawed forceps; six ring-handled forceps with nine oblique claws; four forceps with oval jaws; four long curved forceps. In row next above: Two clawed forceps; six Championnière's hæmostatic forceps; six needle-holder forceps, with short eccentric jaws; five forms of needles with open eyes, of which two are rounded for suture of vessels; four glass drainage-tubes. Higher row: One large écraseur; two curettes; one small écraseur; two short-jawed forceps for veins; two needles mounted on handles; two long blunt-pointed mounted needles of different curves; two needle-holder forceps with eccentric plate; two forceps for holding clasps, and metallic clasps; two forceps with oval eccentric jaws; five numbered tracheotomy cannulæ, with the Krishaber mandrel; ten ordinary hooked forceps; two large hooked forceps for tracheotomy.

1. Transverse cutaneous incision. The cicatrix can then be concealed—in case of a female, by a ribbon; in case of a man, by the collar. I have practised this incision since 1887.

2. Rapid exposure of the tumour after section of the superficial muscles and ligature of the anterior jugular veins.

3. The tumour, on exposure, is rapidly circumscribed by the fingers, which are passed beneath and behind it, so as to luxate it to the outside of the wound, and enucleate it after a fashion from its fibro-cellular pocket.

FIG. 312.—MEDIAN CERVICAL GOITRE COMPLICATED BY THE PRESENCE OF A CONSIDERABLE RETRO-STERNAL PROLONGATION, THE EXISTENCE OF WHICH COULD NOT BE DETECTED BEFORE THE OPERATION.

4. The vascular connections of the neoplasm are thus found after some moments. Crushing of each of the pedicles, superior and inferior, can then be readily effected, followed by ligature. A forceps is applied on the side next the tumour, and we then divide between the forceps and corresponding ligature.

The same procedure of immediate crushing enables the operator to preserve at a favourable point a sufficient lobule of the healthy gland, which is left in place beyond a ligature. Catgut ligatures should be preferred, as they are readily absorbed. Silk is slowly eliminated. This general tech-

nique is applicable to all tumours of the thyroid body, with some modifications appropriate to the individual cases. The ablation of a parenchymatous

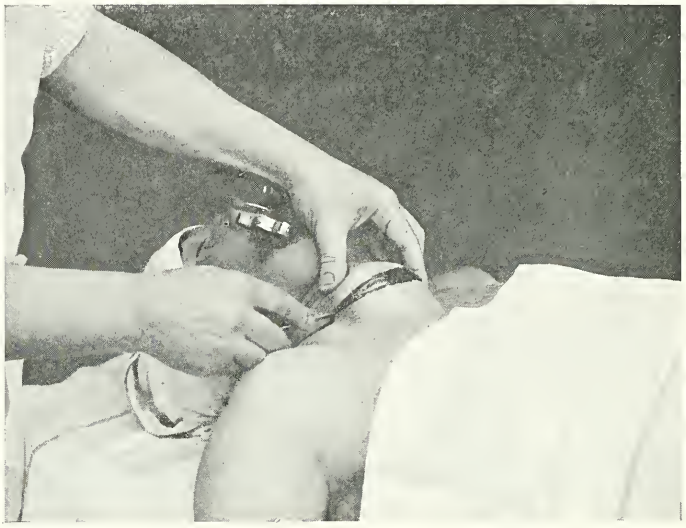


FIG. 313.—UNILATERAL PARENCHYMATOUS GOITRE: THYROIDECTOMY.
First stage: Doyen's transverse incision (1887).

FIG. 314.—UNILATERAL PARENCHYMATOUS GOITRE: THYROIDECTOMY.
Third stage: Luxation of tumour to outside of wound.

goitre of the size of the fist lasts for three to five minutes; the extirpation of a large tumour, fifteen or twenty minutes—inclusive of the subsequent

ablation of the bilateral cervical glands, which habitually complicate the presence of malignant tumours.

Fig. 315.—Unilateral Parenchymatous Goitre: Thyroidectomy.

Fourth stage: Crushing of the whole thickness of the pedicle of the tumour at once by a single movement.

Fig. 316.—Catgut Ligature applied in the Groove formed by the Écraseur: Division of the Pedicle between the Tumour and the Ligature.

The capital consideration is free enucleation of the tumour after hæmostasis of the superficial veins. Hæmostasis of large vascular pedicles and isolation of the trachea are then effected without danger of suffocation, and

without hæmorrhage, in a few moments. The operation is a rapid dissection of the region, a veritable anatomical preparation of the thyroid space, while taking care to push back and preserve the important vessels and nerves, a wound of which would be irremediable.

Operation on exophthalmic goitre is carried out by the same procedure. Removal of the altered lobes is enough. We may be satisfied with leaving a healthy lobule of the size of a walnut, or even of a hazel-nut. Ablation of the altered lobes of the thyroid in a case of exophthalmic goitre produces in the course of four or five days a slowing of the pulse and cessation of the phenomena of intoxication, which had been due to the hypersecretion of the unhealthy lobules. The microscope reveals in every case altered lobes with follicles in the embryonic state, and multiplication of those neoformative structures. I now proceed to examine the various stages of the operation.

Topography of Goitre.—If we consider, for example, benign tumours of the parenchymatous type, goitre is pretty often unilateral. Fig. 317 represents a unilateral goitre; the healthy lobe of the thyroid body is less darkened than the diseased one. The position of the groove made in crushing of the isthmus is distinguished by diagonal lines. Fig. 318 shows a median goitre developed in the isthmus. Fig. 319 represents a parenchymatous goitre of the isthmus and left lateral lobe. Fig. 320 represents a lateral parenchymatous goitre which has deformed the lumen of the trachea by its pressure. The isthmus, when healthy, can be preserved between two grooves made by the écraseur. When it has participated in the process of degeneration, we preserve the posterior part of one of the lateral lobes, or even of both

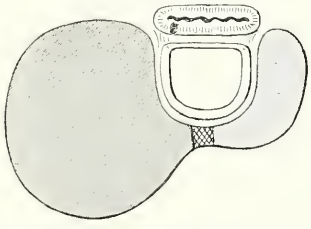


Fig. 317.—Unilateral Parenchymatous Goitre.

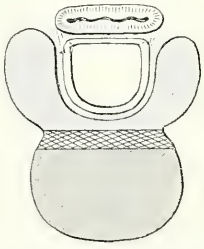


Fig. 318.—Median Parenchymatous Goitre.

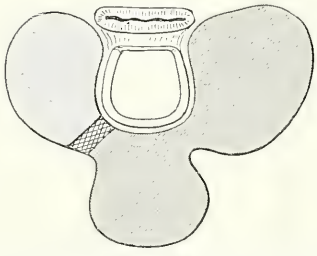


Fig. 319.—Parenchymatous Goitre of Isthmus and Left Lobe.

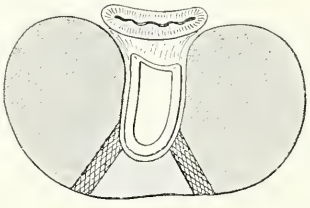


Fig. 320.—Bilateral Parenchymatous Goitre.

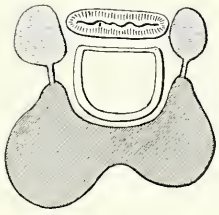


FIG. 321.—GOITRE DEVELOPED AT THE EXPENSE OF THE ISTHMUS AND PORTION OF THE LATERAL LOBES: GROOVES MADE BY ÉCRASEUR.

FIG. 322.—GOITRE DEVELOPED AT THE EXPENSE OF THE ISTHMUS AND PORTION OF THE LATERAL LOBES.

The operation is completed; extremities of lateral lobes, which remained healthy, are left in position.

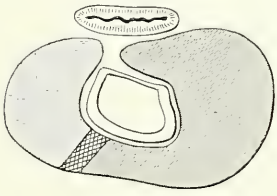


FIG. 323.—RETRO-TRACHEAL GOITRE.

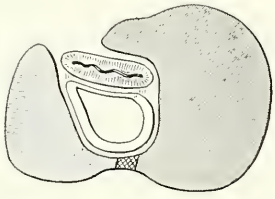


FIG. 324.—RETRO-ŒSOPHAGEAL GOITRE.

(Figs. 321, 322). Some goitres insinuate themselves between the trachea and œsophagus; others between the œsophagus and spinal column. Those have been respectively named retro-tracheal and retro-œsophageal. In all the above diagrammatic figures the shaded portion corresponds to the tumour; the healthy tissue is separated from the goitre by the groove formed by the écraseur. I adopted this procedure of crushing in extirpation of

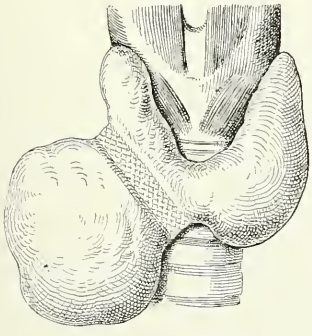


FIG. 325. — GOITRE DEVELOPED IN THE LOWER PORTION OF THE RIGHT LATERAL LOBE.

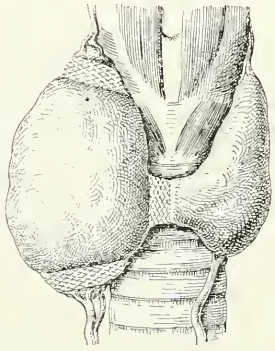


FIG. 326. — UNILATERAL GOITRE DEVELOPED AT THE EXPENSE OF THE RIGHT LOBE.

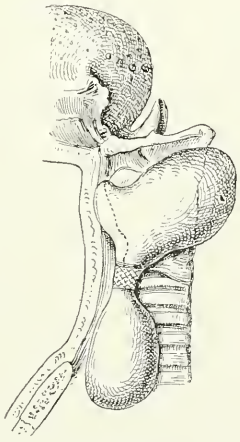


FIG. 327. — PLUNGING OR RETRO-STERNAL GOITRE.

goitre as far back as 1897. Figs. 325 and 326 respectively represent a goitre developed in the lower part of the right lateral lobe, and a unilateral goitre of the whole of the right lobe. In the former there is a single groove of écrasement; in the latter are three, involving the superior and inferior pedicles and the isthmus, respectively. Fig. 327 represents a retro-sternal goitre which compresses the trachea. The groove made by the écraseur is recognizable.

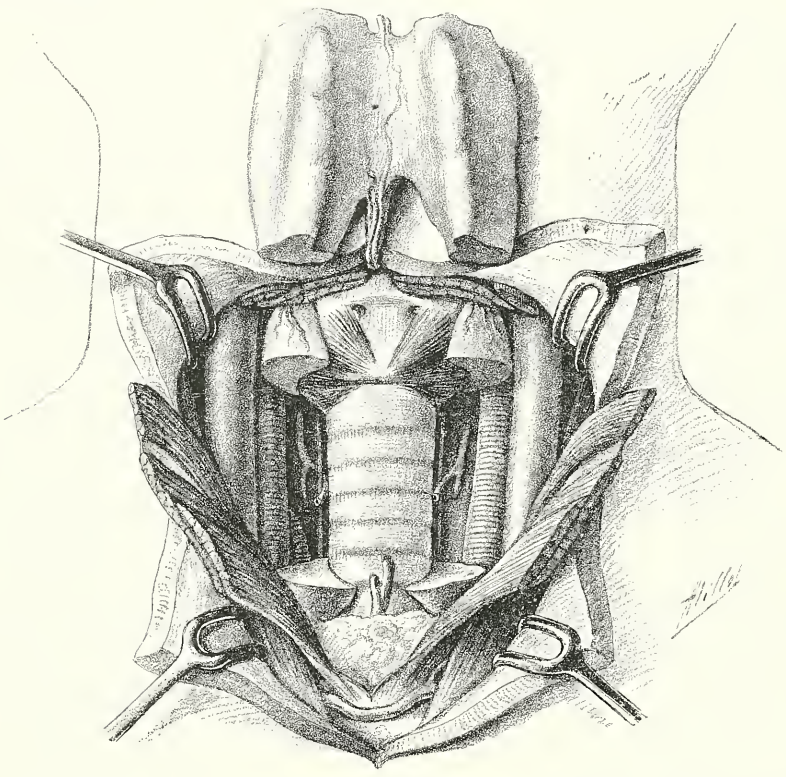


FIG. 328.—DISSECTION OF THE THYROID POUCH, THE WHOLE CELLULAR INVESTMENT OF WHICH HAS BEEN EXTIRPATED.

The thyroid body has been drawn upwards, after division of each of its four cornua. Above, we recognize the pyramid of Lalouette and the lateral crico-thyroid muscles; below, the tendinous head of the sterno-cleido-mastoid muscle; the suprasternal fossa; the transverse venous anastomosis between the two external jugular veins; the middle cervical aponeurosis; the subhyoid muscles; the pre-tracheal cellular space; the cervical portion of the trachea; and, laterally, the common carotid artery; internal jugular vein; and recurrent laryngeal nerve.

Surgical Anatomy of the Thyroid Space.—It is important to study the anatomy of the thyroid space, in order to comprehend properly this technique of the operation of the removal of goitre. If we expose that region by a cutaneous cruciform incision (Fig. 328), we first encounter the platysma and superficial cervical aponeurosis, in which one or two vertical veins of variable volume are met with. The subaponeurotic muscular stratum is

formed superficially by the two sterno-hyoid muscles, which are covered below in their outer portion by the tendinous heads of the sterno-cleido-mastoid muscles; those tendons have been removed in Fig. 328. On division of the sterno-hyoid muscles, the sterno-thyroid muscles are found lying beneath them, which, in Fig. 328, are divided at the level of the lower part of the thyroid cartilage; further to the outer side, the cut surface of the omo-hyoid muscle is discernible. The thyroid body, each of the cornua of which has been divided, is here turned upwards so as to expose its posterior surface. It still adheres by the pyramid of Lalouette, which contains the accessory veins. Below, we recognize the section of the middle thyroid artery, the trachea, and the lateral crico-thyroid muscles. The thyroid space is bounded on the outer side by the common carotid artery and internal jugular vein. On the right is seen the origin of the subclavius, which is very much raised. Near the trachea are the recurrent nerves; the right nerve passes through a loop formed by the inferior thyroid artery. The pneumogastric nerve, which at the level of the thyroid cartilage is placed behind and to the outer side of the common carotid artery, becomes more superficial as it approaches the sternum, and may be seen between the two great vessels.

EXTIRPATION OF CYSTS OF THE THYROID ISTHMUS.

Small cysts are sometimes found in the isthmus of the thyroid body. They are easily enucleated.

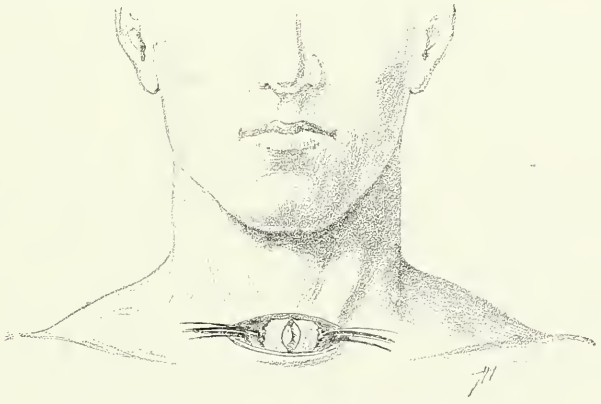


Fig. 329.—Cysts of the Thyroid Isthmus: Transverse Cutaneous Incision, with Exposure of Cysts.

Operation—First Stage.—Transverse cutaneous incision of 5 or 6 centimetres.

Second Stage.—Vertical incision through the median cellular space, taking care to retract the veins and margins of suprahyoid muscles by the method of divulsion.

Third Stage.—Incision of the cellular perithyroid capsule.

Fourth Stage.—Extirpation of cysts. These are isolated by divulsion while avoiding rupture as far as possible.

Fifth Stage.—Reunion, drainage.

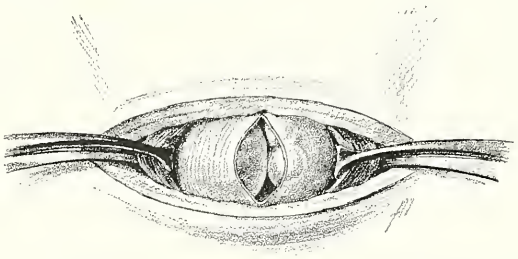


Fig. 330.—Cysts of the Thyroid Isthmus.

The subhyoid muscles are retracted with two hooked forceps. Vertical incision of thyroid capsule, exposing the cysts.

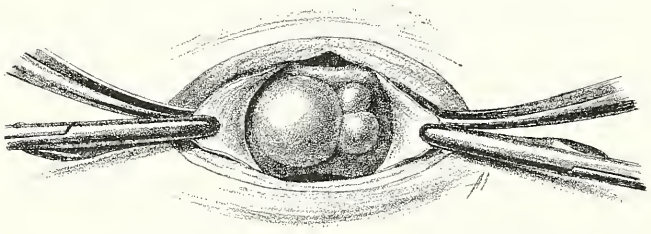


Fig. 331.—Cysts of the Thyroid Isthmus.

The cysts are exposed by retraction of the perithyroid cellular sheath.

TOTAL THYROIDECTOMY.

Author's Procedure.—I now proceed to a careful description of the various stages of thyroidectomy, while giving prominence to the modifications that I have carried out in the technique formerly used in this operation, and which have made it rapid in execution as well as void of danger.

First Stage: Incision of the Integuments.—It was in 1877 that I conceived the idea of replacing the U-shaped incision, then recommended for thyroidectomy, by a straight transverse incision made over the most prominent part of the tumour. I first used this incision in the case of a young female patient, in order to avoid the disfiguring cicatrix of the U-incision. Ever since that first operation I have employed the following procedure without exception: The platysma is divided along the whole extent of the incision, and the superficial veins are retracted by the method of divulsion. The cutaneous incision is made slightly lateral when the tumour is limited to one of the lateral lobes.

Second Stage: Exposure of the Tumour.—When of small volume, retraction of the subhyoid muscles suffices without division. The median veins are retracted—if necessary, divided between two ligatures—and the

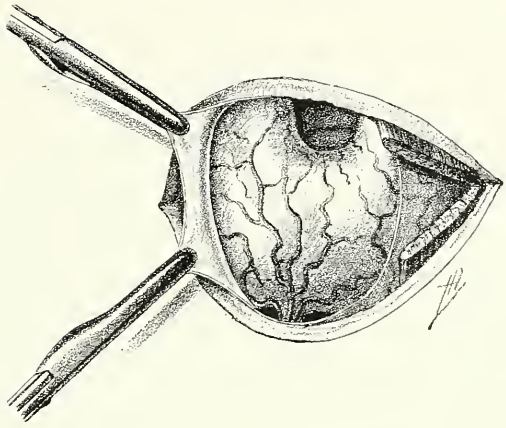


FIG. 332.—THYROIDECTOMY.

First and second stages. On the right of the figure is seen the section of the sub-hyoid muscles; on the other side, elevation of the capsule and exposure of the thyroid body.

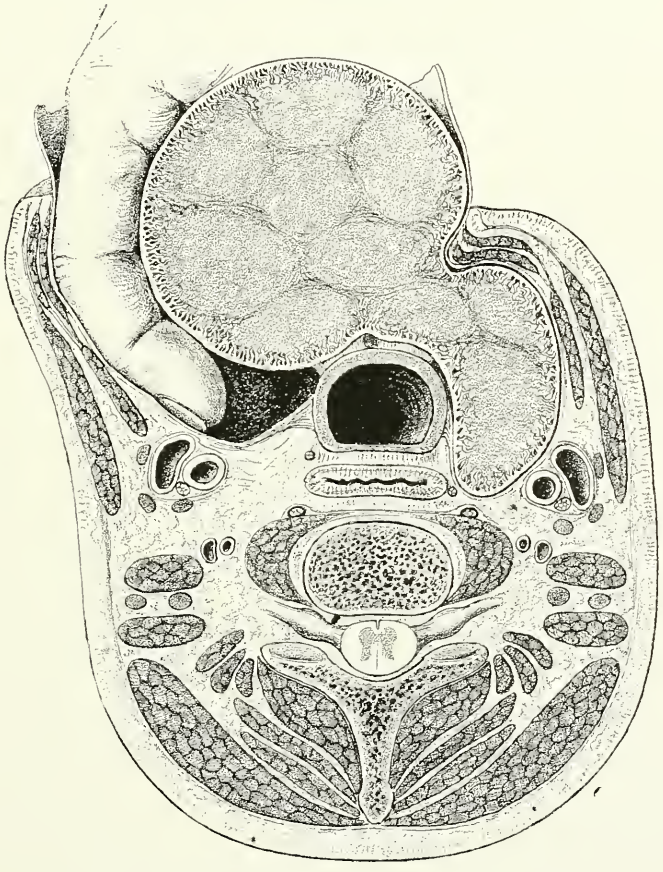


FIG. 333.—EXTRAGLANDULAR ENUCLEATION.

The finger has been introduced into the permeable space situated between the viscera sheath and the glandular capsule, and forcibly luxates the tumour through the wound.

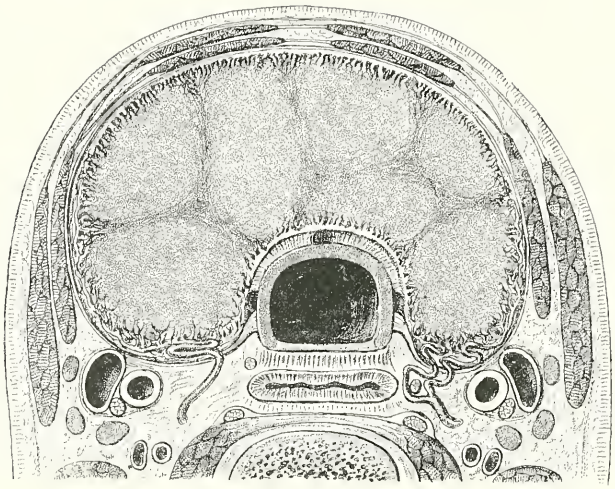


FIG. 334.—SINUOSITIES FORMED BY THE INFERIOR THYROID ARTERY ON PERFORATION OF THE PERIGLANDULAR CELLULAR CAPSULE.

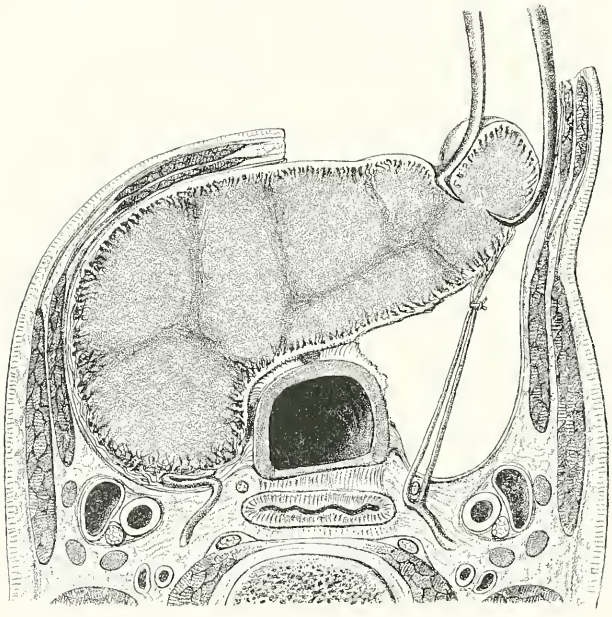


FIG. 335.—ELONGATION OF THE ARTERY AND ITS BRANCHES AS THE GOITRE, AFTER BEING DETACHED FROM ITS CELLULAR CAPSULE, IS LUXATED THROUGH THE WOUND.

On the right side is seen the elongation of the anterior branches which surround the recurrent nerve, while the nerve itself is not drawn forwards.

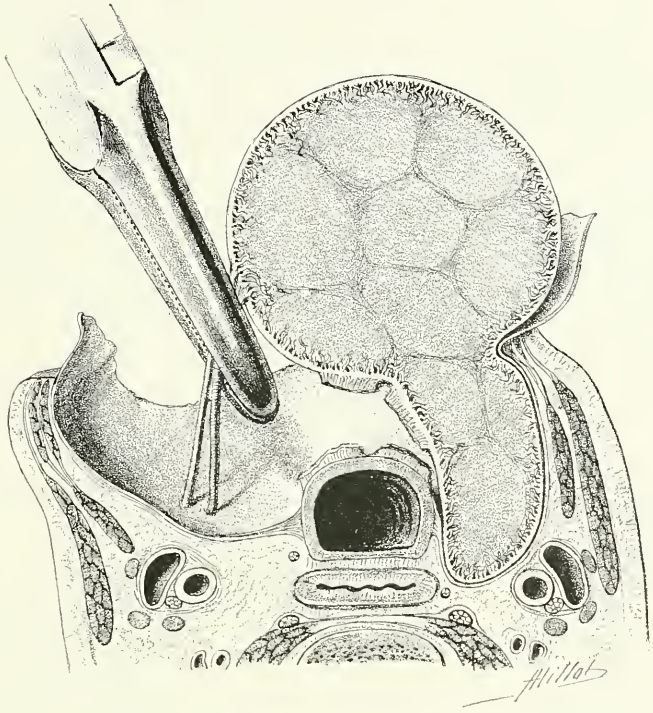


FIG. 336.—SCHEME OF HÆMOSTASIS IN EXTRAGLANDULAR ENUCLEATION.

It is enough to tie the anatomical vascular pedicles after having crushed them quite close to the thyroid tissue. The considerable distance which separates the instrument from the recurrent nerve will be noticed.

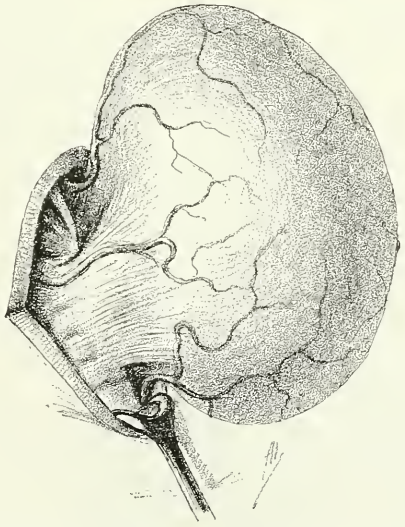


FIG. 337.—UNILATERAL THYROIDECTOMY.

Fourth stage: Formation of a single pedicle.

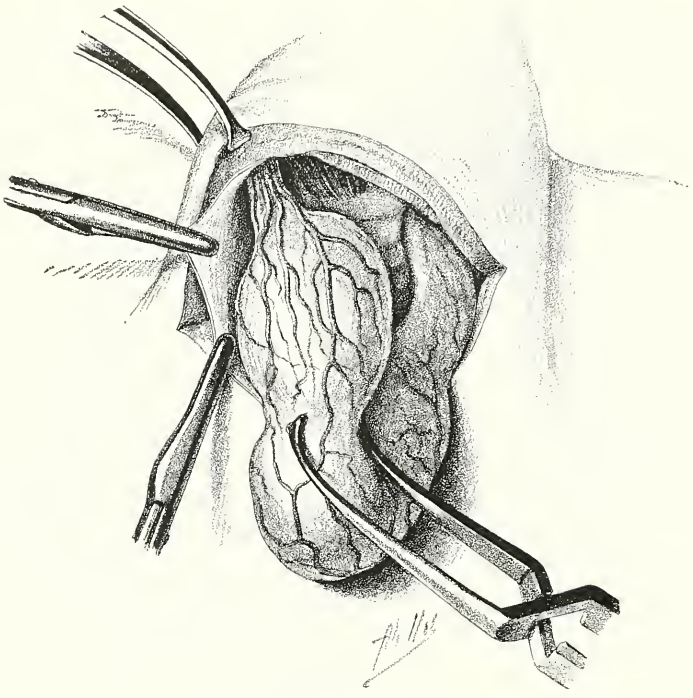


FIG. 338.—THYROIDECTOMY.
Fourth stage: Enucleation of the tumour and formation of the superior pedicle.

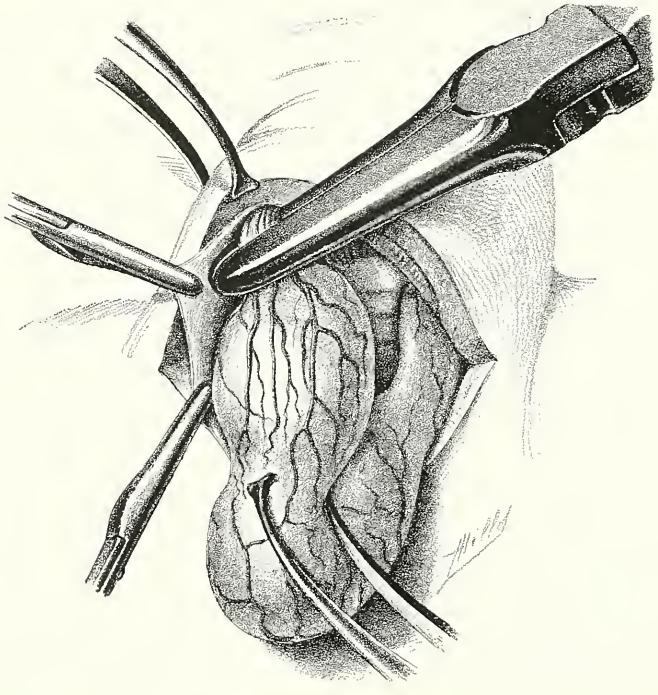


FIG. 339.—THYROIDECTOMY: CRUSHING OF THE SUPERIOR PEDICLE.

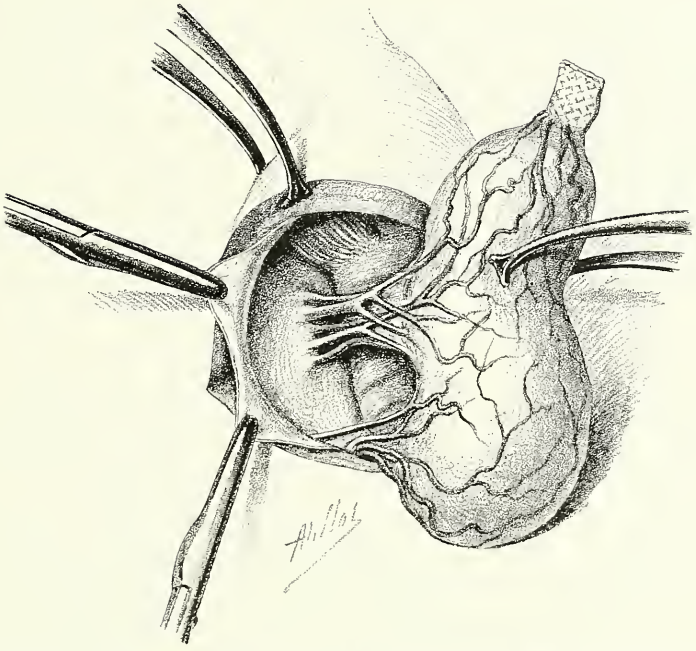


FIG. 340.—THYROIDECTOMY: FORMATION OF THE MEDIAN PEDICLE.

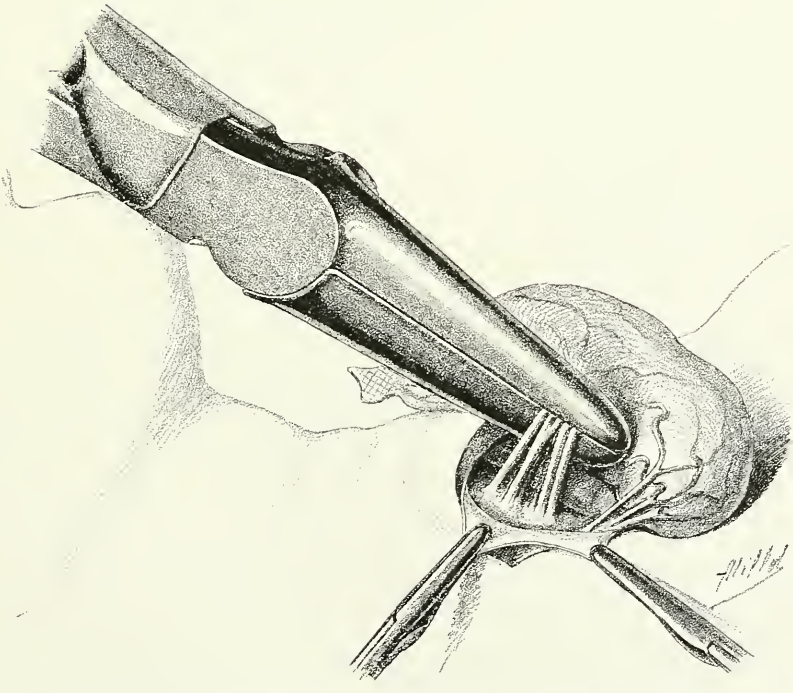


FIG. 341.—THYROIDECTOMY: CRUSHING OF THE MEDIAN PEDICLE.

cellular capsule of the goitre is exposed by divulsion. When requisite, the subhyoid muscles are divided transversely as far as is necessary.

Third Stage: Luxation of the Tumour to the Outside of the Wound.—When the cellular capsule of the goitre has been incised, and the thyroid body exposed with its vascular network, the index-finger is introduced between the tumour and its capsule, from which it isolates it in a few moments. This manœuvre may be so rapid that the tumour is displaced through the wound in a few seconds. It is sometimes necessary to facilitate the luxation of the tumour by seizing it between the jaws of a broad annular forceps. It may be necessary in other cases to extend the commissures of

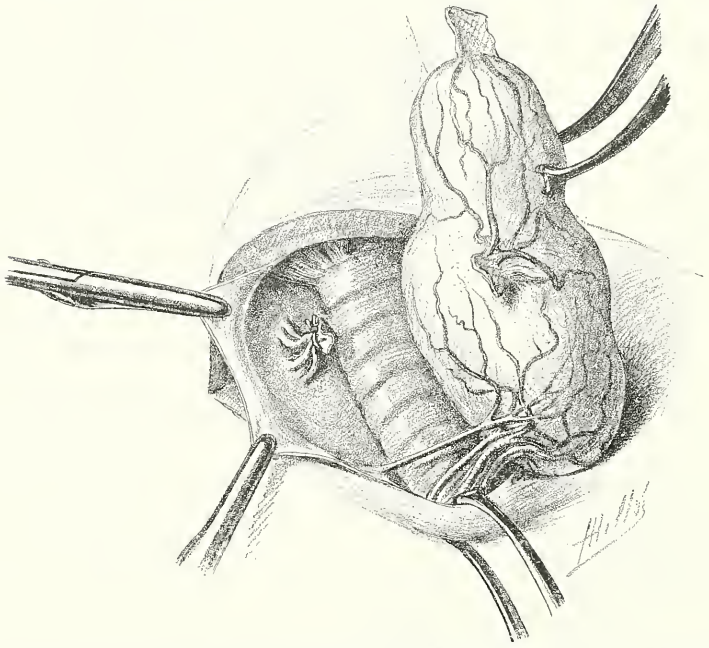


Fig. 342.—Thyroidectomy: Ligature of the Median Pedicle completed; Formation of Inferior Pedicle.

the wound by divulsion. When outside the wound, energetic traction is made on the tumour, so as to expose the vascular pedicles thoroughly. The relations of the inferior thyroid artery with the recurrent laryngeal nerve are intimate, especially on the right side, where the nerve often passes between its branches; and this artery forms numerous sinuosities before penetrating from the perithyroid cellular capsule into the thyroid body. Traction on the tumour elongates its vascular pedicles, and places them in full view (Figs. 332 to 340).

Fourth Stage : Formation and Ligature of the Pedicles.—This stage of thyroidectomy varies greatly, according to the localization of the tumour.

Figs. 338, 339, and 340 show a lateral parenchymatous goitre, which has been pedunculated by a single stroke of the écraseur. Fig. 337 repre-

sents a unilateral goitre, at the moment following its luxation to the outside of the wound. The lateral tracheo-thyroid ligament is distinguishable. On applying sufficiently energetic traction to one of those goitres, the pedicle

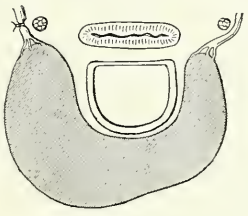


Fig. 343.—Diagram showing the Dangers of Wounding the Left Recurrent Nerve when tying the Middle Thyroid Artery according to the Old Method.

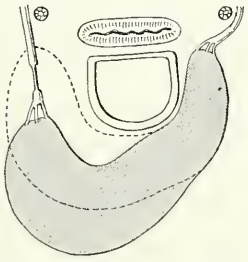


Fig. 344.—Diagram showing the Withdrawal of the Recurrent Nerve in Ligature of the Inferior Thyroid Artery by my Method of Enucleation en masse and Crushing.

undergoes sufficient elongation to allow crushing at a single stroke, and ligature *en masse*. The double Dionis's knot is used in order to secure the fixation of the ligature.

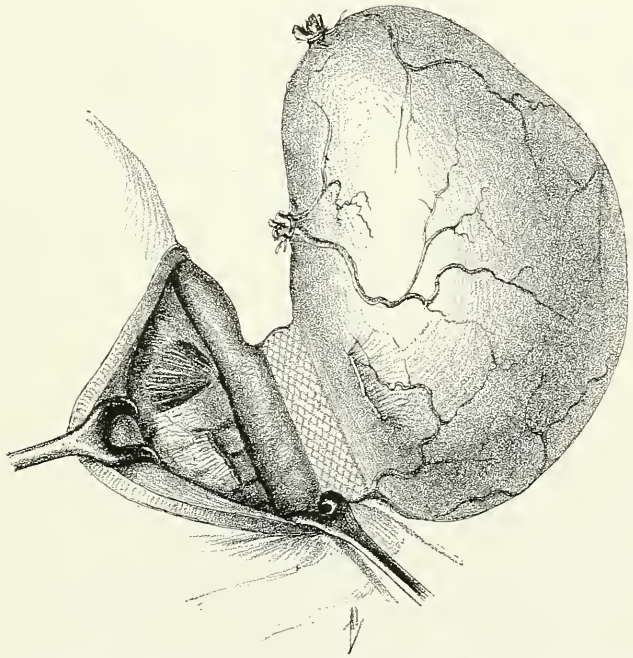


Fig. 345.—Unilateral Thyroidectomy: Isolation of the Trachea and Crushing of the Thyroid Isthmus.

It is often necessary to form a number of pedicles. Fig. 338 shows the appearance of the superior pedicle, which is the first to be crushed and tied (Fig. 339). We then pass to the middle pedicle, which is also crushed and

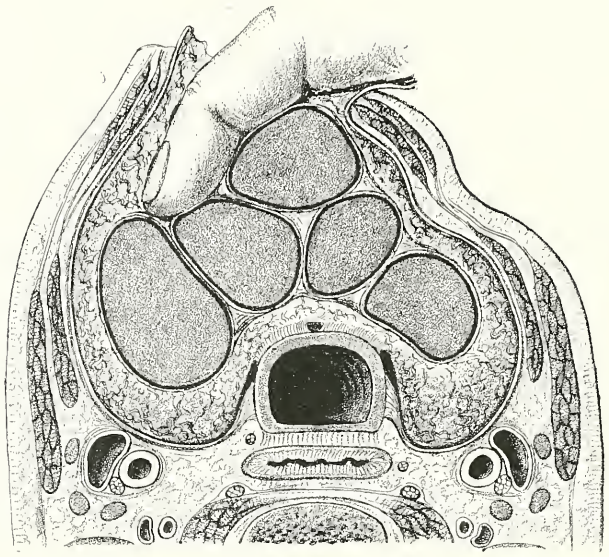


FIG. 346.—DIAGRAMMATIC SCHEME OF INTRAGLANDULAR ENUCLEATION.

After section of the different subhyoid planes, and opening the capsule of the gland, the finger is introduced into the proper thyroid tissue, where it meets the polycystic mass, which is then readily enucleated.

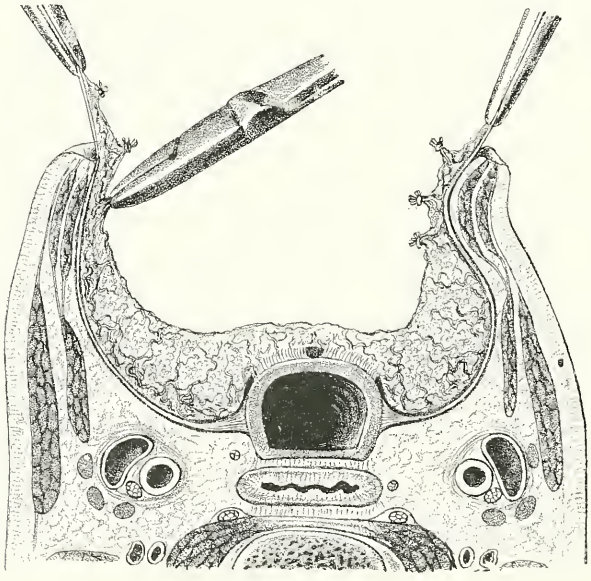


FIG. 347.—DIAGRAMMATIC SCHEME OF HÆMOSTASIS IN A CASE OF INTRAGLANDULAR ENUCLEATION.

After ablation of the adenoma, a considerable oozing hæmorrhage takes place in the wound. The bleeding-points must be respectively seized with artery-forceps.

tied (Figs. 340 and 341). The ligature of this pedicle is seen in Fig. 342. Fig. 343 shows the ligature of the inferior thyroid artery, as formerly applied in the depth of the wound and with danger of wounding the recurrent nerve. On the other hand, if my technique is adopted, the artery is found elongated, as shown in Figs. 336 and 344. By this procedure the processes

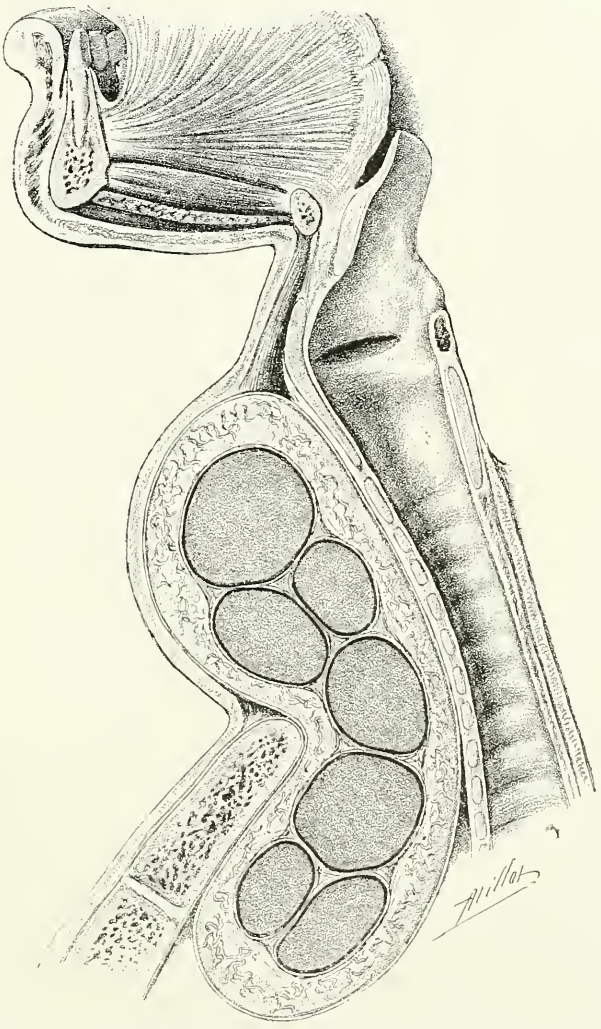


Fig. 348.—Retro-Sternal Polycystic Goitre: Diagrammatic Antero-Posterior Section.

of crushing and ligature are carried out at a distance of several centimetres in front of the recurrent nerve, which remains in contact with the trachea behind the perithyroid cellular sheath. It now remains to treat the inferior pedicle of the isthmus. The pedunculation of the tumour is also inspired by the individual case. We have seen that, in cases in which the tumour

occupies nearly the whole substance of the thyroid body, the method of instantaneous crushing enables us to preserve from a healthy cornu a thyroid lobule sufficient for prevention of cachexia strumipriva.

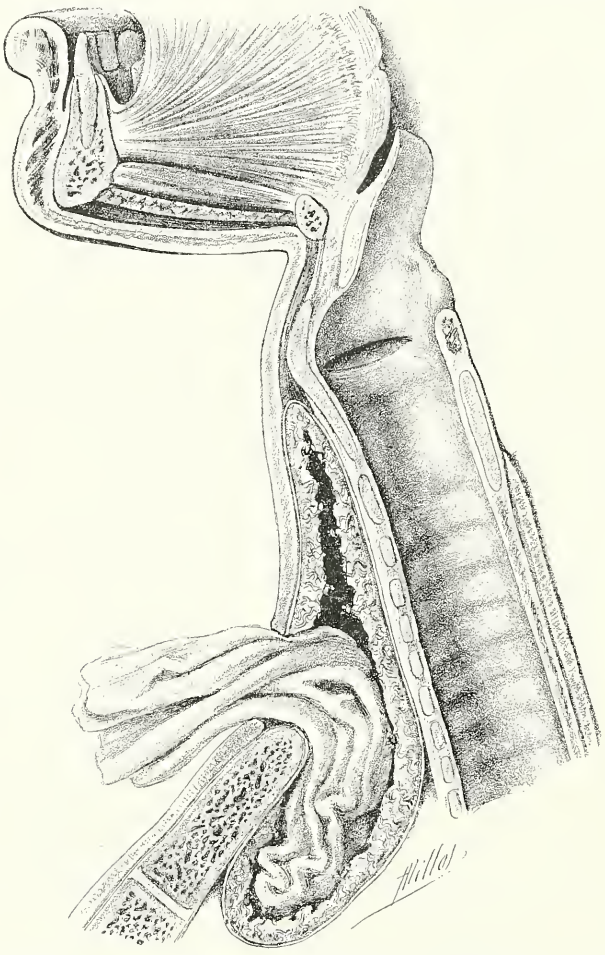


Fig. 349.—Retro-Sternal Polycystic Goitre: Tamponing of the Inferior Cavity, where Some Oozing Hæmorrhage may persist.

Dissection of the Trachea.

The tumour is often strongly adherent to the trachea, to which it is fixed not only by the two lateral tracheo-thyroid ligaments, but also by adhesions to the median portion of the trachea. The lateral ligaments and the antetracheal adhesions should be divided with scissors; the section causes no hæmorrhage. It is also easy to apply a forceps and carry out ligation when necessary. Fig. 345 shows the crushing of a left thyroid pedicle after division of the right lateral ligament, and dissection of the trachea. In this case the healthy left lobe has been left in its place.

PARTIAL THYROIDECTOMY.

Enucleation of Intraglandular Cysts.—Some cystic goitres are formed of an agglomeration of cystic vesicles, enclosed in a kind of fibro-cellular

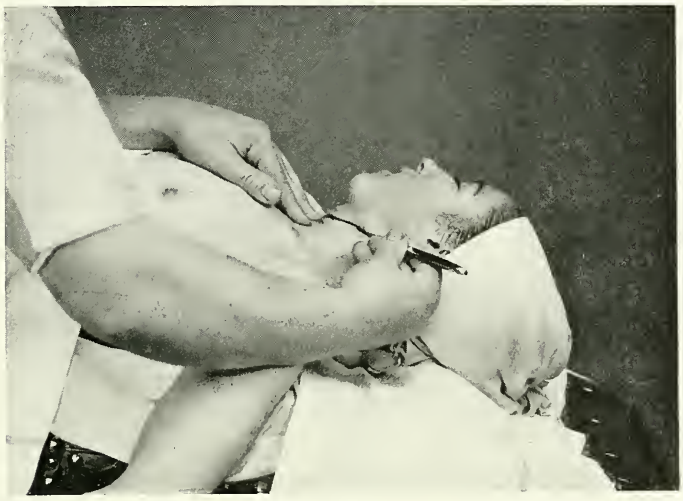


FIG. 350.—UNILATERAL EXOPHTHALMIC GOITRE: OPERATION.
First stage: Cutaneous incision.

FIG. 351.—UNILATERAL EXOPHTHALMIC GOITRE: OPERATION.
Fourth stage: Crushing of the pedicle.

pocket which separates them from the tissues of the healthy gland. In these cases there is a permeable intrathyroid space into which a finger readily penetrates. This stage is then identical with that in which the

index-finger is passed into the perithyroid cellular pouch in a case of parenchymatous goitre. Figs. 346 to 349 represent the intraglandular enucleation of these cystic masses.

Operation—*First Stage.*—Horizontal cutaneous incision.

Second Stage.—Exposure of the thyroid body and incision of the capsule proper.

Third Stage.—Enucleation of the intraglandular cystic groups, and hæmostasis of the arterioles engaged.

Fourth Stage.—Verification of the field of operation, and antiseptic tamponing of the thyroid space.

Fifth Stage.—Reunion of the wound.

Where the thyroid cavity yields but a gradual oozing, the skin is completely sutured over the plugging material with clips or silk. The clips are removed after twenty-four to forty-eight hours, the toilet of the wound is carried out; and the clips are then replaced, with one or two glass drainage-tubes.

RESULTS OF THYROIDECTOMY.

The ablation of benign tumours of the thyroid body may be regarded as a simple and safe operation when a sound technique is adopted. One of the first progressive steps has been the adoption of the transverse cutaneous incision in attacking the tumour, as devised by me in 1887. At that time I had already practised rapid extraglandular enucleation of the neoplasm, and tied the vessels after dragging on them in such a way as to remove all risk of wounding the recurrent nerves. I perfected this technique in 1897 by applying to thyroidectomy the method of instantaneous crushing, which facilitates at the same time the ligature of vascular pedicles and the formation of a fibro-cellular thyroid pedicle at the limit of the glandular lobule which is to be preserved. The ablation of a goitre of the size of an orange, or even of the fist, lasts between three and five minutes by this method, as will be readily estimated from my cinematograph films.

PARTIAL THYROIDECTOMY IN EXOPHTHALMIC GOITRE.

The syndrome of Basedow's disease is often produced in the course of development of small thyroid tumours. I noticed in 1887 that removal of the altered portions of the thyroid body sufficed to cause disappearance of the nervous condition in a few days, with the associated palpitations and tachycardia. The exophthalmos is usually but slightly accentuated; it also disappears, as well as the sensations of waves of heat and the arterial throbbings in the head. The operative technique presents nothing in particular; and I have never found extirpation of exophthalmic goitre more dangerous than that of simple goitre, if the conditions of carrying out my technique were strictly fulfilled. The results are remarkable when the whole of the altered lobes have been taken away. I have seen the number of pulsations fall from 150 to 90 in five or six days. In a recent case it had fallen from 104 to 85 on the following day, and after another

twenty-four hours to 80. The patient who, after mounting twenty steps, had 140 pulsations and a tendency to cardiac syncope, has seen all these painful symptoms disappear in the course of eight days. The symptoms of Basedow's disease may be manifested in the course of the development of the primary thyroid tumour, as well as in the course of evolution of a thyroid growth of old standing which had existed for several years without the slightest cardio-vascular complication. I have observed them also in two cases of thyroid cancer. Histological examination has, in every such case without exception, demonstrated the presence of neoplastic follicles; the secretion of which, when absorbed, produced the nervous and cardio-vascular symptoms. We know, besides, that it is possible to produce the same accidents in a healthy individual by intensive thyroid medication.

It would be very interesting to ascertain if thyroid lobules affected by such alterations were present in cases of Basedow's disease, in which the exophthalmos is the predominant feature, and where no very manifest thyroid tumour exists. But I have not had an opportunity of operating on such patients, for all such cases that I have seen have been dissuaded from operation by physicians who utterly condemn surgical interference, but have given no relief by their own treatment.*

RESECTION OF THE CERVICAL SYMPATHETIC IN EXOPHTHALMIC GOITRE.

I am not a partisan of resection of the sympathetic in exophthalmic goitre, as the direct method has given me complete success in every case in which I have been able to employ it—that is to say, in every case in which the patients have had sufficient confidence in me not to allow themselves to be dissuaded from the procedure by confrères affected by a morbid dread of what they did not understand. I will, however, describe this operation in connection with the surgery of the carotid region.

Experiments on the rabbit have, indeed, demonstrated the fact that bilateral resection of the cervical sympathetic makes the eyeball fall back in the orbit. This experiment leads one to think that resection of the cervical sympathetic may be indicated as a complementary operation, when the exophthalmos persists after partial thyroidectomy.

THYROIDECTOMY IN CANCER OF THE THYROID BODY.

Extirpation of cancerous goitre, when possible—that is to say, when the tumour is still encapsuled and movable—does not differ sensibly as regards technique from extirpation of parenchymatous goitre. Nevertheless, the operation is a more serious one, and requires considerable destruction of tissue, especially in cases in which secondary adenopathy is present. I can here recall, among my observations of malignant tumours of the thyroid body

* One of these patients, who was affected with exophthalmic goitre of the thyroid variety of which I had made the diagnosis, five years previously, died a victim of the obstinacy of a number of highly esteemed physicians who had convinced her that the operation would be fatal. She succumbed to thyroid intoxication.

with bilateral adenopathy, a case treated by operation and antineoplastic vaccination which has remained without recurrence since September 18, 1903.* When the thyroid cancer is diffuse and spreads towards the thorax, all operative interference is useless, for it is utterly impossible to pass beyond the limits of the disease.

EXOTHYROPEXY.

An attempt has been made to transform into a definite surgical procedure the operative accident which resulted from the inexperience of a surgeon who, after having luxated the thyroid body to the outside of the wound, found himself unable to complete the operation. I mention this pretended method only to condemn it without appeal.

OPERATIONS ON THE LARYNX AND TRACHEA.

Methods of Exploration.

External Inspection.—External inspection enables us to recognize whether the larynx is displaced, covered by a neoplastic growth, etc. Its ascent during deglutition is observed.

Palpation by the Buccal Route.—In some cases it is desirable to verify the diagnosis of a lesion of the superior orifice of the larynx by digital examination under chloroform. The dental arcades are then separated with a ring-handled gag, and the index-finger is introduced into the pharynx. The tongue should be drawn out of the mouth by an assistant so as to render the larynx more accessible.

Auscultation.—Auscultation of the larynx reveals special bruits in cases of stenosis and presence of foreign bodies.

Laryngoscopy.—Laryngoscopy is carried out either by the method of inverted image, or with the help of a direct vision endoscope.

Laryngoscopy with Inverted Image.—Laryngoscopy with inverted image, which is the oldest method, is carried out with the help of a small circular mirror mounted at a slightly obtuse angle on a straight metallic rod. The examination is carried out in a dark chamber. The best course of illumination is an Auer lamp furnished with a condenser. We can also use Clarke's frontal concave mirror, which is furnished with a small electric lamp. The patient is seated on a chair, with head erect; the luminous source, if the surgeon has not a frontal light, is placed near the side of the patient and a little behind him. Two or three mirrors of various diameters are arranged on the table in a glass of water of a temperature about 45° C. (113° F.).

Having secured good convergence of the luminous rays, the mirror is grasped with the right hand, and, after wiping it with a sterilized compress,

* "Le Cancer" (Libr. Universelle et Maloine, édit. 1909, p. 362).

we grasp the tongue with the same compress between the thumb of the left hand above, and the other four digits below. The tongue should be drawn out gently, and the patient is requested not to resist the action. The mirror is made to touch the soft palate, and the handle is slightly depressed; we then request the patient to say "Eh," sustaining the note for some time. We then see the vestibule of the larynx and the vocal cords (Fig. 353).

Fig. 352.—Instruments for Examination of the Larynx by Inverted Image, and for Minor Interventions on that Organ.

From right to left: Two laryngeal mirrors, two curved holders for wadding, one galvano-cautery and three curved cauteries, one small syringe with curved cannula; four forceps for polypi and foreign bodies, one tongue-depressor, and one small curved forceps. Lighting apparatus are not shown; they are an Auer lamp furnished with a condenser, Clarke's electric lamp with frontal mirror.

When the patient is indocile, we administer 3 grammes of potassium bromide on the previous evening, and apply a 2 per cent. cocaine solution locally before the laryngoscopy. The examination may be repeated two or three times When the patient is docile, the functional action of the vocal cords can easily be studied.

Direct Laryngoscopy : Laryngeal Speculum.—Direct examination of the larynx is carried by introduction of a straight tube through the mouth, the patient being placed in a very accentuated Rose position. This examination should be carried out under chloroform. Fig. 354 shows the instruments which I have had constructed for direct laryngoscopy. The position of the orifice of the larynx renders introduction of a straight tube rather difficult. My instrumentation includes:

1. A large pharyngo-œsophageal tube, with mandril of which the extremity is cut obliquely for a length of 6 centimetres (two models, large and medium-sized).

2. A conducting stem which is to be introduced into the larynx.

3. The laryngoscope tube (two or three models).

The apparatus for illumination is the same as that for cystoscopy, rectoscopy, and œsophagoscopy by direct vision.

Technique of Laryngoscopy, of Tracheoscopy, and of Direct Bronchoscopy.—The patient is anæsthetized and placed in the Rose position, exaggerated.

First Stage.—Introduction of the pharyngo-œsophageal tube, furnished with its mandril, the cleft looking upwards. The mandril is removed

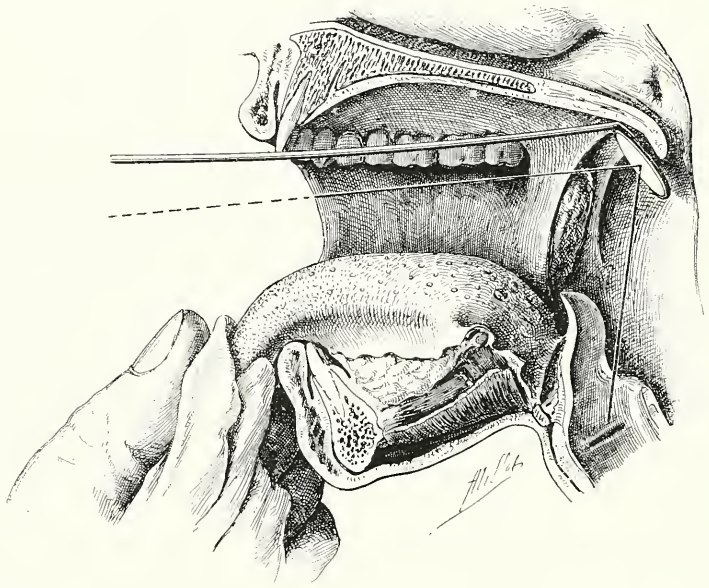


Fig. 353.—Position of Mirror, Elevation of Larynx, and Course of Luminous Rays in Laryngoscopy with Inverted Image.

and the lamp placed in position. It should be noted that the stem on which the lamp-holder is adjusted is placed on the left side of the pavilion of the pharyngeal tube, so as to leave more room for introduction of the intralaryngeal conductor. This stem is also longer than that of other direct endoscopes, so that the surgeon can place the electric lamp at the most suitable distance. The surgeon draws the œsophageal tube very slowly towards himself till the orifice of the larynx comes to correspond with the position of the cleft already described; the characteristic respiratory bruit is then immediately heard. He can then examine the lower surface of the epiglottis, the orifice of the larynx, and in some patients the vocal cords.

Second Stage: Introduction of the Intralaryngeal Conductor.—It is then very easy to introduce the guide, of which the blunt extremity

is slightly incurved (Fig. 356). When the guide has reached the trachea, the pharyngeal tube is removed.

Third Stage: Introduction of the Laryngeal Endoscope.—We then pass the laryngeal endoscope along the guide till its extremity reaches

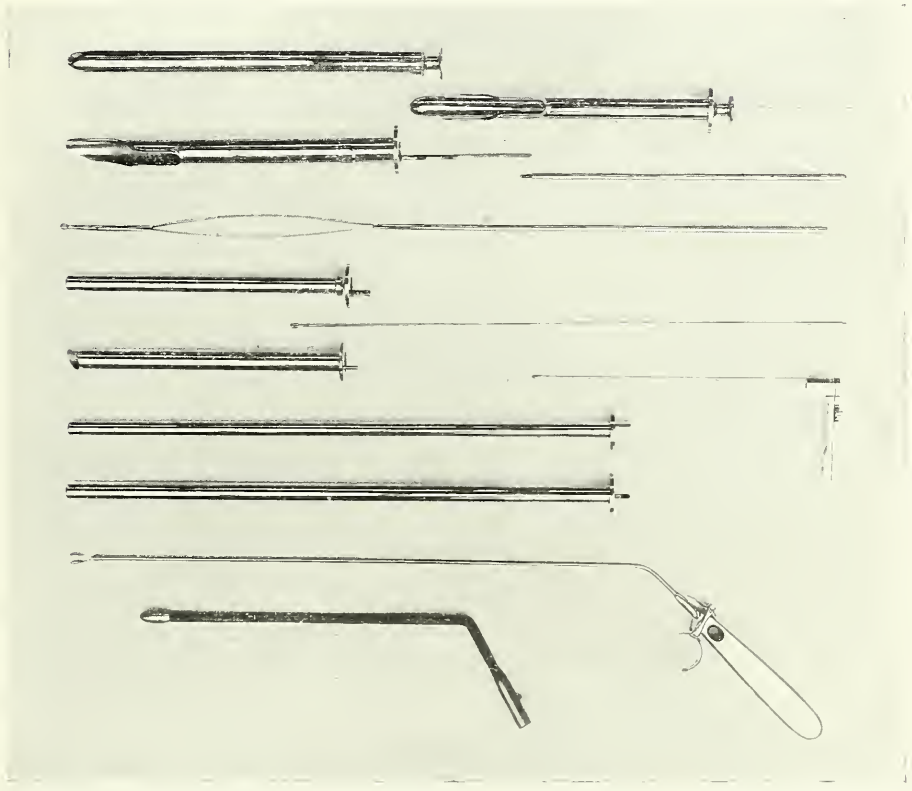


Fig. 354.—Instruments for use in Direct Laryngoscopy in Bronchoscopy, for Extraction of Foreign Bodies from the Bronchi, and for Electro-Coagulation of Intralaryngeal Tumours.

From above downwards: Two pharyngo-œsophageal tubes, for exposure of the opening of the larynx. That on the right is furnished with its mandril, which is separated from the left one in order to show the terminal groove better. Beneath these the button-pointed intralaryngeal metallic conductor, with its stem for elongation. Lower down: two tubes for direct laryngoscopy, two tubes for bronchoscopy, one forceps for foreign bodies, and an electro-cautery for thoracic electro-coagulation of tumours of the larynx. On the right and in the middle of the figure: Lamp-holder, with a small lamp for illumination of the larynx; above this a larger lamp-holder stem, for bronchoscopy.

the two divergent blades which precede the extremity of this instrument. The tube can then be easily made to enter the larynx by pushing both together. The guide is now removed, the lamp adjusted, and we proceed to the necessary manœuvres.

The surgeon should have within reach endoscope tubes of 18 centimetres in length for the larynx, and others of 35 centimetres for direct exploration

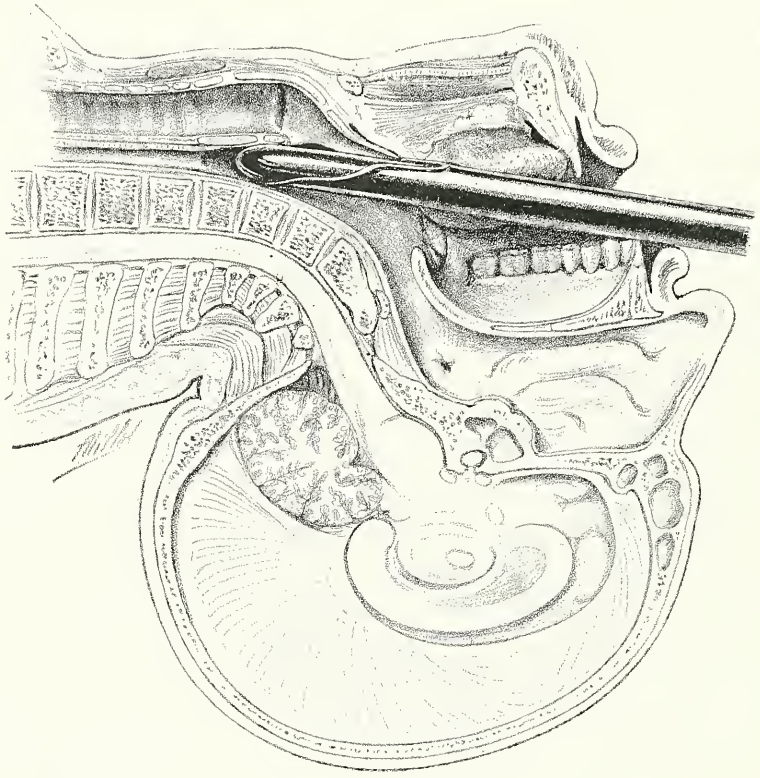


FIG. 355.—DIRECT LARYNGOSCOPY BY THE AUTHOR'S METHOD: INTRODUCTION OF THE PHARYNGEAL TUBE FURNISHED WITH MANDRIL.

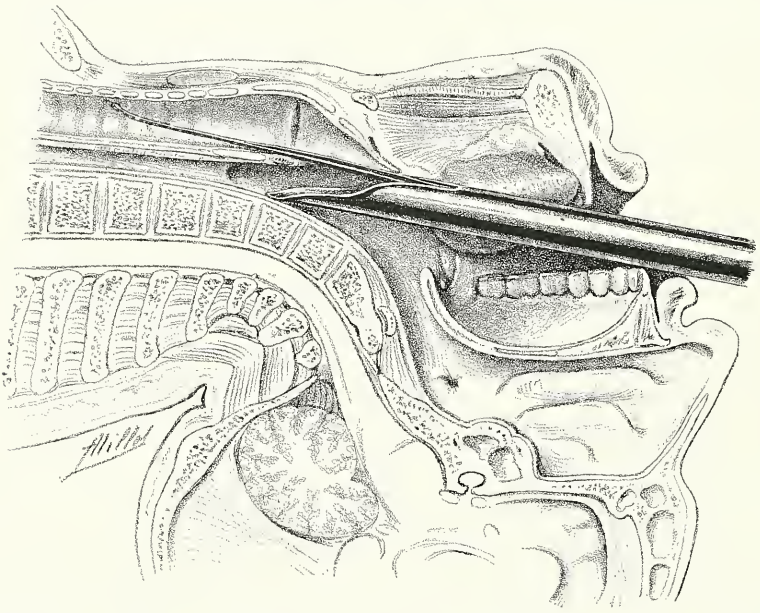


FIG. 356.—INTRODUCTION OF INTRALARYNGEAL CONDUCTOR BY THE ANTERIOR CLEFT OF THE PHARYNGEAL TUBE.

of the trachea and bronchi. Special forceps, the jaws of which are controlled through a long stem, enable us to reach foreign bodies, which are easily extracted by this technique.

Fig. 357.—Direct Bronchoscopy under Chloroform Anæsthesia.

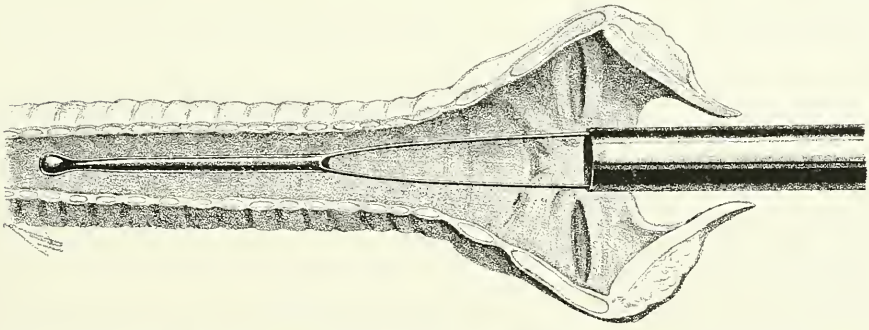


Fig. 358.—Anatomical Preparation showing with the Help of an Anterior Longitudinal Incision of the Larynx and Trachea how the Bronchoscope Tube passes into the Larynx on its Metallic Guide.

Radioscopy.—Finally, radioscopy and radiography can convey valuable indications in some cases, especially when we are dealing with foreign bodies.

Traumatic Lesions.

Commotion and Contusion.

Commotion of the larynx may be followed by extravasation of blood and symptoms of asphyxia, thus necessitating the performance of *tracheotomy*.

Contusion of the larynx in cases of shock and of strangulation may be complicated with fracture of the cartilages, and demand the same operation.

Tubage is little suited to these cases, as it might determine the production of sphacelus of the mucous membrane.

Wounds.

Penetrating wounds of the larynx and trachea are frequently enough met with, oftenest from attempts at assassination or suicide. They are described from this point of view in the treatises on legal medicine. Accidental penetrating wounds of the aerial passages are more rarely subhyoid than supra-hyoid; they may involve the thyro-hyoid membrane, thyroid cartilage, crico-thyroid membrane, or even the trachea.

When the wounded person has not succumbed to the immediate hæmorrhage, reunion of the divided structures may be attempted. When the wound is of several days' standing, and has already suppurated, a tracheotomy tube may be placed in the opening; or tracheotomy may be performed at the seat of election, and the procedure of reparation postponed to a more convenient time.

Fractures of the Hyoid Bone and of the Larynx.

These fractures are accompanied with submucous extravasations and symptoms of suffocation, and may necessitate recourse to tracheotomy, immediate or secondary. When there are depressed fragments, we may endeavour to elevate them by a median incision after the performance of tracheotomy. After careful adjustment, intralaryngeal tamponing is carried out.

Fracture of the Trachea.

These fractures seldom occur except when there is a very considerable interval between the cricoid cartilage and the manubrium sterni. They are accompanied by dyspnœa, emphysema, and extravasation of blood, and they require the performance of tracheotomy, followed or not by suture of the trachea, which it may be necessary to furnish with an articulated cannula of appropriate diameter.

Foreign Bodies.

Fluids.—The introduction of a considerable quantity of blood, of pus, or of the gastric contents into the trachea may produce rapid suffocation.

The patient should be immediately turned back into the Trendelenburg position, so as to facilitate the expulsion of the fluid matters.

Liquids may also enter from below upwards through the bronchi, in cases of the opening of a hydatid cyst or abscess in the neighbourhood. Lateral pressure is then made on the thoracic cage, and the pharynx is sponged out with compresses. When the air has again found entrance into the respiratory tree, we have recourse to rhythmic tractions of the tongue and artificial respiration by suitable movements of the arms.

Solids.—The nature of solid foreign bodies is, of course, of infinite variety. They may become fixed in the larynx or bronchi. If they remain in the trachea, they are usually mobile. The diagnosis is sometimes difficult; for a state of complete tolerance may be set up after one or more paroxysms of suffocation. Some foreign bodies, after transitory retention in a bronchus, are expelled in a violent paroxysm of coughing. Suppression of the vesicular murmur in a pulmonary lobe is one of the signs of the presence of a foreign body in one of the air passages.

Operation.—Foreign bodies in the larynx are recognized on endoscopic examination, and are removed through the natural passages.

Inflammatory Lesions.

Acute Inflammatory Lesions.

Any case of acute laryngitis may become complicated with œdema of the glottis, and necessitate the intervention of the surgeon. These accidents usually yield in one or two hours to the effects of a hypodermic injection of 10 centimetres of mycolysine. We should hold ourselves ready to repeat this dose after an interval of four or five hours. We also meet with cases of suppurative interstitial laryngitis, which may lead to the formation of fistula, with necrosis of the cartilages. Such lesions may necessitate either tracheotomy or laryngotomy.

Subacute and Chronic Inflammatory Lesions.

The subacute and chronic inflammatory lesions which call for surgical intervention are usually of tuberculous nature. The gravity of tuberculous laryngitis is well known. I am now in possession of an heroic method of destroying tuberculous lesions—that of aero-cauterization. Destruction of the lesions should be carried out after complete exposure, and with a combination of laryngotomy or pharyngotomy, according to the locality.

Malformations: Congenital and Acquired.

Stenosis of the Larynx.

Congenital stenosis of the larynx is very rare. Acquired stenosis is usually a sequel of burn. It may also be a result of tubage, the pressure-contact of the metallic tube producing a partial necrosis of the mucous

membrane and vocal cords. Tracheotomy is performed when suffocation threatens. Partial resection of the larynx, followed by partial suture and tamponing of the cutaneous wound, has given excellent results.

Operation.—Tracheotomy has already been carried out as a preliminary step.

First Stage.—Vertical incision of the soft parts and exposure of the larynx.

Second Stage.—Median incision of larynx or thyrotomy, and exploration of the cavity of the larynx.

Third Stage.—Complete resection of the cicatrix.

Fourth Stage.—Partial suture and tamponing of the wound.

Stenosis of the Trachea.

When stenoses of the trachea do not threaten life, they should not be operated on. When symptoms of suffocation appear, tracheotomy should be performed, and dilatation of the strictured portion attempted. In some cases resection of the seat of stricture can be carried out, followed by union of the divided ends of the tracheal canal.

Fistulæ of the Larynx and Trachea.

The fistulæ are oftenest found at the level of the larynx. The congenital fistulæ are treated like the branchial fistulæ already described—by extirpation of the tract and suture. Acquired fistulæ are curable only when there is no constriction above them.

Operation.—Resection of the area around the fistula, and autoplasty by sliding displacement, after having carefully closed the orifice with deep sutures which involve the sterno-hyoid muscles and the deep and superficial cervical aponeuroses.

Tumours.

Tumours of the larynx are of sufficiently frequent occurrence. Among the benign specimens we have cysts and fibromata; unfortunately, we have in most cases epithelial cancer, rarely fibro-sarcoma.

Benign Tumours.

Polypi of the Larynx.

Polypi of the larynx are small benign tumours, more or less pedunculated, and most frequently seated on the vocal cords. They are recognized with the help of the laryngoscope. I have seen a case of horny papilloma of the left vocal cord of the size of a hazel-nut. I extirpated it by thyrotomy; no recurrence took place.

Extirpation by the natural passages should be preferred when practicable. This is effected with a laryngeal fragment forceps (Fig. 352), which is furnished with revolving jaws, and which enable the operator to turn

them in any desired direction. Extirpation of the polypi is carried out either with the aid of the laryngoscopic mirror and inverted image, as the patient sits facing the surgeon; or with the aid of direct laryngeal endoscopy, the patient being in the position of dorsal decubitus with the head bent downwards and backwards.

Malignant Tumours.

The diagnosis of malignant tumours of the larynx is sometimes rather difficult. Laryngeal tuberculosis is sometimes met with under an aspect which may even readily be mistaken for cancer. Syphilitic gummata present a crater-like form with anfractuous surface, coloured a violet tint at the borders and yellowish on the floor; while tuberculous ulcerations present losses of substance, which are characterized by a dull yellowish colour, and having the floor covered by mucosities. I must specially insist on the dangers of antisyphilitic treatment, which is too often applied as a "touchstone." Mercurial treatment, indeed, produces disastrous effects in a case of laryngeal cancer. Accordingly, surgeons cannot be too strongly advised to accustom themselves to exploration of the larynx, so as not to remain tributaries of the specialists, who nearly always satisfy themselves with palliative treatments, and do not recognize the malignant nature of the lesion till it has passed beyond the resources of art. Indeed, invasion of the carotid glands does not, in many of these cases, take place till many months after the appearance of a pronounced epithelial lesion which might have been cured at the outset by the use of thermic electro-coagulation. The only reliable method of deciding the diagnosis, where there is reason to hesitate between one of cancer and of tuberculosis of the larynx, is that of ascertaining the serum reaction of the patient, by using the antigen of Besredka as the test for suspected tuberculosis, and extract of *Micrococcus neoformans* for cancer (see Vols. I. and III.).

Epithelioma of the Larynx.

The form most frequently met with is the pavement epithelioma, and it begins either at the orifice of the larynx or at the level of the vocal cords. Subglottic cylindrical epithelioma is of rather rare occurrence. Epithelioma of the larynx manifests itself with an aspect of reddish-tinted cauliflower, passing into a condition of fungating ulceration. Sarcoma, on the contrary, presents the appearance of a roundish projection covered with a healthy mucous membrane.

The surgical treatment of cancer of the larynx has entered on a new phase since the discovery of thermic electro-coagulation, which enables us to destroy localized cancerous lesions with very little risk of recurrence.

Technique of Operations on the Larynx.

Operations on the larynx include—

1. Intervention carried out through the natural passages.
2. Surgical operations.

Interventions through the Natural Passages.—These interventions are carried out with the aid of the laryngoscope. We have already studied both the laryngoscopy with reflected light and inverted image, and the direct laryngoscopy. Only the minor interventions are carried out through the natural passages—removal of foreign bodies, cauterizations, extractions of small polypi.

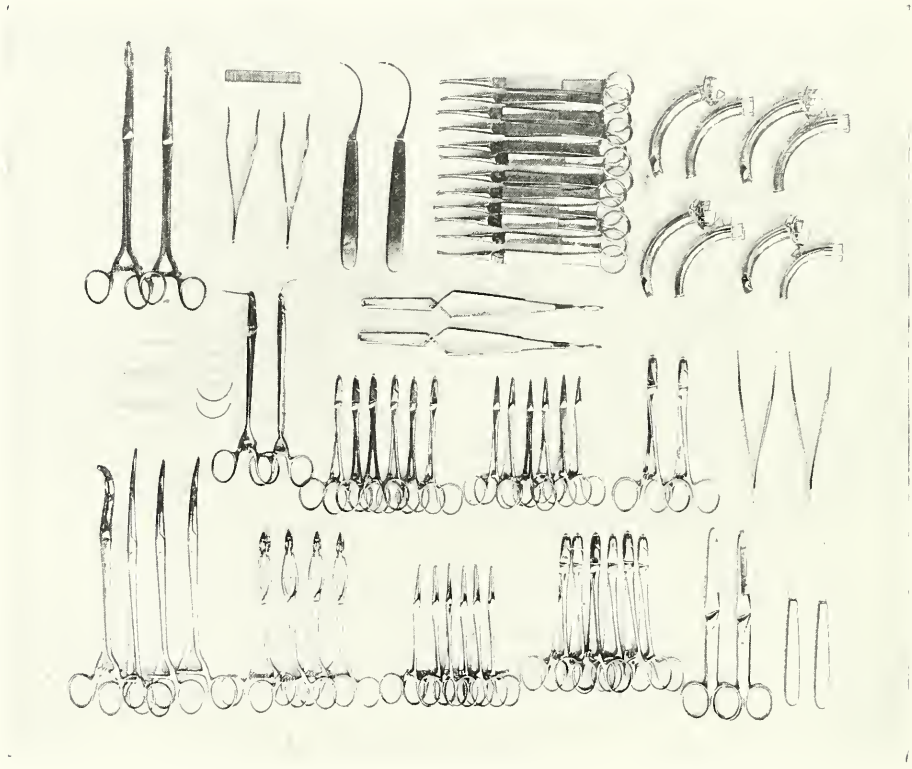


Fig. 359.—Instruments for Laryngo-Tracheotomy.

From right to left, and from below upwards: Two bistouries, two strong straight scissors, six forceps with short jaws and claws, six ring-handled forceps with nine oblique claws, four forceps with oval jaws, three long curved forceps, and a fourth with more pronounced curve for passing ligatures. Above: Two clawed forceps, two short forceps for veins, six Champonnière's hæmostatic forceps, six needle-holder forceps with short hollow jaws, two needle-holder forceps with eccentric jaws, needles, glass drainage-tubes. In the middle: Two strong hooked forceps with six clasps, for tracheotomy. Highest row: Four cannulæ with Krishaber mandrils, twelve hooked forceps, two mounted needles, two clasp-holders forceps and metallic clasps, two forceps with oval eccentric jaws.

Surgical Operations.—Operations on the larynx include laryngotomy and extirpation of the larynx. I will here begin with crico-tracheotomy, which in most instances forms the prelude to other surgical operations.

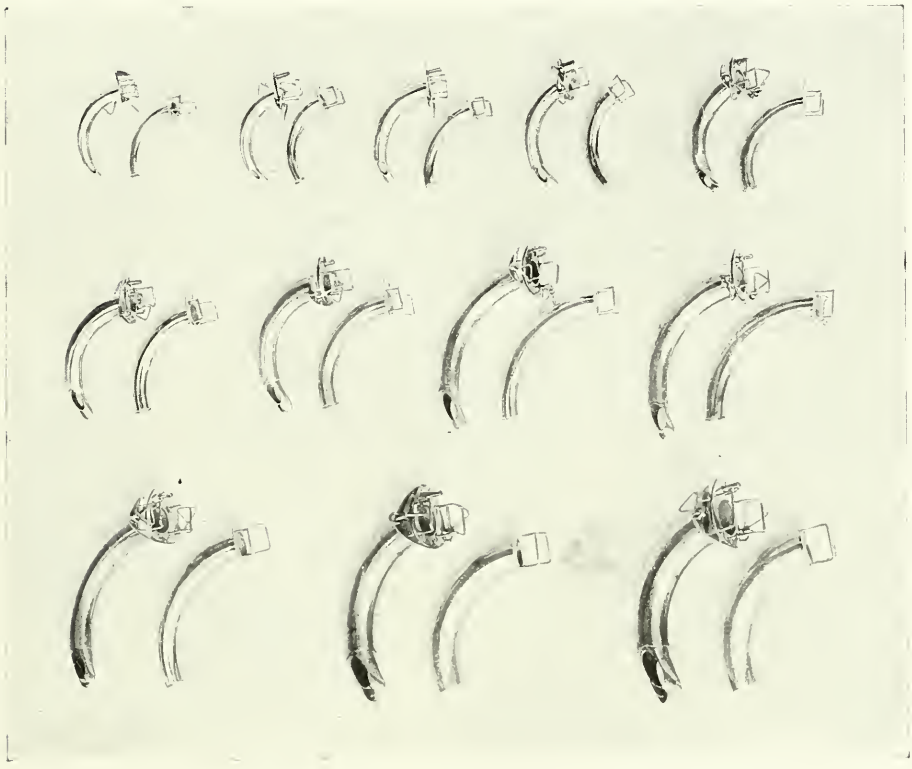


Fig. 360.—Cannulæ with Cutting Edges and Krishaber's Mandril: Nos. 1, 2, 3, 4, 10, 11.

The Nos. 7 to 11 have been constructed according to my directions.

Subthyroid Laryngotomy.

Tracheotomy has lost much of its importance since the vulgarization of the treatment of diphtheria with the antidiphtheritic serum of Behring and Roux. Crico-tracheotomy is much oftener performed now than real tracheotomy.

Choice of Cannulæ for Tracheotomy.—From the time of my first year's experience as hospital intern, I had noticed the general practice of introducing cannulæ of wholly insufficient calibre, very much inferior to the lumen of the normal trachea. I studied the calibre of the trachea in the child and in the adult. The lumen is never less than 10 millimetres in the newly born fœtus; it approaches 15 millimetres towards the age of ten, and in adult age measures from 18 to 22 millimetres in the female, and 25 millimetres in the male. The curvature of the cannulæ was also very irregular.

Fig. 360 represents the series of cannulæ which I employ. It is necessary that the instrument-makers should construct definite types, as well for the calibres as the curvatures, so that, after starting with the numbered series of 0 to 11, each furnished with a Krishaber mandril, the individual mandril will always be adaptable to every cannula of the same number. Cannulæ 7 to 11 are new models prepared for use in adult cases, and especially those in which the trachea is very deeply situated. The longest cannula that had been constructed up to that period, the No. 6, was so far insufficient in length for its purpose that in obese patients the extreimty could hardly be made to enter the tracheal wound.

Operation—Position of Patient and Surgeon.—The patient is placed in the horizontal position, and the anterior cervical region is stretched by resting the nucha on a *bottle* enveloped in a napkin.

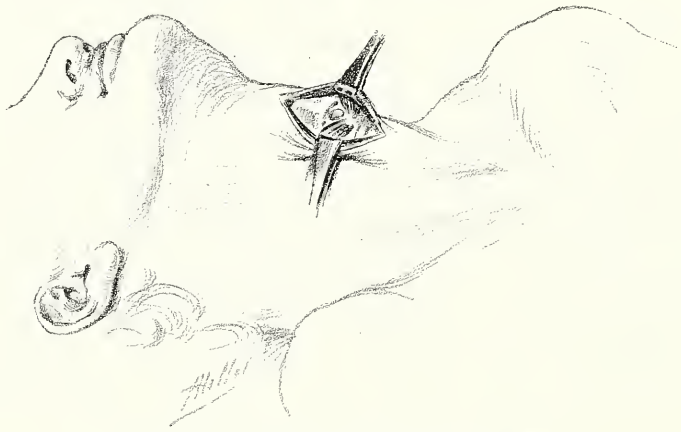


Fig. 361.—Subthyroid Laryngotomy.

The soft parts are retracted with hooked forceps, which also secure hæmostasis.

First Stage.—Vertical incision of 3 to 4 centimetres, beginning at the middle of the thyroid cartilage, and ending at the level of the second ring of the trachea, including all the soft parts as far as the larynx (Figs. 362 and 363).

Second Stage.—Application on each side of a hooked forceps with six teeth, which is made to grasp the whole thickness of the tissues, which can bleed down to the larynx.

Third Stage.—The cricoid cartilage is recognized by the index-finger; the bistoury is then plunged in the middle line below the thyroid cartilage into the crico-thyroid membrane, and is then made to cut through the cricoid ring. The air sizzles through the incision (Fig. 363).

When the tracheotomy is but the preliminary procedure in total extirpation of the larynx, the cannula should be introduced below the cricoid cartilage. The first two rings of the trachea are then divided (Fig. 364).

Fourth Stage.—The cannula is immediately introduced along the index-finger, which has not been withdrawn from the upper extremity of

the tracheal incision. We then replace Krishaber's mandril by the corresponding tube, and knot the two ends of the ribbon behind the neck. The wound is then protected with a sterilized gauze compress. The orifice

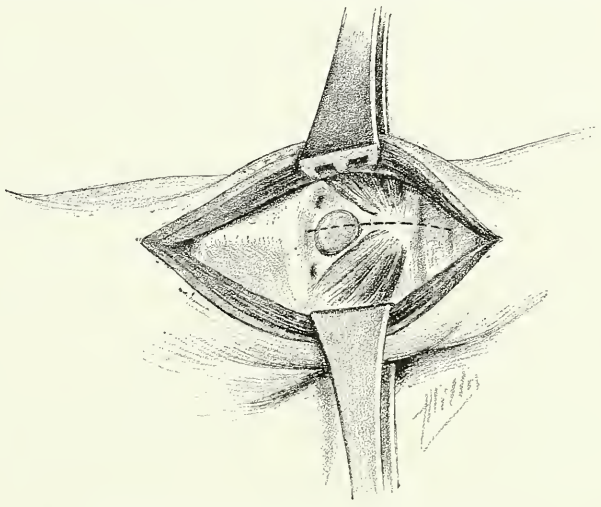


FIG. 362.—SUBTHYROID LARYNGOTOMY.

First and second stages: Incision of the soft parts ; representation of the whole procedure (adult; two-thirds of natural size). The soft parts are retracted with two hooked forceps with six teeth. The dotted line represents the section of the crico-thyroid membrane and cricoid cartilage. On the surface of the membrane is seen a small lymphatic gland.

of the cannula is also covered with a compress, in order to prevent too sudden penetration of the air or of solid particles; also to mucus escaping from the trachea. The inner tube should be cleared out as often as

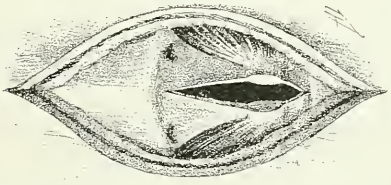


FIG. 363.—SUBTHYROID LARYNGOTOMY.

Second stage: Incision of the crico-thyroid membrane.

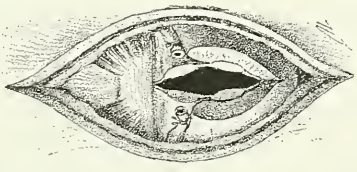


FIG. 364.—HIGH TRACHEOTOMY.

Second stage: Incision of the first two rings of the trachea.

seems necessary. The outer tube should be changed by the surgeon only. When the cannula has not to be retained for relief of a permanent laryngeal obstruction, we can begin to withdraw it towards the sixth or eighth day—at first for some minutes, and then for some hours, in presence of a person capable of reintroducing it if a paroxysm of suffocation should supervene.

Tracheotomy.

Tracheotomy, strictly so called, is indicated in certain cases for retrograde extirpation of subglottic foreign bodies, and for exploration of the bronchi.

Operation—Position of Patient and Surgeon.—The patient is placed as in laryngo-tracheotomy; the surgeon stands on his right. General anæsthesia is necessary, as the object of the operation is to facilitate delicate manœuvres in the laryngo-tracheal canal.

First Stage.—Vertical incision of 4 to 5 centimetres, beginning at the cricoid cartilage and ending at the level of the fourchette of the sternum. and including in two or three repetitions all the soft parts down to the trachea.

Fig. 365.—Tracheotomy in the Adult: Introduction of the Cannula on the Extremity of the Index-Finger.

Second Stage.—Application of a six-toothed hooked forceps on each side, which should grasp all pretracheal tissues with the integument.

Third Stage.—The deep parts of the wound are then sponged with a compress, and the trachea is exposed by the procedure of divulsion. Its ringed surface is recognized by the left index-finger, and incised for a length of 15 to 20 millimetres. The lips of the tracheal wounds are immediately seized with two hooked forceps. Respiration is established through the wound without the necessity of introducing a cannula.

FIG. 366.—TRACHEOTOMY IN THE INFANT.
First and second stages.

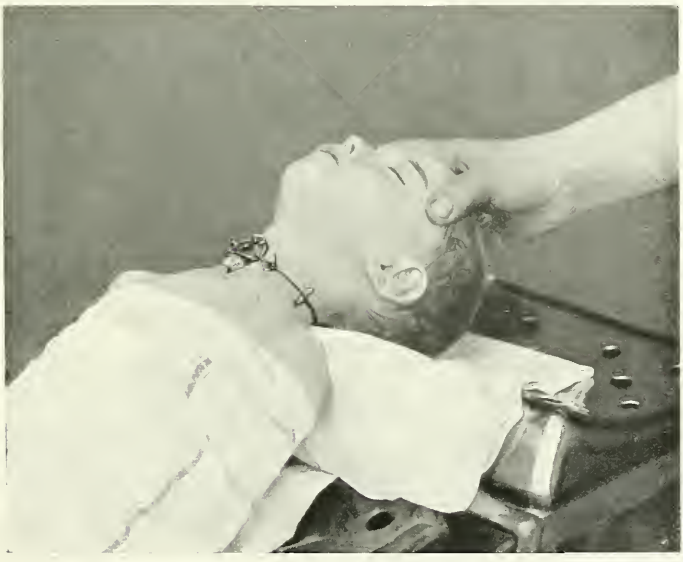


FIG. 367.—TRACHEOTOMY IN THE INFANT.
The operation finished. A wick of gauze is placed under the cannula.

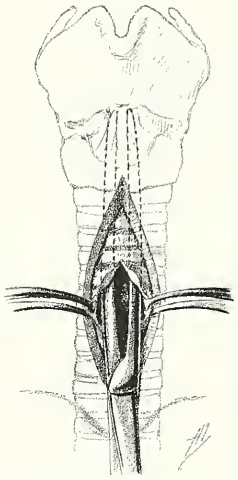


FIG. 368.—REMOVAL OF A SUBGLOTTIC FOREIGN BODY BY TRACHEOTOMY.

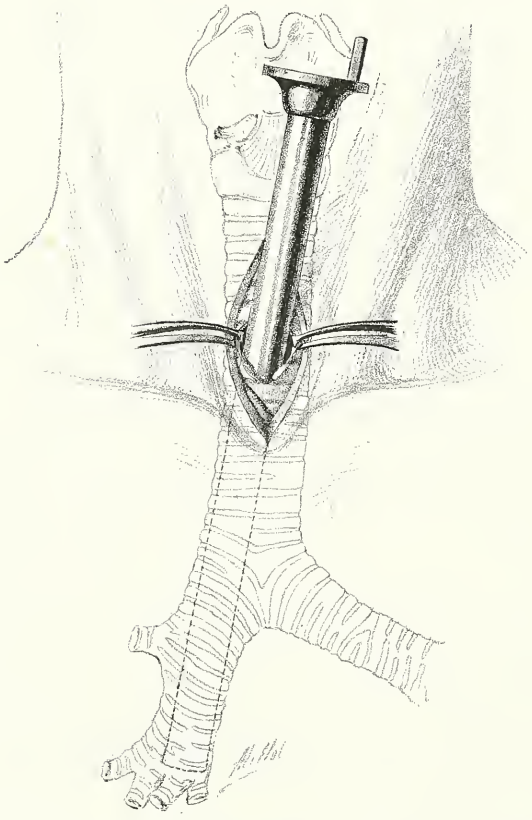


FIG. 369.—DIRECT ENDOSCOPY OF THE RIGHT BRONCHUS THROUGH A TRACHEOTOMY INCISION.

Fourth Stage: Intratracheal Manœuvres.—We may invade the subglottic region of the larynx by this route, as, for example, in cases of stenosis in the vicinity of the glottis (Fig. 365).

In most cases the operation is performed in order to facilitate explora- of the bifurcation trachea or lumen of the right bronchus, or research of a foreign body fixed in the left bronchus. Fig. 369 shows with what facility the bronchoscope-tube can be passed into the right bronchus when introduced

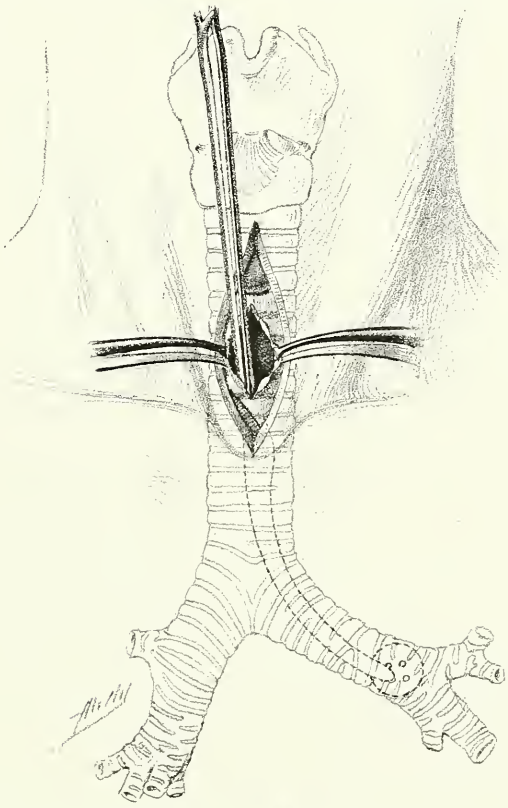


Fig. 370.—Removal of a Foreign Body remotely lodged in the Left Bronchus, with a Curved Forceps introduced through a Tracheotomy Incision.

with a slight obliquity into the tracheal wound. Direct bronchoscopy after tracheotomy may thus enable us to discover and extract very small foreign bodies which have been arrested at the secondary and invisible bronchial bifurcations, if we have recourse to bronchoscopy through the buccal route. Exploration of the left bronchus, which bifurcates almost rectangularly, can be carried out only with the help of a small mirror or of an appropriate endoscope. The foreign body can be seized with a large curved forceps, and extracted through the tracheal wound (Fig. 370).

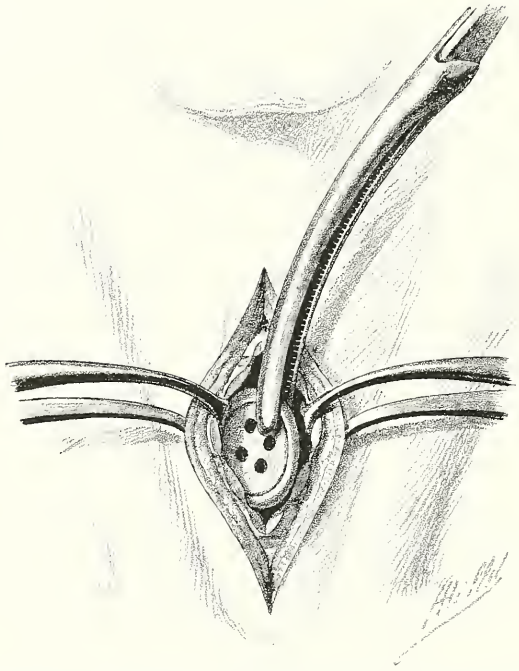


FIG. 371.—REMOVAL OF A FOREIGN BODY REMOTELY LODGED IN THE LEFT BRONCHUS WITH A CURVED FORCEPS INTRODUCED THROUGH A TRACHEOTOMY INCISION

The foreign body is extracted through the tracheal wound.

MEDIAN LARYNGOTOMY, OR THYROTOMY.

Median laryngotomy consists of an invasion of the cavity of the larynx by separation of the two lateral halves of the thyroid cartilage, as in case of two valves.

The incision is made in the median line in the position adopted for tracheotomy. The subcutaneous veins should be carefully tied; and, generally speaking, hæmostasis should be carried out at every bleeding-point before division of the thyroid cartilage. The isthmus of the thyroid gland remains, as a general rule, below the inferior extremity of the incision. When the thyroid cartilage has been exposed, it is incised with a bistoury or stout scissors, or even with a small chisel if very resistant. The two halves are then seized with hooked forceps, and retracted so as to expose the interior of the larynx (Fig. 369).

Thyrotomy suffices for extirpation of large sclerous polpyi and diffuse benign papillomata of the vocal cords, which are inoperable through the natural passages. This operation also enabled us to complete the revelations of laryngoscopy for diagnosis, and to destroy directly, by the method of thermic electro-coagulation, the diffuse papillomata and malignant neoplasms which are there localized. A fragment is first removed for histological

examination. Median laryngotomy is not suitable for extirpation of foreign bodies implanted in the mucous membrane, and ablation of which through the natural passages is impossible. In such cases we have recourse to crico-tracheotomy, which preserves the integrity of the vocal cords. I now proceed to describe in detail the operations of thyrotomy.

Operation.—In many cases paroxysms of suffocation have necessitated a recourse to preliminary tracheotomy. When such has not taken place, a subcricoid tracheotomy is performed before incising the thyroid cartilage, and the anæsthesia is continued with the aid of Trendelenburg's apparatus, which should terminate in a conical adjustment adaptable to all cannulæ

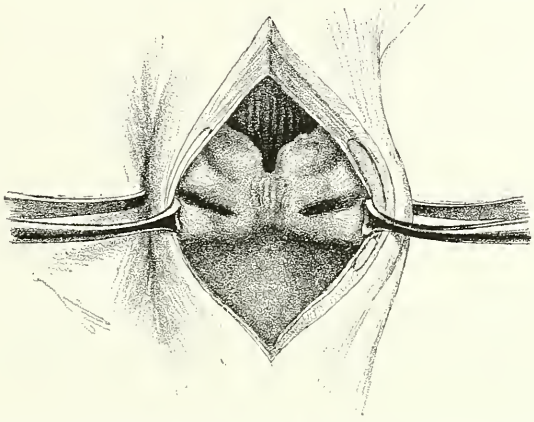


Fig. 372.—Removal of a Foreign Body remotely lodged in the Left Bronchus, with a Curved Forceps introduced through a Tracheotomy Incision: Median Laryngotomy.

The foreign body extracted through the tracheal wound.

Third stage: Vertical incision of thyroid cartilage; aspect of laryngeal cavity after extraction of a foreign body.

for adults. Or, in like manner, the tracheal cannula can be placed in the lower part of the crico-thyroid incision, and the upper part of the wound tamponed.

First Stage.—Median cutaneous incision beginning above the notch of the thyroid cartilage, and terminating below the cricoid.

Second Stage.—Section of the soft parts down to the larynx. We seize and tie, when necessary, the vessels involved. Each lip of the musculo-cutaneous incision is held between the jaws of a hooked forceps with six claws (Fig. 361).

Third Stage.—Vertical median incision of the thyroid cartilage, either lip of which is then seized with a four-toothed hooked forceps. The hooked forceps which had been placed on the soft parts are removed. If necessary, the incision is then prolonged—upwards over the pedicle of the epiglottis, and downwards over the cricoid cartilage.

Fourth Stage: Intralaryngeal Manœuvres—*Localized Polypi.*—These are extirpated with a cutting instrument, and the wound is sutured with a fine catgut.

Diffuse Polypi.—A fragment is first removed for histological examination, and the neoplasm is destroyed by thermic electro-coagulation with a current of low intensity which acts to a depth of 3 or 4 millimetres.

Epithelioma and Sarcoma.—When the lesion is localized and there is no adenopathy, destruction on the spot by thermic electro-coagulation is preferable to extirpation of the larynx, which may afterwards be resorted to, if necessary.

Fifth Stage.—Tamponing of the wound.

Extirpation of the Larynx, or Laryngectomy.

Partial Extirpation.

Partial extirpation of the larynx is indicated when a neoplasm of small extent has passed beyond the mucous tissues, and invaded the cartilage. I have, in cases of this kind, extirpated two-thirds of a thyroid cartilage which had been invaded by an intralaryngeal sarcoma of the size of a hazel-nut. I left behind a portion of the thyroid cartilage, and the whole of the cricoid and arytenoids, with the epiglottis. Five years afterwards there was no recurrence. I consider that an operation cannot be justly referred to as *extirpation of the larynx* when either epiglottis or cricoid has been left behind. The combination of laryngotomy with aero-cauterization in cases of tuberculosis, and with thermic electro-coagulation in those of cancer, will enable us to obtain a permanent cure in many cases when the patients have recognized the necessity for applying in time to competent practitioners. Partial extirpation of the larynx is no longer indicated except in case of vicious cicatrix or benign tumour.

The first three stages of the operation of partial laryngotomy are the same as that of thyrotomy.

Operation—First, Second, and Third Stages.—*Vide supra :* Thyrotomy.

Fourth Stage: Partial Resection of the Larynx.—The resection of the cicatricial orifice or benign tumour is carried out exactly at the limiting border in each case, and without encroaching too much on the healthy parts. The divided vessels having been tied, the bleeding surfaces are then treated by aero-cauterization, and, when necessary, by thermic electro-coagulation, applied with a current of feeble intensity.

Fifth Stage.—Tamponing of the wound.

Total Extirpation.

This procedure can be carried out according to either of two distinct methods:

1. The larynx is removed in two segments by the procedure of hemi-section.

2. The organ is extirpated in a single piece, and from below upwards.

I will describe this operation by way of a commentary on surgical progress. It will henceforth be exceptional to have recourse to this procedure in cases of cancer if these are duly treated by the method of election, anterior laryngotomy, followed by thermic electro-coagulation.

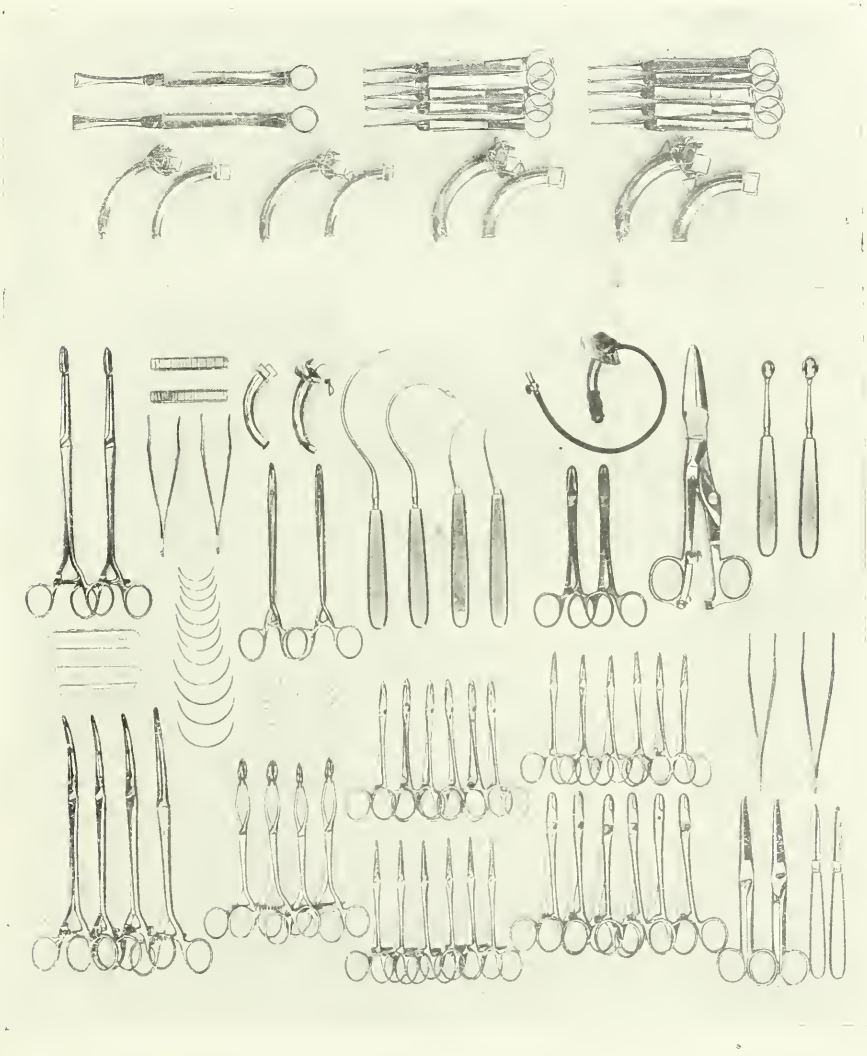


FIG. 373.—INSTRUMENTS FOR EXTIRPATION OF THE LARYNX.

Below, and from right to left: Two bistouries; two straight scissors; six short-jawed artery forceps; six ring-handled clawed forceps; four forceps with oval jaws; four long curved forceps. Next above: Two clawed forceps; six small artery forceps; six needle-holder forceps; needles of various sizes; glass drainage-tubes Middle row: Two curettes; one écraseur (small model); one Trendelenburg cannula; two short-jawed forceps, for veins; two mounted needles; two ligature holders; two needle-holders, with excentric plate; one Krishaber cannula, complete; fifty clasps; two clasp-holder forceps; two forceps with eccentric jaws. Highest: four large tracheotomy cannulæ for adults; ten ordinary hooked four-toothed forceps; two broad six-toothed hooked forceps.

Extirpation of the Larynx by the Procedure of Hemisection.—The technique varies according as the patient has, or has not, been previously tracheotomized. It is better to perform a preliminary tracheotomy, and allow the patient to recover completely from its effects.

Operation—*First Stage.*—Vertical incision from the body of the hyoid bone to the upper rings of the trachea.

Second Stage.—Section of the soft parts down to the larynx, and hæmostasis (Fig. 377).

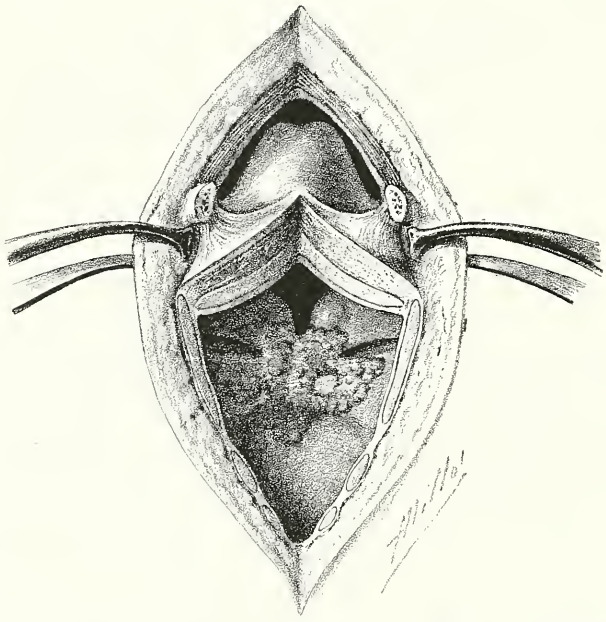


Fig. 374.—Extirpation of the Larynx by Median Hemisection.

Third stage: Median incision of thyroid and cricoid cartilages, section of hyoid bone, and exposure of epiglottis.

Third Stage : Median Incision through Front of Thyroid Cartilage, and Section of Trachea.—The median incision of the thyroid cartilage is made to extend upwards over the pedicle of the epiglottis. The body of the hyoid bone may even be divided in the middle line, in order to admit more light. The epiglottis is then exposed after incision of the mucous membrane of the glosso-epiglottic groove (Fig. 374).

The patient has been tracheotomized. If the patient has had a tracheotomy tube inserted, the upper part of the trachea is plugged around the cannula, and the larynx is detached immediately below the cricoid cartilage. The upper end of the trachea is then sutured to the skin.

The patient has not been tracheotomized. When the patient is not wearing a cannula, the section of the trachea is made in the same way below the cricoid cartilage, and the upper end of the tracheal tube is then drawn forwards to be sutured to the skin by six points of interrupted suture. The

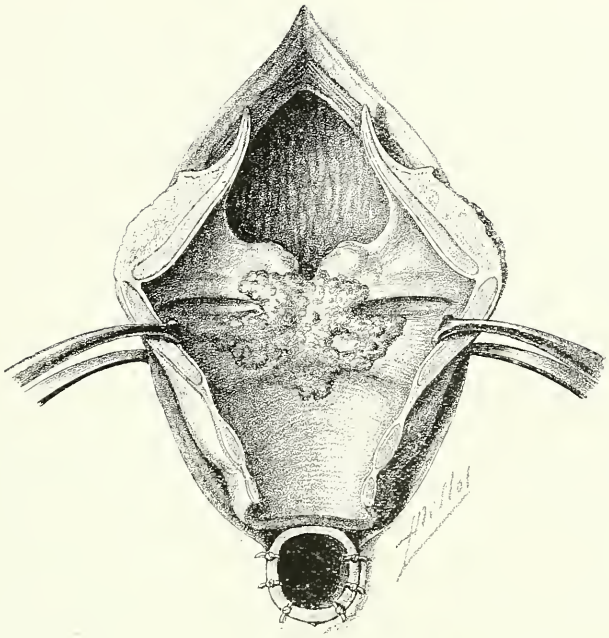


FIG. 375.—EXTIRPATION OF THE LARYNX BY MEDIAN HEMISECTION.

Second stage—Continued: The whole anterior wall of the larynx has been incised. Section of the trachea, which has been sutured to the skin.

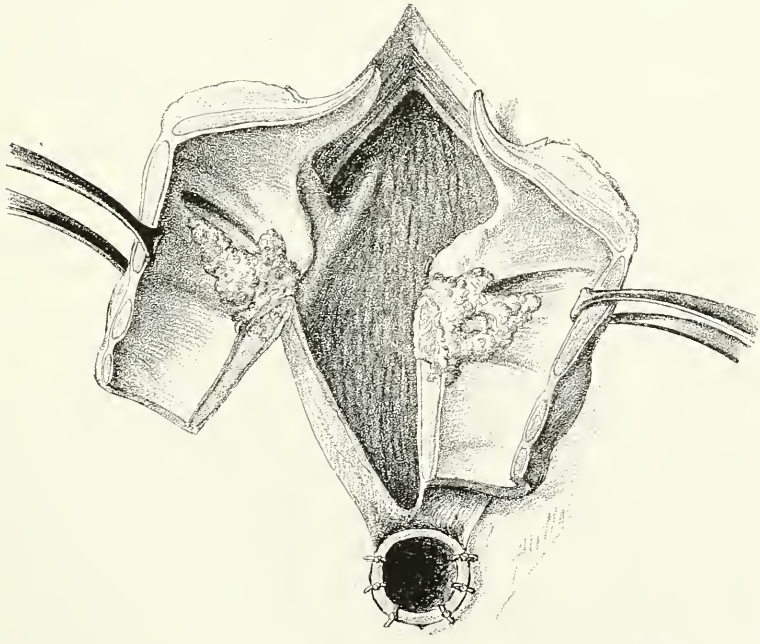


FIG. 376.—EXTIRPATION OF THE LARYNX BY MEDIAN HEMISECTION.

Fourth stage: Extirpation of right half of larynx, which is detached progressively from below upwards.

tracheal cannula is then placed in position, and the anæsthesia is continued with the aid of Trendelenburg's apparatus.

Fourth Stage.—The right half of the larynx is seized with a hooked forceps, and detached from below upwards, care being taken to preserve, when possible, the inferior constrictor muscle and mucous membrane of the pharynx (Figs. 378 and 379). The principal vessels are then tied, and we proceed to ablation of the left half of the larynx from below upwards (Fig. 376).

Fifth Stage.—Verification of the hæmostasis, suture of the pharyngeal mucous membrane and skin, or tamponing of the wound.

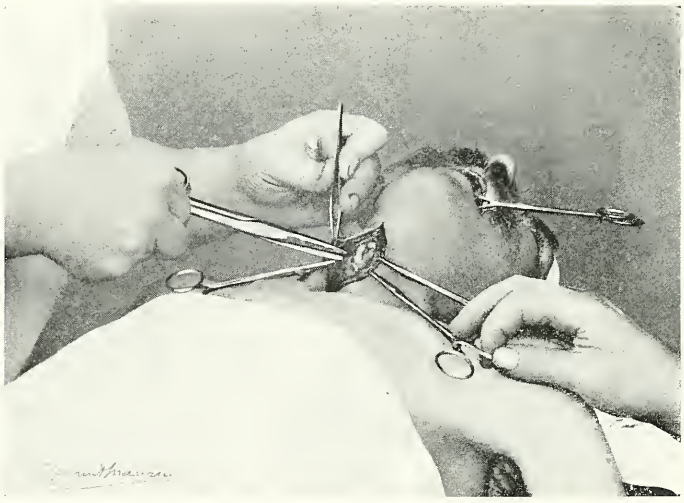


Fig. 377.—Total Extirpation of Larynx by Median Section.

First and second stages: Incision of soft parts and hæmostasis.

It is a very seducing prospect, when the case appears favourable, that of suturing first the pharyngeal mucous membrane, and then the skin (Figs. 388 and 389). But this procedure involves the inconvenience of shutting off the field of operation from the inspection which is so necessary during some months in a case of cancer. I consider it preferable to carry vertical suture of the mucous membrane to the skin on each side. By so doing the slightest recurrence of the growth can be seen from the outset, and the diseased spot can be destroyed by application of electro-coagulation.

Ulterior Autoplasty.—When no recurrence has taken place after ten to fifteen months, and the lymphatic glands remain unaffected, the mucous membrane is detached from the skin, and the process of repair of the pharyngeal tube is carried out in one or more séances.

Extirpation of the Larynx by the Retrograde Ascending Route.—In this procedure the process of total extirpation of the larynx is deliberately carried out, and the organ is removed in a single piece.

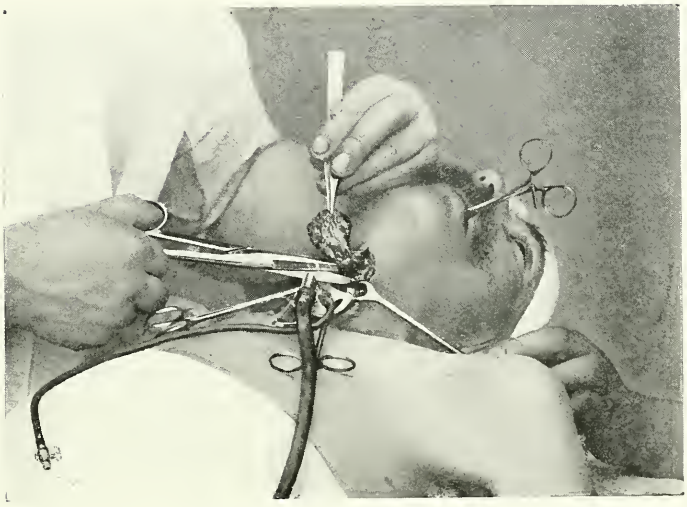


FIG. 378.—TOTAL EXTIRPATION OF LARYNX BY MEDIAN SECTION.
Fourth stage: Extirpation of right half of larynx.

FIG. 379.—TOTAL EXTIRPATION OF LARYNX BY MEDIAN SECTION.
Fourth stage—Continued: Extirpation of right half.

Fig. 380.—Total Extirpation of Larynx.
Tamponing of wound.

Fig. 381.—Introduction of Œsophageal Tube.

Operation—*First Stage.*—A T-shaped incision of the skin. The horizontal section extends from one sterno-mastoid to the other across the thyroid-hyoid space. The median incision descends to the level of the first rings of the trachea (Figs. 382 and 383).

Second Stage.—Vertical section of the soft parts down to the larynx at the level of the superior border of the thyroid cartilage, and horizontal section of the sub-hyoid muscles. The isthmus of the thyroid body is drawn downwards; it is rarely necessary to divide it. The section should be carried out between two ligatures, each placed in a groove formed by the écraseur.

Third Stage : Division of the Trachea.—The cricoid cartilage is seized with two hooked forceps, and drawn upwards and forwards. The trachea is then attacked transversely, and the first ring is seized with a hooked forceps (Fig. 384). The section of the trachea is then completed, and we suture it to the skin. If the patient has been previously tracheotomized, the cannula is removed at this moment to be placed in the open orifice of the trachea, which has just been fixed to the lower part of the cutaneous incision.

Fig. 382.—Total Extirpation of the Larynx by the Retrograde Ascending Route.

First and second stages of the operation: Inclusive view.

Fourth Stage : Extirpation of the Larynx.—The cricoid cartilage is drawn upwards in such a way as to put the attachments of the inferior constrictors of the pharynx on the stretch. We then divide them from below upwards and on both sides, so that the organ is thus extirpated by the retrograde ascending route (Figs. 385, 386, and 387). The pharynx is not opened till the moment at which the instrument reaches the arytenoids. The superior orifice of the larynx, including therewith the epiglottis and the superior cornea of the thyroid cartilage, are lastly extirpated. We tie the bleeding vessels in proportion to their importance, especially the superior laryngeal, after having divided the thyro-hyoid membrane.

Fifth Stage : Repair of the Field of Operation. If we have been able to preserve the mucous membrane of the pharynx when dividing it at its laryngeal attachments, the repair can be effected with a transverse suture (Figs. 388 and 389). The skin is then sutured, leaving room below for a wick of gauze and two or three glass drainage-tubes.

This process of immediate reparation should be carried out only where the lesion has been limited to the laryngeal mucous membrane, and no glandular infection has occurred. Otherwise it is preferable to suture the

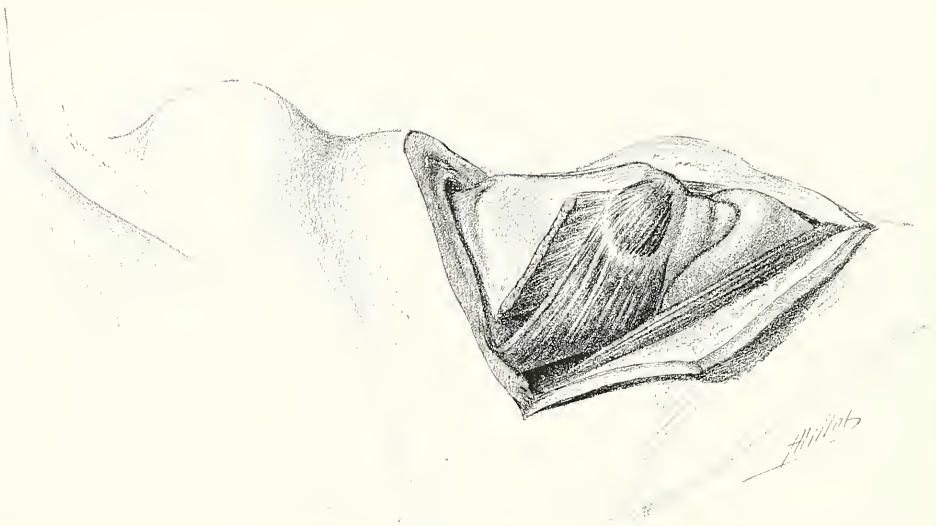


FIG. 383.—TOTAL EXTIRPATION OF THE LARYNX BY THE RETROGRADE ASCENDING ROUTE.

First and second stages of the operation: Incision of the soft parts, section of subhyoid muscles, and exposure of the isthmus of the thyroid body.

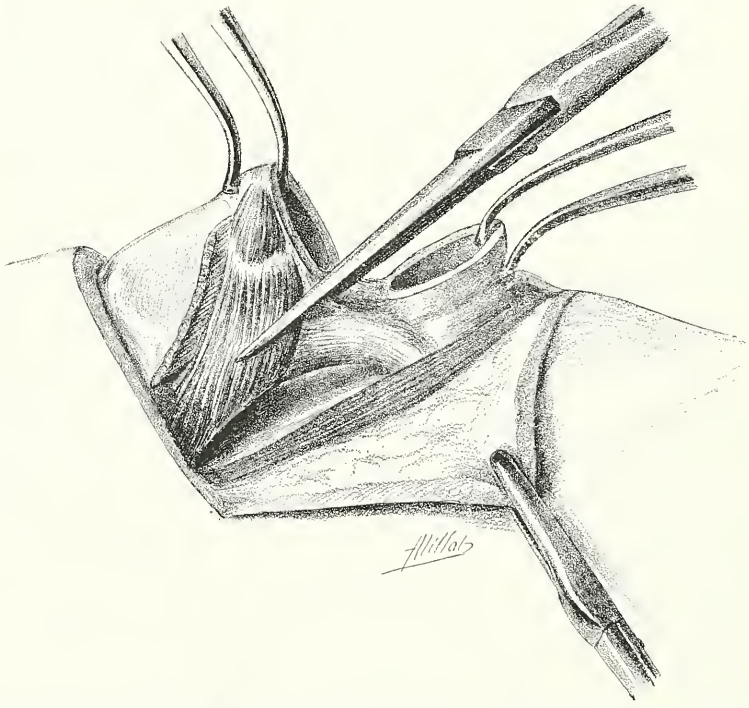


FIG. 384.—TOTAL EXTIRPATION OF THE LARYNX BY THE RETROGRADE ASCENDING ROUTE.

Third stage of the operation: Section of the trachea.

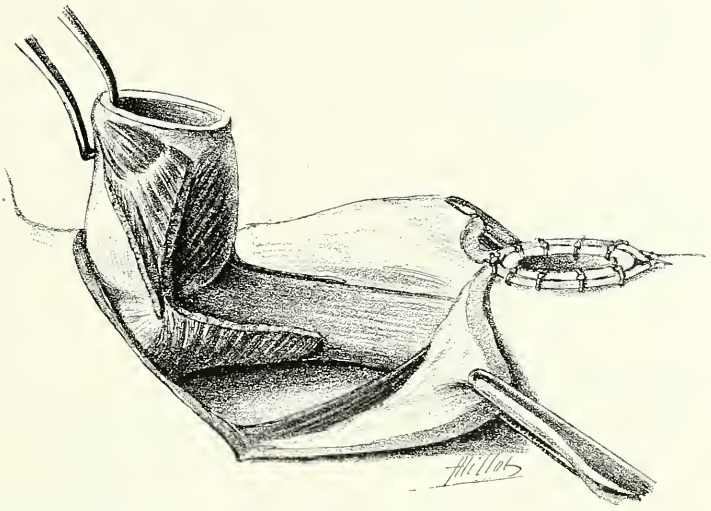


FIG. 385.—TOTAL EXTIRPATION OF THE LARYNX BY THE RETROGRADE ASCENDING ROUTE.

Fourth stage: The trachea has been sutured to the skin. The inferior constrictor of the pharynx has just been divided. The pharyngo-œsophageal mucous membrane is intact.

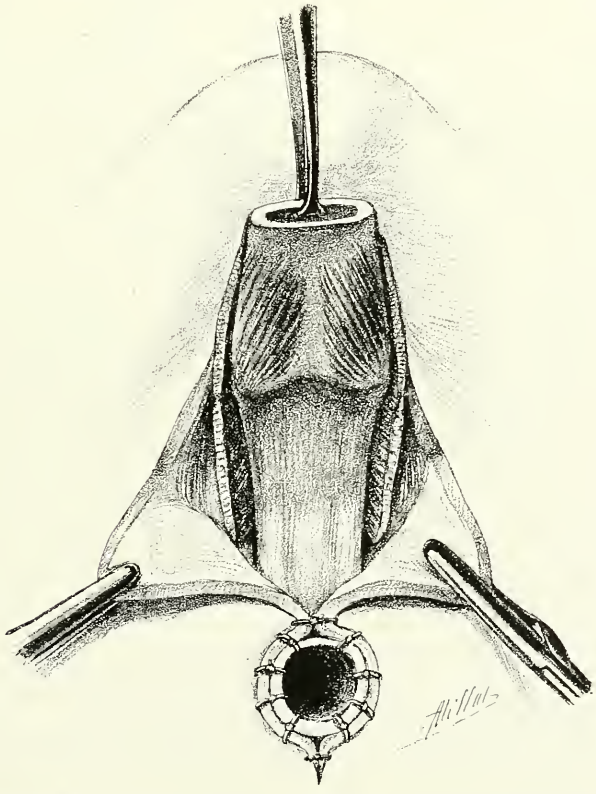


FIG. 386.—TOTAL EXTIRPATION OF THE LARYNX BY THE RETROGRADE ASCENDING ROUTE.

Fourth stage of the operation, seen from the front: We can distinguish the groove of insertion of the pharyngeal mucous membrane into the arytenoid mucous membrane.

mucous membrane to the skin, and treat the wound by tamponing, so as to be able to watch for a possible recurrence. The suture of mucous membrane

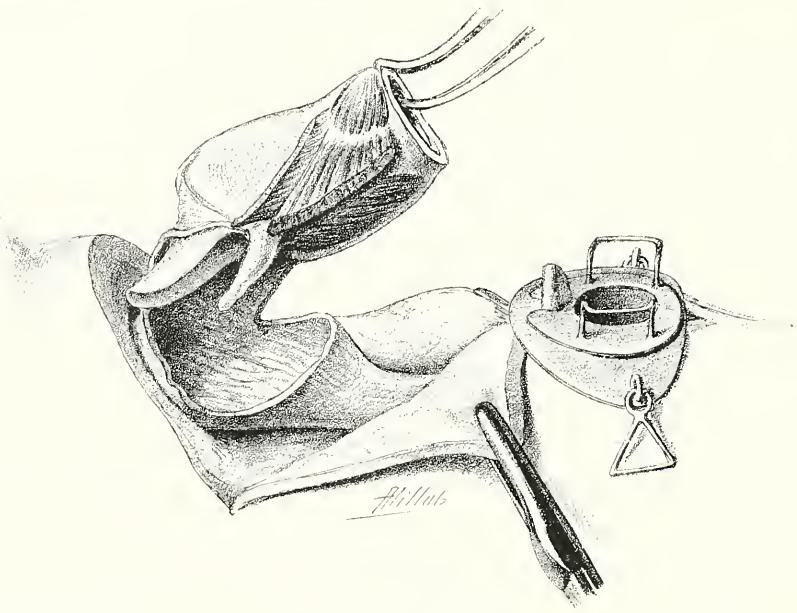


FIG. 387.—TOTAL EXTIRPATION OF THE LARYNX BY THE RETROGRADE ASCENDING ROUTE.

Fourth stage of the operation: Section of the mucous membrane of the pharynx at its laryngeal insertion.

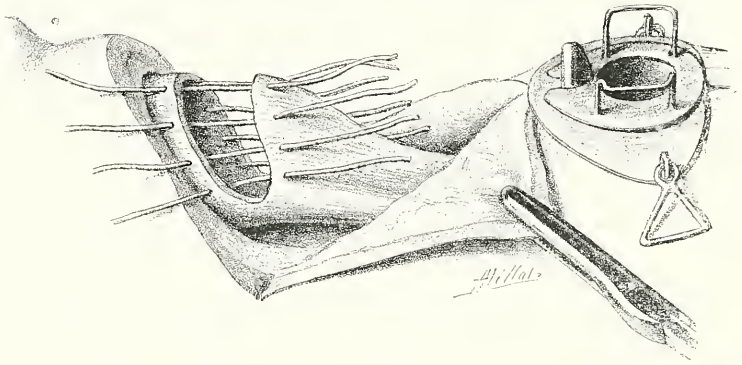


FIG. 388.—TOTAL EXTIRPATION OF THE LARYNX BY THE RETROGRADE ASCENDING ROUTE.

Fifth stage of the operation: Placing of the stitches in suture of the pharyngeal mucous membrane.

to skin should be carried out in those cases in which the invasion of the anterior part of the pharyngeal mucous membrane has made resection of the same necessary for a great portion of its vertical extent (Figs. 390 and

391). We must be always ready to destroy the minutest particle of recurrent growth by thermic electro-coagulation.

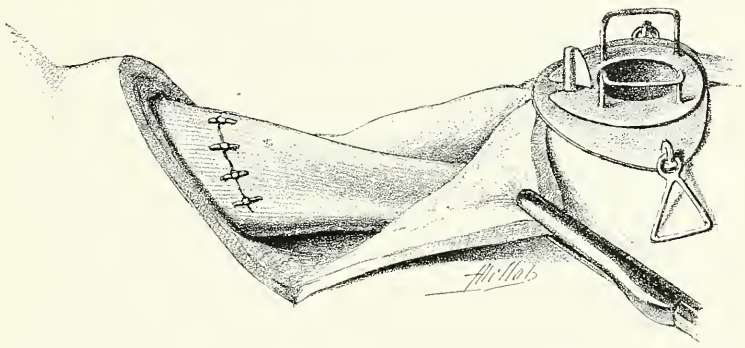


Fig. 389.—Total Extirpation of the Larynx by the Retrograde Ascending Route.

Fifth stage of the operation: Reunion of the anterior wall of the pharynx.

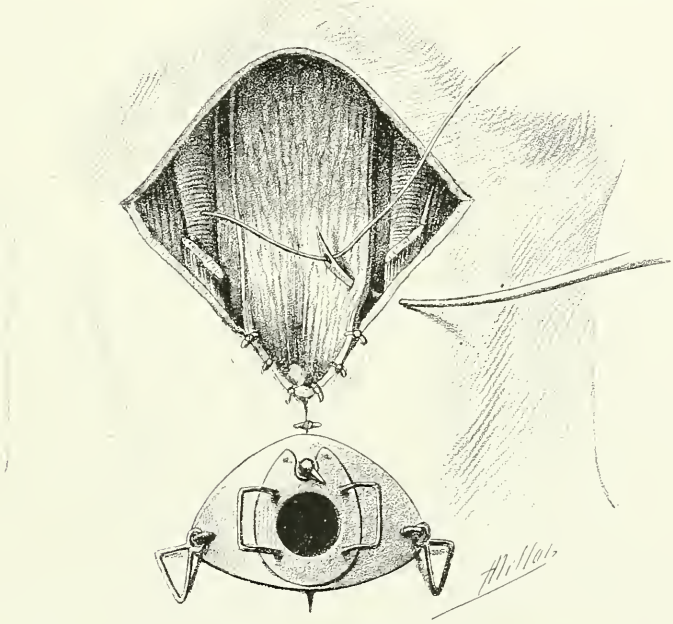


Fig. 390.—Total Extirpation of the Larynx by the Retrograde Ascending Route.

Fifth stage: The anterior wall of the pharynx has been resected. Suture of the posterior pharyngeal mucous membrane to the skin.

Combined Extirpation of Larynx, Base of Tongue, and Portion of Pharynx.—I have had the experience of being obliged to carry out simultaneous extirpation of the base of the tongue, larynx, and a portion of the pharyngeal

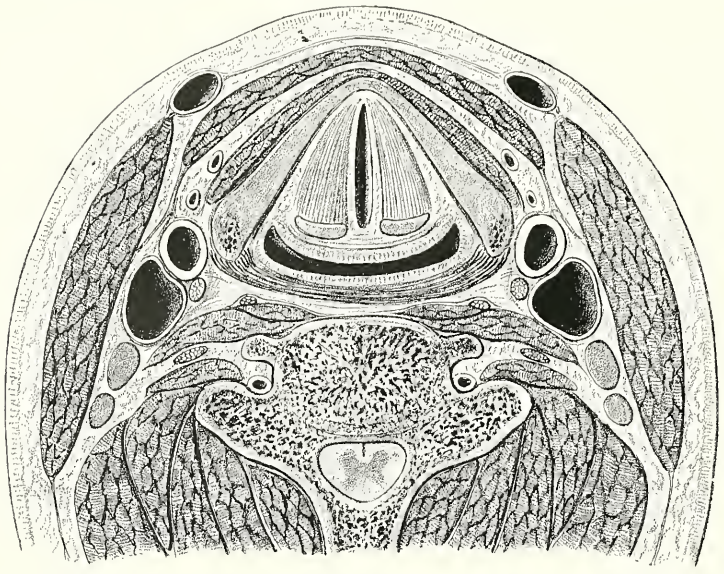


FIG. 391.—HORIZONTAL SECTION OF THE NECK, PASSING THROUGH THE FIFTH CERVICAL VERTEBRA AND THE VOCAL CORDS.

In the middle, and from before backwards, we meet in succession with superficial cervical aponeurosis, subhyoid muscles, thyro-hyoid muscles, thyroid cartilage, thyro-arytenoid muscles, thyroid constrictor, prevertebral plane. Laterally, the external jugular vein, sterno-cleido-mastoid muscle, common carotid artery, internal jugular vein, pneumogastric nerve, great sympathetic, scaleni muscles, brachial plexus, retro-carotid glands.

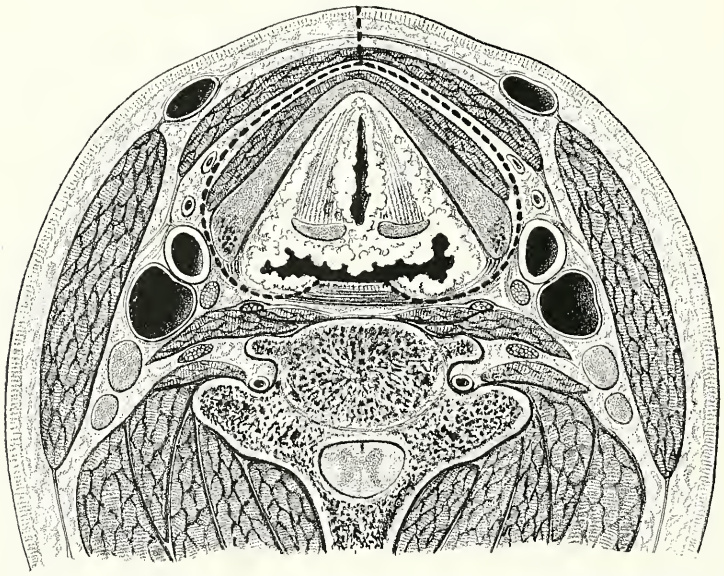


FIG. 392.—HORIZONTAL SECTION OF THE NECK, PASSING THROUGH THE FIFTH CERVICAL VERTEBRA AND THE VOCAL CORDS.

The dotted line indicates the outline of the incision necessary for extirpation of a cancerous larynx, with invasion of a portion of the mucous membrane of the mid-pharynx.

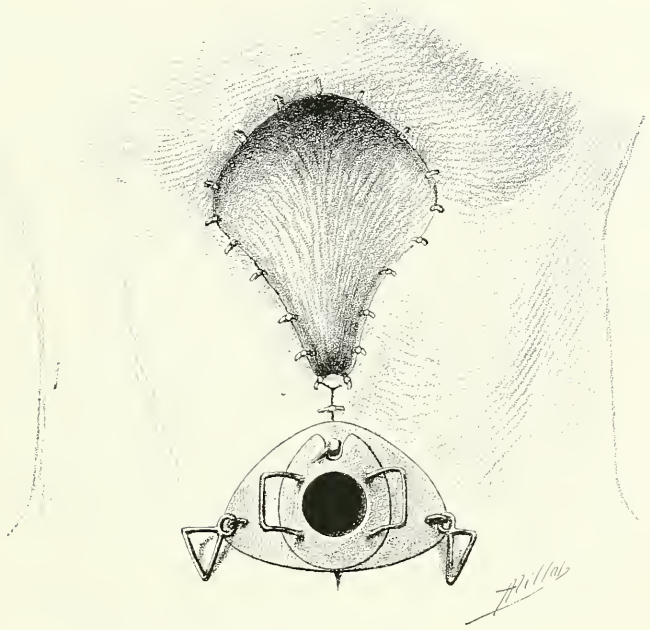


FIG. 393.—HORIZONTAL SECTION OF THE NECK, PASSING THROUGH THE FIFTH CERVICAL VERTEBRA AND THE VOCAL CORDS.

Fifth stage: Appearance of field of operation after complete reunion of mucous membrane to skin.

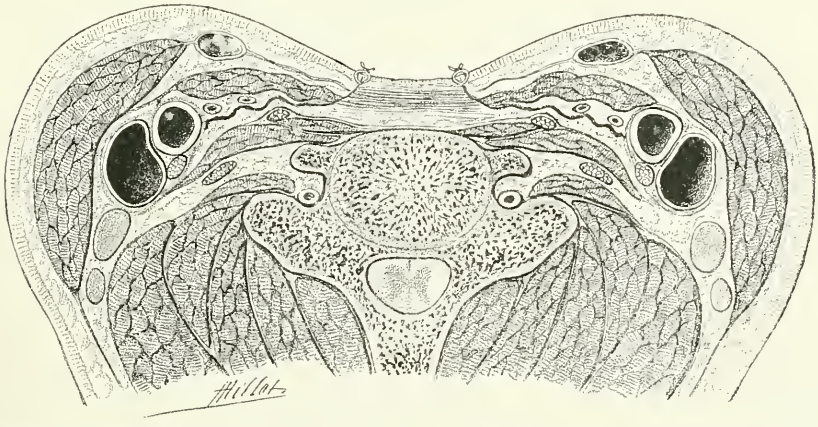


FIG. 394.—HORIZONTAL SECTION OF THE NECK, PASSING THROUGH THE FIFTH CERVICAL VERTEBRA AND THE VOCAL CORDS.

Reunion of wound. Suture of skin to median band of mucous membrane.

mucous membrane. The extent of the lesion is represented in Figs. 394 and 392. In Fig. 395 a dotted line indicates the position of the incision necessary for the complete extirpation of the larynx and greater portion of the pharyngeal mucous membrane invaded by epithelioma. I afterwards treated the field of operation by application of heat. Recurrence took place.

but only after the lapse of eighteen months. Fig. 396 represents the reparation of the wound of operation at the level of the same horizontal plane. Figs. 395 and 396 represent, in vertical incision, the same case before and after the operation.

Operation—*First Stage.*—T-shaped cutaneous incision, as for total extirpation of the larynx.

Second Stage.—Exposure of the larynx, division of thyroid isthmus, and subhyoid muscles.

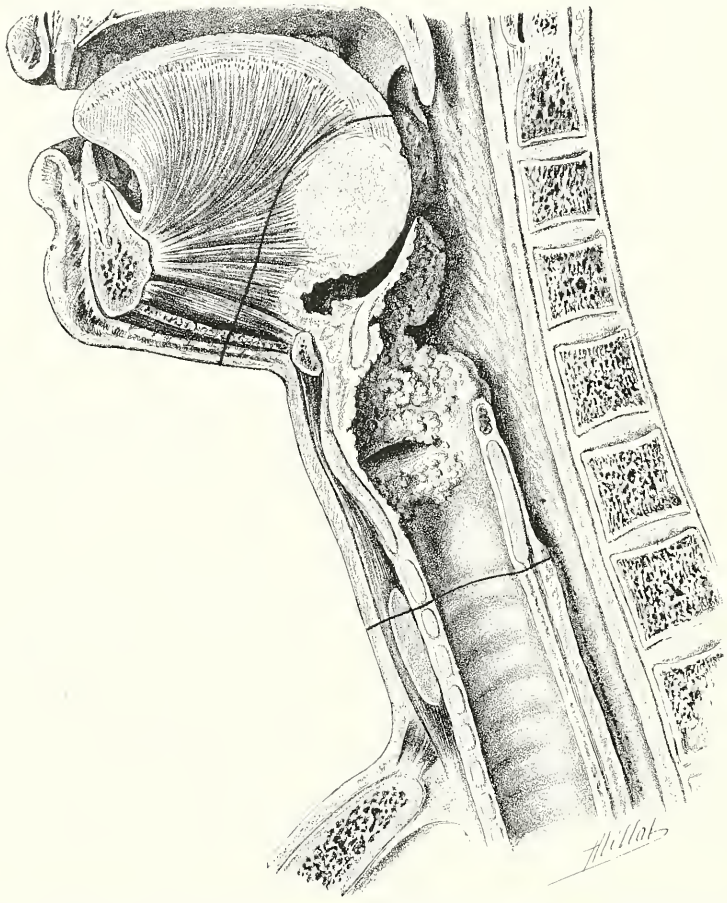


Fig. 395.—Cancer of Base of Tongue, involving Glosso-Epiglottic Groove, Epiglottis, and Laryngeal Mucous Membrane.

The two lines indicate the extent of the operation.

Third Stage : Section of Trachea.—The cricoid cartilage is seized with a hooked forceps; the trachea is divided transversely and sutured to the skin, as above indicated. The tracheal cannula is adjusted.

Fourth Stage : Extirpation of the Larynx.—The larynx is extirpated by the retrograde ascending route. The pharyngeal mucous membrane is in great part extirpated.

Fifth Stage : Extirpation of the Base of the Tongue.—When the larynx has been extirpated, we find the base of the tongue profoundly involved as far as the upper border of the hyoid bone. This excavation, which is represented in Fig. 395 as well as the massive tumour which surmounted it, was not visible in the laryngoscopic mirror. The hyoid bone is extirpated

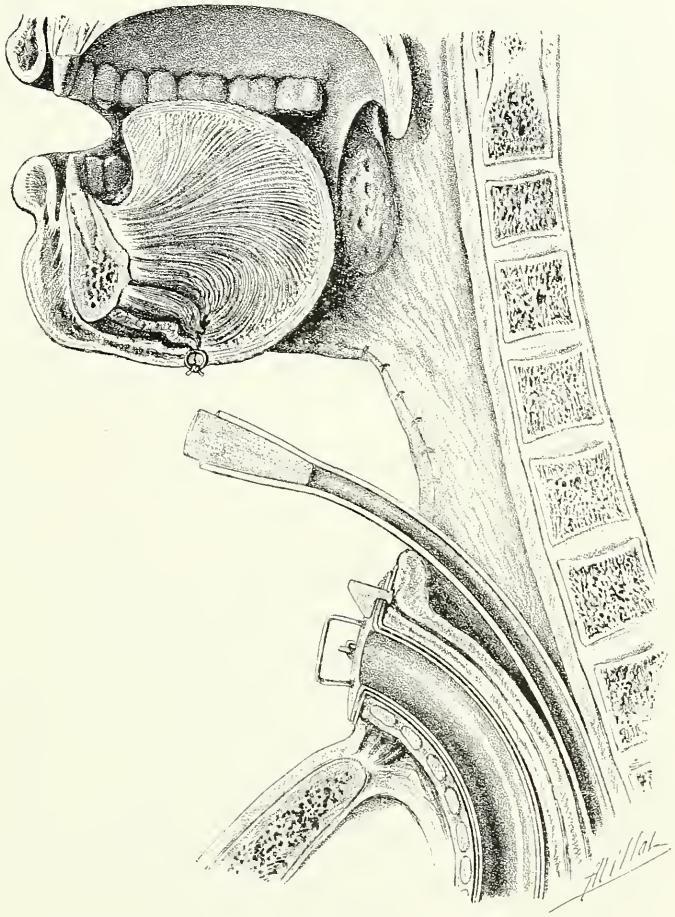


Fig. 396.—Cancer of Base of Tongue, involving Glosso-Epiglottic Groove, Epiglottis, and Laryngeal Mucous Membrane.

The operation has been finished. Reunion of the lingual and bucco-pharyngeal mucous membranes to the skin.

as well as the portion of the base of the tongue, which is limited by the bordering line represented in Fig. 395. Hæmostasis is carried out every time that a vessel bleeds. The only important arteries are the two linguals, which are tied quite close to their respective origins. This operation was carried out while passing but a very little distance beyond the limits of the cancer.

Sixth Stage : Partial Aero-Cauterization—Reunion of Mucous Membrane to Skin.—All doubtful points were treated by aero-cauterization, while taking

FIG. 397.—EXTIRPATION OF BASE OF TONGUE, HYOID BONE, LARYNX, AND PART OF THE PHARYNGEAL MUCOUS MEMBRANE.

Result of operation: Front view.

FIG. 398.—EXTIRPATION OF BASE OF TONGUE, HYOID BONE, LARYNX, AND PART OF THE PHARYNGEAL MUCOUS MEMBRANE.

Profile view.

care to preserve material for a satisfactory reunion of mucous membrane to skin. The patient was treated by the antineoplastic method. Repair of the wound by pharyngoplasty will be subsequently described.

OPERATIONS ON THE PHARYNX.

Exploration of the Cervical Pharynx.—The cervical pharynx can be easily explored through the natural passages, either by direct examination or with the laryngoscopic mirror. But it is impossible to carry out important operations in this region through the buccal route. We shall see at a subsequent stage that it is necessary to attack this region through the lateral cervical route more particularly in cases of cancer of the lower part of the pharynx and of the glosso-epiglottic groove.

Traumatic Lesions.

Wounds of the cervical pharynx passing from without inwards are not grave when they do not involve the vasculo-nervous bundle. They may require incision and tamponing of the focus.

Inflammatory Lesions.

Lateral Pharyngeal Phlegmons.

As the retropharyngeal phlegmon of the region of the middle constrictor of the pharynx projects into the buccal cavity, so does the phlegmon of the region of the inferior constrictor bulge in the carotid region. The same happens in case of cold prevertebral abscesses occurring in the cervical region. These collections should be attacked when situated near the angle of the jaw from the front of the anterior border of the sterno-cleido-mastoid muscle. When, on the other hand, they point in the middle of the neck, they should be incised at the posterior border of the muscle.

The fact that intensive treatment by internal and hypodermic administration of mycolysine often succeeds in procuring the rapid resolution of acute abscesses should not be forgotten in presence of these cases. When pus collects, we must operate.

Operation—First Stage.—Cutaneous incision of 4 to 5 centimetres, either in front of or behind the sterno-cleido muscle, passing over the most prominent point of the purulent sac. When there is a diffuse swelling the incision should be made at the point most readily accessible.

Second Stage.—Incision of the superficial aponeurosis and exposure of the muscle, across which it may be well to pass in some cases. Incision of the posterior lamella of the cellular sheath, and recognition of the focus with the index-finger. It is easy to locate the position of the vasculo-nervous bundle by the arterial pulsations.

Third Stage.—Perforation of the focus with blunt-pointed scissors, which are introduced closed and opened in the act of withdrawing so as to enlarge the opening by divulsion. Evacuation of the pus.

Fourth Stage.—Toilet of the focus with sterilized compresses. Tamponing; drainage.

Malformations: Congenital and Acquired.

Strictures of the pharynx, whatever be their origin, are habitually treated with prothetic dilating apparatus. Surgical intervention is rarely indicated.

Tumours.

Benign Tumours.

I have met with many cases of pedunculated papilloma and submucous fibroma of the pharynx. Extirpation is carried out by section and cauterization of the pedicle in case of the former, and submucous enucleation by divulsion after longitudinal incision in case of the latter.

Malignant Tumours.

Malignant tumours, which are nearly always epithelial, are diffuse in almost all cases. They were long regarded as inoperable. Since 1908 I have obtained remarkable results in these cases from a combination of pharyngotomy and thermic electro-coagulation.

Technique of Pharyngotomy.

The pharynx may be opened either in the middle line or laterally. In median pharyngotomy the bistoury incises the thyro-hyoid membrane, as happens on some cases of attempted suicide with a razor. Laterally the pharynx should be entered either in the neighbourhood of the great cornu of the os hyoides, or lower down at the level of the larynx. Lateral pharyngotomy can be performed in the plane of the glosso-epiglottic groove by a small horizontal incision made parallel to the great cornu of the hyoid bone (Fig. 399). We open up but a small enough field by this incision.

The way of access is made much wider by a vertical incision along the anterior border of the sterno-mastoid, and just behind the above incision. The division of the mucous membrane is made in the former case above, in the latter below, the hyoid cornu. Finally we can enter the lower part of the pharynx at the beginning of the œsophagus by a vertical incision starting from the angle of the jaw, and ending over the margin of the sterno-mastoid at the level of the omo-hyoid muscle. I will here describe these three operations under the respective names of juxtahyoid, retrohyoid, and subhyoid pharyngotomy.

Median Subhyoid Pharyngotomy.

Operation—First Stage.—Horizontal incision of 6 to 7 centimetres over the middle of the thyro-hyoid space.

Second Stage.—Division of the aponeurosis of the subhyoid muscles and discovery of the thyro-hyoid membrane, in front of which are found some small lymphatic glands.

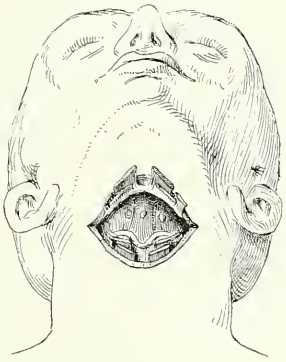


FIG. 399.—MEDIAN SUBHYOID PHARYNGOTOMY.

Second stage: General view.

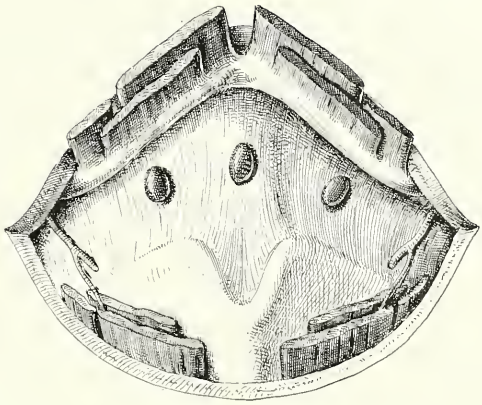


FIG. 400.—MEDIAN SUBHYOID PHARYNGOTOMY.

Second stage: Section of subhyoid muscles. Exposure of the thyro-hyoid membrane.

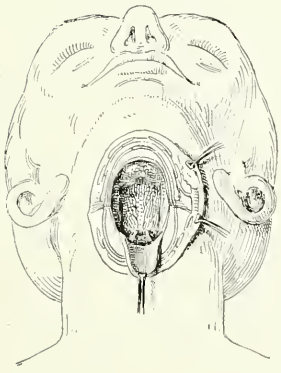


FIG. 401.—MEDIAN SUBHYOID PHARYNGOTOMY.

Third stage: General view.

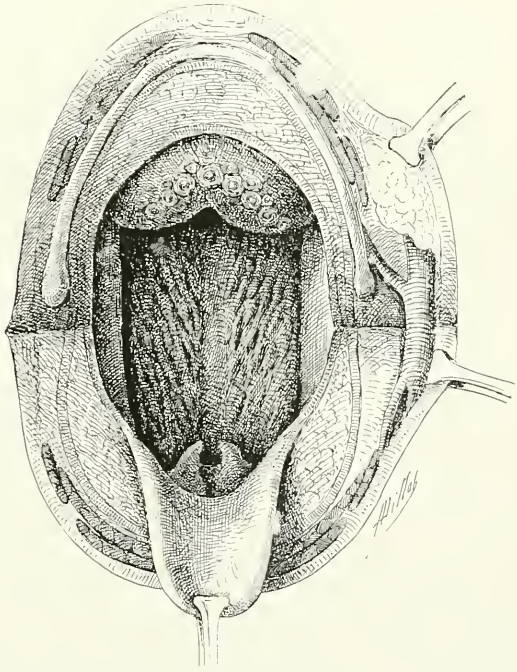


FIG. 402.—MEDIAN SUBHYOID PHARYNGOTOMY.

Third stage: From above downwards are seen—section of subhyoid muscles, hyoid bone, pre-epiglottic pouch, section of glosso-epiglottic mucous membrane, base of tongue, and posterior wall of pharynx. The epiglottis is drawn down with a hooked forceps, so as to show the arytenoid cartilages. On the left, the external carotid artery has been dissected out as it enters the parotid gland.

Third Stage.—Incision of the fibro-elastic membrane, with care to preserve the nerve and superior laryngeal vessels which pass through it. Section of the mucous membrane of the glosso-epiglottic groove and opening of the pharynx.

Fourth Stage.—Intrapharyngeal manœuvres. We proceed, according to the operative indications, to removal of the foreign body or to destruction of the neoplasm by the process of thermic electro-coagulation.

Lateral Juxtahyoid Pharyngotomy.

The goal of this operation is to reach the glosso-epiglotic groove and epiglottis. I have adopted it particularly for destruction of small sessile epitheliomata of that region by means of thermic electro-coagulation.

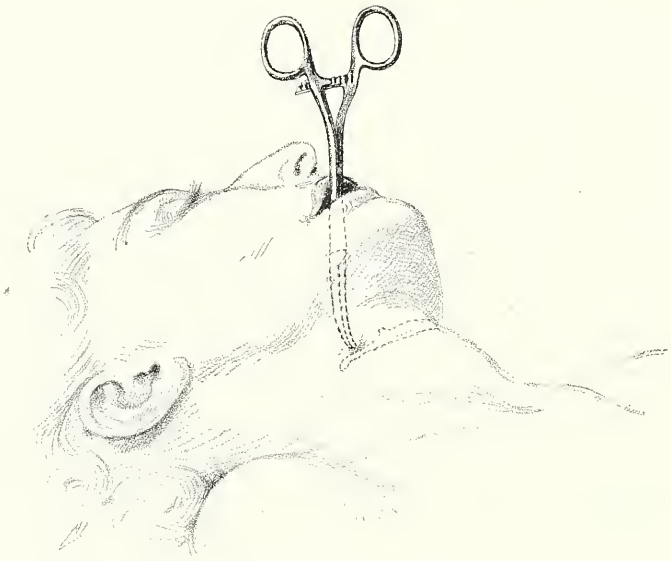


Fig. 403.—Lateral Juxtahyoid Pharyngotomy.

General sketch, first stage: The forceps, with long curved jaws, introduced by the mouth, projects above the great cornu of the hyoid bone.

Operation—First Stage.—The part at which the cutaneous incision should be made is brought into prominence by passing into the mouth a long curved forceps, the extremity of which is made to press on the lateral aspect of the pharyngeal mucous membrane above the extremity of the great cornu of the hyoid bone. Over the projection made externally by this forceps is made an incision of 3 centimetres parallel to the lower border of the lower jaw and in front of the margin of the sterno-mastoid muscle.

Second Stage.—The soft parts are perforated with the forceps from within outwards, the skin and subjacent tissues are incised, the handles of the forceps are forcibly divaricated so as to widen the orifice, and the surgeon introduces a strong blunt-pointed scissors between the jaws of the forceps

for the purpose of enlarging the wound a second time by divulsion in withdrawing the instrument.

Third Stage.—The upper and lower lips of the wound are respectively grasped with clawed forceps. We thus obtain the field of operation represented in Fig. 405. The epiglottis, glosso-epiglottic groove, and tongue are brought into view.

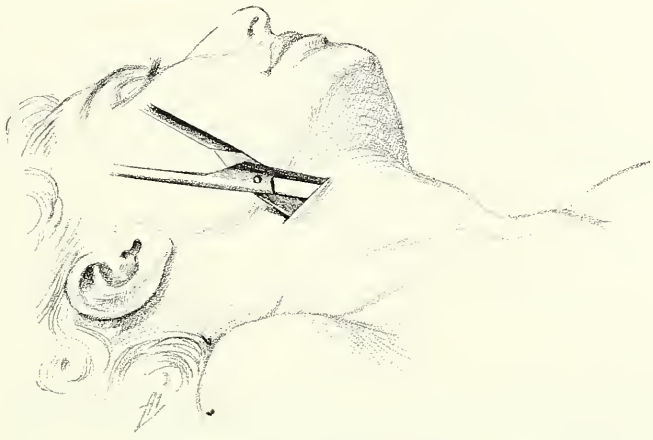


Fig. 404.—Lateral Juxtahyoid Pharyngotomy.

Second stage: The soft parts have been perforated with the forceps. The handles of the forceps are separated. The wound is enlarged by divulsion.

Fig. 405.—Lateral Juxtahyoid Pharyngotomy.

Third stage: General sketch. Wound produced by divulsion.

Fourth Stage.—Intrapharyngeal manœuvres. These are nearly always concerned with the destruction at its onset of a cancroid growth by bipolar voltaization. The pharyngeal mucous membrane is first united to the skin by interrupted suture. The lesion is brought into view with the help of a small wooden speculum; it is destroyed by thermic electro-coagula-

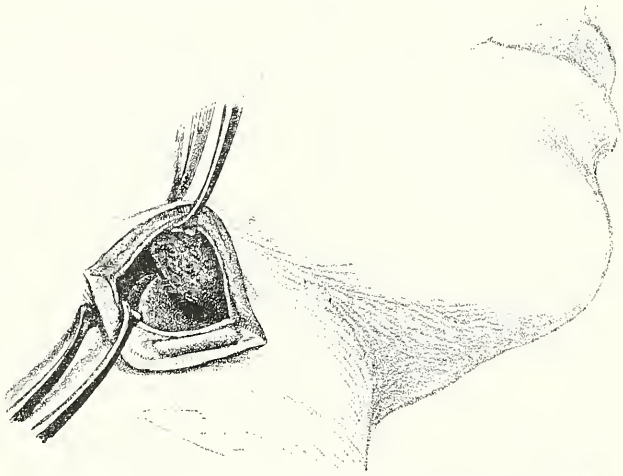


FIG. 406.—LATERAL JUXTAHYOID PHARYNGOTOMY.

The two hooked forceps which are used to separate the lips of the wound bring into view the glosso-epiglottic groove, epiglottis, and base of tongue.

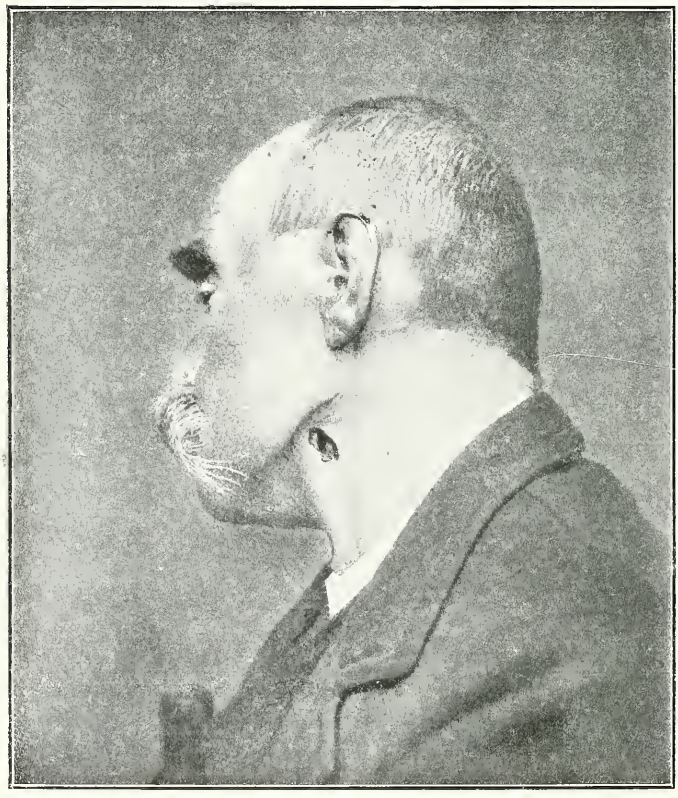


FIG. 407.—APPEARANCE OF WOUND MADE IN LEFT LATERAL PHARYNGOTOMY AFTER CICATRIZATION OF THE LIPS OF THE INCISION AND UNION OF THE MUCOUS MEMBRANE OF THE SKIN (EIGHT MONTHS AFTER OPERATION).

This patient had been successfully operated on by electro-coagulation of an epithelioma of the glosso-epiglottic groove.

tion, and the wound is treated by tamponing, and there remains as a result of the operation a button-hole orifice of 25 to 30 millimetres, which enables the surgeon to follow the progress of cicatrization, and again intervene if recurrence is threatened many months after the operation. Reparation of the wound is afterwards carried out, when the cure appears to be permanent.

Repair of the Wound.

Operation—First Stage.—Cutaneous longitudinal incision of 10 to 15 millimetres at the commissures.

Second Stage.—Vivification by unlining, by detaching the skin from the mucous membrane (see Treatment of Fistula, Vol. I.), which should be mobilized around the whole circumference.

Third Stage.—Reunion of the mucous membrane, with invagination of the epithelial margin, with interrupted, or in case of a very small orifice, with purse-string suture.

Fourth Stage.—Suture of skin, drainage.

Retro-Hyoid Pharyngotomy.

Operation—First Stage.—Vertical incision of 6 centimetres along the anterior border of the sterno-mastoid muscle, crossing at its middle the great cornu of the hyoid bone; second horizontal incision parallel to the great cornu and along its lower border.

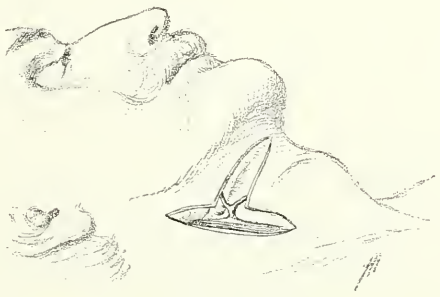


Fig. 408.—Retro-Hyoid Pharyngotomy.

General sketch.

Second Stage.—Incision of platysma and superficial cervical aponeurosis followed by ligature of the venous trunks which present themselves; notably the thyro-linguo-facial.

Third Stage: Opening of the Pharynx.—The thyroid constrictor is made to project below the great cornu of the hyoid bone on the extremity of a long forceps introduced through the mouth, the mucous membrane and muscle are perforated with this forceps, and the orifice is enlarged on divulsion. The lips of the wound, both mucous membrane and skin, are

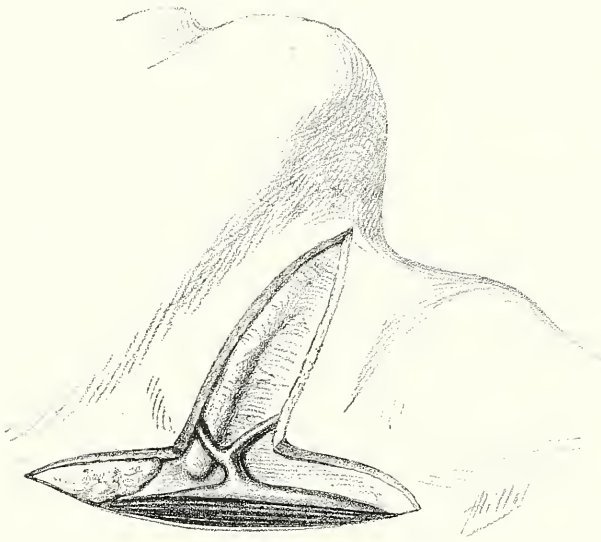


FIG. 409.—T-SHAPED INCISION OF INTEGUMENTS, EXPOSING ANTERIOR BORDER OF THE STERNO-CLEIDO-MASTOID, THYRO-LINGUO-FACIAL VEIN, AND PROJECTION OF HYOID BONE.

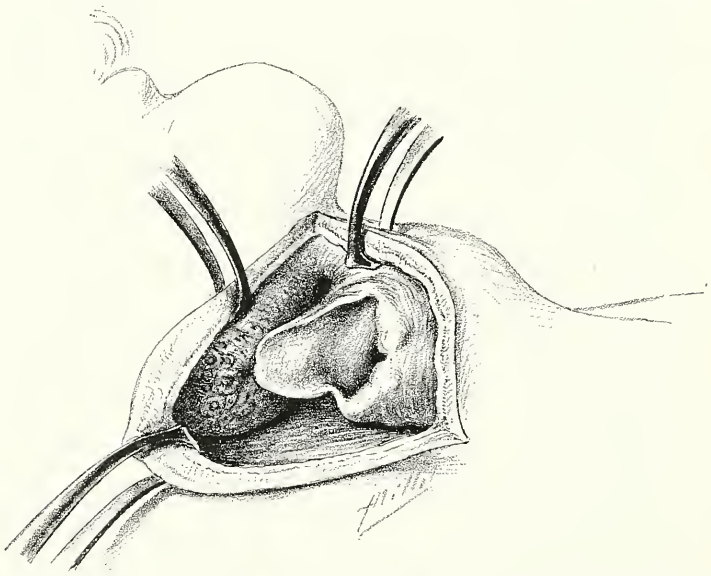


FIG. 410.—PREHENSION OF SKIN AND MUCOUS MEMBRANE WITH HOOKED FORCEPS, WHICH OPEN OUT THE WOUND FORCIBLY.

The laryngo-pharynx thus becomes easily accessible.

then grasped with a number of hooked forceps. In this way the whole base of the tongue and orifice of larynx are exposed (Fig. 135).

Fourth Stage: Intrapharyngeal Manœuvres.—Suppose a case of epithelioma of the inferior aspect of the epiglottis; the lesion is destroyed

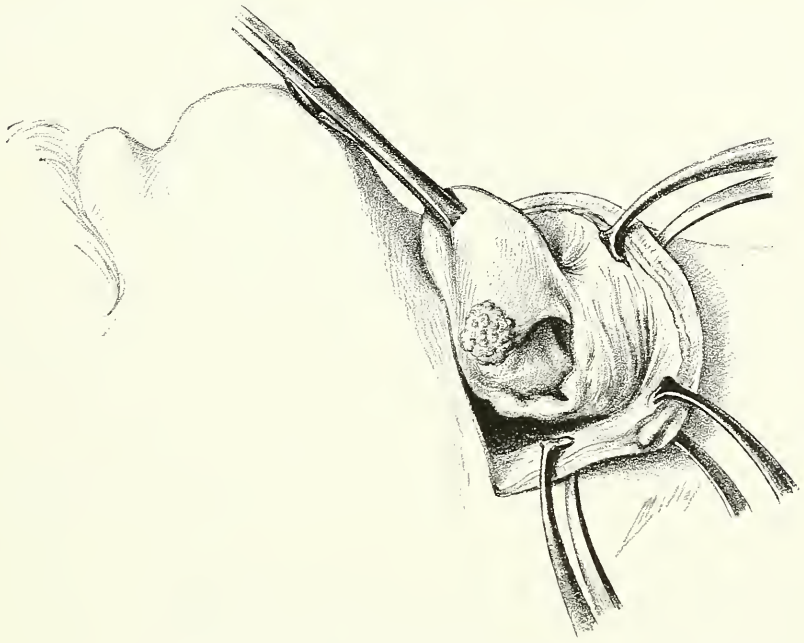


Fig. 411.—Prehension of Epiglottis with a Hooked Forceps.

We can partly exteriorize the larynx now, so as to intervene in the ventricular and even subglottic region. This is the route of selection for obtaining access to small pharyngo-arytenoid epitheliomata which have undergone a laryngeal evolution.

by the procedure of thermic electro-coagulation, after which care is taken to suture the mucous membrane to the skin, as in the preceding operation. The healthy tissues should be protected by using a wooden speculum. A silk thread is passed through the epiglottis when it is necessary to make traction thereon. We can reach tuberculous ulcerations on the orifice of the larynx by this route; they should then be treated by æro-cauterization.

Lateral Subhyoid Pharyngotomy.

Operation—First Stage.—The vertical incision adopted in ligature of the external carotid artery is made along the anterior border of the sterno-cleido-mastoid from the angle of the jaw to the first ring of the trachea.

Second Stage.—Incision of superficial cervical aponeurosis and exposure of inferior constrictor by divulsion below the vessels and superior laryngeal nerve in front of the carotid artery and ansa hypoglossi. The margin of the thyro-hyoid muscle is seen in front of the constrictor.

Third Stage: Opening of the Pharynx.—The pharyngeal wall is perforated from within outwards with a curved forceps, and the opening is enlarged by divulsion. We can divide the muscular fibres of the constrictor with the bistoury if they prove too resistant. We then grasp the mucous membrane and skin with hooked forceps both anteriorly and posteriorly.

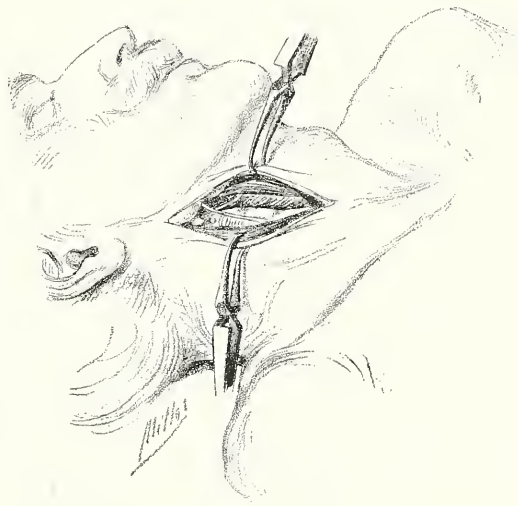


Fig. 412.—Lateral Subhyoid Pharyngotomy.

General sketch, first stage of the operation: Same incision as used for ligature of the external carotid artery.

Fourth Stage: Intralaryngeal Manœuvres.—The mucous membrane is sutured to the skin so far as we wish to preserve a permanent opening, and the diseased tissues are destroyed by thermic electro-coagulation. By prolongation of the incision downwards we can invade the whole of the cervical portion of the œsophagus.

Lateral subhyoid pharyngotomy is the best route of access to the epithelioma which is so frequent in this region, and which the process of thermic electro-coagulation enables us to destroy without fear of recurrence whenever the lesion is still localized. The wound is then treated by tamponing and placing an œsophageal sound in position. We proceed as above described in regard to the care of the wound and for its ultimate reparation.

Atypical Pharyngotomies.

In case of a pharyngeal epithelioma complicated with the presence of adenopathy of enormous extent, the primary incision is prolonged as far downwards as is necessary to permit thorough destruction of the neoplasm. Very extensive operations always produce considerable lacerations of tissue, and expose the patient to the danger of secondary hæmorrhage and of recurrence of the neoplasm.

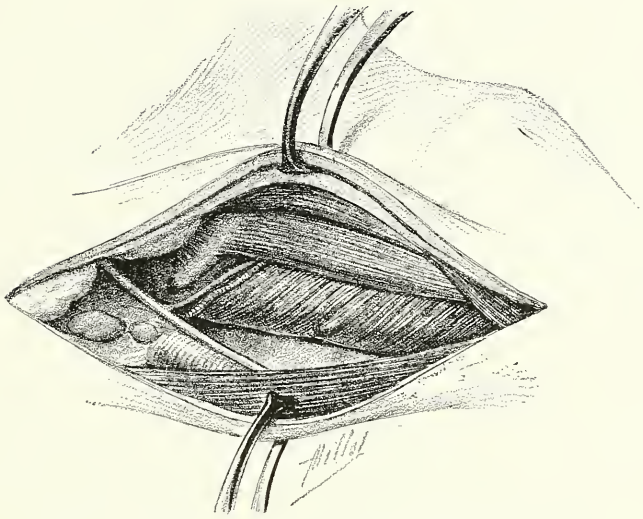


Fig. 413.—Lateral Subhyoid Pharyngotomy.

Second stage: On the left is seen the sterno-cleido-mastoid muscle, above the external carotid artery, descendens noni nerve, prevertebral plane, external laryngeal vessels, hyoid and thyroid constrictor, and subhyoid muscles.

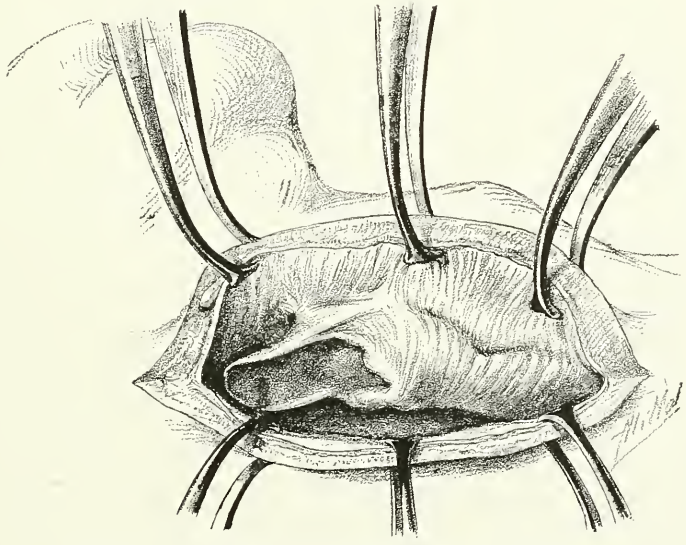


Fig. 414.—Lateral Subhyoid Pharyngotomy.

Third stage: The laryngo-pharynx has been incised beneath the superior laryngeal vessels, as far as to the level of the omo-hyoid muscle. The mucous membrane and skin have been seized with hooked forceps. The laryngo-pharynx appears here as the origin of the œsophagus. It is thus a veritable high external œsophagus, permitting to treat at their onset the extrinsic neoplasms of the larynx, which display an œsophageal evolution.

Pharyngoplasty.

We may have to repair the wound resulting from complete extirpation of the larynx and hyoid bone (Figs. 415, 416). Such reparations can be carried out in any of those cases only with the object of permitting deglutition through the buccal route; the patient must continue to retain the tracheal cannula.

Operation—First Stage.—A U-shaped incision circumscribing the œsophageal orifice (Fig. 415).

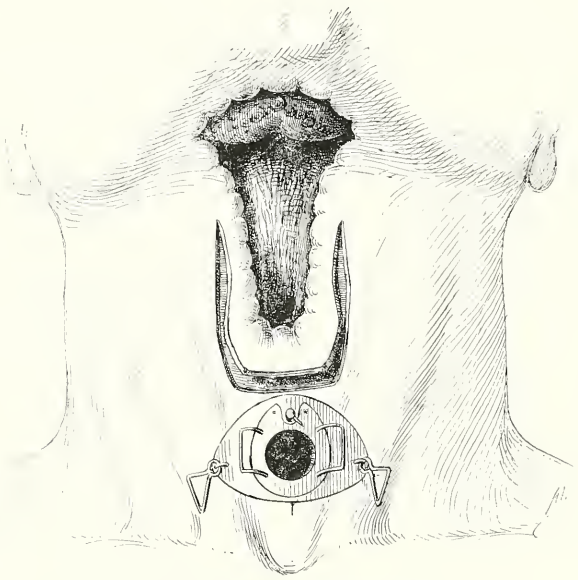


Fig. 415.—Pharyngoplasty.

First stage: Formation of inferior flap.

Second Stage.—The cutaneous flap raised after unlining is sutured to the lateral margins of the upper half of the wound. This suture retains on either side the margins of the cutaneous flap which is destined to form the anterior wall of the œsophagus.

Third Stage.—The lingual mucous membrane is detached from its line of union with the skin of the submental region, care being taken in the process to form a flap by the unlining process of sufficient dimensions to be sutured to the inferior cutaneous flap.

Fourth Stage.—Reunion by interrupted suture.

Fifth Stage.—The superficial wound is partially closed to the extent permitted by adaptation of the skin of the neck after making a number of lateral compensatory incisions.

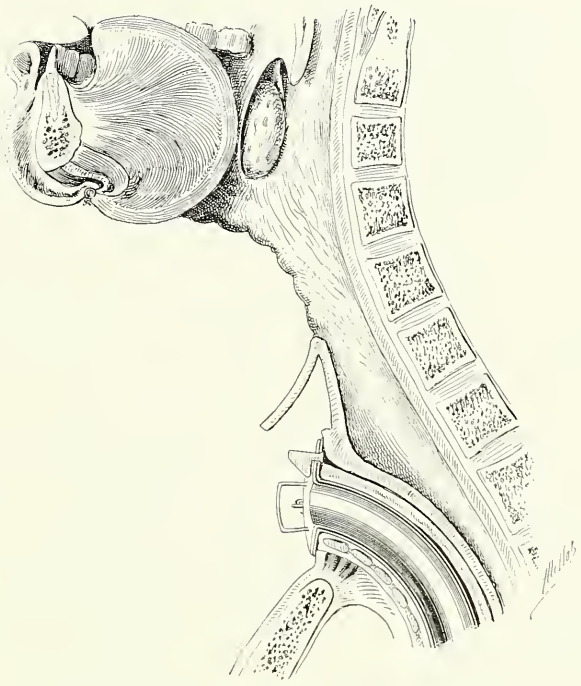


FIG. 416.—PHARYNGOPLASTY.

First stage: Diagrammatic section. Profile view.

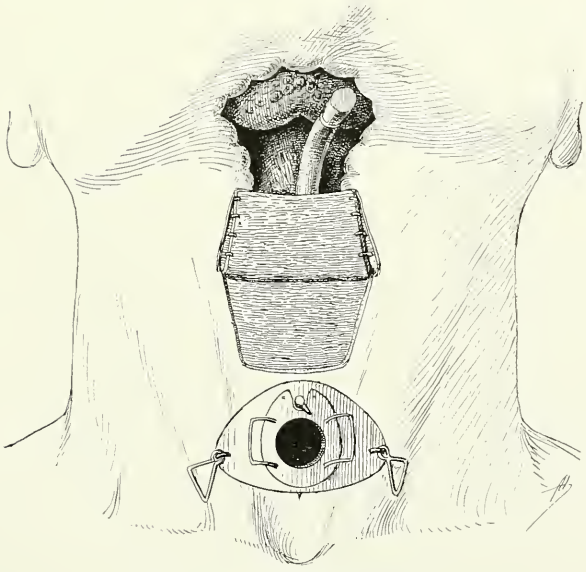


FIG. 417.—PHARYNGOPLASTY.

Second stage: Lateral suture and lateral reunion of cutaneous flap.

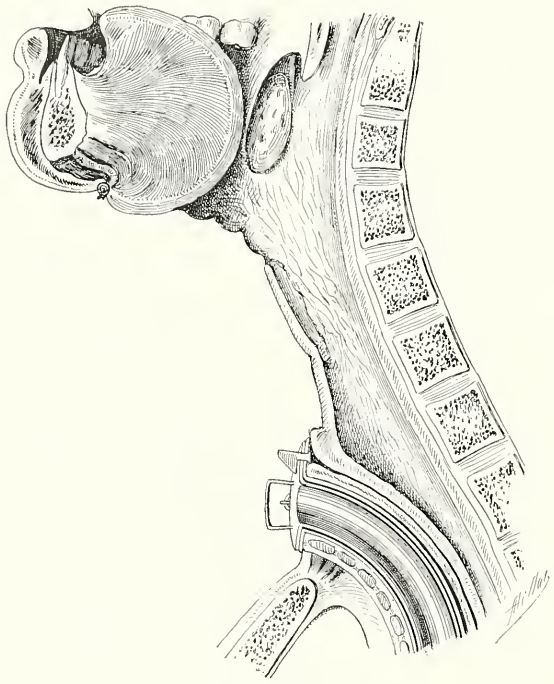


FIG. 418.—PHARYNGOPLASTY.

Second stage: Profile view showing reconstitution of the œsophagus.

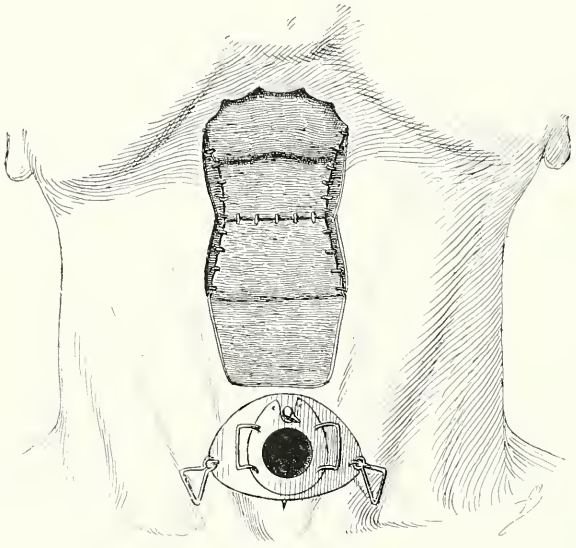


FIG 419.—PHARYNGOPLASTY.

Sixth stage: Reconstitution of the pharynx.

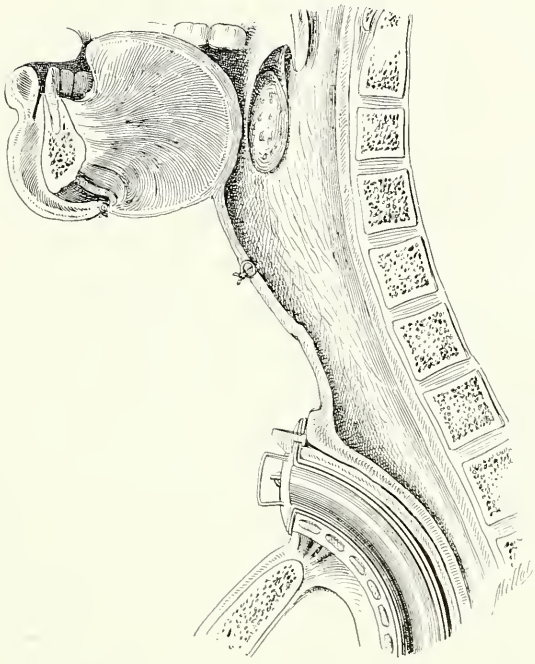


FIG. 420.—PHARYNGOPLASTY.

Sixth stage: Profile view showing the reconstitution of the pharyngo-œsophageal canal.

OPERATIONS ON THE ŒSOPHAGUS.

Exploration of the Œsophagus.—The distance between the dental arcade and the cricoid cartilage is 15 centimetres in the adult, and the length of the œsophagus being about 25 centimetres, the cardiac orifice is about 40 centimetres from the dental arcades. The œsophagus is accessible to palpation only in its cervical segment, which measures about 4 or 5 centimetres.

Exploratory Catheterism.—The instrument oftenest used for this purpose is a flattened metallic rod, to the extremity of which olives of various calibre may be attached. In case of stricture we may employ hollow bougies sliding on a conducting solid one. This guiding bougie is introduced along the left index-finger, which is made to depress the base of the tongue at the same time.

Dilating Catheterism.—When the œsophagus admits a sound of 6 to 8 millimetres, I prefer to employ conical bougies filled with small pieces of lead, and which penetrate readily by their own weight. Exploration of the œsophagus with olive-shaped and conical bougies should precede every other exploration. This exploration enlightens us regarding the calibre of the tube and the seat of stricture when such exists.

Œsophagoscopy.—Direct endoscopy of the œsophagus is carried out with the help of a straight metallic tube furnished with a mandril, and

into which is introduced a small electric lamp mounted on a stem of the same length as that of the tube. The œsophageal endoscope may be introduced either with the patient in the position of dorsal decubitus, or in that represented in Fig. 421, the patient being seated on a stool. If the upper incisor teeth form an obstruction to the passage of the endoscope, it will suffice to turn the head of the patient a little and pass the tube between the molars. When the subject is refractory, recourse to general anæsthesia is indispensable.

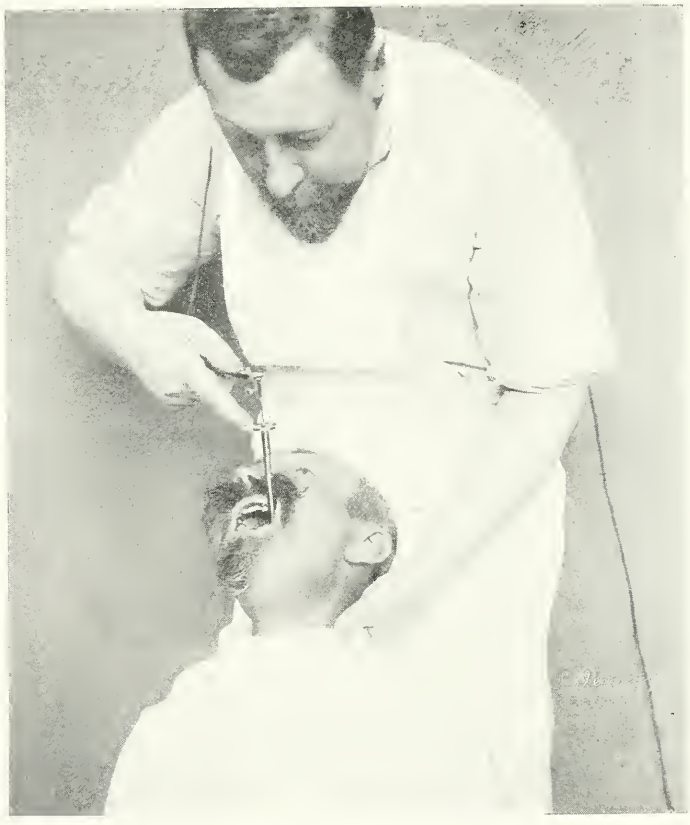


Fig. 421.—Direct Œsophagoscopy without Previous Anæsthesia.

After the tube has cleared the cricoid cartilage, it passes readily to the cardia if there is no intervening obstacle. The aspect of the mucous membrane and the physiological narrowings of the tube are readily perceived.

Endoscopy of the œsophagus is within practical range of all surgeons, and is wrongly made a speciality.

Radioscopy and Radiography.—Diverticula of the œsophagus and the dilatations of that tube, which often form above strictures, are perfectly recognizable by the help of the X rays, on condition of previous introduction

into the œsophageal lumen or diverticulum or dilated portion of the tube a sound of red caoutchouc filled with mercury, or with a paste of carbonate of bismuth.

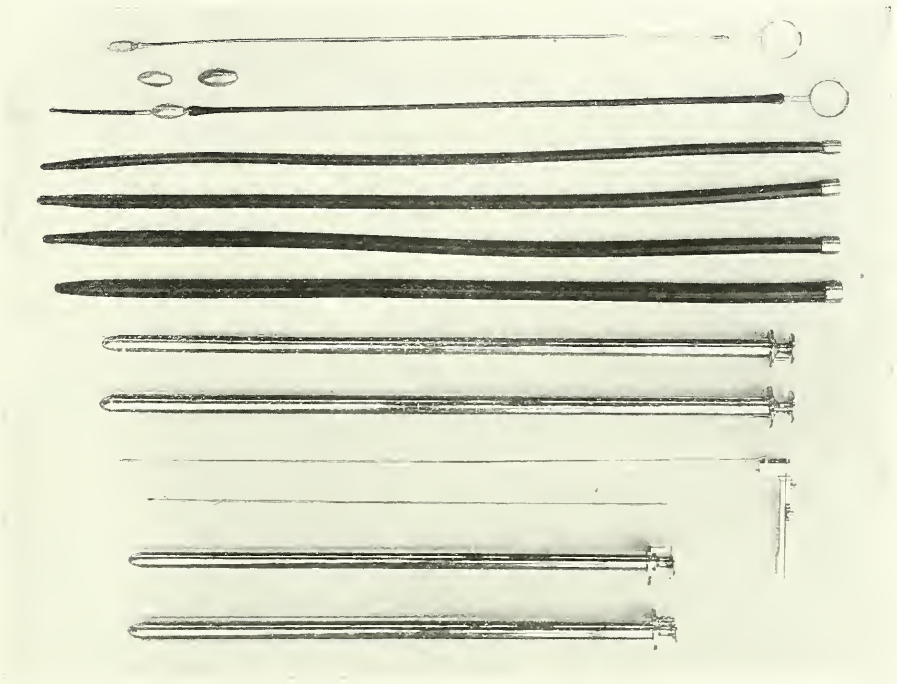


Fig. 422.—Instruments used in Exploratory Catheterism and Endoscopy of the Œsophagus.

From above downwards: Œsophageal catheter with bulb. The series of bulbs should include two graduated bulbs of 15 to 16 millimetres in diameter. The author's bougie-guides are screwed on the lower extremity of the bulb. A series of conical sounds of 8, 10, 12, and 14 millimetres diameter, respectively, and 35 centimetres in length, filled with small shot to facilitate their introduction. Beneath these: Two tubes for endoscopy of the lower third of the œsophagus, of 12 and 14 millimetres diameter, respectively, and 35 centimetres in length; and a lamp-holder, on which is mounted a lamp-holding rod of the same length. Lowest: A shorter lamp-holding rod, and two œsophagoscope tubes of 12 and 14 millimetres respective diameter and 25 centimetres in length, for exploration of the two upper thirds of the tube.

Traumatic Lesions.

Wounds.

Wounds of the œsophagus may occur from without inwards in cases of wounds of the neck. If liquids escape from the wound during the act of swallowing, a tube must be placed in the œsophagus and the wound tamponed. Suture may be tried if suppuration has not been established. We reach the œsophagus from the side of the wound by a longitudinal incision analogous to that adopted for external œsophagotomy. A urethral

sound (Nos. 16-20) may be introduced through one of the nostrils, and passed down to the thoracic part of the œsophagus, then left in place for six to eight days.

Foreign Bodies.

Foreign bodies are of very varied nature. The most dangerous are those such as dental plates, which are at the same time voluminous, rigid, and of irregular form, with prominent angles.

Extraction of Foreign Bodies of Soft Consistence—Graefe's Panier.—Foreign bodies, when *soft or rounded* (such as coins), can be extracted with the help of Graefe's panier, or pushed down into the stomach with the sponge which is usually fixed at the extremity of the stem which bears it in case of a sharp-pointed substance. This instrument may, however, become fixed above the foreign body, so that it cannot be extracted.

Kirmisson's Crotchet.—Professor Kirmisson has devised an instrument in crotchet shape, with the object of replacing Graefe's panier. This presents the advantage of being easily withdrawn after rotation on its axis through 180 degrees, when the foreign body is implanted in the œsophageal wall. This crotchet is a better instrument for the purpose than Graefe's panier.

Extraction of Foreign Bodies with the Aid of the Endoscope.—The endoscope-tube is introduced cautiously, and the mandril is removed as soon as it has cleared the cricoid cartilage. It is then pushed on by degrees till the foreign body is reached. This is then seized with a suitable long forceps, and extracted while withdrawing the tube in case of a soft substance. When the body is hard and pointed, as in case of a dental plate, it may be necessary to use an elliptical endoscope of large diameter (16 to 18 millimetres), in order to be able to detach and tilt it so as to bring the smoother aspect to the upper side. When the foreign body cannot be extracted, it can be pushed downwards into the stomach, whence it may easily be removed by gastrotomy.

Inflammatory Lesions.

Œsophagitis : Acute and Subacute.

Œsophagitis is nearly always consecutive to a burn or the lodgment of a foreign body. It frequently ends in stricture of the tube, and thus leads to chronic or cicatricial œsophagitis.

Peri-Œsophagitis.

Peri-œsophageal abscesses are always of very grave import, whatever be the cause—deep wound of the neck, perforation of the œsophagus from within outwards, cancerous or other ulceration of the œsophagus. The prognosis is grave, because the pus, which is of eminently septic quality, passes very soon into the posterior mediastinum. The accidents of this condition should be combated by hypodermic injections of mycolysine, which should be repeated once or twice daily during the whole of the acute period.

Operation.—Free incision of the focus, following the same route as for external œsophagotomy (see description of that operation), and tamponing of the wound. Œdema of the glottis, a result of juxtaposition, may necessitate tracheotomy.

Malformations: Congenital and Acquired.

Congenital Malformations.

Atresia of the Œsophagus.

This malformation, which is usually accompanied with œsotracheal fistula, is not compatible with life.

Diverticula of the Œsophagus.

Diverticula of the œsophagus appear to be of congenital origin. They nearly always make themselves conspicuous in adult age, when the pouch has become sufficiently dilated. We recognize the presence of a diver-

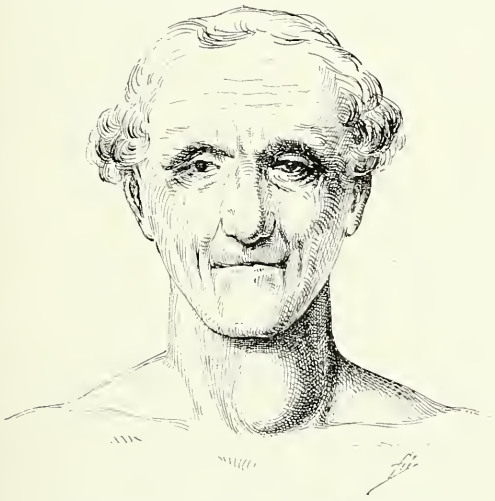


Fig. 423.—Diverticulum of the Œsophagus.

Aspect of the region when the pouch is filled after ingestion of food.

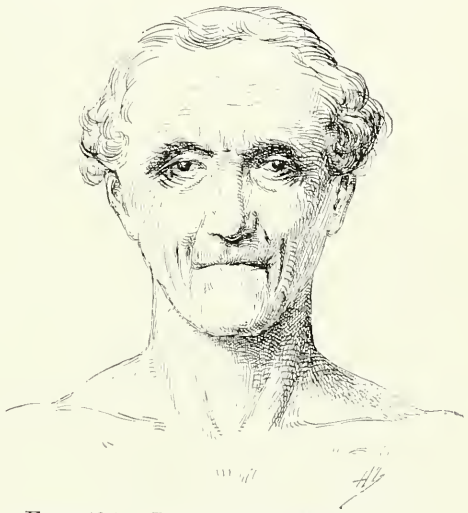


Fig. 424.—Diverticulum of the Œsophagus.

Aspect of the region when the contents of the pouch have been evacuated.

ticulum by the appearance of a fluctuating latero-laryngeal tumour, which the patient himself empties by pressure. Figs. 423 and 424 represent a diverticulum of the œsophagus on the left side. In Fig. 423 the pouch is full; in Fig. 424 it has just been evacuated.

Operation—First Stage.—Longitudinal incision and aponeurosis along the border of the sterno-cleido-mastoid, and exposure of the pouch, which has been designedly filled before the operation or made prominent by the introduction of the extremity of a long, curved forceps.

Second Stage: Removal of the Pouch.—Denudation of the pouch by divulsion with blunt-pointed scissors. It is then drawn out through the wound, and the pedicle is crushed. The large écraseur is used, and is left tightly closed for three to four minutes. We then cut along the groove which it forms, the tissues of which have been reduced to a parchment consistence, and proceed to extirpate the diverticular pouch.

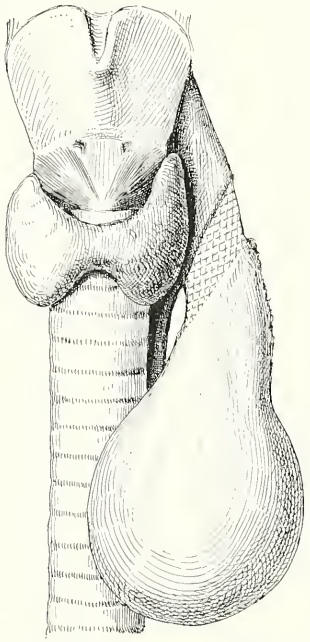


Fig. 425.—Diverticulum of the Œsophagus.

Operation: Diagrammatic scheme demonstrating the extirpation of the pouch by the method of crushing, followed by invagination of the lips of the wound with continuous or purse-string suture.

Third Stage: Suture of the Œsophagus.—The margins of the wound are invaginated in the lumen of the œsophagus, and it is then closed with a double purse-string suture (see Vol. I.) when the orifice is small, and by double superposed continued silk sutures when the opening is too large.

Fourth Stage.—Reunion of skin; drainage.

Acquired Malformations.

Stricture of the Œsophagus.

The cicatricial strictures of great extent which form after swallowing corrosive substances are beyond the reach of art. Cancerous strictures are the most frequent. We rarely meet a case of stricture of the œsophagus after the age of thirty-five, where there is no history of a possible cause that is not of cancerous nature. Stricture of the œsophagus is preferably

treated by dilatation or electrolysis. Then, in cases where the presence of cancer is dreaded, antineoplastic vaccination should be carried out. This procedure has succeeded in many cases in my own practice.

Progressive Dilatation.—This process is preferably carried out with a graduated series of conical bougies, of 4, 6, 8, 10, 12 and 14 millimetres in diameter; the three largest numbers should have a turn of a screw-thread at the extremity for adaptation of a guiding bougie. These bougies, as I have had them constructed, are filled with shot or mercury; their weight, accordingly, makes them penetrate much more easily. Dilatation of œsophageal strictures should be carried out with great gentleness, so as not to produce lacerations.

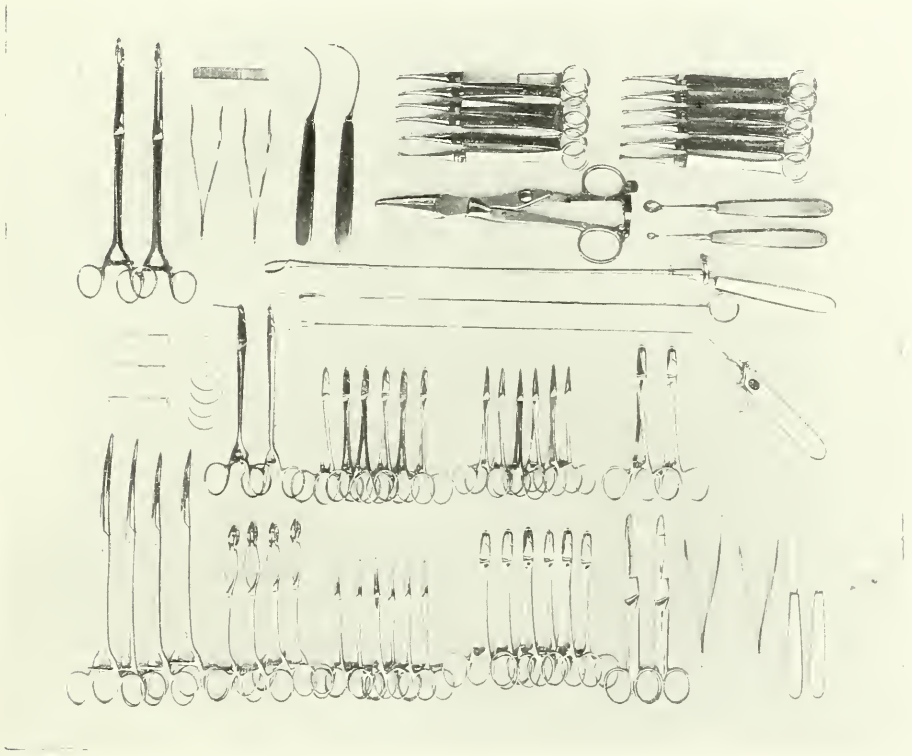
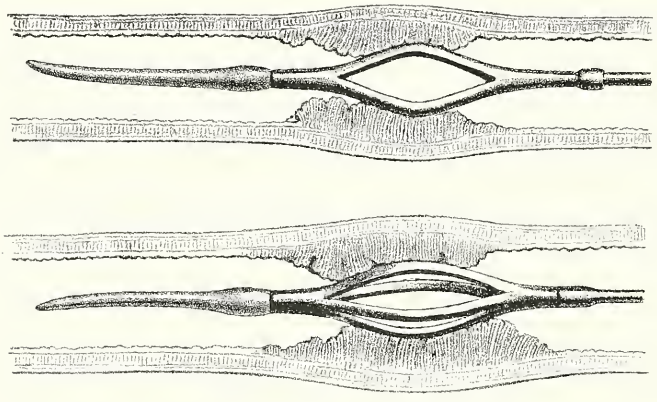


Fig. 426.—Instruments used in External Œsophagotomy, and for the Extraction of Foreign Bodies in Cases in which Attempted Removal by the Natural Passages has failed.

From right to left, and from below upwards: Two bistouries; two clawed forceps; two strong straight scissors; six short-jawed clawed forceps; six ring-handled forceps with oblique claws; four forceps with oval jaws; six long curved forceps. Above: two short forceps for veins: six Champonnière's small hæmostatic forceps; six needle-holder forceps with short hollowed jaws; two needle-holder forceps with eccentric plate; various forms of needle with divided eyelet; three glass drainage-tubes. Highest: Two forceps for foreign bodies, and one Kirmisson's crotchet; two curettes; one écraseur, smaller form; twelve hooked forceps; two needles mounted on handles; two clip-holder forceps, and twenty-five metallic clips; two long forceps with oval eccentric jaws.

Electrolysis.—Electrolysis of the œsophagus is carried out with a special fenestrated sound of lozenge outline of form, which is borne on a flat conductor. This form of sound penetrates in many cases in which cylindrical bougies fail to pass. The positive electrode, which is formed by a flat metallic plate covered with tarlatan soaked in a tepid 1 per cent. saline solution, is placed in contact with the skin of the dorsal region. We press gently on the sound, and pass a current of 30 or 40 milliampères. When the lozenge-shaped electrode has penetrated, we withdraw it gently and cut off the current. Strong pressure is then not necessary to make the electrolytic sound to pass. This procedure should be repeated every week or every fortnight so long as it is found to be necessary. Generally speaking, there is no use in passing a sound during the interval.



FIGS. 427 AND 428.—LOZENGE-SHAPED ELECTROLYZERS, SINGLE AND (FIG. 428) DOUBLE WINDOWED, PASSING THROUGH A NEOPLASTIC STRICTURE.

LOZENGE-SHAPED ELECTROLYZER WITH DOUBLE WINDOW.—When the lozenge-shaped electrolyzer with single window passes readily, we employ the form with double window, the passage of which traces four parallel grooves instead of the two made in the former case.

Tubage of Œsophageal Stricture.—We can introduce a celluloid tube, with upper rim furnished with a solid silk thread, in certain cases of stricture. This tube is conveyed with the aid of a conical bougie, on which is introduced a flexible metallic tube coiled in spiral form, which serves to maintain the œsophageal tube in position when we are withdrawing the bougie.

External Cervical Œsophagotomy.—External cervical œsophagotomy is indicated in various classes of cases. I have adopted it in order to reach cancers of the cervical segment of the œsophagus, and also for extraction of pointed foreign bodies, before proceeding to direct œsophagoscopy.

OPERATION—*First Stage.*—Longitudinal incision at anterior border of left sterno-mastoid muscle, from cricoid cartilage to near clavicle.

Second Stage.—Exposure of the anterior border of the muscle and lateral lobe of the thyroid body, which is immediately isolated from the vasculo-

nervous sheath with the help of the index-finger, which plunges in as far as the prevertebral aponeurosis.

Third Stage.—The sterno-mastoid and the vasculo-nervous bundle are raised with a retractor, the thyroid body and trachea with another, the

Fig. 429.—External Œsophagotomy.

Second stage: General sketch.

omo-hyoid muscle is isolated and divided, and the œsophagus appears with the aspect of a reddish muscular band with longitudinal fibres. When recognized, it is seized with two clawed forceps and divided laterally. In most cases I incise the œsophagus over the extremity of a long curved forceps introduced by the mouth.

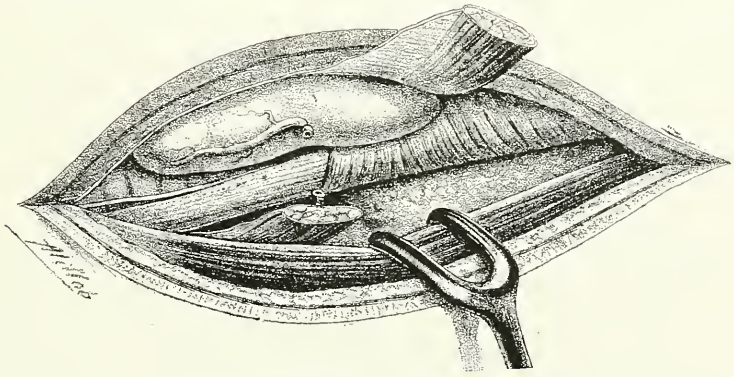


Fig. 430.—External Œsophagotomy.

Second stage: Division of omo-hyoid muscle. Exposure of thyroid gland and inferior constrictor.

Fourth Stage.—Search for the foreign body. In case of a dental plate with many crochets which had perforated the mucous membrane (Fig. 435), the index-finger was introduced into the wound, and the foreign body felt,

which was drawn upwards 3 or 4 centimetres by drawing on the Graefe's panier. The denture was then seized with a long curved forceps, cautiously

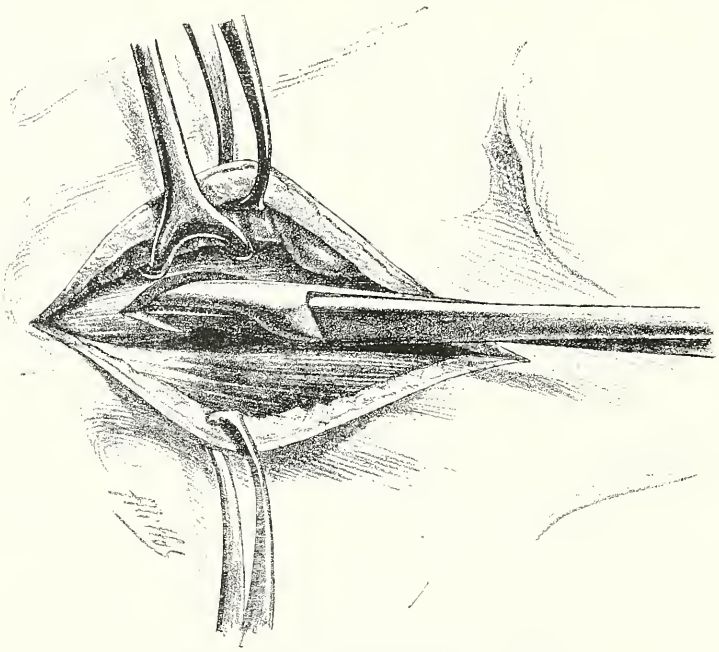


FIG. 431.—EXTERNAL ŒSOPHAGOTOMY.

The œsophagus is raised with the extremity of a long curved forceps introduced into the pharynx.

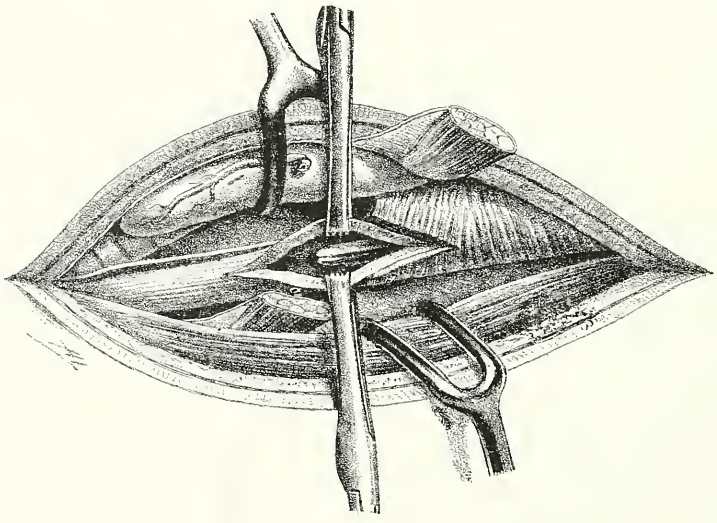


FIG. 432.—EXTERNAL ŒSOPHAGOTOMY.

Third stage: Division of œsophagus on extremity of forceps.

detached by raising and lowering it alternately, and then extracted through the wound.

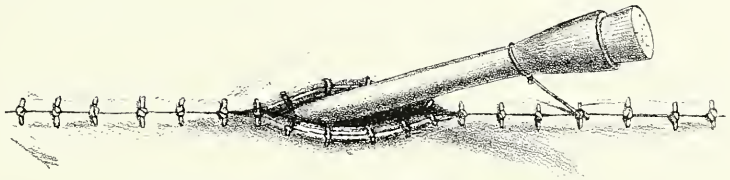


FIG. 433.—EXTERNAL ŒSOPHAGOTOMY.

The operation is finished. The mucous membrane of the œsophagus has been sutured to the skin. A sound has been introduced, to remain permanently.

FIG. 434.—LOW CERVICAL ŒSOPHAGOTOMY FOR NEOPLASTIC STENOSIS SITUATED AT THE LEVEL OF THE BRONCHIAL STRICTURE.

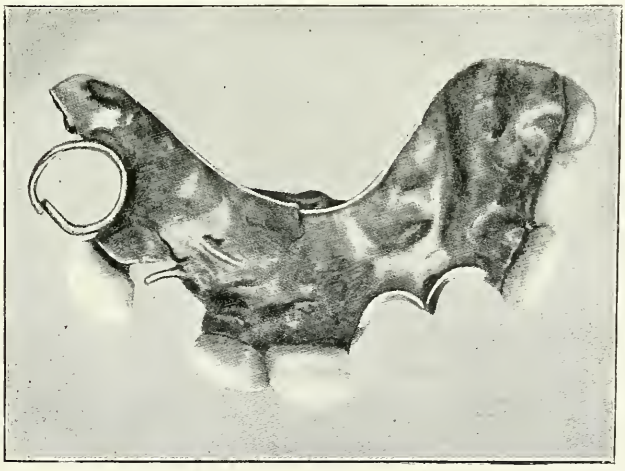


FIG. 435.—PHOTOGRAPH OF THE DENTURE, OF NATURAL SIZE.

The hooks which were implanted in the mucous membrane are seen.

Fifth Stage.—Continued suture of œsophageal wound. Tamponing of cervical wound, which will be united subsequently.

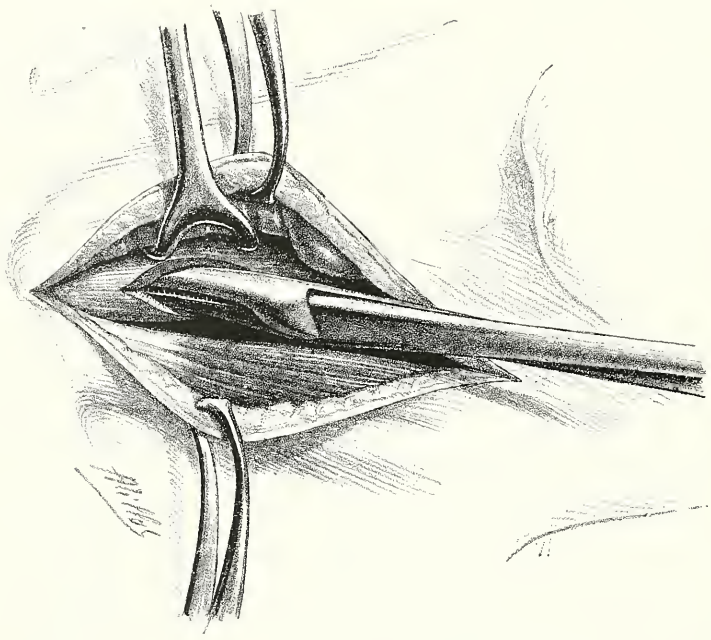


Fig. 436.—Introduction of a Long Curved Forceps into the Lower Part of the Œsophagus for Extraction of a Denture implanted in the Mucous Membrane.

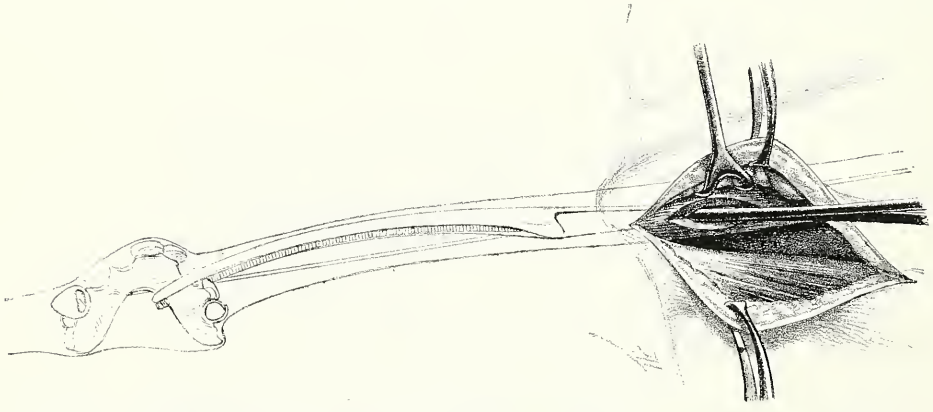


Fig. 437.—Schematic Design showing the Graefe's Panier hooked Beneath the Denture and drawing it upwards

The foreign body is seized and disentangled with the help of a curved forceps.

In simple cases we can suture the skin and drain, while keeping ready to withdraw the suture in case of deep-seated suppuration.

External œsophagotomy is sometimes necessary to allow retrograde catheterism of an impassable cicatricial stricture.

Retrograde Catheterism of the Œsophagus—Operation—*First Intervention.*—External œsophagotomy and suture of the œsophagus to the skin.

Second Intervention—First and Second Stages.—Median subumbilical laparotomy (see Vol. III.) and exposure of the stomach, which is drawn out through the wound with a ring-handled forceps.

Third Stage.—Suture of the stomach to the abdominal wall, incision of its tunics, and introduction of a semi-rigid filiform bougie into the cardia. The extremity of this bougie is made to pass through the cervical wound. It may happen in cases of stricture which have proved impassable by the buccal route that the filiform bougie can be made to pass when introduced through the cervical wound; in such a case we seize its extremity in the stomach, and draw it out through the abdominal wound.

Fourth Stage.—Two stout silk threads of a metre in length (No. 14) are knotted on the extremity of the bougie, and drawn from below upwards as far as the cervical wound. The two ends of one of these are then knotted so as to have one thread in store if the first breaks or is completely extracted. The other thread serves to draw from below upwards a hollow sound of appropriate diameter, which is left in place for some days. The dilatation is continued in this way till we are able to pass bougies and sounds of 8 to 12 millimetres in diameter by the natural passages. The subumbilical wound can then be closed by detaching the stomach and closing the orifice with a double purse-string suture or a double continued longitudinal suture; the cervical wound is then closed. Dilatation by the natural passage should then be kept up for several months.

Gastrostomy.—The creation of a subumbilical gastric mouth is but a palliative procedure in cases of impassable strictures of the œsophagus. It seldom, however, secures a long survival for the patient. It will be described in connection with the surgery of the Stomach (see Vol. III.).

Tumours.

Benign Tumours.

Benign tumours of the œsophagus are exceptional. We can recognize pedunculated papillomata or cysts by œsophagoscopy. It is easy to extract polypi in this way, and to destroy the projecting wall of cysts by the galvano-cautery.

Malignant Tumours.

Cancer of the œsophagus is in most cases recognized only after dysphagia has set in. The attempts at extirpation of cancer of the cervical portion of the œsophagus have not given encouraging results. Extirpation of the thoracic part is impracticable with sufficient chance of success. In 1896 I thought of attacking the œsophagus by the right transpleural route, and to replace the resected portion with a loop of small intestine separated from

the rest of the jejunum and left adherent to its mesentery. One of the principal obstacles to this procedure would be the situation of the pneumogastric nerves, which are nearly always adherent to the neoplasm. The mesentery is too short to permit intrathoracic exclusion of an intestinal loop well supplied with vessels. I did not attempt this intervention. Dilatation in cases of œsophageal cancer is a palliative which ends sooner or later in perforation of the œsophagus into the trachea, pleura, or peritoneum.

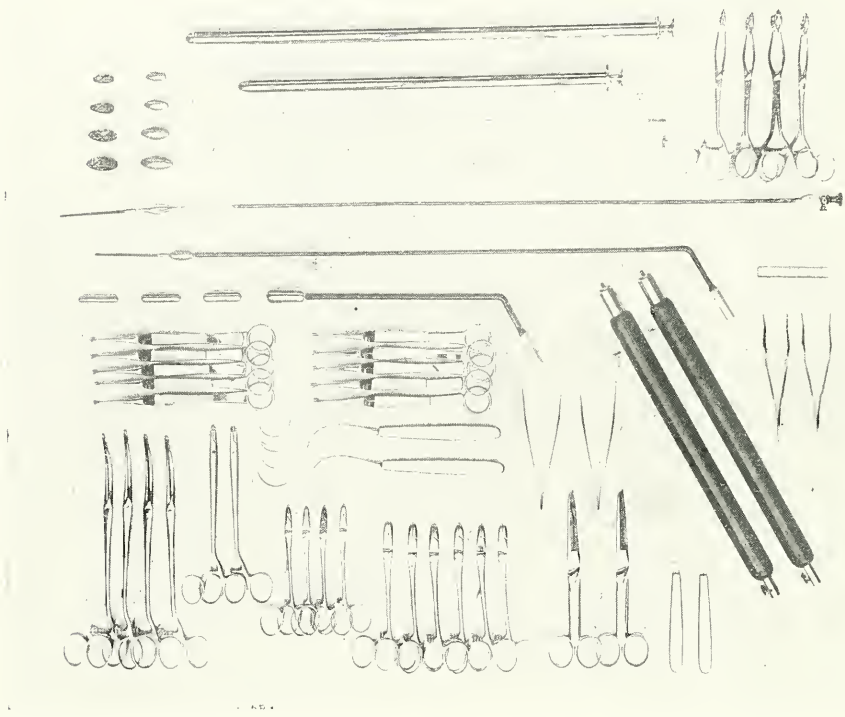


FIG. 438.—INSTRUMENTS FOR ELECTROLYSIS OF THE ŒSOPHAGUS AND FOR ELECTRO-COAGULATION OF EPITHELIOMATA AT THE BEGINNING, EITHER THROUGH THE NATURAL PASSAGES OR AFTER EXTERNAL ŒSOPHAGOTOMY.

Below and from right to left: Two bistouries; two strong straight scissors; six short-jawed clawed forceps; four needle-holder forceps with short hollowed jaws; two needle-holder forceps with eccentric plates; a variety of needles; four long curved forceps. Next above: Two clip-holder forceps, and a series of clips; two clawed forceps; two needles; handles; ten hooked forceps; and, in the topmost row, four forceps with oval ring handles. These instruments are destined for the practice of external œsophagotomy. Highest: Two endoscope tubes of 25 and 35 centimetres in length; a lamp-holder, and two lamp-holding stems of suitable length. Beneath the above: A sound for electrolysis, at the end of which a lozenge-shaped electrolyzer is mounted; below this, an electrolyzer with four branches, furnished with a conducting bougie. Beneath the electrolyzer: Two isolating stems of angular form, for electro-coagulation, and two insulating handles with a series of cylindrical or olive-shaped electrodes. Some of these have an insulating surface so arranged that they act on one side only.

General Treatment with Antineoplastic Vaccination—Local Treatment with Bipolar Voltaization and Electro-Coagulation.

Antineoplastic Vaccination.

In a case of cancer of the œsophagus taken at the beginning and recognized with the help of the endoscope, antineoplastic vaccination with cytolase has already given me the gratifying result of prolongation of nearly three years of life in an old man of seventy years, in whose case a specialist in œsophagoscopy had given a fatal prognosis. I have also obtained good results in many other cases, but I have not been able to follow their subsequent course sufficiently long to decide whether the evolution of the cancerous growth has been permanently inhibited, as I have many times observed in cases of cancer of the stomach. Antineoplastic vaccination should be commenced as soon as possible. Locally, I have tried to act on cancer by applications of radium; this method is very uncertain, for it is impossible to limit clearly the area of radio-cauterization. We incur the risk of making the application too high or too low, or either of not reaching or of going beyond the depth of the neoplasm. This mode of treatment has not given any permanent result. I have had electrodes constructed of very small diameter for applying the procedure of electro-coagulation in cases of œsophageal cancer, which permits complete destruction of the cancerous tissues in less than one minute if the lesion is still in its initial stage.

Electro-Coagulation.

The feeble tension of the current used in the procedure of thermic electro-coagulation permits ready insulation of the conducting stem, on which olive-shaped or cylindrical terminals of suitable diameter are mounted. We thus obtain in less than a minute—the time varying according to the extent of surface of the electrode and the intensity of the current—a penetrating heat which reaches to 60° C. (140° F.) at the surface, the effect of which is to destroy the virulence of the neoplastic tissues to a certain depth. The virulence disappears, in fact, when the tissues have become heated above 56° C. (132·8° F.); and, accordingly, by taking care not to allow the temperature to rise beyond 60° C., we can cause the death of the cancer cells in the deep structures. This procedure enables us to pursue epitheliomatous cells into the depths without destruction of any part of the healthy tissues.

In order that the cicatrization may be watched with due care, it is preferable to perform an external œsophagotomy first, and suture the œsophageal mucous membrane to the skin (Fig. 439). The œsophageal fistula so formed is then kept open as long as required for the supervision of the healing process. It is better, even when endoscopic examination appears completely satisfactory, to leave the orifice still open for three or four months more. It is afterwards closed by an autoplastic operation carried out by dislining (see Vol. I., Electro-Coagulation).

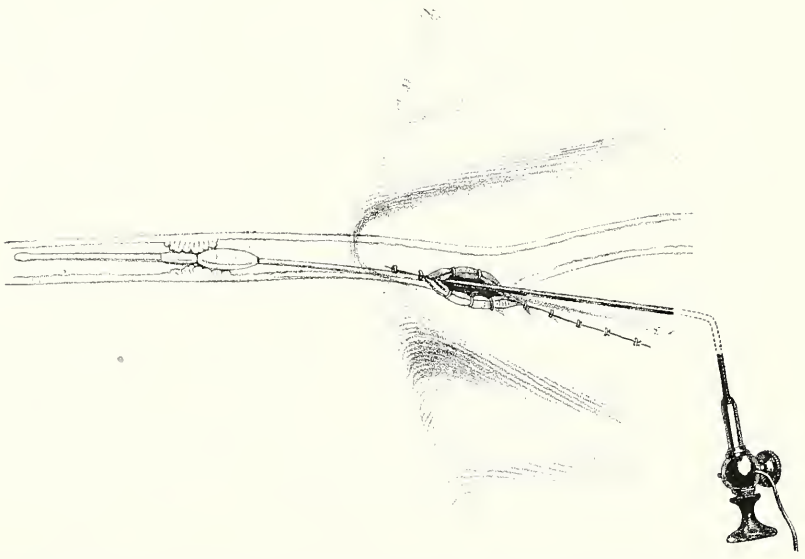


Fig. 439.—Electro-Coagulation of a Cancerous Stricture of the Œsophagus, through the Incision for External Œsophagotomy.

The œsophageal mucous membrane has been sutured to the skin, so as to facilitate endoscopic supervision of the cicatrization.

OPERATIONS ON THE SUPRACLAVICULAR FOSSA.

Anatomical Considerations.—From its importance the supraclavicular region deserves a special anatomical description. The contained structures are shown in Fig. 440, after removal of skin, platysma, and superficial aponeurosis. The supraclavicular triangle is bounded internally and in front by the sterno-cleido-mastoid, behind by the anterior border of the trapezius, and below by the clavicle. In Fig. 441 we see on the right side the anterior border of the trapezius; beneath it the scaleni group, a deep cervical vein and artery; above, a portion of the superior border of the scapula, subscapularis, coracoid notch, to which is inserted the omo-hyoid muscle, the supraclavicular segment of which is horizontal. This muscle and the middle cervical aponeurosis have been divided so as to expose the great vessels.

The subclavian artery emerges between the scaleni muscles and descends almost vertically in front of the first rib. It will be seen how this anatomical disposition has induced me to modify the incision for ligature of the subclavian artery. To the outer side of and behind the artery is found the brachial plexus. On the left side of the figure the clavicular head of the sterno-cleido-mastoid has been divided for a distance of 20 to 25 millimetres in order to expose the trunk of the subclavian vein and the termination of the external jugular. The lower cutaneous incision corresponds to the border of the clavicle.

FIG. 440.—SUPRACLAVICULAR FOSSA.
General sketch.

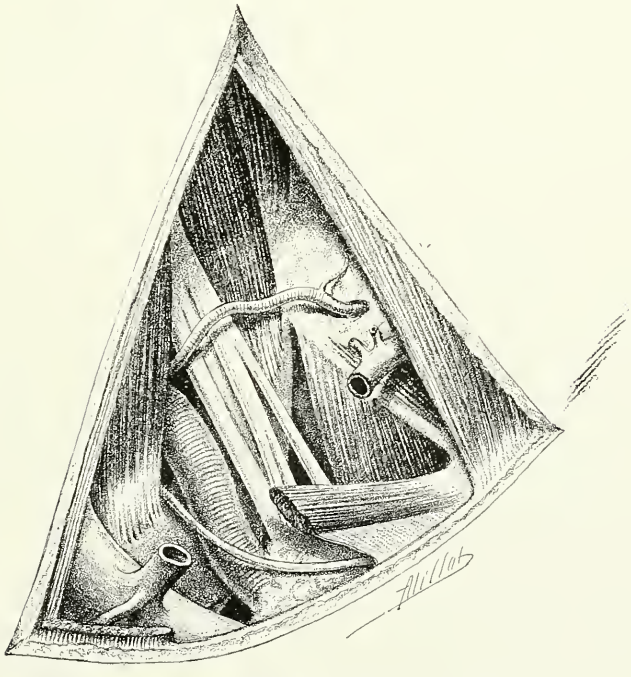


FIG. 441.—LEFT SUPRACLAVICULAR FOSSA.
View of the deep strata, showing the relations of the vasculo-nervous bundle.

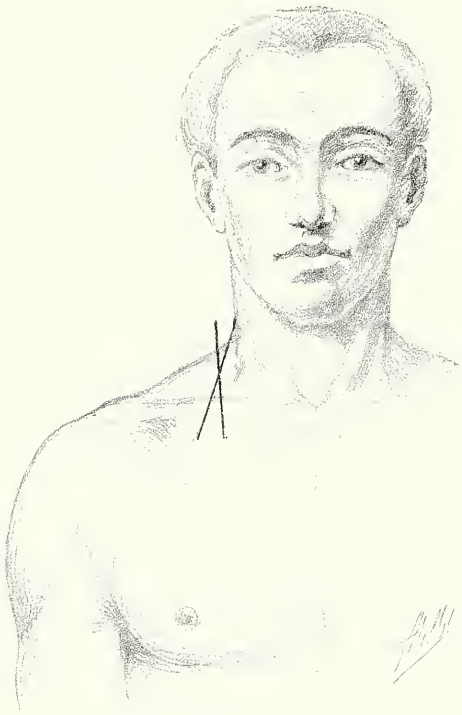


FIG. 442.—SUPRACLAVICULAR REGION.

Superficial view: General sketch, indicating the position of the plans of the following sections (Figs. 443, 444.)

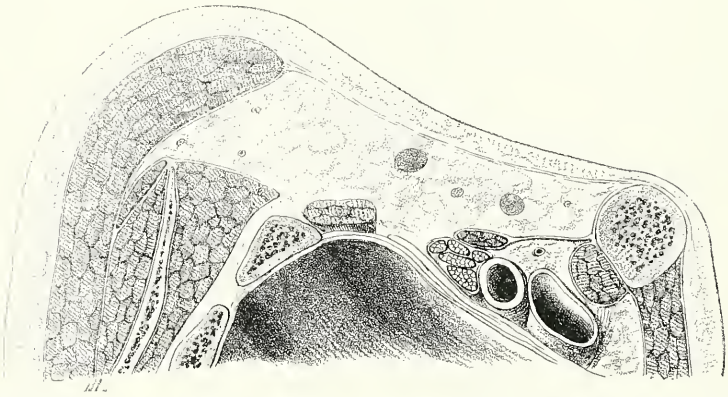


FIG. 443.—VERTICAL ANTERO-POSTERIOR SECTION OF THE LEFT SUPRACLAVICULAR REGION, AT A FINGER'S BREADTH TO INNER SIDE OF ITS MIDDLE.

External segment of the section. In front: Clavicle, great pectoral and subclavius, middle cervical aponeurosis and omo-hyoid muscle covering the superior scapular artery and the vasculo-nervous bundle. At the level of the dome of the pleura the posterior scalenus tangent to the second rib, to which it is attached. Behind: The subscapularis, supraspinatus, deltoid, and trapezius, which is very highly developed.

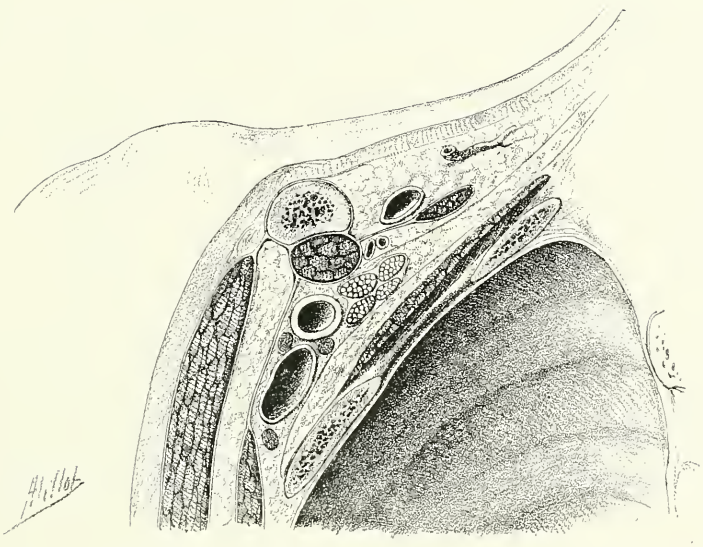


FIG. 444.—VERTICAL OBLIQUE SECTION OF THE CLAVICULAR REGION.

We recognized above and outside the pleural *cul-de-sac* a portion of the second rib, which has been divided almost tangentially to its concave border. Above this is the first dentation of the serratus magnus, then the vasculo-nervous bundle, covered by the subclavius and middle cervical aponeurosis, beneath which lies the superio-scapular artery. The external jugular vein is found superficial to the middle aponeurosis. On the left the clavi-pectoral aponeurosis and the lesser pectoral muscle; superficially, the great pectoral.

Relations of the Dome of the Pleura.—I have already pointed out that the portion of the pleural dome which corresponds to the first intercostal space may be wounded in extirpation of tumours of the supraclavicular region. I will afterwards study the relations and the surgery of the dome of the pleura in connection with the surgery of the thorax.

Traumatic Lesions.

Wounds of the clavicular region are very serious when penetrating, and, above all, when their direction conducts the point of the instrument behind the manubrium. The hæmorrhage is always of fulminating violence.

Gunshot Wounds.

Revolver bullet wounds nearly always pass on the outer side of the vasculo-nervous bundle when the orifice of entry is situated on the outside of the posterior border of the sterno-cleido-mastoid, especially when the projectile has been fired from before backwards. The pleural dome may be wounded if the lesion took place when in the position of forced inspiration. Indeed, the pleural *cul-de-sac* ascends above the clavicle. In such case

the first rib is nearly always fractured behind the vasculo-nervous bundle. When the lung is wounded, emphysema may develop. Surgical intervention, when indicated, will vary with the position and extent of the wound.

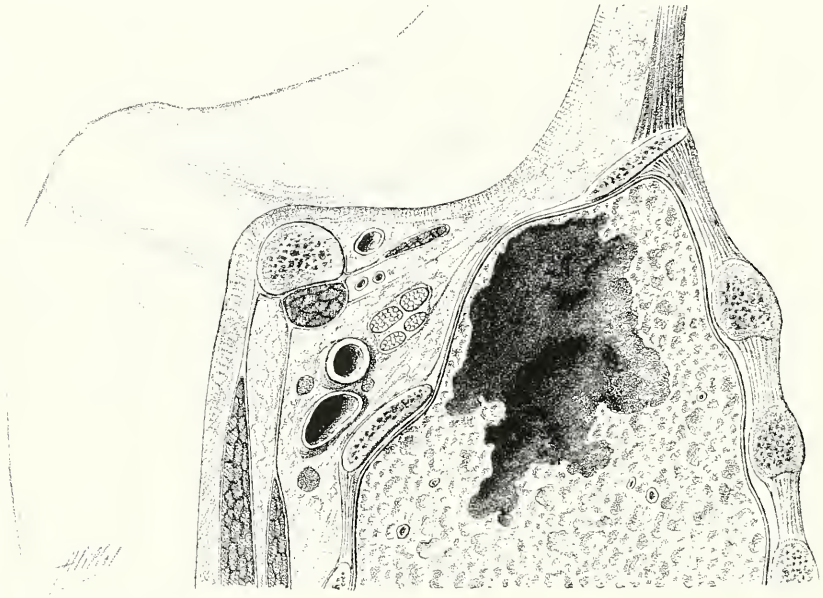


FIG. 445.—VERTICAL OBLIQUE SECTION OF THE CLAVICULAR REGION IN A SUBJECT IN THE FOURTH STAGE OF PULMONARY TUBERCULOSIS.

The upper wall of the cavity, which pusnes up the first intercostal space, is found near the skin, which is depressed in the supraclavicular fossa. Such a cavity is accessible from above the clavicle, at a finger's breadth outside the middle of the bone.

Inflammatory Diseases.

Phlegmons and cold abscesses of the supraclavicular region project under the skin. The surgical intervention does not merit special description. Mycolysine should be administered in cases of acute suppuration, and phymalose in those of chronic abscess.

Malformations: Congenital and Acquired.

Supernumerary Ribs.

Supernumerary cervical ribs are in reality only hypertrophied transverse processes. The malformation is generally unilateral, and involves only the seventh vertebra. The costiform excrescence is rarely more than 6 centimetres in length. The attention of the surgeon is drawn to its existence by some of the accidents of compression of the brachial plexus.

Operation—FIRST STAGE.—Vertical incision of 6 to 8 centimetres along the anterior margin of the trapezius and corresponding at its middle to the osseous projection.

Second Stage.—Division of superficial aponeurosis and exposure of the costiform apophysis.

Third Stage.—Denudation of the supernumerary rib, extending posteriorly as far as possible. It is then divided with a cutting forceps. The anterior segment is then seized with a gouge-forceps, drawn into the wound, and detached with the help of raspatory and blunt scissors.

Tumours.

Benign Tumours.

Of benign tumours special to the supraclavicular I will here mention the erectile lipoma, which is found in young subjects in the form of a soft, pulsatile, and partially reducible swelling. At Rheims, in 1888, I removed from a young man of eighteen years a tumour of the size of an orange, the deep aspect of which was adherent. The pleural *cul-de-sac* was wounded in dissection of its deeper portion from the first intercostal space. A hissing sound at once indicated aspiration of air into the pleural cavity. At the surprise of the first moment I thought that air had been drawn into the veins. But the perforation of the pleura was recognized almost as soon, and this was rendered impermeable after a plugging for some minutes. Some few years ago I performed a similar operation on a young woman. In this second case I avoided the perforation of the pleura.

Malignant Tumours.

With the exception of epithelioma and cutaneous sarcoma, we seldom meet with any such in this part of the body other than secondary cancerous

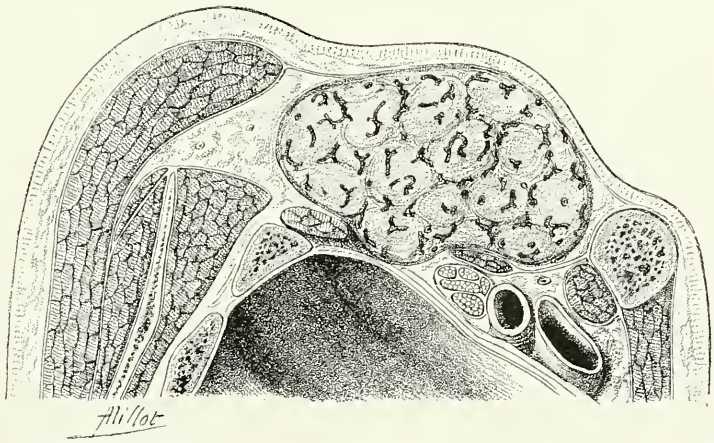


Fig. 446.—Vertical Antero-Posterior Section of Supraclavicular Region invaded by Erectile Lipoma.

This section passes some millimetres outside the first rib. We see the deep part of the tumour in contact with the pleura at the level of the first intercostal space. This I happened to perforate when detaching the neoplasm from its deep adhesions.

adenopathies, which it is useless to extirpate, inasmuch as the chain of cancerous glands is continued downwards into the thoracic cavity. Cutaneous supraclavicular sarcoma presents an evolution of special malignity.

Fig. 447 represents the case of an unfortunate young man of sixteen, who had presented a subcutaneous sarcoma of the supraclavicular fossa of the size of a hazel-nut. A first operation, which was performed in the country, had been followed by recurrence; so were the second and third interventions

Fig. 447.—Invasion of the Cervico-Clavicular Region and Prominence of the Shoulder by a Sarcoma which has undergone Subacute Evolution as the Result of Injudicious Surgical Intervention.

respectively. The sarcoma would seem to have been whipped on its course, and rapidly invaded the carotid and supraclavicular regions, as well as the summit of the shoulder. At this stage of its development the patient was brought to me.

I at once decided for destruction of the neoplastic tissue of the supra-acromial region. The cervical portion of the tumour, which had invaded the vasculo-nervous sheath, was then successively submitted to the action of X rays in massive doses (ten sittings of thirty minutes each) and of

radium (introduction into the interior of the tumour of six tubes, with a total content of 16 centigrammes of radium salt). The radium tubes were placed on two successive occasions for three days each time, or a total period of 144 hours. In spite of all these efforts, I obtained but a partial amelioration of the conditions, and the patient succumbed to the tachycardia produced by the destruction of the pneumogastric nerve. The case is a very instructive one; it shows at once the mischievous effects of bloody operation in case of cervical sarcoma. The original tumour had been a very small one; the intervention which had been very extensively carried out had the effect of grafting the pathological cells over the whole area of the field of operation. It is interesting to have pointed out that neither the X rays nor radium produced the slightest amelioration in this case. Electro-coagulation was the only procedure which could have cured that patient, but it would have been necessary to employ it before the invasion of the vasculo-nervous bundle by the pathological tissues. About the same date I succeeded in obtaining a complete cure by thermic electro-coagulation of many cases of recurrent sarcoma of the clavicular region which were adherent to the periosteum of that bone.

OPERATIONS ON THE NERVES OF THE NECK.

Anastomosis of the peripheral segment of the facial nerve with the spinal accessory or hypoglossal has been tried with the object of re-establishing muscular movements in the sphere of the facial nerve when this has been compressed or divided in its intracranial or intrapetrous segments. This operation deserves to be repeated, for it has already given satisfactory results.

Anatomy of the Region.—If we expose the posterior border of the parotid gland by a vertical incision, beginning at the anterior border of the mastoid process and passing along the sterno-mastoid to the angle of the jaw, we expose the posterior belly of the digastric in the depth of the wound. The facial nerve emerges at the upper part of the incision between the digastric muscle and the parotid gland which it penetrates. If we now retract the sterno-mastoid muscle and dissect away the cellulo-fatty tissue, which is found behind the digastric, we expose some lymphatic glands and the internal jugular vein, in which a parotid vein is seen to terminate. The hypoglossal nerve is found placed more deeply in front of the vein and outside the external carotid artery; the spinal accessory nerve emerges between the posterior belly of the digastric and the lateral tubercle, to plunge immediately beneath the sterno-mastoid muscle. This osseous tubercle is the best guide in searching for the spinal accessory nerve.

Anastomosis of Spinal Accessory and Facial Nerves.

First Stage.—Vertical section of 6 centimetres along the anterior border of the sterno-cleido-mastoid, commencing in front of the lobule of the ear. Division of the superficial aponeurosis and exposure of the parotid gland.

Second Stage.—Incision of the parotid capsule and search for the trunk of the facial nerve at the upper and anterior part of the mastoid attachment of the digastric; the nerve is then dissected for a certain portion of its intraglandular course.

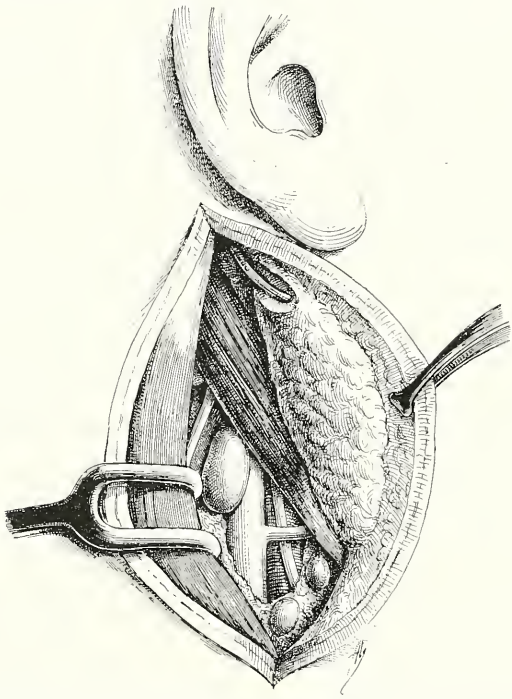


Fig. 448.—Dissection of the Posterior Aspect of the Capsule of the Parotid.

Exposure of the hypoglossal and spinal accessory nerves.

Third Stage.—Search for the spinal accessory nerve. The anterior border of the sterno-cleido-mastoid is raised with a retractor. Above and in the depth of the wound we see emerging from beneath the posterior belly of the digastric the external branch of the spinal accessory nerve. We can readily find its point of emergence by recognizing with the index-finger the anterior tubercle of the transverse process of the atlas.

Fourth Stage.—Division of the facial and spinal accessory nerves, followed by anastomosis. We isolate the spinal accessory nerve far enough down to obtain, on section close to the surface of the sterno-mastoid muscle, a segment sufficiently long to be sutured to the peripheral segment of the

facial nerve. The latter is divided transversely in a case in which the paralysis is complete; when this is not the case the extremity of the spinal accessory nerve is divided so as to present a levelled point, which is inserted in a lateral notch made in the facial. The neurilemma is united with points of interrupted suture inserted with minute round needles.

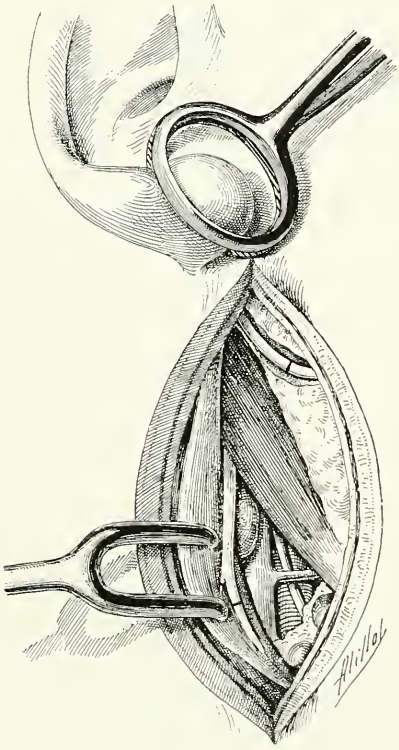


FIG. 449.—DISSECTION OF THE POSTERIOR ASPECT OF THE CAPSULE OF THE PAROTID.

Appearance of the field of operation before the anastomosis. Dark lines indicate the position of division of the facial and spinal accessory nerves, and of a branch of the latter.

Hypoglosso-Facial Anastomosis.

FIRST AND SECOND STAGES.—As above.

THIRD STAGE.—Search for the hypoglossal nerve. After raising up the anterior border of the sterno-cleido-mastoid, the hypoglossal nerve appears at the anterior border of the vasculo-nervous bundle, and beneath the digastric which it accompanies in a nearly parallel course as it passes towards the base of the tongue; the nerve is divided above the great cornu of the hyoid bone.

FOURTH STAGE.—The anastomosis of the facial nerve with the hypoglossal is carried out with the same technique as that with spinal accessory above described.

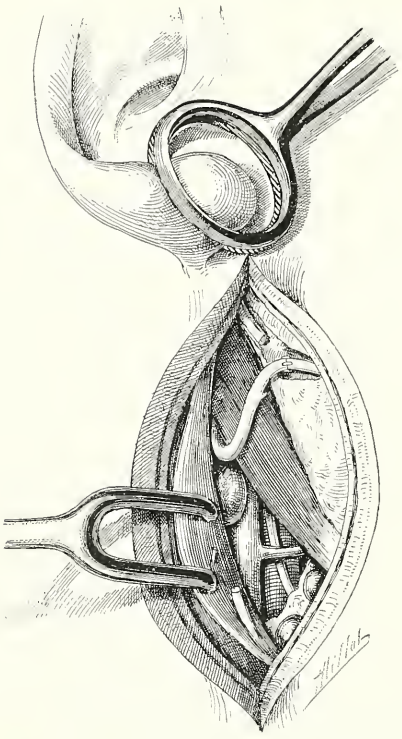


Fig. 450.—Dissection of the Posterior Aspect of the Capsule of the Parotid.

Fourth stage: The anastomosis has been completed.

Resection of the Cervical Sympathetic.

The results of this operation, which has been recommended in cases of exophthalmic goitre, of epilepsy, and of glaucoma, are very questionable. I have never seen a case of exophthalmic goitre develop in which I could not ascertain hypertrophy or induration of a certain portion of the thyroid body, the resection of which brought about cessation of the tachycardial phenomena sooner or later. Histologically the resected portion of the gland displays stricture of young follicles void of colloid contents. In two of my cases there had been partial cancerous transformation of the gland.

Two cases of epilepsy which I treated formerly with bilateral section of the cervical sympathetic on the faith of premature observations were aggravated by the operation. The *ictus epilepticus* is preceded, as we can readily ascertain when a paroxysm occurs during a craniectomy operation, by hyperæmia and a sudden augmentation of the volume of the encephalon. Resection of the cervical sympathetic aggravates the congestive phenomena by paralyzing the vaso-constrictor nerves. And, finally, notwithstanding the testimony of certain over-hasty communications, not a single case of glaucoma that was really improved by the operation has yet been published. Thus resection of the cervical sympathetic is rarely indicated. It may

specially be adopted in cases of atypical Basedow's disease — that is to say, when there is no trace of thyroid hypertrophy—in order to secure

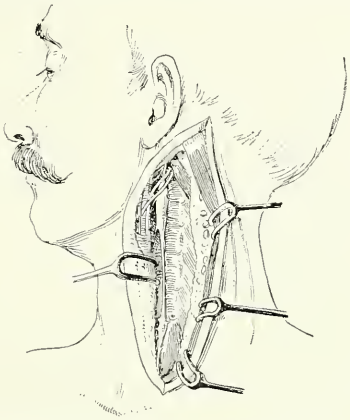


FIG. 451.—RESECTION OF THE CERVICAL SYMPATHETIC.
Third stage: General sketch.

disappearance of the enophthalmos. We know, indeed, that in animals — notably the rabbit—unilateral resection of the cervical sympathetic produces enophthalmos on that side, and bilateral resection enophthalmos on both sides.

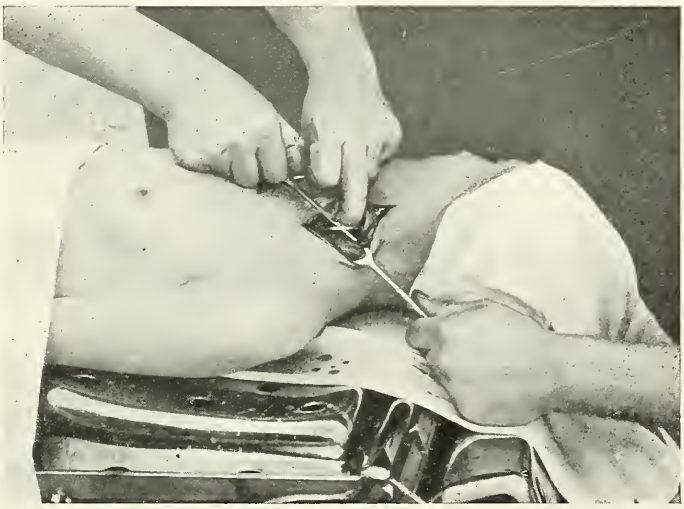


FIG. 452.—RESECTION OF THE CERVICAL SYMPATHETIC.
The trunk of the sympathetic is raised on a forceps.

Operation—FIRST STAGE.—Incision of the skin along the posterior border of the sterno-mastoid.

SECOND STAGE.—Discovery of the border of the muscle and of that of the vasculo-nervous bundle, which is drawn aside with a retractor.

Third Stage.—Exposure of the prevertebral aponeurosis in a fold of which is immediately seen the superior cervical ganglion, if by mistake this has not been drawn aside on the retractor with the vasculo-nervous sheath, at the posterior aspect of which it will be recognized without difficulty.

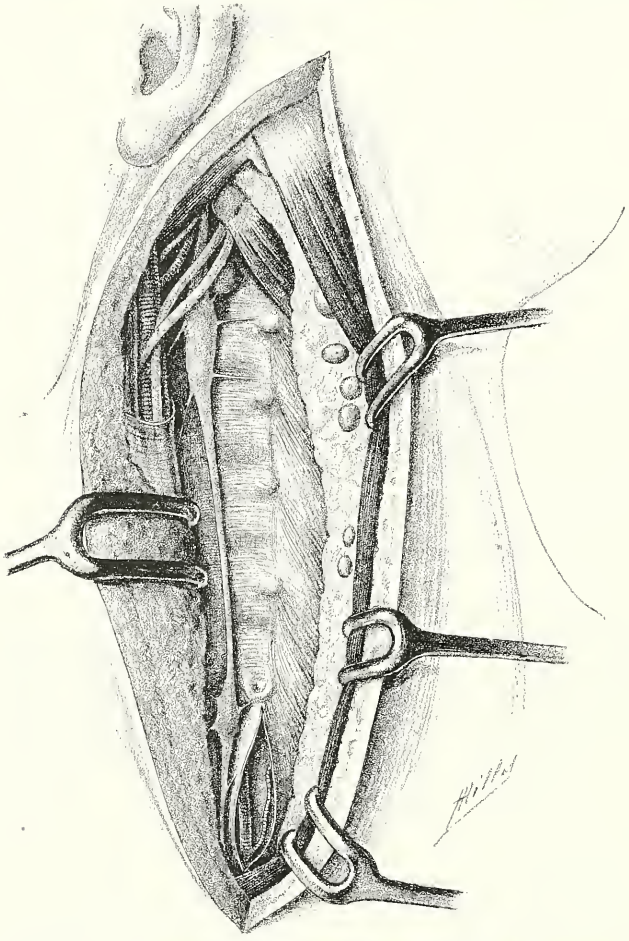


Fig. 453.—Resection of the Cervical Sympathetic.

Third stage: The superior and middle cervical ganglia of the sympathetic are seen behind and beneath the vasculo-nervous bundle of the neck, which is raised by the retractor. Above, the glosso-pharyngeal, pneumogastric, and hypoglossal nerves are exposed, with the attachment of the triangularis colli to the tubercle of the transverse process of the atlas. Below, a longitudinal incision of the prevertebral aponeurosis below Chassaignac's tubercle reveals the origin of the vertebral artery.

Fourth Stage.—Isolation of the superior cervical ganglion and nerve trunk as far down as we wish to resect it, while taking care to divide the collateral branches and preserve the vessels and nerves of the region. It is not necessary to search for the inferior cervical ganglion, exposure of which would involve serious injury to the structures of the supra-retro-pleural fossa.

Fifth Stage.—Suture of skin; drainage.

OPERATIONS ON THE GREAT VESSELS OF THE NECK.

Operations on the Arteries.

Surgical interventions in the neck often necessitate ligature of arteries, notably of the external carotid and its branches. Ligature of the internal carotid should be carried out only in exceptional conditions,

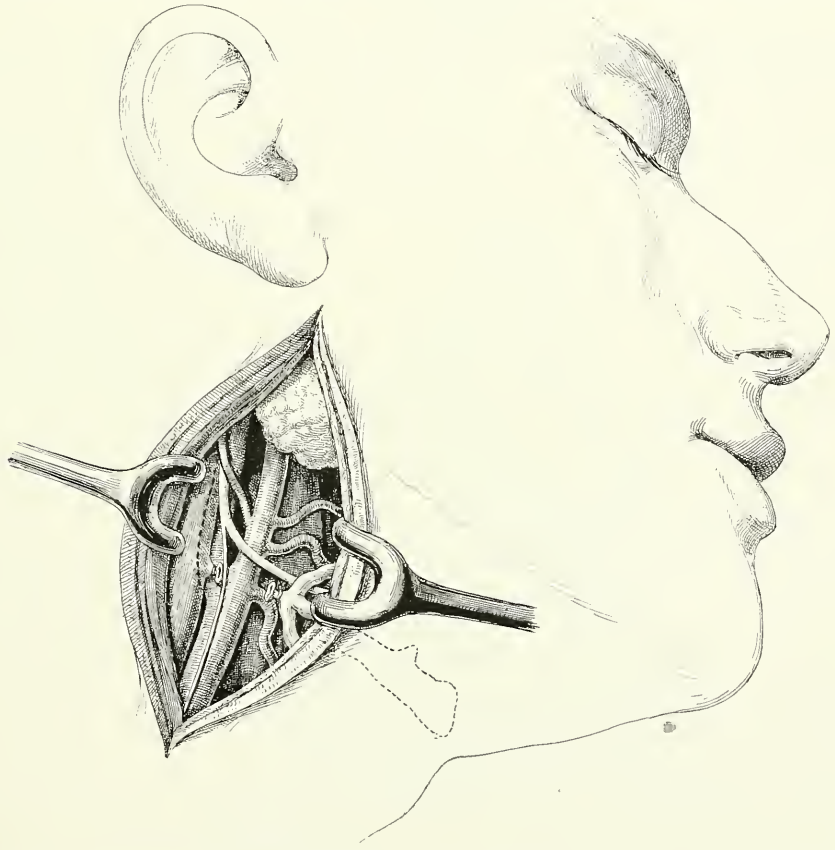


FIG. 454.—LIGATURE OF THE EXTERNAL CAROTID ARTERY AND ITS BRANCHES.

Diagrammatic sketch. In the centre of the wound is represented the procedure of ligature of the thyro-linguo-facial vein.

as it is nearly always fatal. When possible. ligature of the common carotid trunk should be resorted to in preference. The latter procedure does not expose us to the same central complications as does ligature of the internal carotid artery, the collateral circulation being almost

immediately sufficient to restore equilibrium of the intracranial circulation after the latter operation, on account of the copious communications of the

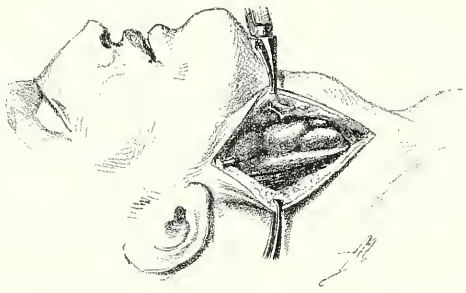


FIG. 455.—ASPECT OF CAROTID REGION WHEN THE SHEATH OF THE VESSELS IS COVERED WITH ADHERENT GLANDS.

General Sketch.

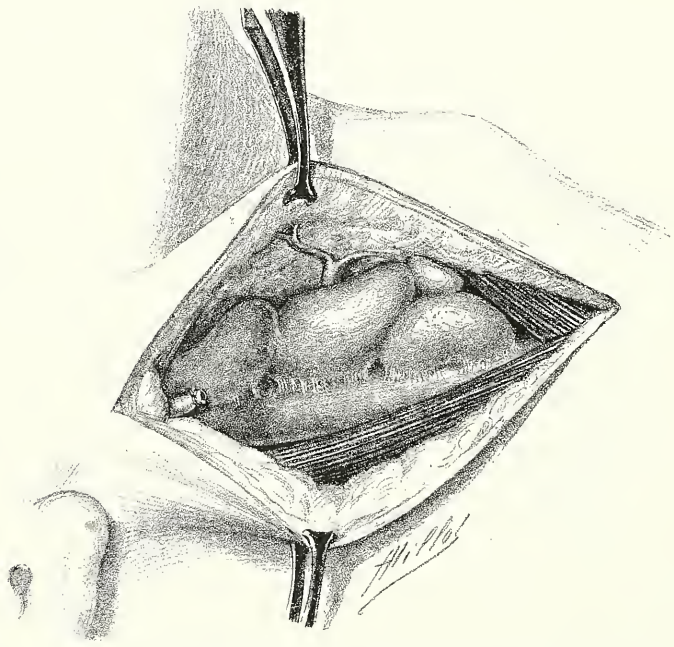


FIG. 456.—ASPECT OF CAROTID REGION WHEN THE SHEATH OF THE VESSELS IS COVERED WITH ADHERENT GLANDS.

Hypertrophied glands are seen between the anterior border of the sterno-mastoid and the upper lip of the wound. In the upper angle of the wound is seen the stump of the external jugular vein, with a ligature applied.

branches of the external carotid. Ligature of the common carotid, subclavian, and innominate arteries will be afterwards described in connection with the surgery of aneurisms.

Ligature of the External Carotid Artery and of its Branches.

Operation—First Stage.—Vertical incision of 7 centimetres along the anterior border of the sterno-cleido-mastoid muscle, crossing at its middle the great cornu of the hyoid bone.

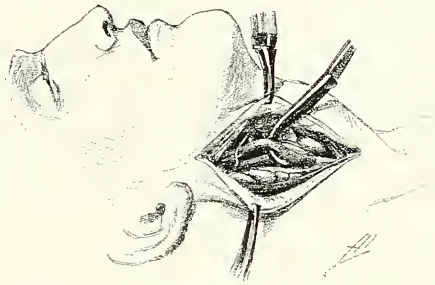


Fig. 457.—Aspect of Carotid Region when the Sheath of the Vessels is covered with Adherent Glands.

Fourth stage: Discovery and ligature of the external carotid artery and its branches.

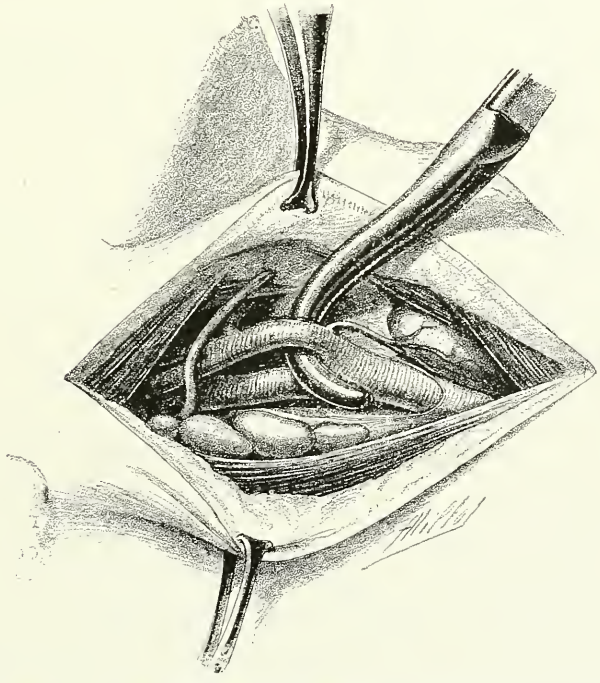


Fig. 458.—Aspect of Carotid Region when the Sheath of the Vessels is covered with Adherent Glands.

The prevascular cellular sheath has been removed, and the external carotid is raised on a curved forceps. Above the forceps is seen the superior thyroid artery; higher up, near the hypoglossal nerve, are the lingual and facial artery.

Second Stage.—Exposure and dissection of the anterior border of the muscle, taking care to avoid the external jugular vein, which is eventually divided between two ligatures.

Third Stage.—Exposure of the cellular sheath of the vasculo-nervous packet. This sheath is easily brought to view by retracting the lower lip of the wound with a hooked forceps. We then recognize the superior thyroid artery, which usually arises close to the bifurcation. Above this and to the inner side are the lingual and facial, which have sometimes a common trunk, and 10 or 15 millimetres still higher and posteriorly we see the occipital. If we want to avoid all recurrent circulation—for instance, to prevent any hæmorrhage in extensive operations on the jaw, it will be necessary to adopt the method of divulsion, either with the extremity of blunt scissors or with the index-finger covered with a compress. This stage does not involve serious difficulty, except when the region abounds in tuberculous or cancerous glands. Such glands are extirpated, and the perivascular cellular sheath is incised.

Fourth Stage.—Exposure and ligature of the external carotid and its branches. We rapidly recognize the following structures: First, the great cornu of the os hyoides, then at its side the bifurcation of the common carotid artery, above which is seen crossing at a right angle the collecting thyro-linguo-facial venous trunk. This must be divided between two ligatures. In order to prevent recurrent hæmorrhage the following vessels must be tied: (1) The external carotid at its origin; (2) the superior thyroid; (3) the lingual; (4) the facial; and (5) the occipital. This multiplex ligation can be repeated on the opposite side after an interval of eight days.

Aneurism.

Arterial aneurisms, spontaneous and traumatic, are not exceptional in the cervical region. The classic operative procedure is that of ligature. Till recently the operation which was usually adopted, and deliberately preferred, was that of ligature of the affected vessel above the sac, between the aneurism and the heart, according to the method of Anel. This method gives better results than ligature beyond the sac as practised by Brasdor. Nevertheless the latter is the only method practicable when the aneurism is placed near the origin of the carotid. Ligature below the sac has been unsuccessful in but 22 per cent. of the cases since the introduction of antisepsis, instead of the 44 per cent. before. Vertigo, numbness in the limb of the opposite side, and hemiplegia occur in a good many cases. When the sac can be isolated, we may try to carry out a partial extirpation, after temporary ligature of the artery above and below, to be followed by arteriorrhaphy.

Aneurism of the External Carotid Artery.

The size and location of the aneurism usually compel us to ligature the common carotid. The classic operations are now described, after which

I will describe my new method of surgical cure of aneurisms, *incomplete ligature below the sac, followed in certain cases by partial extirpation of the sac, and reconstruction of the arterial segment.* I have not yet carried out in the human subject the procedure of replacement of the carotid artery with a graft taken from another vessel (see Vol. I.).

Aneurism of the Common Carotid Artery.

1. *Ligature of the Common Carotid Artery in its Cervical Portion.*

Operation—First Stage.—Vertical incision of 6 to 7 centimetres along the anterior border of the sterno-mastoid muscle, the middle of which corresponds to the level of the cricoid cartilage.

Fig. 459.—Ligature of the Common Carotid in its Cervical Portion. General sketch.

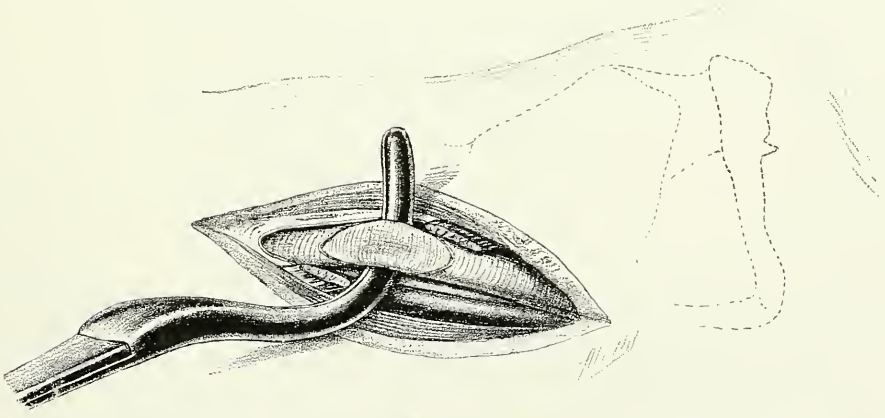


Fig. 460.—Ligature of the Common Carotid in its Cervical Stage. Fourth stage: Denudation of the artery which is raised with a curved forceps.

Second Stage.—Exposure of the anterior border of this muscle, which has been dissected out so as to be raised on a retractor.

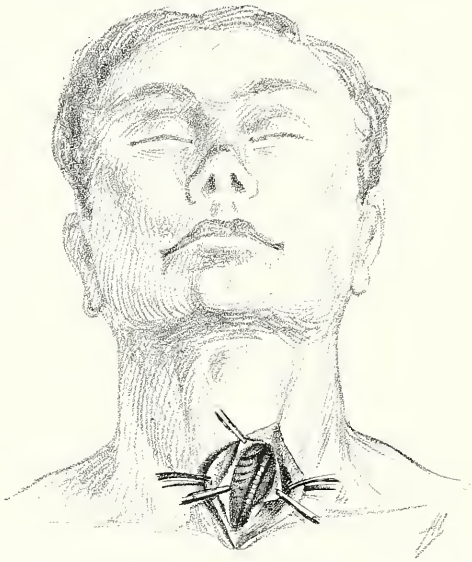


Fig. 461.—Ligature of the Left Common Carotid in its Thoracic Portion

General sketch.

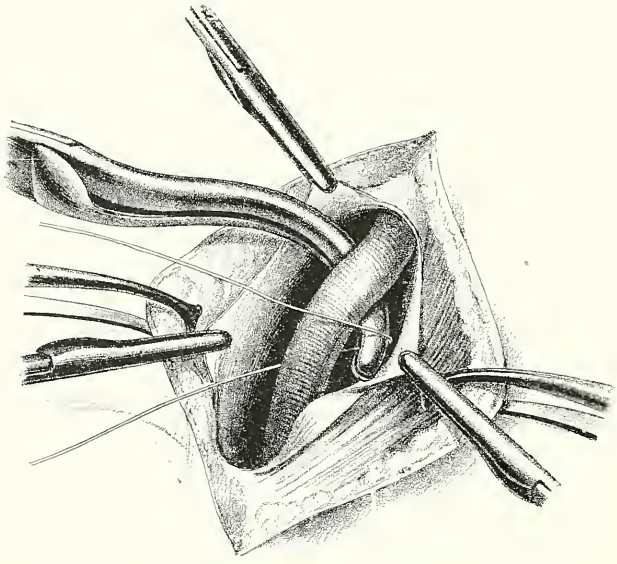


Fig. 462.—Ligature of the Left Common Carotid in its Thoracic Portion.

The sternal head of the sterno-cleido-mastoid is drawn to the right. The cervico-pericardial aponeurosis is held aside with three forceps. The ligature has just been passed under the artery.

Third Stage.—Exposure of the lower margin of the aneurismal sac and the vasculo-nervous bundle with the help of the index-finger.

Fourth Stage.—Denudation and ligature of the trunk of the carotid between the aneurism and the heart.

Fifth Stage.—Reunion and drainage.

2. *Ligature of the Common Carotid in its Thoracic Portion.*

Operation—First Stage.—Vertical cutaneous incision along the anterior border of the sterno-cleido-mastoid, extending from the sterno-clavicular articulation to the lower border of the thyroid cartilage.

Second Stage.—Exposure of the sternal tendon of the muscle. The head is flexed so as to relax the muscle; the sternal head can then be drawn well outwards.

Third Stage.—Division of the cervico-pericardial aponeurosis. This should be torn through with a curved forceps.

Fourth Stage.—Exposure of the common carotid with a curved forceps, which is then laid bare as far down as possible.

Fifth Stage.—The ligature is passed at the level of the suprasternal notch, and is slipped down as far as possible into the thorax with the help of the two index-fingers. In this way it is possible to apply a ligature so low as to be almost in contact with the arch of the aorta.

Extirpation of the Aneurism—*First Stage.*—Incision as above, along anterior border of sterno-mastoid.

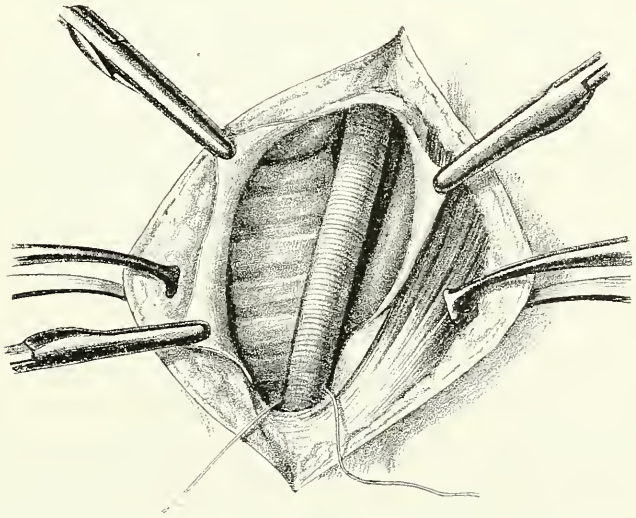


Fig. 463.—Ligature of the Left Common Carotid in its Thoracic Portion.

The ligature has been slipped down as near the origin of the artery as possible, so as to tie it close to the level of the arch of the aorta.

Second Stage.—Dissection of the anterior border of the muscle, and exposure of the aneurismal tumour.

Third Stage.—When the dissection of the sac is practicable, we seek out the trunk of the common carotid beyond the sac, in order to apply the ligature.

Fig. 464.—Ligature of the Left Common Carotid in its Intrathoracic Portion

The patient is placed in the Rose position. General sketch.

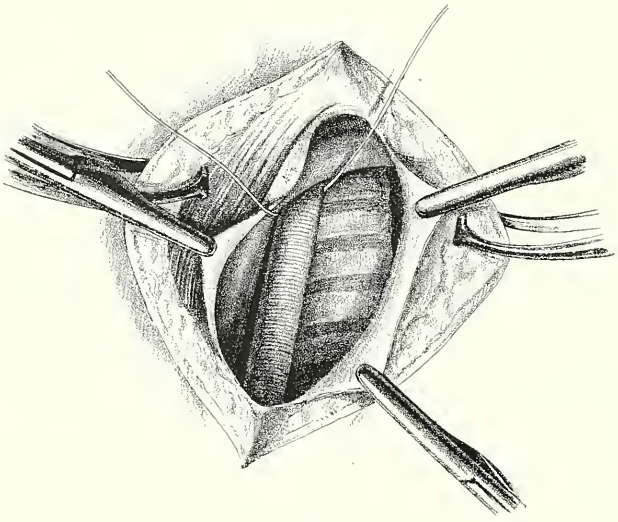


Fig. 465.—Ligature of the Left Common Carotid in its Intrathoracic Portion

The ligature may be applied in contact with the innominate vein, which is seen crossing the thoracic trachea horizontally.

Fourth Stage.—Dissection of the upper part of the sac and ligature of the carotid below the aneurism.

Fifth Stage.—Resection of the sac.

Sixth Stage.—Reunion and drainage.

Aneurism of the Arteria Innominata.

In this case ligature according to the method of Anel, between the sac and the heart, is very seldom possible. Ligature between the sac and the capillaries, according to Brasdor's method, has been carried out in various ways. We may tie (1) the subclavian only, (2) the common carotid only, (3) both these arteries, with an interval of some weeks, (4) both arteries at the same operation. Ligature of the artery of the upper limb should be applied on the subclavian, and not on the axillary, in order to suppress as completely as possible all collateral reflux into the sac. Ligature of the common carotid trunk has been already described.

Ligature of the Arteria Innominata.

Ligature of the arteria innominata, where there is no arterial anomaly present, is carried out by making a vertical incision, commencing at the middle of the anterior border of the right sterno-cleido-mastoid muscle, and ending at the level of the clavicle, between the two heads of the muscle.

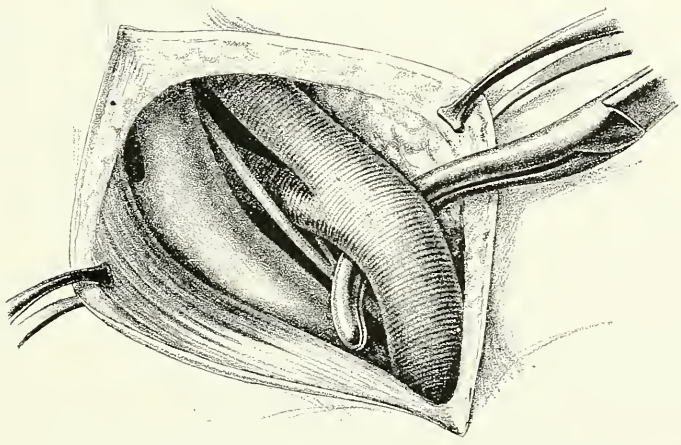


Fig. 466.—Ligature of the Arteria Innominata.

Third stage. We recognize the right innominate vein on its outer side, beneath the border of the sternal head of the sterno-mastoid muscle. Beneath the extremity of the forceps which holds up the artery are seen the pneumogastric nerve and the origin of the recurrent.

Operation—First Stage.—Incision of the skin and superficial aponeurosis along the anterior border of the right sterno-mastoid, and ending at the level of the sterno-clavicular articulation.

Second Stage.—Exposure of the external jugular vein, and its division between two ligatures.

Third Stage.—Exposure of the common carotid and recognition of the

arteria innominata, which is then raised on a curved forceps or on a curved needle used for ovarian pedicles.

Fourth Stage.—Passage of the ligature and tying.

Fifth Stage.—Reunion and drainage.

Fig. 467.—Ligature of Right Subclavian Artery outside the Scaleni.

General sketch.

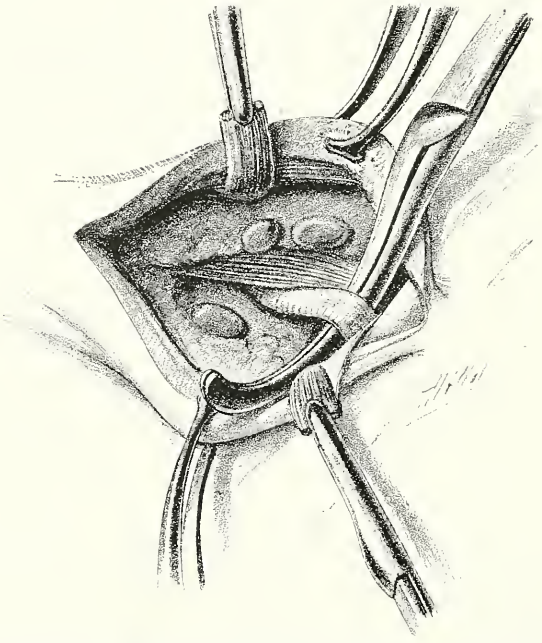


Fig. 468.—Ligature of Right Subclavian Artery outside the Scaleni.

The omohyoid muscle has been divided. The soft parts are retracted with two hooked forceps, and the artery is raised on a curved forceps.

Aneurism of the Subclavian Artery.

Ligature of the Subclavian Artery.

The ligature is preferably applied outside the scaleni muscles.

Operation—First Stage.—Vertical incision of 6 to 8 centimetres in length along the posterior border of the sterno-cleido-mastoid, analogous to the incision made for ligature of the arteria innominata, but ending at the middle of the clavicle. This longitudinal incision is much to be preferred to the incision parallel to the clavicle, which has been hitherto exclusively adopted.

Second Stage.—Exposure of the outer border of the anterior scalenus, and of the tubercle on the first rib to which it is attached; the artery pulsates immediately on its outer side.

Third Stage.—Denudation of the artery, which is then raised on a curved forceps. Passage of the thread with the curved forceps or needle.

Fourth Stage.—Ligature of the artery.

Fifth Stage.—Reunion and drainage.

Aneurism of the Right Subclavian Artery.

Monod had a successful case of double ligature at a single séance of right common carotid and subclavian arteries (1895).

Aneurism of the Left Subclavian Artery.

Ligature of the left subclavian artery has given satisfactory results, especially that of the third stage. Extirpation of the sac may be tried when it seems possible. Those operations have, however, given successful results only in exceptional instances. The brusque interruption of the blood-current in the great arterial trunks of the neck is nearly always followed by circulatory troubles which are of grave if not mortal character; and when the patient survives the first day of the operation, he is in a large proportion of cases afterwards carried off by the complications of embolism or of secondary hæmorrhage. I consider that these operations should now be made to give place to a more delicate and more rational surgical practice: that of incomplete ligature of the artery, followed, when the procedure is possible, by partial resection of the sac and arteriorrhaphy.

Treatment of Arterial Aneurisms by the Author's Method.

Incomplete Ligature on the Cardiac Side of the Aneurism, followed or not by Partial Extirpation of the Sac and Reconstitution of the Arterial Segment—Arterial Grafting.

The sole cause of the increase of size of aneurisms being the pressure of the blood-current, the only mechanical means of opposing such increase is

the reduction of the fluid tension within the sac. If the aneurism is still of recent date, reduction of the pressure of the wave of blood within the sac should suffice to keep its dimensions stationary. Such reduction of the blood-pressure can be realized by incomplete ligation of the artery so as to reduce its calibre to a third or half of its original diameter. Incomplete ligature of the artery presents the immense advantage of not completely arresting the blood-current.* This artifice may also be adopted as a preliminary stage of the complete ligature of the artery and extirpation of the aneurismal sac. The incomplete ligation of an artery, with a degree of constriction sufficient to cut off half or three-quarters of the blood-current, but not to arrest it completely, will not deprive the corresponding capillaries of circulating blood, and will favour the establishment of a collateral circulation. Accordingly, this procedure of incomplete ligation is now the operation of election, as it enables us to avoid the accidents which so frequently followed the immediate application of complete ligature.

Aneurism of the External Carotid Artery.

Aneurism of the external carotid artery is rarely situated in its terminal portion—that is to say, after the origin of its lingual and facial branches. Most frequently the dilatation begins close to the origin of the artery.

Here the advantage of the incomplete ligature over the complete is that it can be carried out close to the seat of bifurcation of the common carotid, as the thread, instead of dividing the inner and middle coats of the vessel, as is recommended in carrying out complete ligature, simply narrows the calibre of the artery while respecting the structure and resistance of its walls. The intervention should vary according as the aneurism is still in the initial stage or has acquired a considerable volume.

We adopt either incomplete ligature of the artery on the proximal side of the sac without opening the latter, or incomplete ligature followed by reconstitution of the arterial segment. The former method should be reserved for cases of very small aneurismal sac, and the calibre of the artery is reduced to a half or third of the normal. If the operator is possessed of the requisite manual dexterity, it is not difficult to estimate the degree of constriction of the artery. The reconstitution of the artery can be carried out only in cases in which the condition in the walls of the aneurismal sac is suitable.

Operation—First Stage.—Incision of the skin and exposure of the aneurismal sac.

Second Stage.—Dissection of the sac: temporary hæmostasis is secured above and below with elastic-pressure forceps, and the exuberant portion of the sac is resected, while preserving exactly the extent of the same necessary for reconstitution of the arterial segment.

* Communication made to the Société de l'Internat., published in the *Revue Critique de Médecine et de Chirurgie*, July, 1898. Communications to the Congress held at Buda-Pesth, published in same *Revue*, September, 1909.

Third Stage.—Incomplete ligature of the artery between the sac and the heart. We ascertain the diameter of the remaining lumen of the artery by opening the jaws of the elastic forceps, which are then again closed.

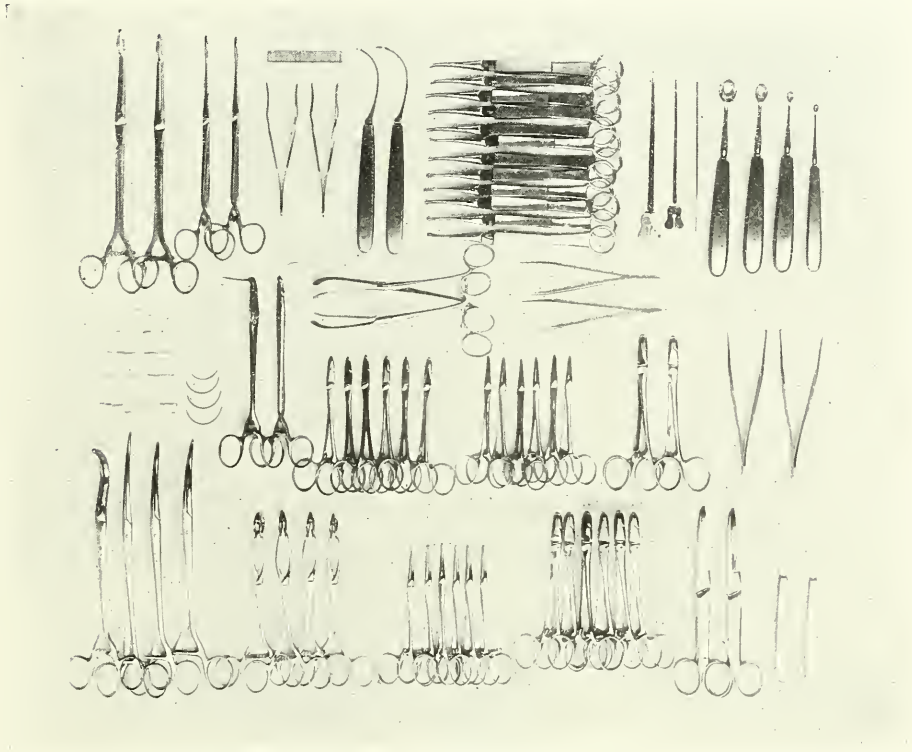


Fig. 469.—Instruments used for Arteriorrhaphy, and for Operation on Arterio-Venous Aneurisms.

Below and from right to left: Two bistouries; two strong straight scissors; six short-jawed and clawed artery forceps; six ring-handled forceps with oblique claws; four forceps with oval jaws; three long curved forceps; and one forceps of large curve for ligatures. Next above: Two clawed forceps; two short-jawed forceps for veins; six Championnière's small artery forceps; six needle-holder forceps with short hollowed jaws; two needle-holder forceps with excentric plate; extra fine needles and Doyen's needle-holder forceps for arteriorrhaphy, and many assorted cutting needles with divided eye; five glass drainage-tubes. Middle row: Two fine dissecting forceps; two elastic curved forceps for hæmostasis of the great vessels. Highest: Four sorted curettes; one grooved stylet; two grooved directors; twelve hooked forceps; two needles mounted on handles; two dissecting forceps and twenty-five staples; two bullet forceps; and two long forceps with oval excentric jaws.

Fourth Stage.—Reconstitution of the arterial segment with a double continued suture, made with very fine silk and special round needles. The forceps placed on the distal side of the aneurism is first removed, and then that on the proximal side. When the suture has been well applied it permits no leakage of blood.

Fifth Stage.—Suture of skin; drainage.

When reconstitution of the artery is impossible—for example, if the walls of the sac are very friable—complete ligation is carried out both above

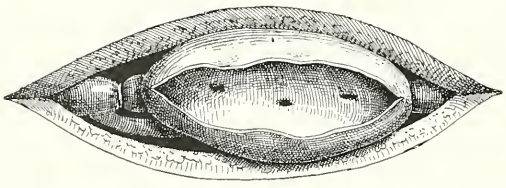


Fig. 470.—Aneurism of External Carotid.

Third stage: Opening of sac and incomplete ligature between it and the heart.

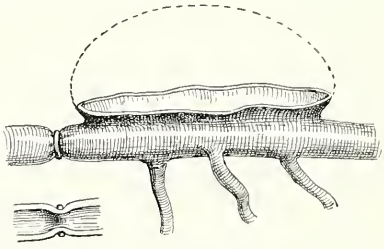


Fig. 471.—Aneurism of External Carotid.

Diagrammatic sketch showing incomplete ligature of the artery and the extent of the wall of the sac that should be resected.

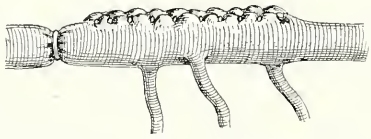


Fig. 472.—Aneurism of External Carotid.

Reconstitution of the artery by double continued suture.

and below the sac, with suture and ligature of the collateral branches connected with the aneurismal cavity. In some of those cases we can

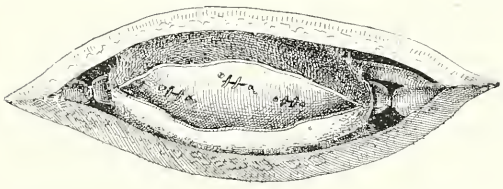


Fig. 473.—Aneurism of External Carotid.

When the walls of the sac are too friable, complete ligation of the artery is carried out both above and below the sac, and the orifices of the collateral vessels are closed with some points of suture.

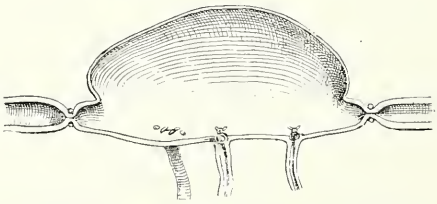


Fig. 474.—Aneurism of External Carotid.

Diagrammatic section illustrating complete ligature of the artery above and below the sac, and obliteration of the three collateral branches by some points of suture.

preserve a portion of the sac, and include in a continued suture the orifices of the collateral branches arising in its plane.

Aneurism of the Common Carotid Artery.

As this artery has no collateral branches, its aneurisms may affect two typical forms. One is the sacciform aneurism, which communicates with

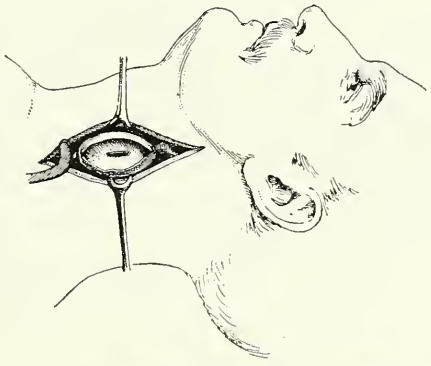


Fig. 475.—Sacciform Aneurism of Common Carotid.

Third stage of operation. General sketch.

the lumen of the artery by a narrow opening; in this case more than half of the circumference of the artery is intact. In the other class the aneurism

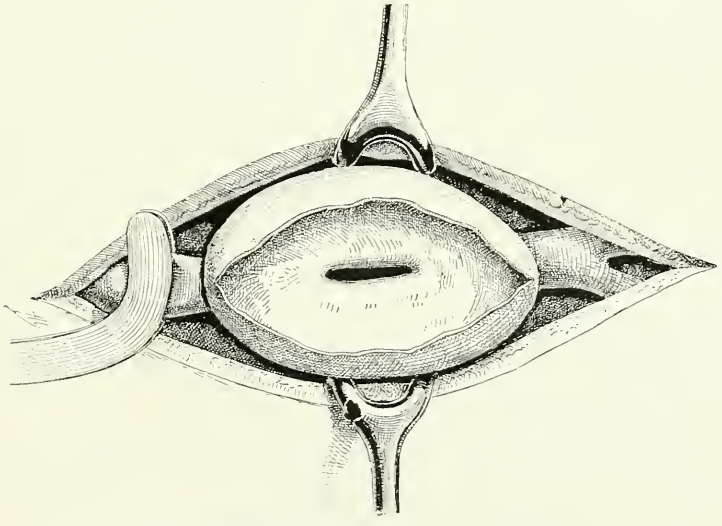


Fig. 476.—Sacciform Aneurism of Common Carotid.

Hæmostasis on proximal side of sac, with an elastic forceps for aneurismorrhaphy. Opening and toilet of the sac. When necessary, a second forceps is placed on the artery beyond the sac.

is fusiform in configuration, and the sac involves the whole circumference of the artery, so that the cavity presents two orifices, respectively provided

for the entrance and exit of the circulating blood; thus we can readily conceive that the reconstitution of the artery is much more difficult when we

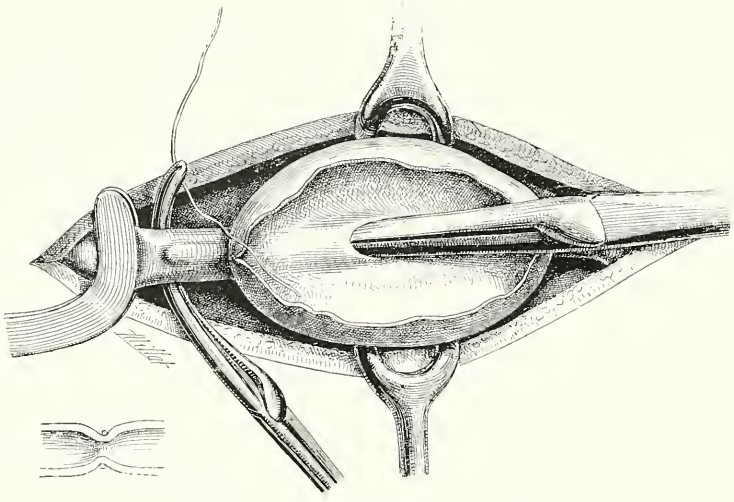


FIG. 477.—SACCIFORM ANEURISM OF COMMON CAROTID.

Passage of the ligature beneath the artery on the proximal side of the sac, and incomplete ligation of the vessel.

have to deal with this disposition. Those different varieties of aneurism are represented in Figs. 482 to 485. We may remark that when the sac

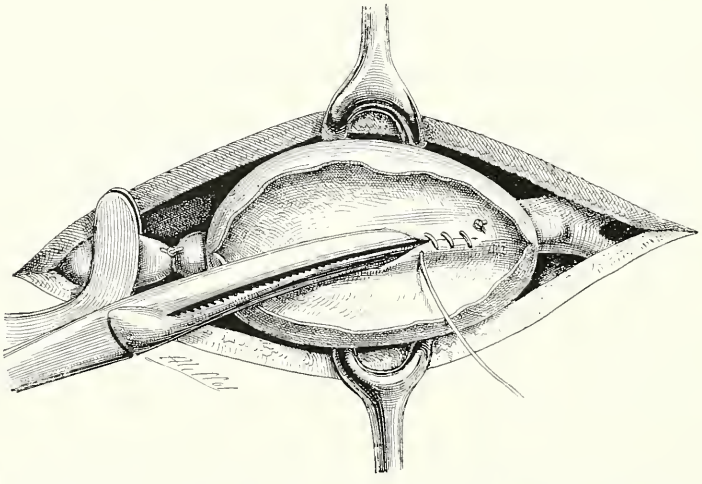


FIG. 478.—SACCIFORM ANEURISM OF COMMON CAROTID.

Reconstitution of the artery by endo-aneurismorrhaphy.

is opened it is easy to calibrate the incomplete ligature of the artery on the extremity of a forceps or of a cylindro-conical mandrel. The reconstitution

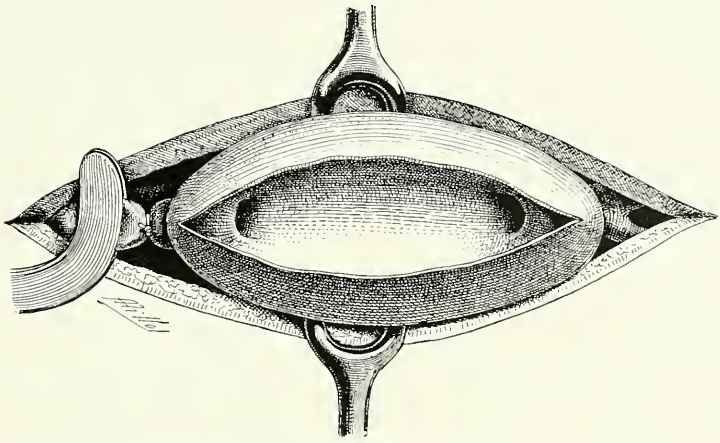


FIG. 479.—FUSIFORM ANEURISM PRESENTING TWO DISTINCT ARTERIAL ORIFICES.

Incomplete ligature of artery on proximal side of sac. An elastic forceps is placed on the artery beyond the sac if recurrent hæmorrhage takes place.

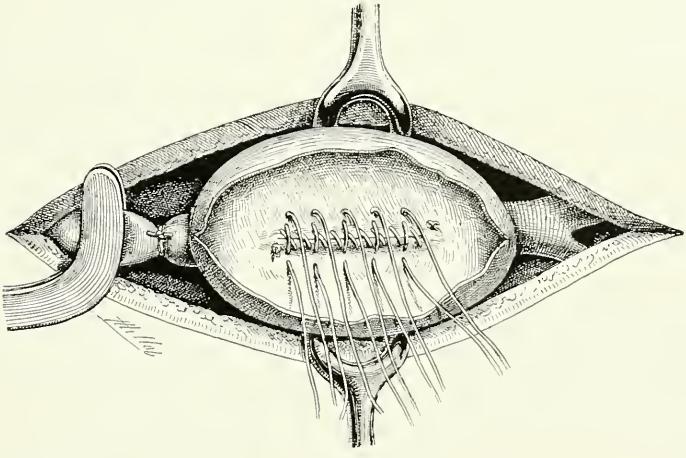


FIG. 480.—FUSIFORM ANEURISM PRESENTING TWO DISTINCT ARTERIAL ORIFICES.

Disposition of the second plane of suture, which may be of the interrupted form. The walls of the sac may be resected before arrangement of the second plane of suture.

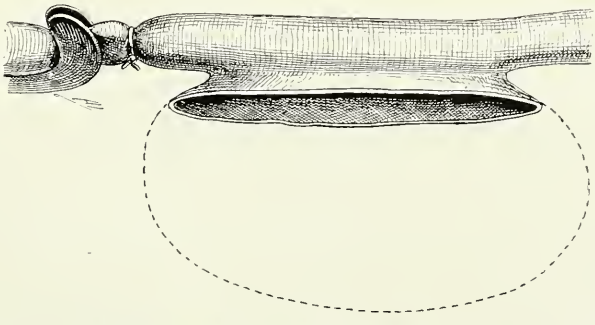


FIG. 481.—FUSIFORM ANEURISM PRESENTING TWO DISTINCT ARTERIAL ORIFICES.

Diagrammatic figure representing partial resection of the sac.

of the sac is usually effected with a double continued suture. This arrangement of suture may be carried out in one of two ways, according to the

FIG. 482.—FUSIFORM ANEURISM PRESENTING TWO DISTINCT ARTERIAL ORIFICES.

Section of the repaired artery after disposition of first layer of suture.

FIG. 483.—FUSIFORM ANEURISM PRESENTING TWO DISTINCT ARTERIAL ORIFICES.

Section of reconstituted artery after completion of second layer of suture.

FIG. 484.—FUSIFORM ANEURISM PRESENTING TWO DISTINCT ARTERIAL ORIFICES.

Reconstruction of a peri-arterial cellular sheath from the neighbouring tissues.

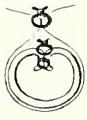


FIG. 485.—FUSIFORM ANEURISM PRESENTING TWO DISTINCT ARTERIAL ORIFICES.

The reparation of the arterial wall has been effected with the help of invagination of the first layer of sutures.

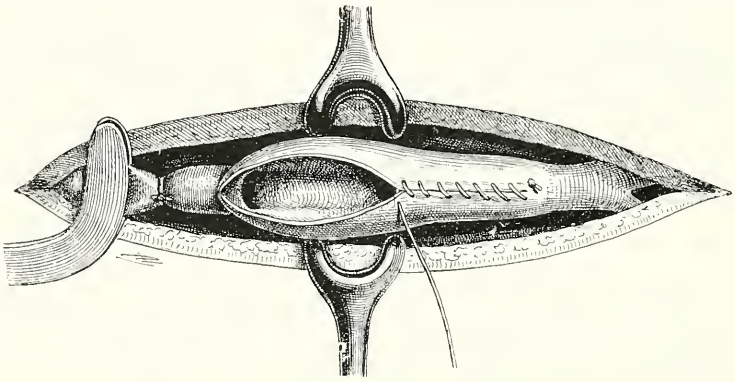


FIG. 486.—FUSIFORM ANEURISM PRESENTING TWO DISTINCT ARTERIAL ORIFICES.

Reconstitution of the artery by continued suture of the remainder of the wall of the sac, in two planes. The first is folded beneath the second.

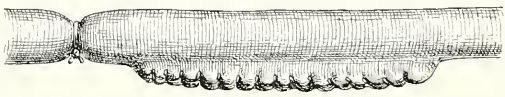


FIG. 487.—FUSIFORM ANEURISM PRESENTING TWO DISTINCT ARTERIAL ORIFICES.

Aspect of reconstituted artery.

extent of the walls of the sac of which we have to dispose by autoplasty. If such extent be very limited, the sutures should be applied as repre-

sented in Figs. 483 and 484, when the two arterial sutures are then further fortified by a very close superficial continued suture involving the peri-arterial connective tissue (Fig. 484). If the extent of the walls available for the repair is sufficient to guarantee a calibre above the normal, the first stratum of suture is invaginated towards the interior of the artery. The technique thus described can be applied to all the great arteries, peripheral and visceral.

Aneurism of the Innominate and Subclavian Arteries.

In cases of aneurism of the thoracic portion of the right common carotid, innominate, and subclavian arteries respectively, the simplest plan, when the sac is not of considerable size, is not to open it, but simply have recourse to incomplete ligation of the vascular trunk between the sac and the heart.

Arterial Grafting.

In certain cases of aneurism, more especially those of the upper third of the common carotid artery, we may try the duplex procedure of extirpation of the sac and replacement of the corresponding portion of the carotid trunk with a segment of a vein of the umbilical cord of a new-born fœtus (see Vol. I.).

Arterio-Venous Aneurism.

Arterio-venous aneurisms may develop either on the lateral aspects of two wounded vessels or between them. The accompanying figures illustrate their formation. For example, a pointed instrument passes through the middle of a vein, which is the more superficial vessel, and then reaches the

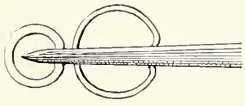


Fig. 488.—Diagram of the Accidental Perforation of a Vein and Artery through the Middle of Each.

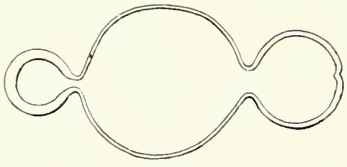


Fig. 489.—Diagram of the Accidental Perforation of a Vein and Artery through the Middle of Each.

Diagram of the structure of the consecutive inter-arterio-venous aneurism.

adjacent artery; the external opening in the vein then closes, and a mixed inter-arterio-venous aneurism is the result. On the other hand, when the wound is nearly tangential in direction a lateral arterio-venous aneurism is formed.

Operation—First Stage.—Incision of the skin and exposure of the sac.

Second Stage.—Dissection of the sac and exposure of the two vascular trunks. Application of an elastic forceps to the artery and to the vein above and below the seat of the aneurism.

Third Stage.—Extirpation of the aneurism while preserving a collarette of 3 to 4 millimetres at the level of each orifice.

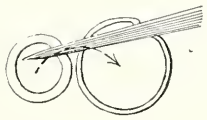


Fig. 490.—Accidental Perforation of a Vein and Artery in Almost Tangential Direction.

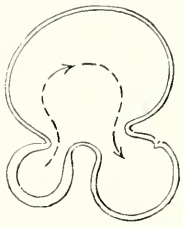


Fig. 491.—Accidental Perforation of a Vein and Artery in Almost Tangential Direction.

Lateral arterio-venous aneurism. The arrow indicates the movement of the arterial blood.

Fourth Stage.—Closure, first of the artery, and then of the vein, with a double invaginating purse-string suture. We can, on the side of the

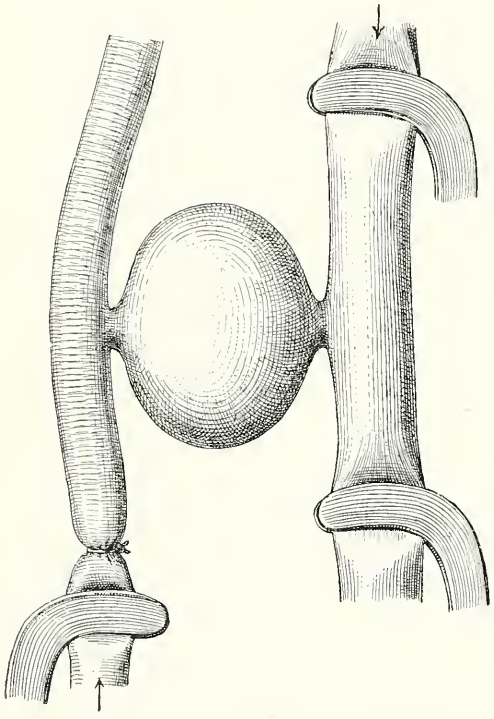


Fig. 492. — Inter-Arterio-Venous Aneurism between Two Large Vessels.

Temporary hæmostasis. Incomplete ligation of the artery on the cardiac side of the sac.

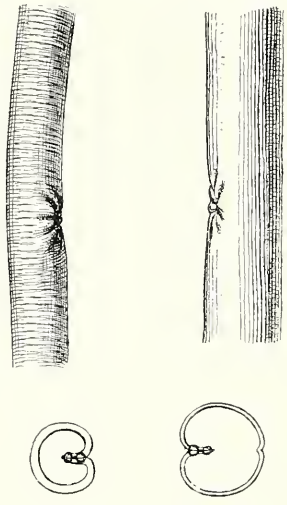


Fig. 493. — Inter-Arterio-Venous Aneurism between Two Large Vessels.

The sac has just been extirpated. Closure of the arterial and venous orifices with double purse-string sutures.

artery, apply an incomplete ligature beneath the suture, so as to diminish the pressure of the blood-current.

Fifth Stage.—Reunion; drainage.

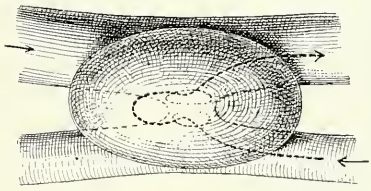


Fig. 494.—Lateral Arterio-Venous Aneurism.

The arrow indicates the penetration of the arterial blood.

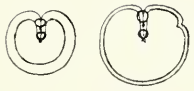


Fig. 495.—Lateral Arterio-Venous Aneurism.

Separate suture of artery and vein after extirpation of the sac.

OPERATIONS ON THE VENOUS TRUNKS.

The internal jugular vein, from its relations to the lateral sinus and the pericarotid chain of lymphatic glands, is exposed to numerous lesions.

Phlebitis of the Internal Jugular Vein.

Phlebitis of the jugular vein is produced by extension of phlebitis of the lateral sinus, of otitic origin. When this affection evolves in subacute form, it may present the appearance of a phlegmon of the region. Intervention for phlebitis of the internal jugular vein is nearly always preceded

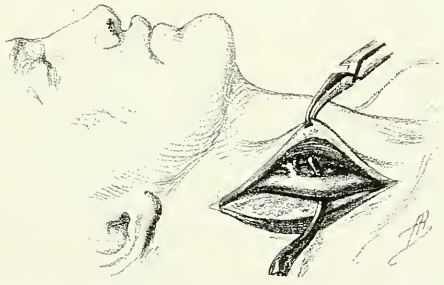


Fig. 496.—Exposure of Internal Jugular Vein affected with Phlebitis.

General sketch.

by evacuation of the mastoid process, the formation of a wide opening by the occipital route, and curettage of the lateral sinus affected by phlebitis. The carotid region is tumefied and painful, and the vein, which is filled with septic clots, gives to the fingers the sensation of a hard cord.

Operation—First Stage.—Vertical cutaneous incision, from the retro-auricular groove to the sterno-clavicular articulation, along the posterior border of the sterno-cleido-mastoid.

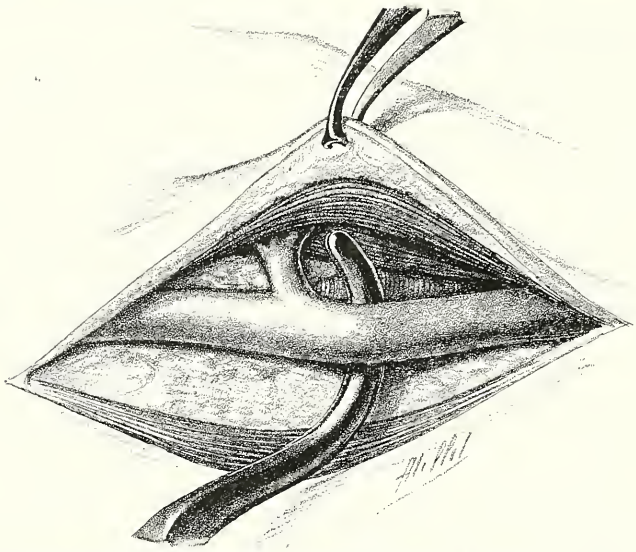


Fig. 497.—Exposure of Internal Jugular Vein affected with Phlebitis.

First and second stages: Cutaneous incision along the posterior border of the sterno-cleido-mastoid muscle. Exposure of the vein, which is raised on a curved forceps.

Second Stage.—Dissection of the posterior border of the muscle and of the lower third of the vein, on which is placed (with care to exclude the pneumogastric nerve) a circular ligature, with the object of protection from septic emboli during the dissection of the vessel.

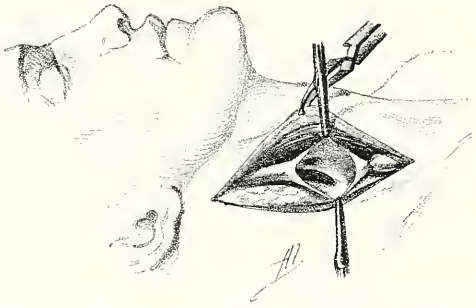


Fig. 498.—Exposure of Internal Jugular Vein affected with Phlebitis.

Ligature of the lower part of the vein. General sketch.

Third Stage.—Dissection of the vein up to the level of the styloid process. The vessel is divided above the ligature and extirpated at the highest possible level, the collateral branches being tied in succession. All disturbance of the pneumogastric nerve is avoided, care being taken to preserve its investing cellular sheath as completely as possible.

Fourth Stage.—Suture of the skin with clips; drainage.

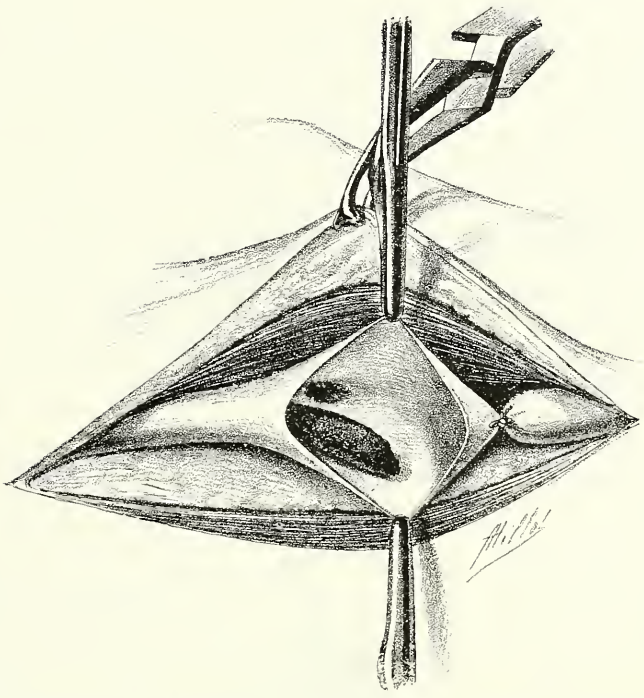


Fig. 499.—Exposure of Internal Jugular Vein affected with Phlebitis.

The vein has been tied below the seat of the phlebitis. The walls have been incised above the ligature for the purpose of extracting the clots. The terminal orifice of the thyro-laryngo-facial trunk is seen.

Adhesions of the Internal Jugular Vein to Tuberculous or Cancerous Lymphatic Glands.

Tuberculous or cancerous lymphatic glands, when themselves invaded by the degenerative pathological process, may be found adhering intimately to the walls of the internal jugular vein. When the vein is wounded to a certain extent in the direction of its longitudinal axis, or if a collateral tributary is torn at its termination in the principal trunk, a continued suture is applied, with suitable round needles and fine silk. Venous suture should be preferred to lateral ligature, even in those cases in which the latter is possible. When the vein is included in the ganglionic mass, the adherent portion is extirpated between two ligatures, with special care to ligature the collateral branches also and to exclude the pneumogastric nerve.

Venous Grafting.

When the field of operation is aseptic, we may try to replace the missing jugular vein by the jugular vein of a sheep. I carried out this procedure successfully in 1909 in the case of a popliteal vein (see Popliteal Aneurism).

OPERATIONS ON THE LARGE LYMPHATIC VESSELS.

The topography of the termination of the thoracic duct in the sinus between the internal jugular and subclavian veins is interesting to define, on account of the relative frequency with which that vessel is wounded. I will not refer further to wounds of the great lymphatic trunk, as this accident is extremely rare. The termination of this vessel is easily exposed by making a cutaneous incision of 6 centimetres parallel to the outer border of the sternal head of the sterno-cleido-mastoid and ending at the level of the clavicle. If we then retract the sternal and clavicular heads

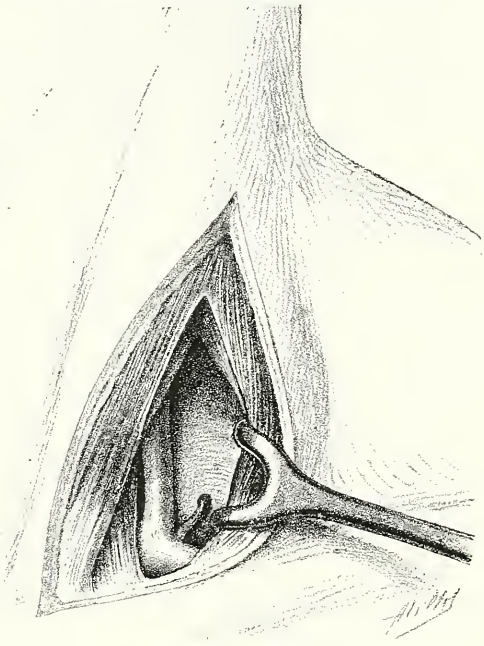


Fig. 500.

The two heads of the sterno-mastoid have been retracted by divulsion. The thoracic duct emerges from the cellular tissue which fills the laryngo-supraclavicular space, and ends at the angle of confluence of the left subclavian and internal jugular veins.

of the muscle forcibly, so as to dissociate them as far as the upper end of the cutaneous incision, the sinus between the two veins is exposed, into which the duct empties. In order to ascertain the relations of the terminal portion of the duct, the clavicular head of the muscle must be drawn outwards, and the sternal head, with the carotid artery and the internal jugular vein, inwards. We then see the terminal cross formed by the thoracic duct as it hooks round the pneumogastric nerve, close to the subclavian artery and the origin of its vertebral branch. If we draw the carotid artery and pneumogastric nerve inwards with the internal jugular vein so far as

to expose the trachea, we expose behind the inner lip of the incision the junction of the two great nervous trunks and the termination of the duct, which is seen to emerge from the depth of the prevertebral region.

Wound of the Thoracic Duct.—Accidental wound of the thoracic duct is characterized by continuous lymphorrhœa; the patient's strength fails

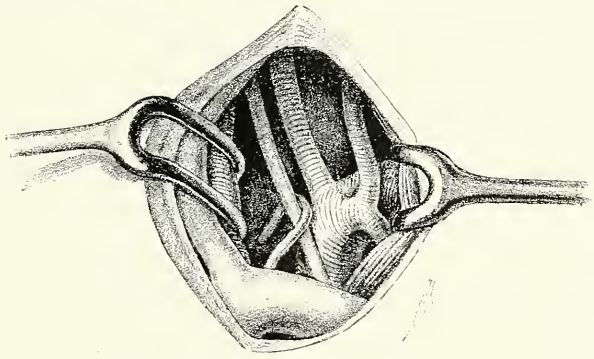


FIG. 501.

The cellulo-adipose tissue has been removed. Hooking of the thoracic duct around the pneumogastric nerve, in contact with the subclavian and vertebral arteries.

very rapidly. The duct has often been involved as an accident of surgical intervention on the left carotid region.

Ligature of the Thoracic Duct.—The peripheral end only requires to be tied; after this ligature the lymph flows into the venous torrent by the great lymphatic canal. When the duct is wounded in the course of an operation,

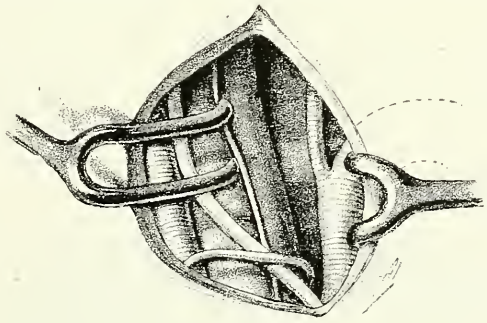


FIG. 502

The pneumogastric nerve has been raised on a retractor with the carotid artery and internal jugular vein, so as to expose the trachea, œsophagus, and recurrent nerve. We see the thoracic duct emerging from the prevertebral region.

the ligature is immediately applied. When a fistula exists, we seek the peripheral end of the duct by minute dissection, and there apply the ligature. The free extremity should be sutured with catgut. We may also try to implant it in the most accessible part of the venous trunk. This very delicate procedure can possibly be carried out only when the peripheral end of the thoracic duct can be freed for a sufficient portion of its length.

OPERATIONS ON THE NUCHAL REGION.

Resection of the Great and Lesser Occipital Nerves.

1. Unilateral Resection.

Operation—First Stage.—Transverse incision commencing a finger's breadth below the mastoid process and ending at the middle line opposite the spinous process of the axis.

Fig. 503.—Resection of Right Occipital Nerve.

General sketch.

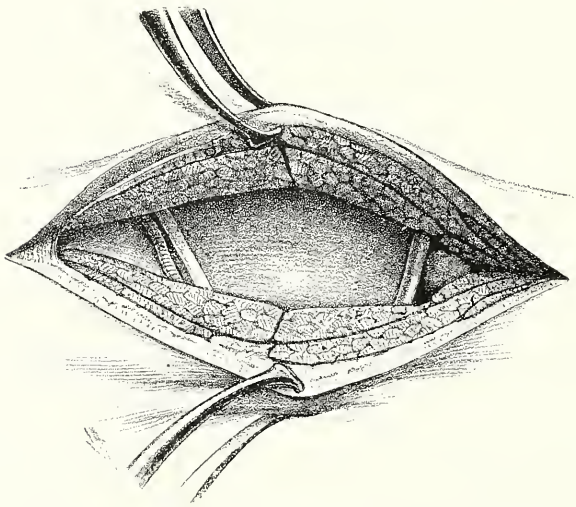


Fig. 504.—Resection of Left Occipital Nerve.

Third stage of the operation, showing the division of the superficial muscular strata and exposure of the great occipital nerve lying on the deep aponeurosis.

Second Stage.—Division of the trapezius, splenius, and complexus, and exposure of the deep posterior cervical aponeurosis.

Third Stage.—Exposure of Arnold's great occipital nerve below the great oblique muscle, the middle of which it crosses. The nerve is divided as low down as possible, and resected through a great part of its length.

Fourth Stage.—Reunion and drainage.

2. Bilateral Resection.

Operation—First Stage.—Median transverse incision of 6 to 7 centimetres at a level of a finger's breadth below the horizontal bi-mastoid line.

Fig. 505.—Multiple Unilateral Myotomy of the Muscles of the Nucha.

Right side. General sketch.

Second Stage.—Division of the superficial muscular stratum, which is formed by the trapezii; then division of the splenius and complexus, and exposure of the deep posterior cervical aponeurosis, which covers the recti and obliqui muscles.

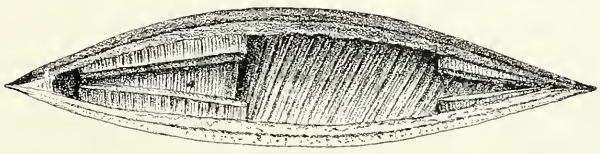


Fig. 506.—Multiple Unilateral Myotomy of the Muscles of the Nucha.

Second stage. The section of the trapezius is shown at the inner side, and that of the sterno-mastoid outside. Beneath is seen -outside, the splenius; and inside, the complexus.

Third Stage.—Exposure of Arnold's great occipital nerve at its emergence, beneath the great oblqiue and to the outer side of the attachment of this muscle to the spinous process of the axis. The nerve is divided as low down as possible, and resected for a length of several centimetres. Same operation on the opposite side.

Fourth Stage.—Reunion; drainage.

The lesser occipital nerve of Arnold emerges quite close to the spinous process of the third cervical vertebra, and ascends towards the nuchal region close to the middle line. It is readily exposed on carefully dissecting the interval which separates the two nerves.

Multiple Myotomy of the Muscles of the Nucha.

This operation, which was conceived by Kocher and described by Quervain in 1895 in the *Semaine Médicale*, consists of a transverse section of all the muscles of the neck, not excepting the deep stratum. This operation can be carried out in a single stage if unilateral. When bilateral, it must be divided into two stages.

Fig. 507.—Multiple Unilateral Myotomy of the Muscles of the Nucha.

Second stage. General sketch.

1. Unilateral Spasmodic Torticollis.

Operation—First Stage.—Transverse posterior incision, commencing 20 millimetres below the mastoid process and ending behind opposite the spinous process of the third cervical vertebra.

Second Stage.—Transverse section of all the superposed muscles. We meet in succession the sterno-mastoid and trapezius, beneath these the great and lesser complexus, and then the inferior or great oblique. The superior oblique and both recti muscles are preserved.

Third Stage.—Verification of the field of operation and minutely detailed hæmostasis. It suffices to tie some of the muscular branches of the occipital artery.

Fourth Stage.—Reunion of superficial cervical aponeurosis; suture of skin, and drainage.

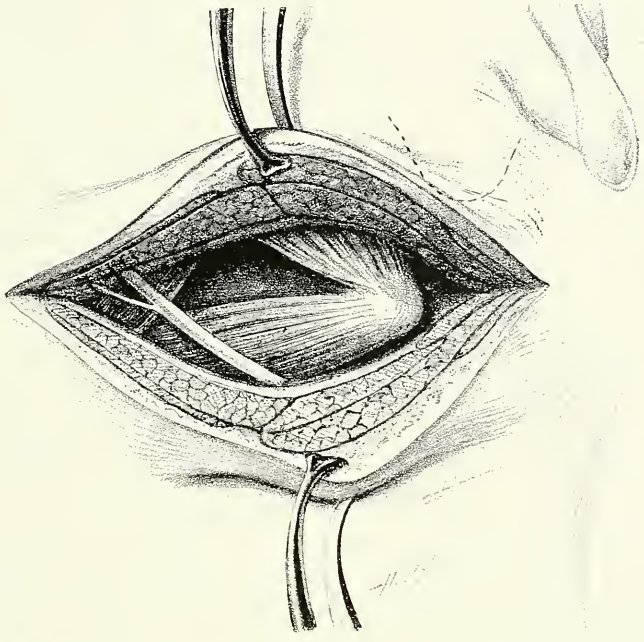


FIG. 508.—MULTIPLE UNILATERAL MYOTOMY OF THE MUSCLES OF THE NUCHA. Second stage. The complexi muscles have just been divided; the great occipital nerve of Arnold and the great oblique muscle are exposed.

2. Bilateral Spasmodic Torticollis.

The operation is carried out in two stages. When one side is more affected, unilateral myotomy is performed on that side in the manner just described. The same operation is carried out on the other side at the

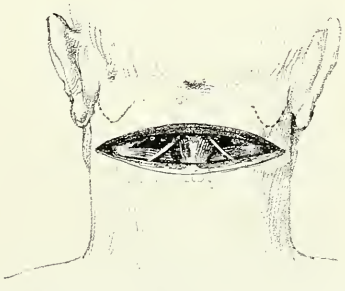


FIG. 509.—BILATERAL MULTIPLE MYOTOMY OF THE MUSCLES OF THE NUCHA. General sketch.

end of two or three months. Or we can, in the first intervention, complete the bilateral division of the superficial muscles, and leave the section of the great oblique and recti for an ulterior procedure.

The operation in two stages, as I have practised it, followed by reunion of the superficial cervical aponeurosis, has been followed by a very satisfactory result. The facility with which that immense open wound undergoes

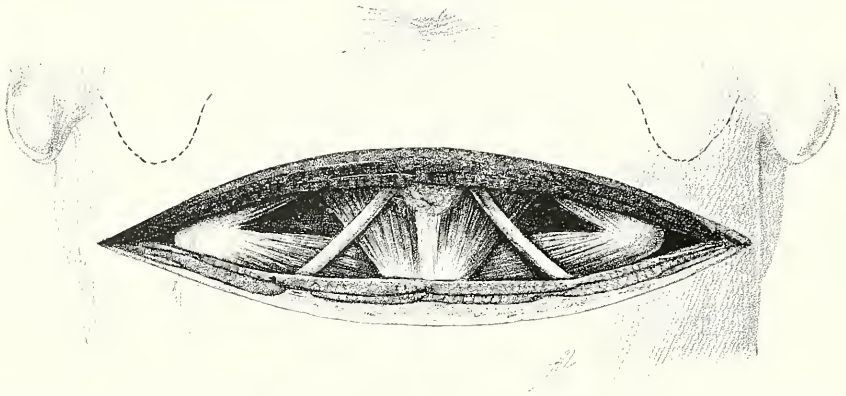


Fig. 510.—Bilateral Multiple Myotomy of the Muscles of the Nucha.

Bilateral section of all the superficial muscles and of the lesser occipital nerve of Arnold. Exposure of both the great occipital nerves, which will be resected, if necessary. In a second intervention, if it appear requisite, the deep muscles will be divided, especially the great oblique and great rectus.

repair recalls the condition in the demi-decollations with sabre-strokes which used to be seen in cavalry charges. I recently treated with success by this method a woman of thirty-five who had suffered for a dozen years from spasmodic torticollis.

OPERATIONS ON THE ARTERIES OF THE NUCHA.

Ligature of the Occipital Artery.

Ligature of the occipital artery is carried out in cases of wounds of the main trunk or of its principal branches if the hæmorrhage is formidable.

First Stage.—Transverse incision, with a slight upward inclination from without inwards, starting from the apex of the mastoid process and ending in the vicinity of the external occipital protuberance.

Second Stage.—Division of the sterno-mastoid, splenius, and complexus minor muscles.

Third Stage.—Exposure of the artery, the fluxuosities of which lie on the outer surface of the deep aponeurosis of the nucha; it then passes over the complexus major to pierce the superficial aponeurosis in the neighbourhood of the middle line.

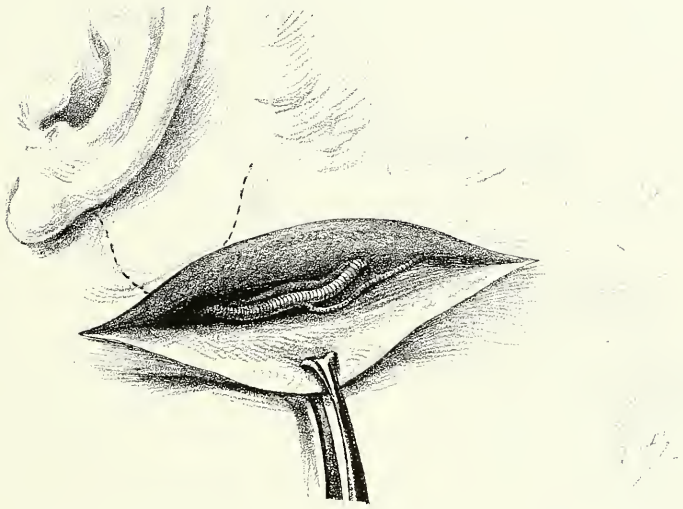


Fig. 511.—Ligature of the Left Occipital Artery.

Exposure of the artery.

Ligature of the Vertebral Artery in its Course through the Transverse Process.

The vertebral artery may be accidentally wounded in the course of operation for Pott's disease in the cervical region.

Operation—First Stage.—The field of operation is extended, by incision or by divulsion, till the source of hæmorrhage is exposed and the tubercles

Fig. 512.—Ligature of the Vertebral Artery.

Diagrammatic Sketch.

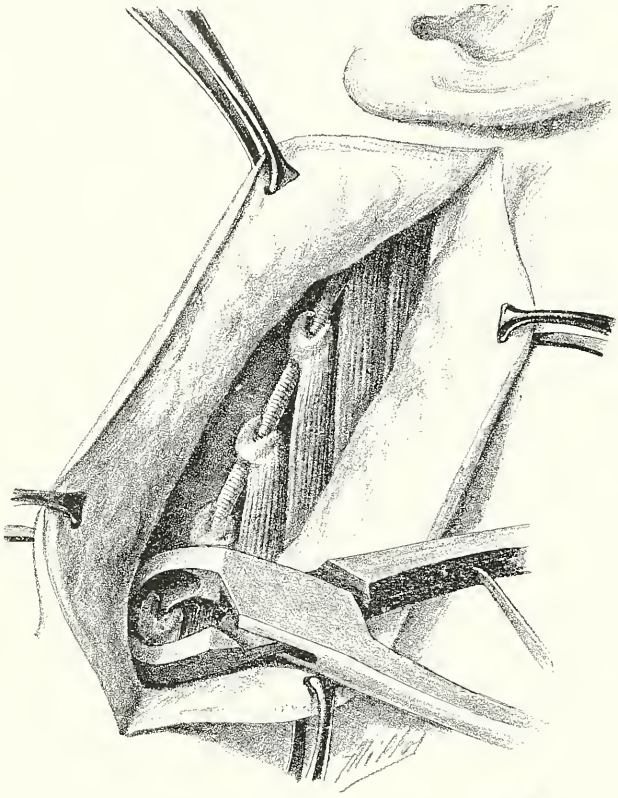


FIG. 513.

LIGATURE OF THE VERTEBRAL ARTERY.

The transverse processes of the cervical vertebræ have been exposed. Resection of the external semicircumference of the vertebral canal of Chassaignac's tubercle.

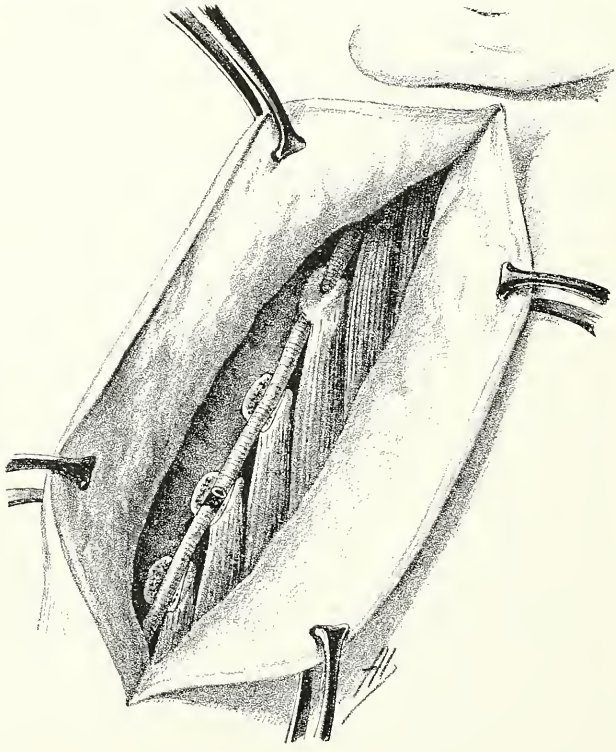


FIG. 514.

LIGATURE OF THE VERTEBRAL ARTERY.

The vertebral artery has been exposed by successive resection of the outer segment of the respective tubercles of the transverse processes of the fourth, fifth, and sixth cervical vertebræ.

of the transverse processes of the vertebræ laid bare. The hæmorrhage is arrested by direct compression.

Second Stage.—We may now try to ligature the artery after partial resection of the wall of one of the canals of the transverse processes, or we may obliterate its lumen above and below the bleeding-point by introducing between the wall of the canal and the contained artery a conical fragment of bone obtained from the vicinity.

Third Stage. — Deep tamponing of wound. Partial suture of the skin.

OPERATIONS IN THE CERVICAL SEGMENT OF THE VERTEBRAL COLUMN.

Traumatic Affections.

Wounds.

Wounds of the cervical vertebral column are not dangerous when not penetrating, and when the instrument has not injured one of the important structures of that region.

Foreign Bodies.

The traumatic foreign bodies most frequently met with are either the point of a broken knife-blade or a revolver bullet. Radiography and radioscopy greatly facilitate operation.

Gunshot Wounds in the Mouth.

I have removed a Flobert bullet of 6 millimetres from the body of the second cervical vertebra, which had been discharged within the mouth. I made a cervical incision of 8 centimetres at the anterior border of the sterno-mastoid muscle in order to be able to pass beneath the prevertebral aponeurosis. The opening in the body of the vertebra was exposed, and the bullet was luxated easily with the help of a small narrow curved raspatory.

In another case I extracted through the same retro-mastoid route a leaden revolver bullet of 8 millimetres in diameter, which had been fired from the front, and had penetrated between the vasculo-nervous bundle and the trachea, to be arrested in its course on the lateral portion of the body of the seventh cervical vertebra. These projectiles are represented in position in Figs. 276 and 277.

Inflammatory Lesions.

Acute Inflammatory Lesions.

Acute infective osteitis of the cervical vertebræ is rarely observed. This condition will require very early intervention, unless we are able to secure resolution by the administration of mycolysine by hypodermic injection.

Chronic Inflammatory Lesions.

Cervical Pott's Disease.

Pott's disease in the cervical region may require the intervention of the surgeon when it proceeds to suppuration. Having incised the focus and exposed the carious portions of the bones, these can be resected with the

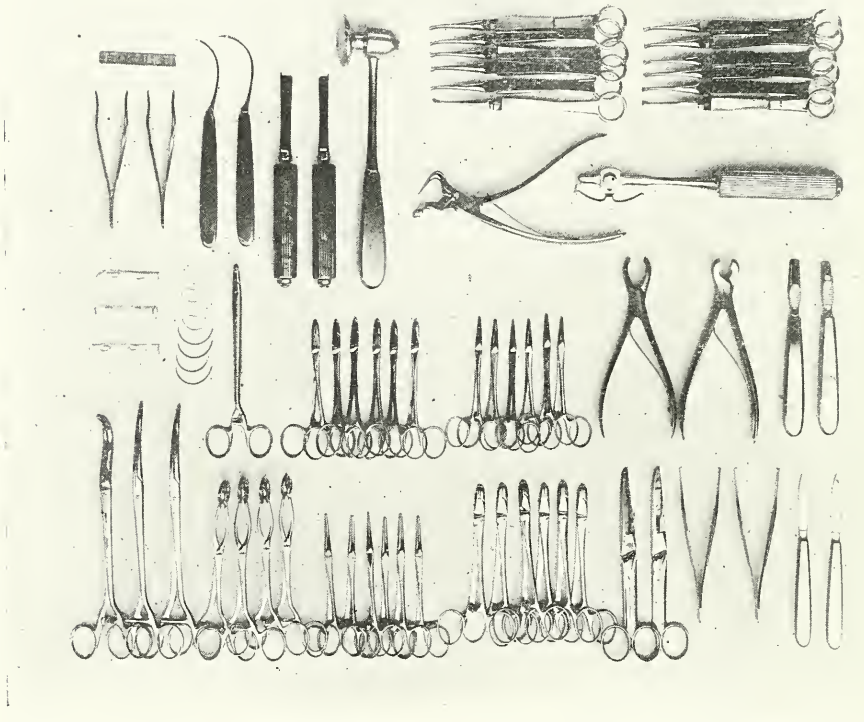


Fig. 515.—Instruments required for Interventions on the Spinal Column.

From right to left, and from below upwards: Two bistouries; two strong straight scissors; six short-jawed clawed forceps; six ring-handled forceps with nine oblique claws; four forceps with oval jaws; two long curved forceps; one long curved ligature-holder forceps. Above these: One curved raspatory; one straight raspatory; two cutting forceps; six Championnière's hæmostatic forceps; six artery forceps; one long forceps with eccentric jaws; assorted needles; drainage-tubes. One Doyen's lamina; one rachitome-raspatory; one mallet; two straight craniectomy chisels; two needles mounted on handles; two clip forceps; metallic clips; a dozen hooked forceps.

gouge-forceps, taking care not to wound the vertebral artery. When the vertebral artery is wounded, the ligature of the vessel may present certain difficulties. We may procure hæmostasis by wedging the ends of the artery in the osseous canal of the transverse processes by introducing a

conical osseous fragment taken from the vicinity. Ligature may be carried out by the procedure of resection of the anterior tubercle of the transverse process.

Cervical Laminectomy.

Opening the rachidian canal in the cervical region may be necessitated by some exceptional affections. The cervical vertebræ and first three dorsal are represented in Fig. 516, where we can also clearly distinguish the

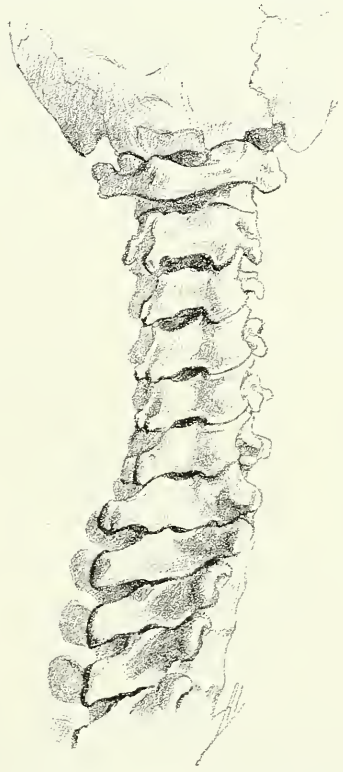


Fig. 516.—Cervical Spine.

Appearance of the interlaminar spaces, which diminish from above downwards, and disappear in the dorsal region.

interlaminar spaces which, along the whole extent of the cervical spine, permit the introduction of the raspatory of our rachitome under the vertebral arch. Fig. 517 is intended to demonstrate the introduction of the tip of the raspatory, the rachitome having been detached so as to place this stage of the operation more clearly in evidence.

The introduction of the horizontal branch of the rachitome is easy when the manipulation of the instrument has been carefully studied. The vertebral lamina is then divided, as shown in Fig. 518, either quite close to the spinous process or at some distance to the outside. The section is

repeated successively on the laminæ which have to be resected (Fig. 519). We then require merely to grasp in succession with the gouge-forceps and as near the base as possible each of the spinous processes one of the sup-

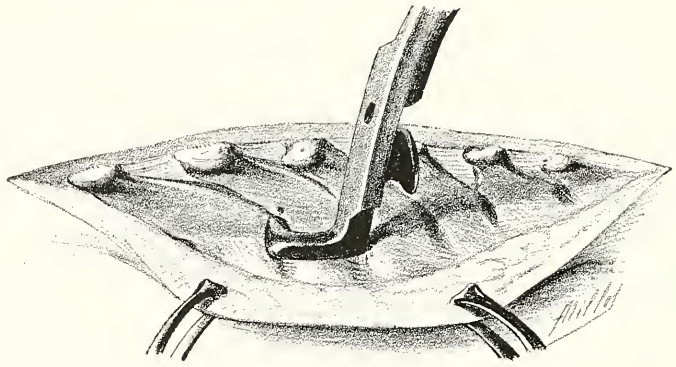


FIG. 517.—INTRODUCTION OF THE HORIZONTAL BRANCH OF THE RACHITOME BENEATH THE LAMINA OF THE SIXTH CERVICAL VERTEBRA.

porting laminæ of which has been divided, and fracture the other lamina by a movement of oscillation (Figs. 520 and 521). The soft interspinous tissues are divided, and the detached spines thus isolated with their laminæ

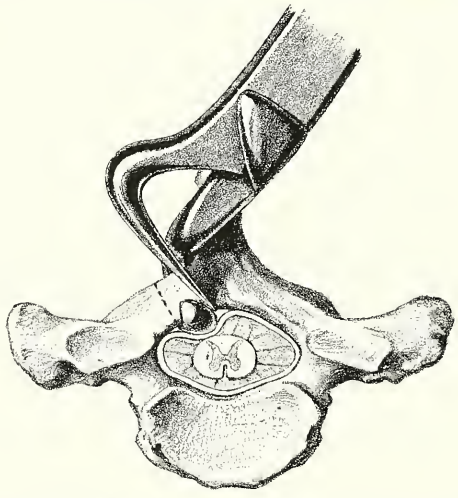


FIG. 518.—CERVICAL LAMINECTOMY WITH THE RASPATORY-COSTOTOME.
The rachidian dura mater is protected by the horizontal branch of the instrument.

are extracted by a single wrench, as represented in Fig. 521. If the opening thus obtained is not large enough, it can be increased with the gouge-foreps.

I have performed this operation on a young woman whose spinal cord was compressed by a tumour of the size of a bean, which had grown at the intra-rachidian portion of the posterior root of the third cervical nerve of

the right side. This tumour, which must have developed slowly, had hollowed out an actual pocket for itself at the expense of the right lateral

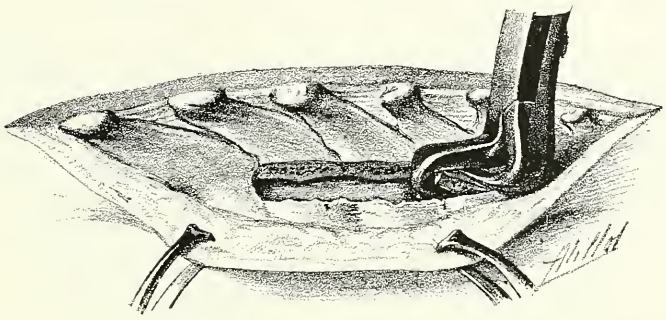


Fig. 519.—Cervical Laminectomy with the Raspatory-Costotome.

Successive section of the sixth, fifth, and fourth cervical laminæ of the right side.

wall of the rachidian canal, which had been the seat of a slow process of absorption. The patient was brought to me in an almost moribund con-

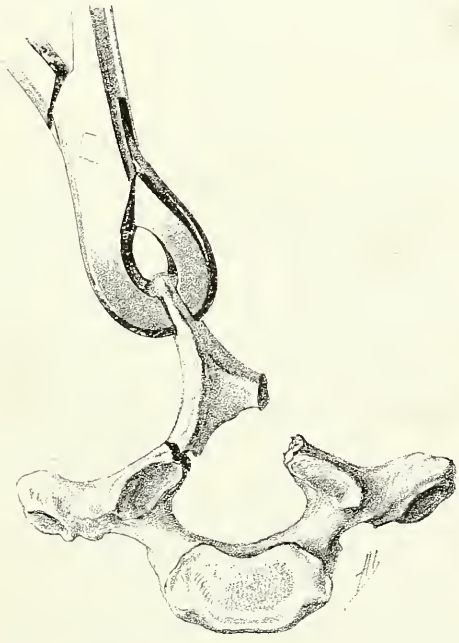


Fig. 520.—Cervical Laminectomy with the Raspatory-Costotome.

Extirpation of the spinous process and segments of the vertebral laminæ by oscillation of the spinous process towards the side opposite to that of the first section.

dition. She had been affected for several weeks with diplegia, which had come to involve even the muscles of respiration. The diaphragm alone

served to maintain respiration, and it contracted but feebly. The seat of compression was immediately above the third cervical vertebra.

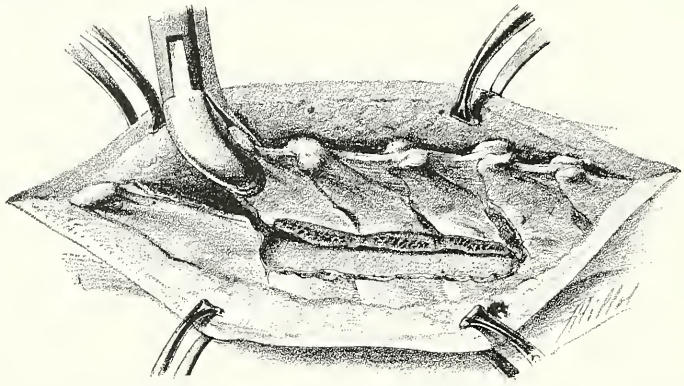


FIG. 521.—LUXATION OF SIXTH SPINOUS PROCESS TOWARDS THE LEFT SIDE, TO PRODUCE FRACTURE OF THE LEFT VERTEBRAL LAMINA.

Operation.—I performed the following operation:

FIRST STAGE.—Vertical median incision of 8 centimetres, commencing immediately below the external occipital protuberance.

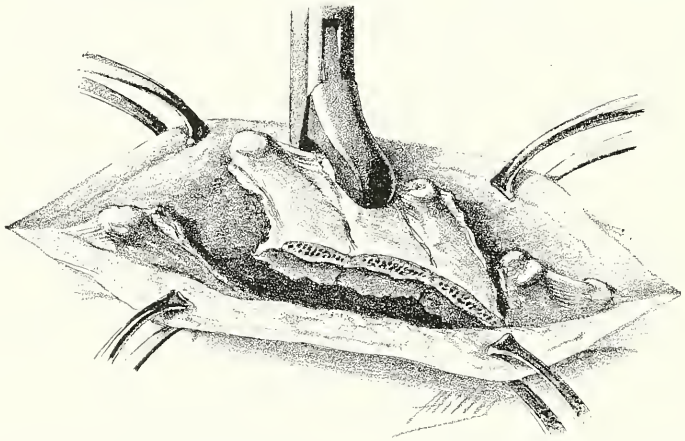


FIG. 522.—EXTIRPATION OF THE SIXTH, FIFTH, AND FOURTH SPINOUS PROCESSES, AND A PORTION OF THE CORRESPONDING LAMINÆ.

SECOND STAGE.—Exposure of the posterior arch of the atlas, spinous processes, and laminæ of the axis, and of the third cervical vertebra.

THIRD STAGE.—Resection of two-thirds of the posterior arch of the atlas on the right side, beneath which the tumour made a very appreciable projection, and exposure of the tumour, which appeared of considerable volume.

FOURTH STAGE.—Tamponing of wound for arrest of the rather copious oozing hæmorrhage.

The relations of this exceptional neoplasm are represented in Figs. 524 and 525. In Fig. 526 the tumour is seen lodged in the excavation which

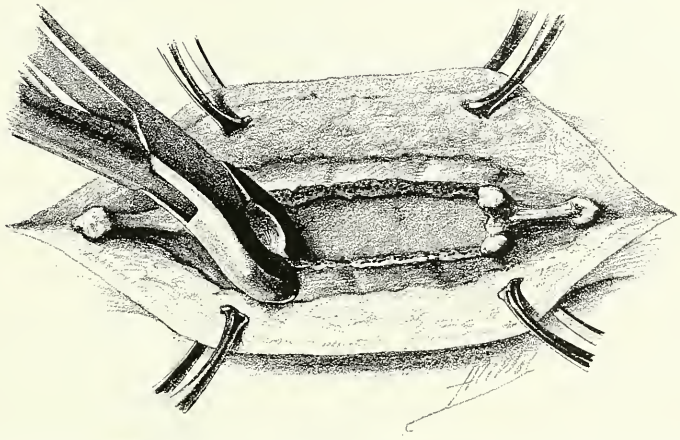


FIG. 523.—ENLARGEMENT OF THE OPENING INTO THE RACHIDIAN CANAL WITH A GOUGE-FORCEPS.

it had hollowed out for itself at the expense of the bodies and transverse processes of the atlas and axis. The growth was so tightly walled up in its osseous cell that it was impossible to estimate its exact volume. It was

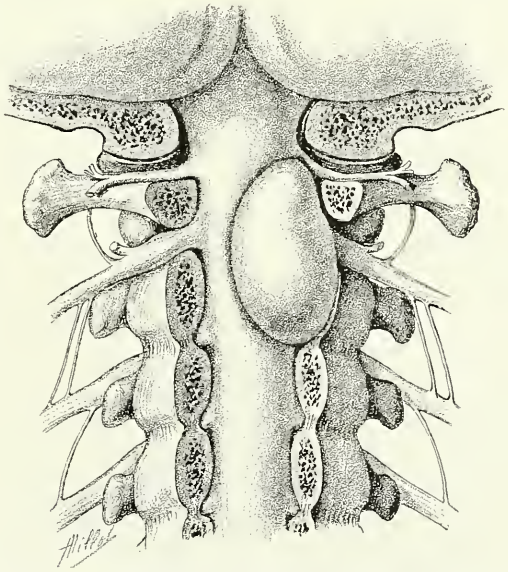


FIG. 524.—TUMOUR OF THE THIRD POSTERIOR NERVE-ROOT OF THE RIGHT SIDE, COMPRESSING THE CERVICAL CORD.

luxated therefrom with the help of a narrow raspatory. It was at the moment of displacement that I perceived its relation to the third posterior nerve-root, on which the neoplasm had developed. The osseous pocket

presented a smooth wall, and its depth showed that the development of the tumour must have occupied a certain number of months. There must also

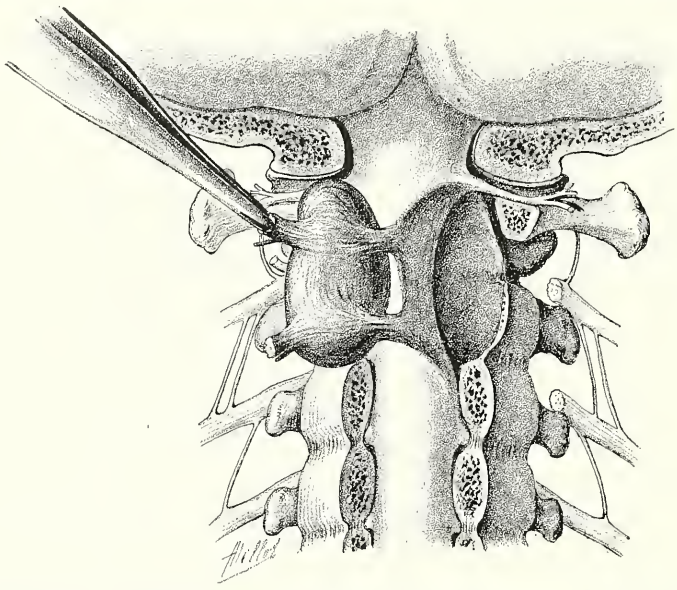


FIG. 525.—TUMOUR OF THE THIRD POSTERIOR NERVE-ROOT OF THE RIGHT SIDE COMPRESSING THE CERVICAL CORD.

Osseous cavity hollowed out by the tumour in the body of the axis. The concavity of the dura mater indicates the degree of compression of the spinal cord.

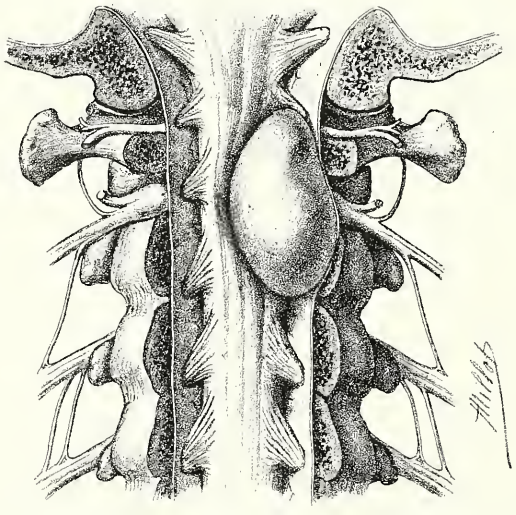


FIG. 526.—TUMOUR OF THE THIRD POSTERIOR NERVE-ROOT OF THE RIGHT SIDE, COMPRESSING THE CERVICAL CORD.

The dura mater has been incised and removed, so as to show the degree of compression of the cervical cord.

have been produced some months before the intrusion of the mortal complications some very serious functional symptoms which would not have escaped the notice of a good clinician.

The osseous recess is represented in Fig. 525. In Fig. 526 the tumour has been replaced after incision of the dura mater. We can estimate from this figure the degree of compression of the spinal cord. The paralysis of the diaphragm developed only in the last days of life, from direct compression of the third anterior nerve-roots on both sides. I had adjourned the extirpation of the tumour to a second intervention, which was to have taken place after an interval of forty-eight hours. The patient, already reduced to a state of extreme weakness, succumbed during the interval. Her age was twenty-two years. I was able to make a local examination and secure the anatomical specimen. The cord was hollowed out so as to present a deep recess. The little tumour could have been enucleated, for the depth of its osseous niche was not considerable, as it was situated outside the dura mater. Thus its extirpation would have produced an operative success if the patient had been brought to me some months previously. I cannot insist too much, in relation to this intervention, on the carelessness of certain physicians, who do not perform their duty to suffering humanity, when, being themselves incapable of making an accurate diagnosis, they neglect to obtain a more enlightened opinion in good time.

OPERATIONS ON THE THORAX

Traumatic Lesions.

Contusions.

Deep contusions may be complicated with fractures of the ribs, wounds of the lung, and cutaneous emphysema. Compression suffices if there are no visceral lacerations.

Non-Penetrating Wounds.

Non-penetrating wounds, with or without foreign bodies, are recognized by local and general symptoms, direct examination, and radiography. They are treated by suture, flat dressing, and simple tamponing, with or without incision of the tract. All bleeding vessels are tied. Wounds of the mammary gland do not give rise to any particular indication.

Wounds of the Pleura and Lung.

If the orifice is large, the brusque passage of air into the pleura is audible with each respiratory movement. When the orifice is narrow, we find in most instances a hæmothorax more or less complicated with pneumothorax.

Hernia of the lung is sufficiently rare. Suppose the surgeon to be in the vicinity when the accident occurs. The wounded person, stretched on the back, will be resuscitated by the usual procedures, and the wound is in-

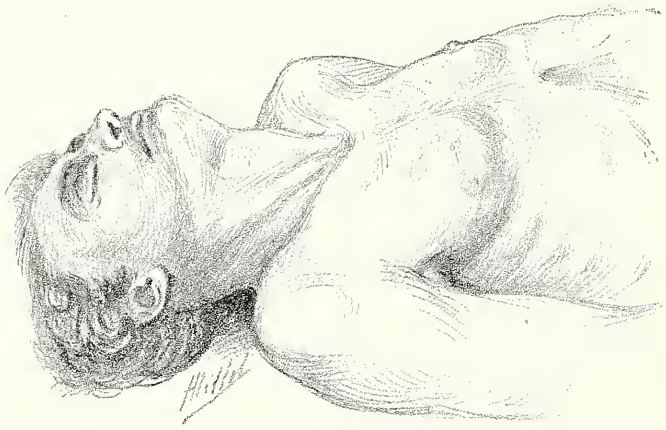


FIG. 527.—WOUND OF THE INTERNAL MAMMARY ARTERY OPPOSITE THE THIRD RIGHT INTERCOSTAL SPACE.

General sketch.

spected at once. When not in immediate danger, the patient is made comfortably warm and kept strictly watched. A well-known duellist was seen to succumb after thirty-six hours to the accumulation of blood

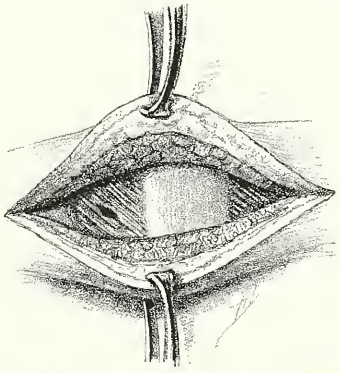


FIG. 528. — WOUND OF THE INTERNAL MAMMARY ARTERY OPPOSITE THE THIRD RIGHT INTERCOSTAL SPACE.

First stage: Exposure of the perforated inter-chondro-costal space.

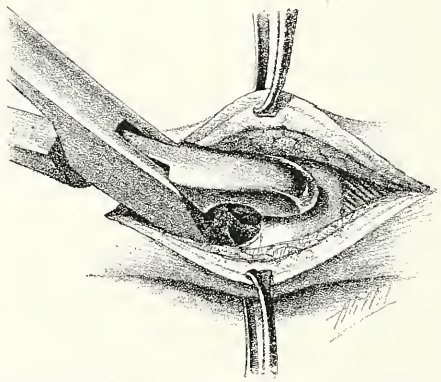


FIG. 529.—WOUND OF THE INTERNAL MAMMARY ARTERY OPPOSITE THE THIRD RIGHT INTERCOSTAL SPACE.

Second stage: Partial resection of the inferior costal cartilage with gouge-forceps.

in the pleura which followed the wound of an internal mammary artery close to its origin. A procedure without gravity would have saved that unfortunate individual, who was attended by an inexperienced practitioner.

When there are signs of internal hæmorrhage, we should immediately resect two or three ribs, tie the bleeding artery if parietal, internal mammary, or intercostal; and when the hæmorrhage comes from the lung itself, we draw it out and apply suture or partial ligature. The least temporization may cause a fatal result. A continued suture is rapidly applied to the skin wound, after leaving, when necessary, an aseptic tampon, and the air is aspirated from the pleural cavity in a series of stages with a 250-gramme syringe. Compressive dressing and expectation. On the least alarm the patient is submitted to a more complete intervention. The surgeon will act according to the indications of the moment.

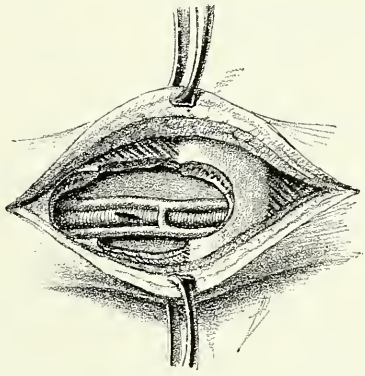


Fig. 530. — Wound of the Internal Mammary Artery Opposite the Third Right Intercostal Space.

Third stage: Exposure of the arterial wound; forcipressure of the vessels, followed by division between two forceps.

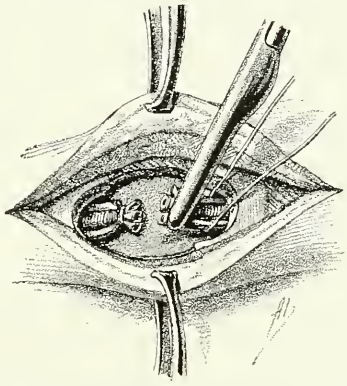


Fig. 531.—Wound of the Internal Mammary Artery Opposite the Third Right Intercostal Space.

Third stage: Ligature of the ends of the divided artery and adjacent veins.

Operation—First Stage.—Vertical incision of the soft parts, of about 5 centimetres, exposing the perforated inter-chondro-costal space.

Second Stage.—Denudation of the costal cartilages above and below, and partial resection of those cartilages with gouge-forceps, in order to expose the endothoracic fascia.

Third Stage.—Discovery and denudation of the artery, which is then secured with forceps above and below the seat of perforation, and division between the two forceps. Ligature of the two ends of the divided artery and satellite veins.

Wounds of the Great Arterial and Venous Trunks.

When the wound is a narrow one, we treat it preferably by suture. Ligature is applied in exceptional cases only, being specially required when the process of suture cannot be carried out. Ligature of the axillary vessels will be described subsequently.

Wounds caused by Tearing.

The tearing away of the upper limb completely from the axillary space is not accompanied by grave hæmorrhage, on account of the retraction of the vessels. Ligature is applied, and the wound is duly dressed and watched.

Division of Nerves.

Division of nerves is treated by immediate suture, or late suture when the diagnosis has proved to be tardy. In the latter case we should await complete cicatrization of the wound in order to avoid all cause of infection. We know that suture of nerves does not give constant results (see Vol. I.).

Foreign Bodies.

Foreign bodies, which are nearly always leaden bullets projected with a feeble velocity, usually become encysted without production of grave complications.

Wounds of the Heart.

The recent case of a young soldier who shot himself in the heart with a revolver bullet, and succumbed ten days later to purulent pericarditis while the projectile had remained lodged in the thickness of the cardiac muscle, proves that intervention should be attempted in every case in which the wounded person has not succumbed immediately, and is nevertheless in a grave condition. Such an operation has been successfully carried out in a certain number of cases.

Operation.—Rubber gloves, covered with cotton gloves, must be worn. This latter precaution is indispensable, in order to enable the surgeon to hold the heart steadily during the process of suturing.

First Stage.—Vertical incision passing through the wound.

Second Stage.—Resection of costal cartilages and ribs; exposure of the pericardium.

Third Stage.—Incision and toilet of the pericardium.

Digital exploration of the surface of the heart, exposure of the foreign body if accessible, and suture of the perforating wound if very narrow. Such an operation necessitates great presence of mind and corresponding manual dexterity.

Wounds of the Mediastinum.

If the wounded person has survived, and is in a grave condition, it is necessary to intervene on the spot. In less urgent cases the patient's strength may be recruited, and the surgeon holds himself in readiness for operation.

Operation—First Stage.—Vertical incision passing through the wound.

Second Stage.—Sterno-chondro-costal resection to as great an extent as seems useful.

Third Stage.—Toilet of the traumatic focus, hæmostasis, and tamponing of wound. The technique of thoracotomy will be subsequently described.

DISLOCATIONS AND FRACTURES.

Dislocation of the Clavicle.

Osseous Suture.

Luxations of either extremity of the clavicle are almost impossible to retain in position. A good position cannot be secured without the application of osseous sutures. The two bony extremities which have to be retained in contact must be vivified.

Operation—First Stage.—Longitudinal incision of 20 millimetres through the skin opposite to the seat of dislocation.

Second Stage.—Denudation of the clavicle and resection of the articular cartilage with a cutting forceps.

Third Stage.—Resection of the articular cartilage of the acromion process with the cutting forceps in case of a dislocation of the external extremity; at the internal extremity the sternal cartilage can be extirpated with a curved raspatory.

Fourth Stage.—On the outer side perforation of clavicle and acromion; on the inner side perforation of the clavicle and sternum; passage of the suture which secures the absolute coaptation, the extremities of which are then twisted. The end of the suture is cut off, and the twisted portion is turned back beneath the subjacent fibro-cartilaginous tissue.

Fifth Stage.—Suture of the skin.

Fracture of the Clavicle.

Osseous Suture.

Whether we are dealing with a recent fracture or with a pseudo-arthrosis consecutive to non-consolidation, the only procedure which yields a perfect coaptation is osseous suture. It will be of interest to study the subclavicular organs which may be wounded by a slip of the raspatory or of the perforator before proceeding to describe the operation itself.

Relations of the Clavicle.

Fig. 532 represents the left clavicle laid bare by incision of the skin, subcutaneous tissue, and platysma at the level of the delto-pectoral space. The termination of the external jugular vein is seen above and to the inner

side. Fig. 533 was sketched after resection of the osseous segment, of which the limits are indicated by dotted lines in Fig. 532. In order to

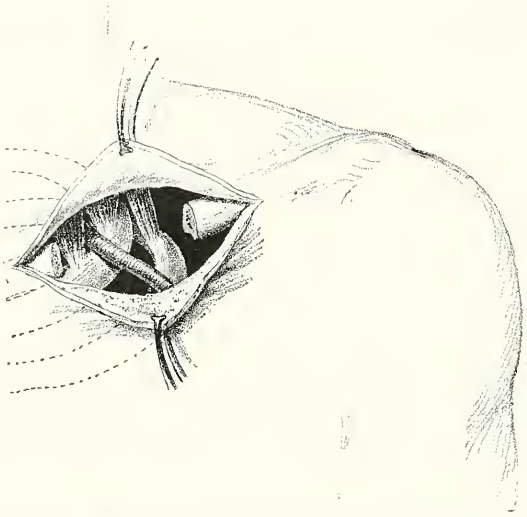


Fig. 532.—Relations of Middle Part of Clavicle to the Subclavian Artery, First Two Ribs, and Scaleni Muscles.

reach the vasculo-nervous bundle, it will be necessary to divide the internal coraco-clavicular ligament, which proceeds from the inferior attachment of

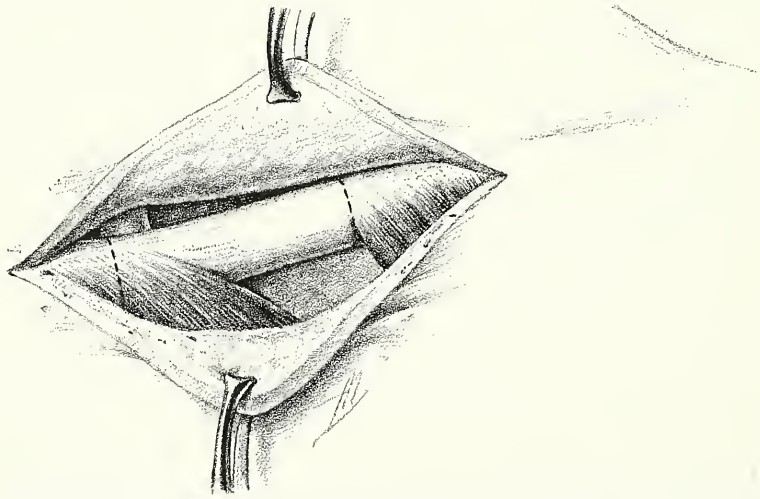


Fig. 533.—Exposure of Middle Part of Clavicle at the Level of the Delto-Pectoral Space.

the middle cervical aponeurosis. Fig. 534 shows that during osseous suture of the clavicle it is easy to avoid wounding the vein, which is covered with a resistant aponeurosis. Fig. 534 is intended to show the relations of the middle portion of the clavicle with the subclavian artery, first two ribs, and scaleni muscles.

Operation—First Stage.—Longitudinal cutaneous incision of 15 millimetres at the level of the traumatic focus.

Second Stage.—Exposure of the fracture or pseudarthrosis, and in the latter case vivification of the osseous extremities with mallet and chisel in the adult, with bone forceps in case of children. The subjacent structures are protected with a straight raspatory.

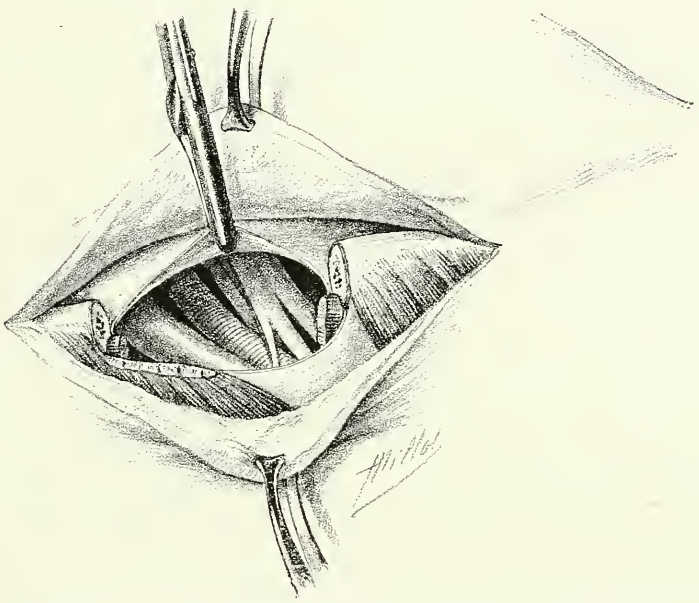


Fig. 534.—Exposure of the Vasculo-Nervous Bundle after Resection of Middle Part of Clavicle.

Third Stage.—Oblique perforation of the two osseous extremities, passage of suture, coaptation, torsion of ligature, and incrustation of the twisted portion in the focus of the fracture.

Fourth Stage.—Suture of skin, without drainage.

Fractures and Dislocations of the Sternum.

In case of comminuted fracture, with depression and compression of the organs of the mediastinum, incision of the skin and extraction of the depressed fragments may be indicated. Tamponing of the wound is then carried out.

Dislocation of the Xiphoid Appendix.

Unreduced dislocation of the xiphoid appendix may be productive of acute pains, and require extirpation. This operation is easily carried out with the raspatory and curved forceps.

Fractures and Dislocations of the Costal Cartilages.

Multiple fractures and dislocations of the costal cartilages are not rare among railway-porters, who are in the habit of pushing the waggons with their shoulders. I have met with two cases of bilateral fracture and dislocation of the costal cartilages, complicated with dislocation of the internal extremity of the clavicle of one side and of the external extremity of that of the opposite side. The injured persons had been crushed between the side of a waggon and a wall, and had been forcibly twisted in this position. Reduction may be difficult to obtain in such cases; besides, it is to be sought for only from the plastic point of view.

Fractures and Dislocations of the Ribs.

Fractures and dislocations of the ribs but rarely give rise to accidents which demand operative intervention. Such intervention will vary with the individual case.

Inflammatory Lesions.

Subcutaneous Abscess.

Small subcutaneous abscesses are treated with mycolysine, which provokes a polyvalent hyperphagocytosis. If pus collects, a small incision is made.

Tuberculous Abscesses of the Axilla.

These abscesses may be multiple, and sometimes result in forming a veritable tumour, indurated and fistulous. Mycolysine should be administered, both by subcutaneous injection and by the mouth. If resolution is not rapidly produced, an incision is made. Chronic fistulous abscess consecutive to tuberculous abscess is treated like fistula of the anus —by complete extirpation of the fistulous tract.

Subaponeurotic Phlegmon.

If the phlegmon evolves without acute symptoms, antistaphylococcic medication is first tried, not forgetting that it has no action antagonistic to infection with streptococci. In the latter case, we have recourse to mycolysine. We must be ready to incise freely. The purulent focus is reached with blunt scissors made to function as director, and the opening is increased by divulsion. The focus is then tamponed.

Deep-Seated Phlegmon and Subpleural Abscess.

Deep-seated phlegmons and subpleural abscesses are recognized by the classic signs which characterize accessible purulent collections.

Operation. — Early incision, followed by divulsion, tamponing, end drainage.

Tuberculous Abscess.

Every superficial cold abscess which does not arise from the osseous skeleton is treated by complete extirpation of the sac. When such complete extirpation is impossible, curettage is carried out, and the wound is treated by tamponing after aero-cauterization.

Caries of the Sternum, Ribs, and Costal Cartilages.

Caries of the sternum, ribs, and costal cartilages is frequently of tuberculous origin. It may, however, be produced as the result of infection of various kinds, notably during convalescence from typhoid fever. The topography of such lesions is very variable. They are always more extensive than we would have been led to suppose. The frequent recurrences which are observed should be imputed to the insufficiency of the surgical intervention.

Caries of the Sternum.

Caries of the sternum, which is sometimes a suppuration produced by staphylococci, but oftener a tuberculous lesion, is a very rebellious affection.

Operation.—Free incision of the soft parts, and osseous resection carried out far beyond the limits of the carious focus which are difficult to define clearly; tamponing of wound, and flat dressing.

Caries of the Costal Cartilages.

Caries of the costal cartilages is at least as rebellious as that of the sternum. A number of the cartilages may be attacked in succession. I have seen the costal cartilages of the left side become the seat of multiple foci of caries many months after cicatrization succeeding to operation on corresponding foci on the right side.

Operation—First Stage.—Incision of the subcutaneous collection, when such exists, or the fistulous tract, which is often very narrow. We proceed very gradually till the denuded bone is reached.

Second Stage.—Whether we are dealing with the sternum, ribs, or costal cartilages, we must freely extirpate the infected bones. Here arises the delicate question of the intervention. The process of extirpation is a very easy one, and is carried out with the raspatory and gouge-forceps. The delicate question is that of recognizing the limit which must be attained, and where it is necessary to stop. We may without inconvenience pass beyond the parts which are obviously affected to a distance of several centimetres. It is necessary to scrape carefully the endothoracic fibrous stratum, and ascertain whether a minute fungosity does not lead to a subjacent abscess.

Third Stage.—The wound, after being carefully curetted, is treated by aero-cauterization, which does not act at a depth greater than 3 to 4 millimetres; tamponing of wound; flat dressing.

The elimination of the tissues after cauterization is quickly effected. Cicatrization takes place much more rapidly after aero-cauterization than after the simple tamponing of the wound.

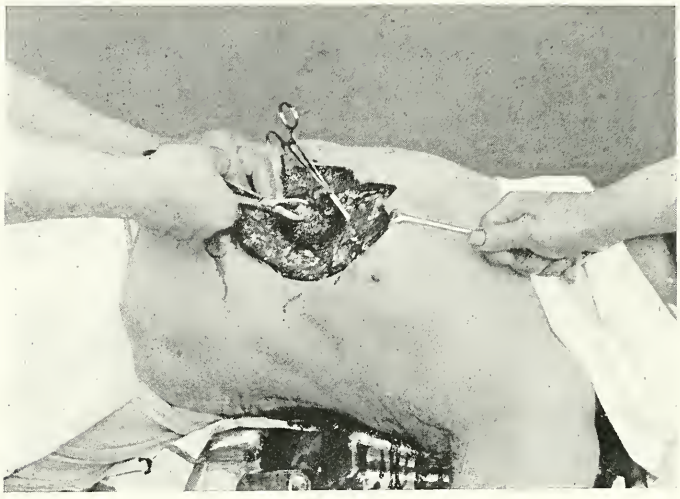


FIG. 535.—CARIES OF STERNUM AND COSTAL CARTILAGES.

Extirpation of a fragment of the sternum with the gouge-forceps.

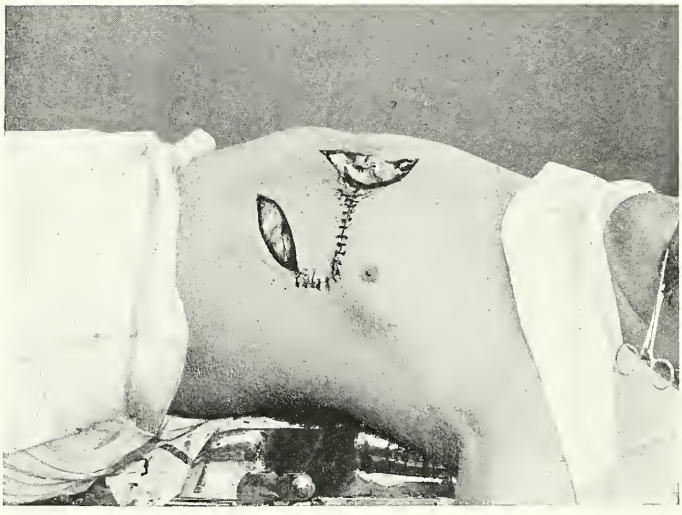


FIG. 536.—CARIES OF STERNUM AND COSTAL CARTILAGES.

The operation has been completed. Partial reunion of the skin and tamponing of the wound.

Costal Caries.

Costal caries, whether of tuberculous or osteomyelitic origin, is usually complicated with the presence of juxta-pleural foci of suppuration.

Operation—First Stage.—Incision and curettage of the superficial focus.

Second Stage.—Exposure and extensive resection of the carious rib or ribs.

Third Stage.—Minutely careful curettage of the depths of the wound, followed by aero-cauterization; tamponing; flat dressing.

These operations will be described in detail in connection with the general technique of interventions on the thoracic walls.

General Treatment.—Caries of the sternum, ribs, or costal cartilages is not always of tuberculous origin. We should always confirm our diagnosis by having recourse to the Besredka reaction, and inoculation of a fragment of the fungating tissue beneath the skin of a guinea-pig. We can then judge from the result whether the general treatment should be by administration of mycolysine alone, or in combination with phymalose.

Malformations : Congenital and Acquired.

Congenital malformations rarely demand surgical intervention.

Cicatricial Contraction of the Integuments of the Axilla and of the Adjacent Thoracic Region.

Cicatrices of Great Extent.

The contraction of cicatrices of deep burns of the skin of the axillary fossa is an obstacle to the mobility of the upper limb. Operation is carried out as follows:

First Stage.—Excision of the cicatricial band and mobilization of the limb, in order to obtain the maximum degree of separation of the lips of the wound.

Second Stage.—Formation of flap of healthy skin by a curvilinear incision and gliding displacement of the same, which is made to cover the axillary wound. Reunion with points of interrupted suture. A flat dressing is applied to the wound made by displacement of the autoplastic flap.

Cicatrix of Small Extent.

The cicatrix is completely extirpated throughout its entire depth, and the wound is then closed by utilizing some liberating autoplastic incisions.

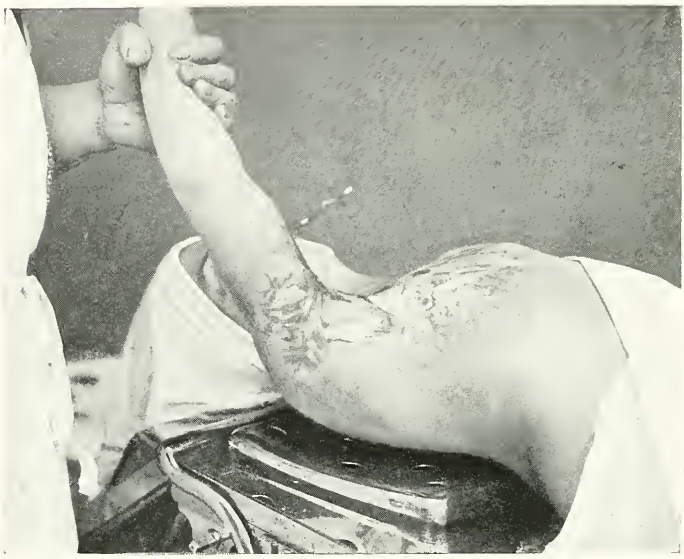


FIG. 537.—AXILLARY CICATRICIAL BAND CONSECUTIVE TO A BURN OF THE FOURTH DEGREE.

FIG. 538.—AXILLARY CICATRICIAL BAND CONSECUTIVE TO A BURN OF THE FOURTH DEGREE.

Division of the cicatrix and extension of the arm, displaying the loss of substance which has to be replaced.

FIG. 539.—AXILLARY CICATRICIAL BAND CONSECUTIVE TO A BURN OF THE FOURTH DEGREE.

Cutting out a dorsal cutaneous flap for autoplasty.

FIG. 540.—AXILLARY CICATRICIAL BAND CONSECUTIVE TO A BURN OF THE FOURTH DEGREE.

Application of the dorsal flap to the raw surface of the axillary fossa.

Fig. 541.—Axillary Cicatricial Band Consecutive to a Burn of the Fourth Degree.

Suture of the autoplastic flap, which now fills up the loss of substance of the axillary fossa. The dorsal wound is allowed to cicatrize.

Tumours.

Benign Tumours.

Angiomata—Lipomata—Cysts.

Such angiomata as are merely cavernous fibromata or lipomata should be totally extirpated. So should also lipomata, cysts, and other benign tumours. The operation is carried out without difficulty.

Operation—First Stage.—Horizontal incision of the skin.

Second Stage.—Exposure of the tumour by incision and dissection of the cellulo-adipose tissue.

Third Stage.—The scissors, followed by the index-finger, penetrates beneath the mass, which is then raised by them so as to facilitate its extirpation. Hæmostasis, reunion, drainage.

Malignant Tumours.

Small epitheliomata and superficial sarcomata should be destroyed by thermic electro-coagulation.

Sarcoma of the intercostal spaces is operable only in those cases in which the lesion is definitely localized. This affection necessitates a grave intervention—that of a partial resection of the thoracic wall. That operation will be described in connection with the general technique of operations on the thoracic wall.

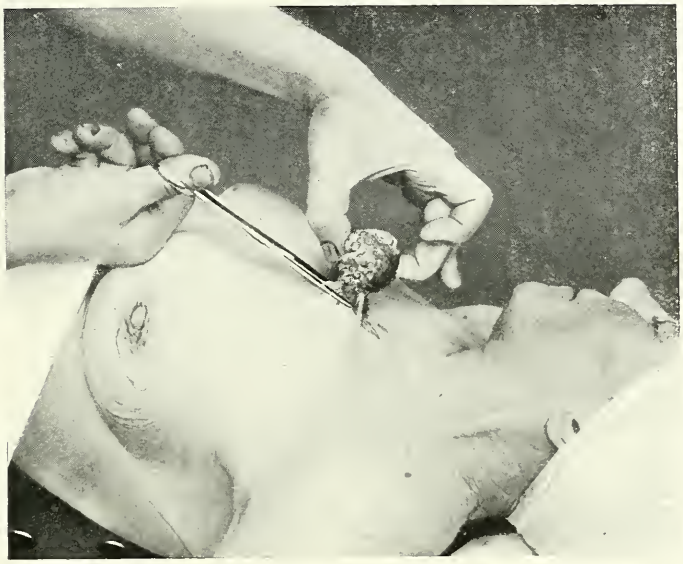


Fig. 542.—Pedunculated Epitheliomatous Papilloma of Anterior Thoracic Region: Extirpation.

OPERATIONS ON THE MAMMA.

Traumatic Lesions.

Wounds of the mammary gland do not convey any special indications. Violent contusion may necessitate the evacuation of a hæmatoma or provoke indurations, which are sometimes regarded as neoplasms by inexperienced practitioners. Every contusion of the breast is liable to prove the starting-point of a veritable neoplasm, adenoma, or carcinoma. In those tumours, both adenomata and carcinomata, we constantly meet with the characteristic parasite of cancer—the *Micrococcus neoformans*.

Inflammatory Lesions.

Acute Inflammatory Lesions.

Mammary Abscess.

I will not deal in this place with the question of the prophylaxis of abscess of the breast, which includes asepsis of the nipple and of the buccal cavity of the nurseling. When lymphangitis begins to develop, we should try to arrest the evolution by subcutaneous injections of mycolysine. When pus has collected, an incision must be made.

Operation.—General anæsthesia with ethyl chloride.

1. Superficial Abscess.—Incision of 10 to 15 millimetres at the most dependent part, rapid curettage, and tamponing of the focus.

2. Deep Abscess.—Incision of 25 to 30 millimetres, and divulsion of the inflamed gland tissues with blunt scissors and then with the index-finger, which recognizes and tears through the septa of the focus of suppuration. Tamponing and flat dressing. Tamponing for forty-eight hours is very much better than immediate drainage.

Chronic Inflammatory Lesions.

Fistulous Abscess.

I have met with many cases of mammary fistula due to the persistence of a deeply seated focus of suppuration. Mammary fistulæ should be treated by total extirpation of the tract, followed by tamponing.

Tubercle of the Mamma.

Tubercle of the mammary gland presents the appearance of a knobby irregularly shaped tumour, often fistulous and with caseous nodules. In certain cases in which no fistula is present the nature of the lesion has been recognized only by histological examination of the affected mamma and of the degenerated axillary glands. Tubercle of the mamma has been observed in the male. In all those cases antituberculous treatment with phymalose is carried out. If cicatrization is not obtained in this way, the fistulous tracts and caseous foci must be extirpated.

Actinomycosis of the Mamma.

This disease evolves in the form of a cold abscess, and forms near the nipple, which is the usual place of entrance, a small tumour of wooden feel and of violet-red tint. The pus which escapes through the fistulæ, or by incision if we incise before an opening has formed spontaneously, contains the well-known actinomycosic granules, the ramifying filaments of which are seen in specimens stained by the Gram method.

Operation.—Extirpation of the mammary tumour and of the infected lymphatic glands, if any such are present.

Hydatid Cysts.

Hydatid cysts of the mamma appear under the aspect of a spherical fluctuating tumour, more or less localized. Puncture is the only way of confirming the diagnosis.

Operation.—Incision and evacuation of the membranes, or, when the tumour is a small one, extirpation of the cellular capsule which surrounds the hydatid membrane.

Malformations: Congenital and Acquired.

Polymastia—Hypertrophy of the Mammæ.

The presence of supernumerary mammæ and pathological hypertrophy of these glands may respectively necessitate the ablation of the supplementary or exuberant organs. These exceptional operations are indicated only with a plastic aim; they are simple, and unattended by danger.

Tumours.

Benign Tumours.

Molluscum Pendulum—Cysts: Sebaceous or Dermoid—Angiomata—Lipomata—Neuromata—Enchondromata—Calcified Tumours.

I have met with two cases of calcified tumour—one of the external mammary region, which was of absolutely stony consistence, like a calcified fibroma of the uterus; the other, cystic, was situated in the supero-external mammary region, and resembled to an extreme degree an oyster-shell with its two valves. All these tumours can be extirpated without difficulty. The technique is one of great simplicity; nevertheless, I would insist on some points which to me appear essential. When dealing with a tumour situated outside the gland structure, such as a more or less voluminous lipoma, I recommend its seizure with my large model forceps, which I use for grasping the fundus of the uterus. When thus firmly fixed with the left hand, the growth can be very readily and very gracefully isolated from its cutaneous attachment by two curved incisions. When, on the other hand, I am dealing with a non-pedunculated tumour, such as an angioma, I grasp the excised angle with one of my oval-jawed forceps with elastic pressure, which, by assuring hæmostasis, allow rapid completion of the operation.

Benign tumours of the breast all present the characters of being mobile, definitely limited, and of more or less globular form. They are nearly always adenomatous. I have removed one of these adenomata of the size of a hazel-nut which had developed in eighteen months after the receipt of a violent contusion by the stroke of a tennis-ball. Culture of that adenoma yielded a pure growth of *Micrococcus neoformans*.

The smallest and most freely mobile adenoma of the mamma may, after a longer or shorter period of microbism, prove the starting-point of the evolution of a rapidly growing cancer. Such was the case in an observation recorded in my *Memoire* of 1904 on the treatment of malignant neoplasms.* Antineoplastic treatment should be instituted in all cases of benign tumour of the breast. If the tumour undergoes notable diminution of volume, it is unnecessary to operate, and the case should be kept under observation.

* Communication to the *Académie de Médecine*, February 23, 1904.

Some mammary adenomata are centres for radiation of neuralgic pains, as in cases of painful subcutaneous fibromata. Those growths are sometimes multiple. In such cases the danger of cancerous transformation is specially menacing. Before operating, we should try the effect of vaccination with cytolase. This procedure has, in a certain number of cases, led to the resorption of adenoma.

Operation—First Stage.—Cutaneous incision of 2 to 4 centimetres, according to the volume of the tumour. Keeping the plastic end in view, this incision should be made by preference in the submammary groove.

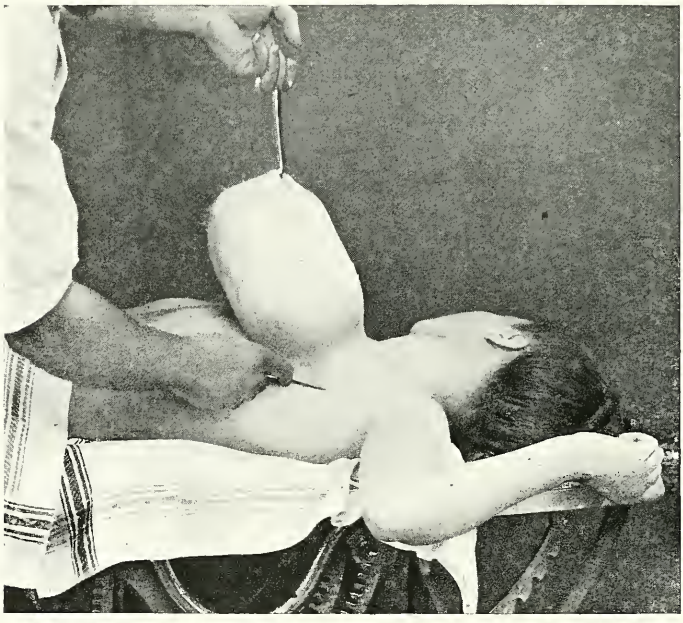


Fig. 543.—Voluminous Adeno-Fibroma of the Breast.

Operation: First stage.

Second Stage.—Introduction of blunt scissors and exposure of the tumour by divulsion, so as to avoid uselessly wounding the numerous arterioles of this region.

Third Stage.—The tumour is drawn outside the wound with forceps, and detached with some snips of the scissors. We often find that it is less limited than palpation had led us to anticipate, and that it is continuous with the proper tissues of the mammary gland itself.

Fourth Stage.—Reunion with clips and drainage. If a little blood comes from the depths of the wound, hæmostasis may be difficult to attain on account of the narrowness of the incision. In this case we should plug with an aseptic compress, and apply clips. The clips and the plug are removed at the end of forty-eight hours, a glass drainage-tube is inserted, and the clips are replaced. Some adeno-fibromata of the breast may attain

a considerable volume while retaining a benign character. Such was the tumour represented in Fig. 543. Extirpation is easy if we take care to hold up the neoplasm with a helicord hook.

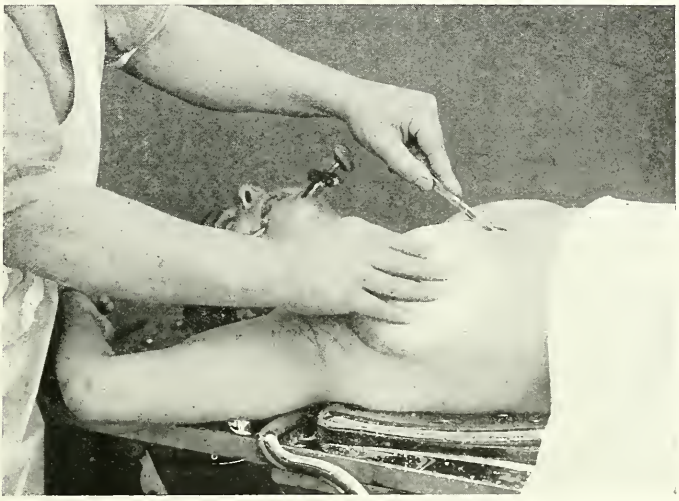


Fig. 544.—Amputation of Breast.
First stage: Superior curvilinear incision.

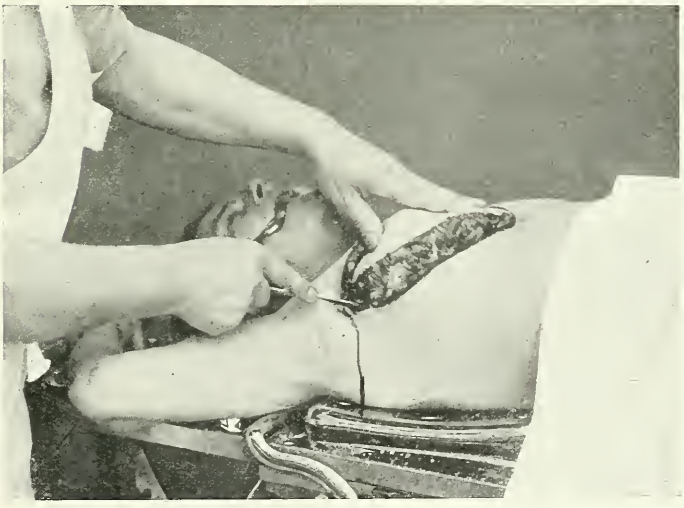


Fig. 545.—Amputation of Breast.
Second stage: Inferior curvilinear incision.

For several months after the operation vaccination with cytolase should be regularly repeated. If recurrence takes place, the new growth should at once be destroyed by thermic electro-coagulation.

Malignant Tumours.

From the point of view of pure surgical intervention, we place together all malignant tumours of the breast, whatever be their histological

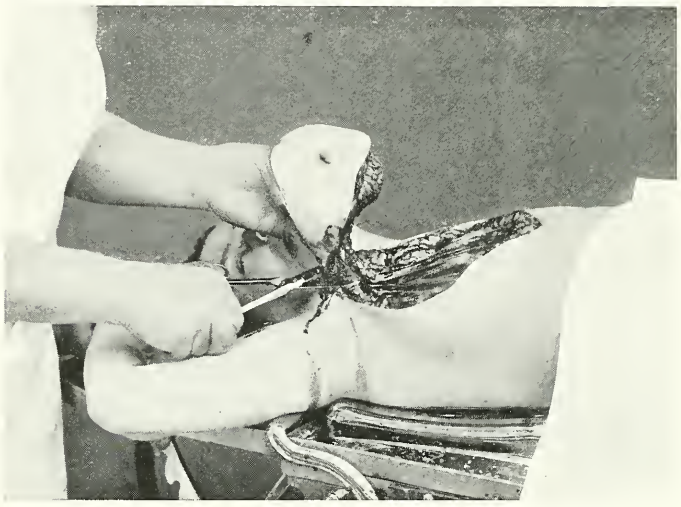


Fig. 546.—Amputation of Breast.

Third stage: Exposure of the great pectoral muscle. The breast, when not adherent, separates on traction with the hand.

Fig. 547.—Amputation of Breast.

Seventh stage: Placing of first point of interrupted suture in the middle of the incision.

structure. I now proceed to describe the ablation of the breast with the bistoury. I will then point out how this procedure should be preceded and followed by anticarcinomatous vaccination; also how it

FIG. 548.—AMPUTATION OF BREAST.

Seventh stage: Placing of second point of suture in the middle of the outer half of the wound.

FIG. 549.—AMPUTATION OF BREAST.

Three points of suture have been inserted. Perforation of the skin for passage of a drainage-tube.

may be combined with the use of thermic electro-coagulation of the thermo-electric bath.

The operation should be carried out under favourable conditions, and enough healthy skin should be preserved to obtain a good reunion. I well remember still those horrible operations of former times when the whole breast was removed bodily with its integument, and the wound was then dressed on the flat. The recurrent disease invaded the wound, which did not cicatrize. The first condition to be fulfilled before operating on malignant tumours of the breast is to make sure that there are no signs of visceral generalization, and the next is to ascertain whether enough healthy skin can be preserved to permit reunion of the edges of the wound. In the accompanying illustrations will be seen represented the various autoplastic incisions which enable us to close the wound in cases in which it is necessary

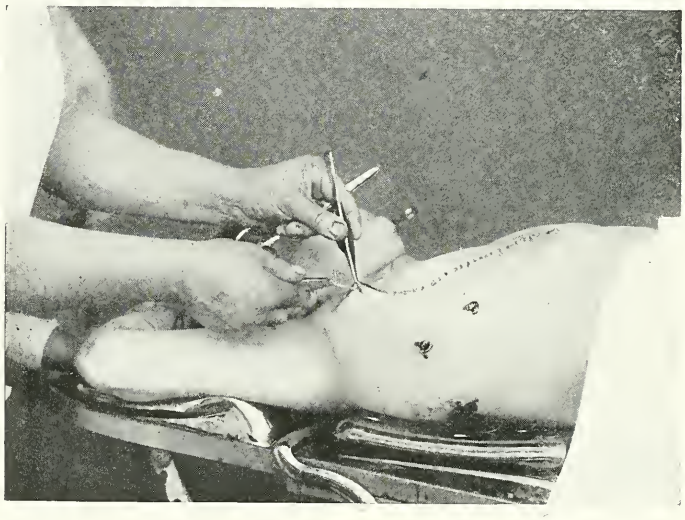


Fig. 550.—Amputation of Breast.

Completion of interrupted suture. The two drainage-tubes are seen.

to sacrifice too large an area of skin to permit the direct approximation of the lips of the cutaneous incision. In all cases without exception the anti-neoplastic treatment should be instituted before the operation. In most cases the tumour diminishes in volume during the first eight days of the treatment, and the overlying skin, when ruddy, or even when affected with that white, hard œdema which precedes diffuse cancerous invasion, again recovers its suppleness to a certain extent.

Contra-Indications to Operation.—The formal contra-indications to removal of a cancerous breast are the establishment of either unquestionable generalization of the disease, or a local extension of such magnitude that operation must inevitably remain incomplete. Such are those cases in which there are infected supraclavicular glands on both sides, or perhaps a nodular hypertrophy of the liver, coinciding with a rapidly progressing state of

cachexia, vertebral pains, spontaneous fracture of the femur, etc. The condition known as cancer *en cuirasse* is equally inoperable by reason of the extent of the integument invaded.

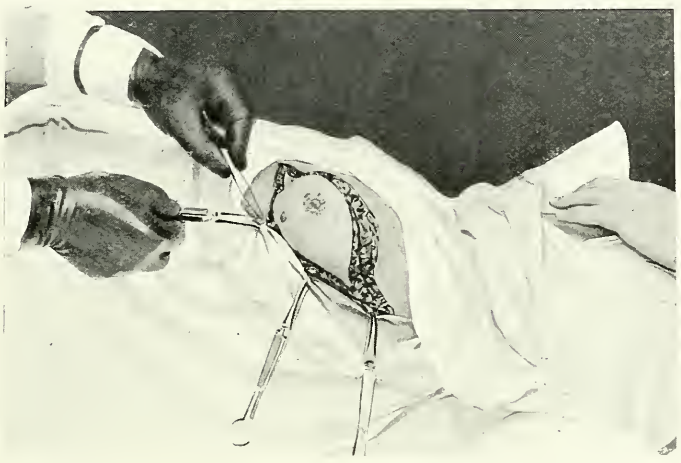


FIG. 551.—AMPUTATION OF THE BREAST, WITH ASEPTIC FIELD OF OPERATION. The border of the lower napkin is fixed to the lower lip of the incision.

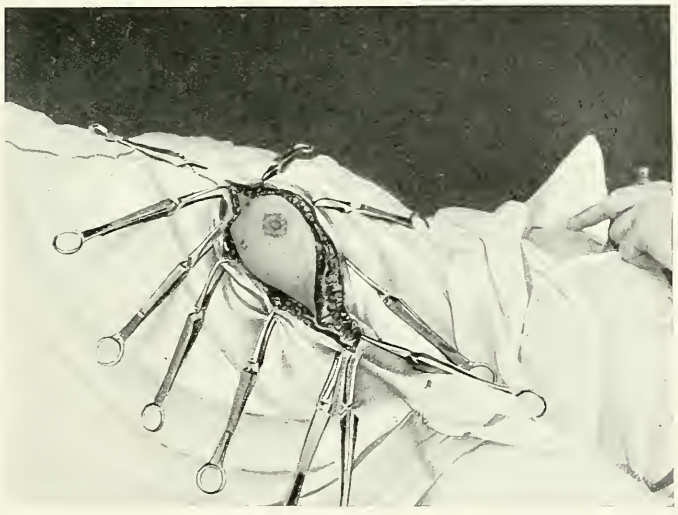


FIG. 552.—AMPUTATION OF THE BREAST, WITH ASEPTIC FIELD OF OPERATION. A second napkin has been fixed to the upper lip of the incision.

Amputation of the Breast.

Mobile Tumour (Skin not very extensively invaded).—The patient is placed lying on the back, the side to be operated on is turned to the light, and the corresponding arm is raised by an assistant.

Operation—*First Stage.—Superior Curvilinear Incision*, beginning at the median line, and opposite the antero-superior limit of the breast, passing above the areola, and made to reach the axillary fossa.

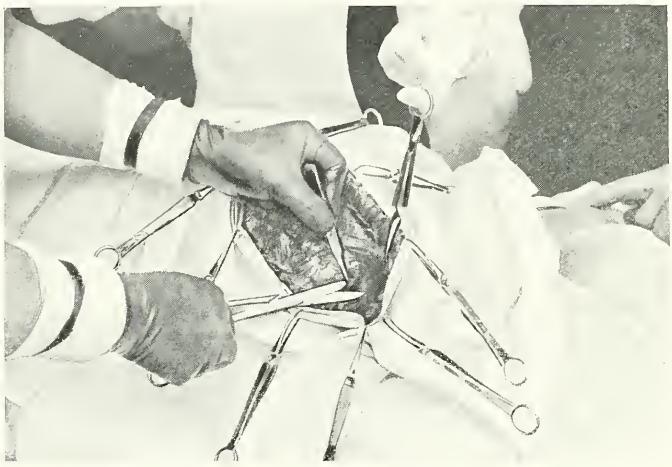


Fig. 553.—Amputation of the Breast, with Aseptic Field of Operation.

Extirpation of an axillary cancerous nodule. It will be seen that the skin remains invisible during the whole period of the operation.

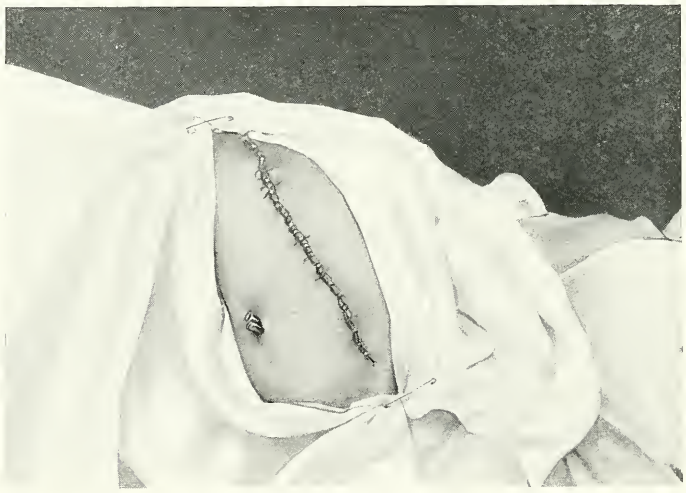


Fig. 554.—Amputation of the Breast, with Aseptic Field of Operation.

The operation has been completed. The sterilized towels have been removed so as to allow suture of the skin and insertion of the drainage-tube.

Second Stage.—Inferior Curvilinear Incision, joining the two extremities of the former, and passing below the areola.

Both these incisions should be freely made, and in a position exactly

suitable for extensive removal of the tumour, while preserving the amount of skin necessary for reunion of the edges of the wound. Before making the first incision, it will be well to mobilize the perimammary integuments by grasping the breast firmly between the two hands, and forcibly displacing it in every direction, as if we wanted to tear it away from the thorax.

Third Stage : Discovery and Dissection of the Great Pectoral Muscle.— The cutaneous lip of the superior incision is grasped with several hooked forceps, and the mamma is dissected off with a bistoury, while taking care not to approach the skin too nearly and to remove all the glandular acini. At the superior limit of the gland the bistoury is guided directly into the depth of the wound, and is made to expose the aponeurosis of the great pectoral muscle. The mass of the tumour is then grasped with the left hand, and drawn downwards and outwards. Most frequently the mamma is detached from the muscle by simple traction. When the deep aspect of the tumour is adherent, the corresponding portion of the muscle is detached with the bistoury.

Fourth Stage : Opening and Clearance of the Axillary Fossa.—The margin of the great pectoral muscle is reached. The deep aponeurosis is divided with the bistoury in such a way as to expose the margin of the lesser pectoral in the wound. The mass of axillary fat is detached from the depth of the fossa with the index-finger till the axillary vein is reached, which presents its bluish coat in the upper and anterior part of the space. The bistoury acting below and behind then exposes the deep surface of the latissimus dorsi muscle.

Fifth Stage : Liberation of the Mass of the Tumour.—Nothing more is now required for complete detachment of the tumour but to divide with scissors or bistoury the subcutaneous adipose tissue beyond the uttermost acini of the gland between the border of the latissimus dorsi muscle and the inframammary cutaneous incision. The mass of glands with the whole of the axillary fat are then removed with the breast, without omitting the posterior glandular group, which is nearly always infected, and which is found very low down in contact with the latissimus dorsi and subscapularis muscles and the thoracic wall.

The operation thus conducted is a veritable anatomical preparation of the axillary fossa, which is made by following with the bistoury the great and lesser pectoral muscles, the thoracic wall, the vasculo-nervous sheath, and the subscapularis, teres major, and latissimus dorsi muscles. All the intermediate tissues fall into the hands of the surgeon. The special technique of the ablation of glands and tumours from the axillary fossa will be described in connection with operations on the axilla.

Sixth Stage : Hæmostasis.— Sometimes two or three ligatures are enough; in other cases we must search carefully for venules of a certain calibre, which may bleed slowly, and lead to the formation of a subcutaneous hæmatoma. The vessels are seized with short-jawed forceps, and tied with fine silk or catgut.

Seventh Stage : Verification of the Wound, Reunion, and Drainage.—The finger is plunged behind and beneath the axillary vein in order to remove

any infected supraclavicular glands that may be present. Hæmostasis is then verified, and we proceed to the reunion.

The first silk suture is placed exactly in the middle of the wound; two others are then placed respectively at the middle of each of the two halves thus formed—that is to say, at the limit of the inferior and superior fourths. The application of those separate points is meant to prevent all dragging of the line of reunion. The needle should penetrate and emerge at about 10 millimetres from the lip of the incision. It is not necessary to place any deep sutures. Two large drainage-tubes are then inserted at the points indicated in the figure. The fatty tissue is perforated with a long curved forceps till the skin is reached, which is then incised over its extremity. The openings for drainage are not made till after insertion of the first three points of suture, in order that they may be placed exactly in the inferior sinus of the wound. The reunion is completed with clips, which give better coaptation than either continuous or interrupted suture. Interrupted suture is practicable only when the line of reunion is very extensive.

Amputation of the Breast, with Protection of the Field of Operation, with the help of Hooked Forceps.—Subsequent to the preparation of the photographs reproduced in Figs. 546 to 549, I have realized complete asepsis of the field of operation in the following manner: After disinfection of the skin with black 2 per cent. formal soap, ether, and 3 per 1,000 sublimate solution, the region to be operated on is surrounded with sterilized napkins. When the two incisions which circumscribe the tumour have been made, the napkins are fixed by the help of several hooked forceps (Figs. 551 to 553) to the lips of the cutaneous incision. The surgeon and his assistant being furnished with sterile gloves, amputation of the breast, clearance of the axilla, and hæmostasis are concluded with a rigorous asepsis. The sterile napkins are removed to allow the insertion of the sutures and adjustment of the drainage-tubes.

Adherent Tumour, with Diffuse Axillary Cancerous Mass.

Extirpation of tumour of the breast may present certain operative difficulties. I now proceed to examine the principal examples. Amputation of the breast may involve real difficulties when there are deep adhesions, and especially when the axillary fossa is invaded with massive cancerous degeneration of the lymphatic glands and cellulo-adipose tissue. The great pectoral muscle, if involved, can be readily removed with the tumour by the technique above described. The difficulties begin when we reach the superior wall of the axillary fossa, where a diffuse cancerous mass is recognized adherent to the sheath of the vessels. In order to avoid all dragging from that side, we detach the principal mass by cutting into the tumour, leaving the axillary portion adhering to the vasculo-nervous sheath, which will afterwards be dissected at the proper time. This dissection, which may prove a very delicate one, should be carried out, as described with regard to the internal jugular vein, with bistoury and scissors, in order to avoid tearing the coats of the veins. When these have been invaded by

the cancer, a small layer of the substance of the neoplastic tissue must be left. A large wound of the axillary vein would necessitate suture of the opening. Small lateral loss of substance in the walls of the vein are likewise treated with suture.

FIG. 555.—AUTOPLASTY OF THE MAMMARY WOUND BY SLIDING DISPLACEMENT OF A CURVILINEAR FLAP.

FIG. 556.—AUTOPLASTY OF THE INTERNAL MAMMARY REGION BY SLIDING DISPLACEMENT OF THE BREAST OF THE OPPOSITE SIDE AND OF A CERVICAL FLAP.

Removal of the Supraclavicular Glands.

When there are but one or two very mobile supraclavicular glands to be dealt with, they can be reached and extirpated through the axillary

wound. When there is a large gland situated above the clavicle, a suitable incision can be made in the supraclavicular fossa. Blunt-pointed

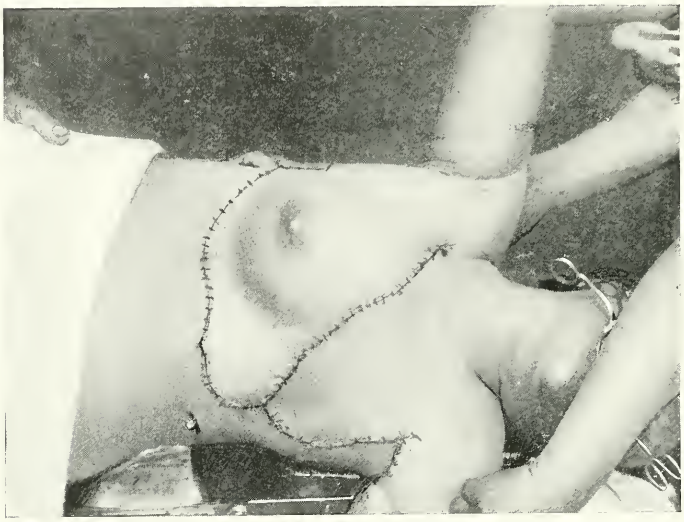


FIG. 557.—CLOSURE OF LARGE WOUND MADE BY AMPUTATION OF LEFT BREAST, BY TRANSPLANTATION OF THE RIGHT BREAST OVER THE MIDDLE LINE.

The number of liberating incisions will be noticed.

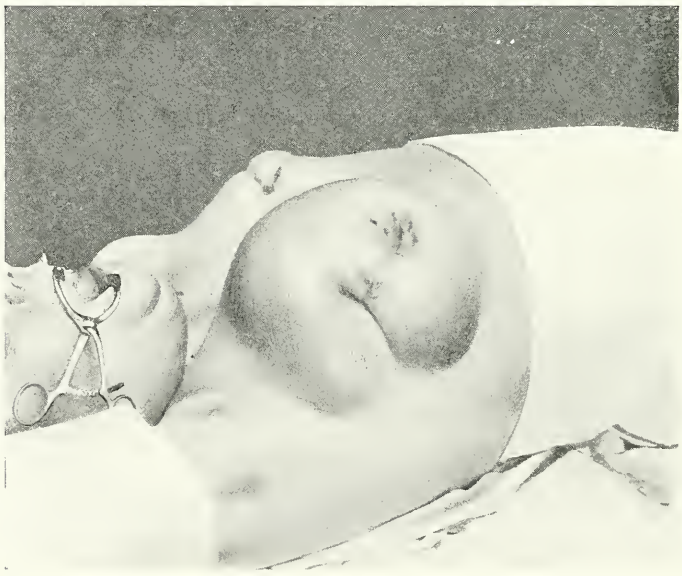


FIG. 558.—MASSIVE CANCER OF RIGHT BREAST AND ATROPHIC SCIRRHUS OF LEFT BREAST.

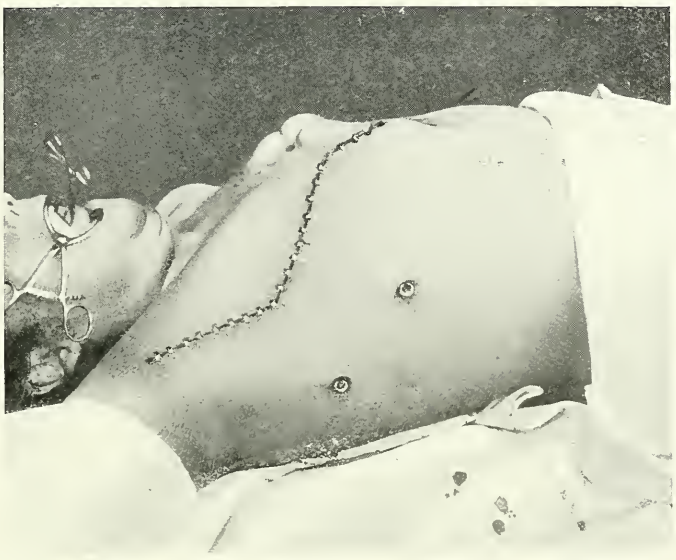


FIG. 559.—MASSIVE CANCER OF RIGHT BREAST, AND ATROPHIC SCIRRHUS OF LEFT BREAST.

Suture of wound left on amputation of right breast.

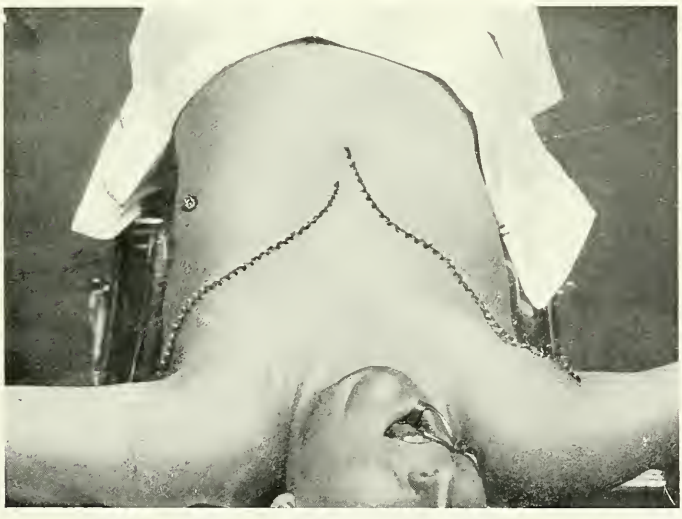


FIG. 560.—MASSIVE CANCER OF RIGHT BREAST, AND ATROPHIC SCIRRHUS OF LEFT BREAST.

Amputation of left breast has been carried out in the same séance. Aspect of both sutures.

scissors are then introduced into the deep tissues in order to expose the gland by divulsion, which is then extirpated after tying the pedicle if it appears to be vascular.

Operation in Cases of Local Recurrence.

In case of recurrence of such extent as to constitute a veritable tumour we proceed in the way above described. Where there are small limited and discrete nodules, we have to decide whether these should be all included between two curvilinear incisions or be extirpated each separately.

Fig. 561.—Ulcerated Cancer of Both Breasts.

Autoplasty of the Mammary Region.

When the loss of skin is too considerable to permit reunion of the wound by coaptation of its lips, it is necessary to have recourse to autoplasty by sliding displacement. The expert surgeon will be able to judge before undertaking the operation whether direct reunion is possible, and, on the other hand, he will be able to foresee how the wound can be filled when its extent must be such as to prove incompatible with direct

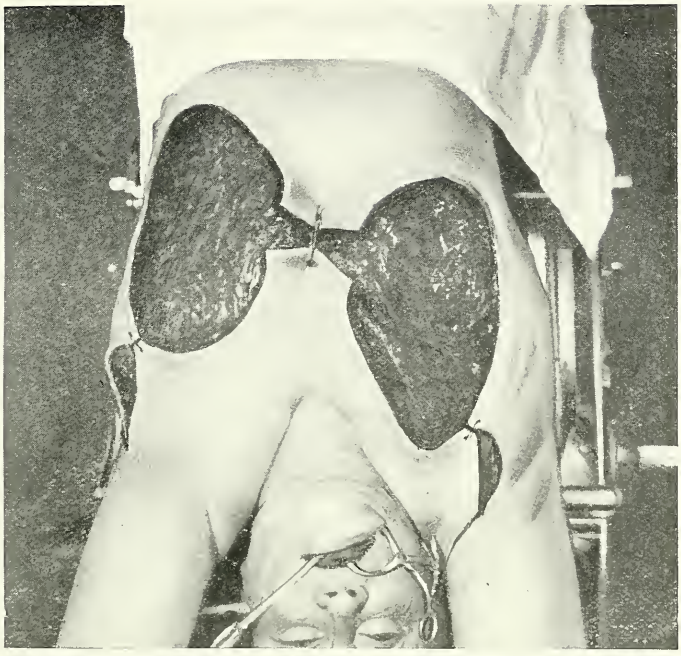


FIG. 562.—ULCERATED CANCER OF BOTH BREASTS.

Wound of vast extent produced by ablation of both breasts. Three provisional sutures have been placed.

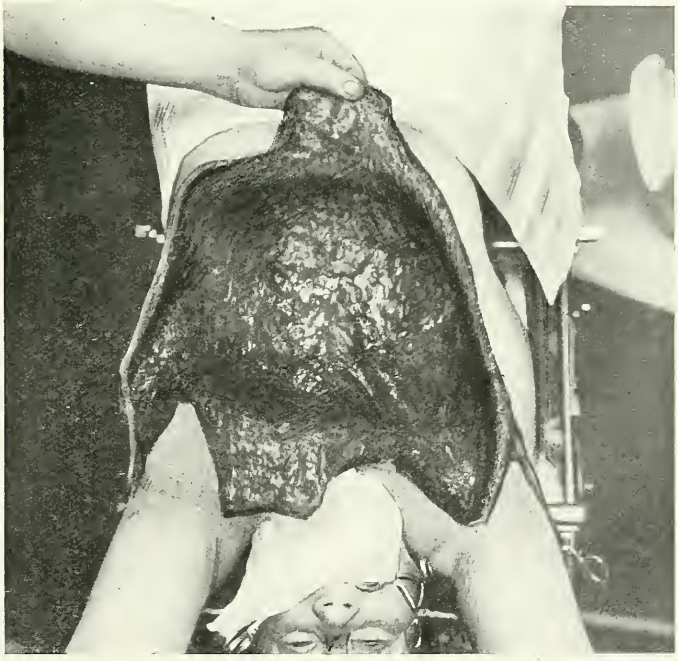


FIG. 563.—ULCERATED CANCER OF BOTH BREASTS.

Preparation of two autoplastic flaps by subcutaneous decollation towards abdomen and cervical region.

reunion. The following are the principal procedures of autoplasty which are to be adopted in cases of extensive loss of substance in the mammary region:

Autoplasty by Sliding Displacement of a Curvilinear Flap.—The liberating incisions should be made in the position from which the displacement can be effected with most advantage. Points of interrupted suture are applied. They should be very superficial and very close to the point of reunion of the two branches of the T.

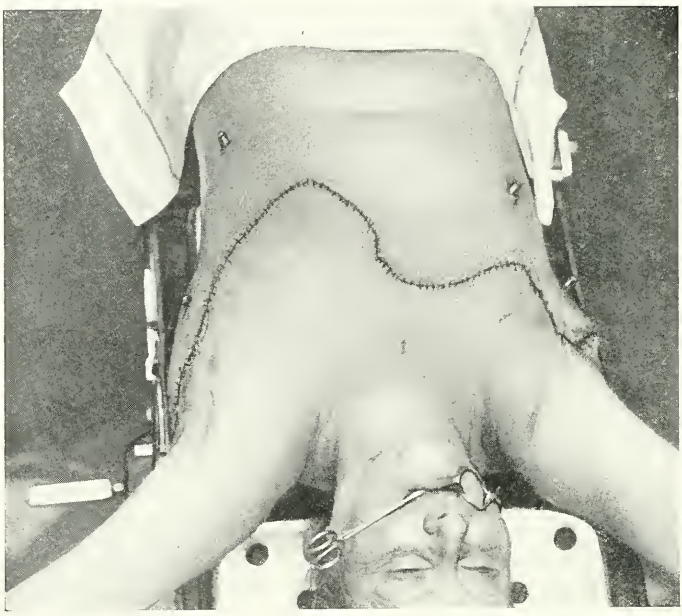


FIG. 564.—ASPECT OF THE SUTURE, WHICH HAS BEEN MADE THROUGHOUT WITH SEPARATE POINTS.

The orifices of the four glass drainage-tubes are seen.

Autoplasty by Combination of One or Several Curvilinear Incisions and Sliding Displacement of the Whole Breast of the Other Side.—When the wound is too extensive to be closed by the above procedure, we must detach the other breast completely, and incise it, if necessary, to spread its cutaneous surface, and thus cover in the wound by fixing it nearly in front of the sternum. It will be seen by the photographs that the outlines of the incisions vary according to the special conditions of each case and the conformation of the breast which is utilized for the autoplasty.

Ablation of Both Mammæ.

Ablation of both breasts can be carried out in the same seance. The procedure usually presents no peculiar features. In an exceptional case (Figs. 562, 563) where the whole of the skin had been removed, I deemed

it possible to close the wound by sliding displacement and dovetailing of the skin of the superior thoracic and epigastric regions. When both breasts had been removed and the hæmostasis terminated, the two approximately circular wounds were united by a transverse incision. The dissection of the superior and inferior flaps then gave a wound of vast dimensions, which was then so effectively reunited that the cicatrization was complete in ten days.

Fig. 565.—Aspect of the Cicatrix Three Months after the Operation.

Cancer of the Breast in the Male.

Cancer of the male breast rarely forms a voluminous tumour. The axillary glands are frequently invaded, and generalization is not rare, especially in young subjects. I have operated on a confrère for adenoma of the breast which had proceeded to cancerous transformation. The operation was carried out as in cases of atrophic scirrhus of the breast in a spare female subject. Enough skin must be preserved to obtain a good reunion.

General Considerations on the Treatment of Tumours of the Breast.

What is the best method of treatment to be applied in cases of malignant disease of the breast ? The tendency with most surgeons is to adopt early and very extensive operation, with ablation of the pectoral muscles and even division of the clavicle to facilitate removal of the deep-seated lymphatic glands. The surgeons who have deceived themselves regarding the value of those extensive operations have been recalled to reality by the observation of rapid and inoperable recurrences.

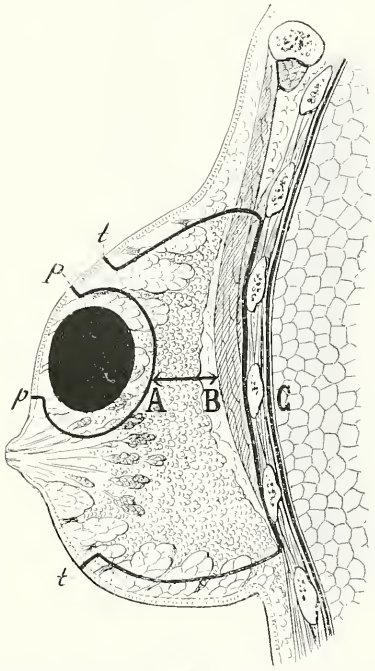


FIG. 566.—DIAGRAMMATIC SKETCH OF A NODULAR CANCER OF THE BREAST.

pp, Limits of parsimonious extirpation of the tumour; *ll*, limits of total extirpation.

A, mammary gland; *B*, pectoral muscles; *C*, pleura and lung.

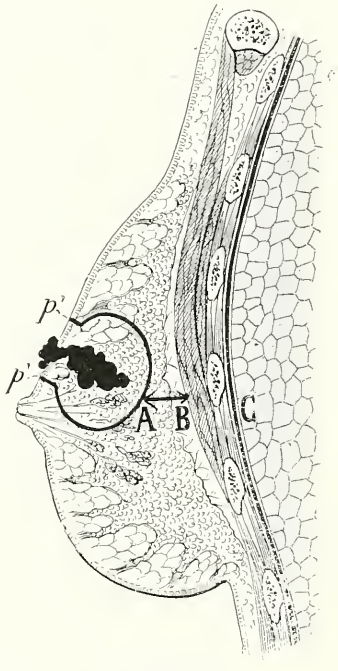


FIG. 567.

The recurrence, when it follows parsimonious intervention within the limits *pp*, permits a new operation at *p'p'*.

A, Mammary gland; *B*, pectoral muscles; *C*, pleura and lung.

When there are infected glands beneath the clavicle, it is probable that the infection has extended into the thorax. If it was positively certain that a very extensive operation could assure a permanent cure, I should be the first to advise it, whatever the extent and gravity may be; but rigorous observation of the facts leads to very different conclusions. Perform very extensive extirpation of a cancer of the breast in process of rapid evolution, and you nearly always find in two or three months after the operation multiple recurrence in the wound of operation and extensive

adenopathies in the axillary fossa. In one of these cases the tumour was of the size of an egg, and well localized, without adhesions to either skin or muscles. No infected glands were perceptible. A surgeon who was a partisan of extensive operations extirpated the whole of the breast and cleared out the axilla. Two months after the patient presented a disseminated recurrence *en cuirasse*, with involvement of the vasculo-nervous bundle in the axilla. Such recurrence has been frequently observed within six weeks after the bloody intervention. The fact is certain that many ex-

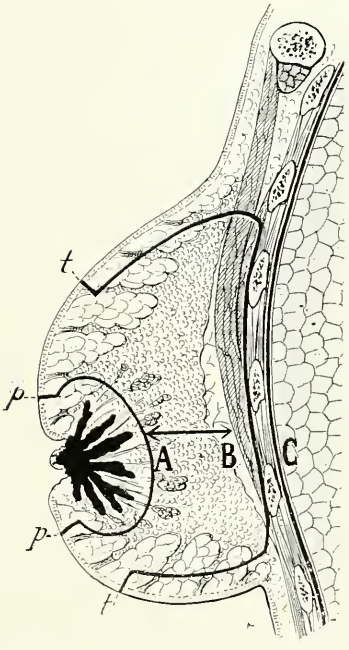


FIG. 568. — DIAGRAMMATIC SECTION OF A DENDRITIC EPITHELIOMA.

pp, Limits of parsimonious extirpation of the tumour; *tt*, limits of total extirpation.

A, mammary gland; *B*, pectoral muscles; *C*, pleura and lung.

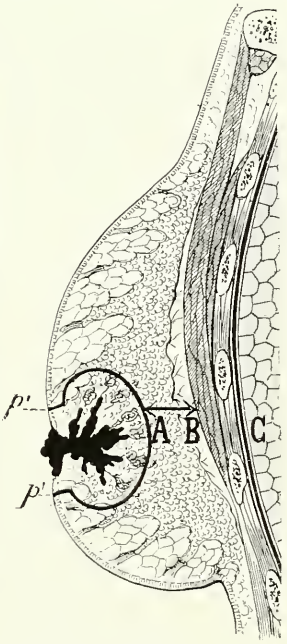


FIG. 569.

Recurrence, if it takes place after a parsimonious intervention at *pp*, permits afterwards a second intervention at *p'p'*.

A, mammary gland; *B*, pectoral muscles; *C*, pleura and lung.

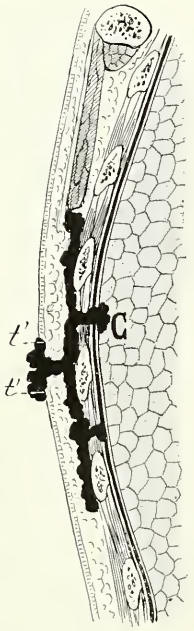


FIG. 570.

The cancer, after very extensive exeresis at *tt*, invades the thoracic wall, as the patient does not delay in succumbing to a rapid generalization.

A, mammary gland; *B*, pectoral muscles; *C*, pleura and lung.

tensive operations also hasten the death of the patient by provoking adipose inoculation of the cancer over the wound of operation to a great distance from the seat of the primary tumour. But submit the patient, on the contrary, at the onset of cancer of the breast to antineoplastic vaccination, and the tumour will nearly always be found to diminish in volume during the first weeks of the treatment. In a certain number of cases in the male, as well as in the female, these tumours may become wholly reabsorbed. It has even happened to me in presenting a number of cases in which the

patients had undergone neoplastic vaccination, that I was unable to show on which side the tumour had been. This particular patient had been treated for a tumour of the right breast of the size of a hazel-nut, accompanied with retraction of the nipple. Three years after the commencement of the treatment, we were faced with the impossibility of recognizing the seat of the tumour, for the nipple had resumed its normal appearance, and the most careful palpation discovered nothing. If the process of resorption

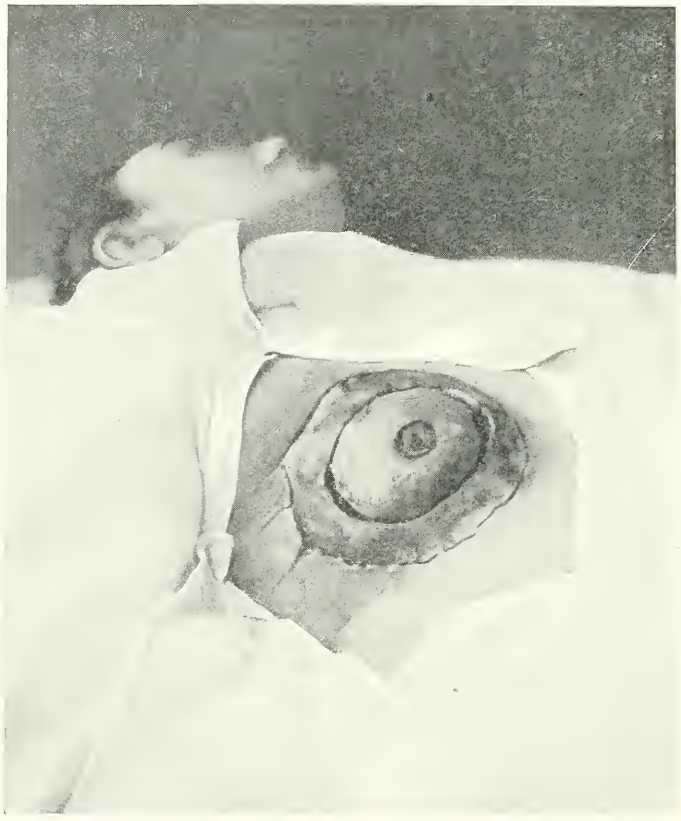


FIG. 571.—TREATMENT OF A DIFFUSE TUMOUR OF THE BREAST BY THE METHOD OF THERMIC ELECTRO-COAGULATION.

Aspect of the sphacelated zone after a circular incision has been made to facilitate the elimination.

becomes arrested, and the lymphatic glands are increasing in size, it is because the organism is found incapable of producing the reaction of immunity. This condition is observed more especially in massive tumours of very wide extent. It is then necessary to intervene.

Two varieties may be met with. If the tumour is very limited, I practise ablation at 10 to 15 millimetres from its limits, and leave the breast behind. I do not open the axilla if I discover no enlarged glands. These limited operations, which I call parsimonious, have given me remarkable

results in cases of epithelioma in which the diagnosis was confirmed by histological examination, notably in two cases operated on in 1905 with Dr. Nélaton, and which were followed by no recurrence, even after a partial operation which some surgeons would have qualified as incomplete and irrational. But when the tumour is voluminous and very widely extended, we must not calculate on the efficacy of the vaccine. The best procedure for prevention of dissemination of cancer cells in the organism is that of thermic electro-coagulation. This method is the only one that enables us to pursue the pathological cells to a certain depth in the healthy tissues, especially in the vicinity of the great vascular trunks, and to destroy them by the selective action of heat, while preserving the arterial and venous walls which are kept at the normal temperature by the blood-current. If we are fully acquainted with the technique of electro-coagulation, it becomes possible to limit its destructive effect to the neoplastic cells alone, while preserving all the healthy tissues. This result is obtained by the use of the thermo-electric bath. The cavity of the field of operation is filled with isotonic saline water heated to a temperature of 56° C. (132·8° F.). This fluid, which is a good conductor, causes the dissemination of thermal effects. With this object the metallic electrode which is immersed in the liquid should be continuously moved about, while the temperature of the field of operation is read off every succeeding moment on a mercurial thermometer which is unceasingly moved about with the left hand over every part of the surface of the wound. In some exceptional cases I have destroyed the whole of the tumour directly by thermic electro-coagulation (Fig. 571). The surface of the wound was then allowed to cicatrize.

OPERATIONS ON THE AXILLARY FOSSA.

Anatomy.—The surgical anatomy of the axillary fossa should be studied on a vertical antero-posterior section passing through the plane of union of the middle and outer thirds of the clavicle at a distance of 4 centimetres to the inside of the coracoid apophyses. We remark on this section (Fig. 572) that the axillary fossa presents four walls. It is limited above by the clavicular insertion of the trapezius, the clavicle, and subclavius muscle; in front by the greater and lesser pectoral muscles and the clavi-pectoral aponeurosis, in contact with which lies the vasculo-nervous bundle. Behind we meet, from above downwards, the supraspinatus, subscapularis, and latissimus dorsi muscles. The inferior wall, which corresponds to the cutaneous depression of the axilla, is formed first by the skin and then by an aponeurosis very similar to the fascia cribriformis. This aponeurosis is traversed at its middle by the lymphatic vessels and the nerve filaments, while its brachial and thoracic attachments are strengthened by interlacing arciform fibres. It is inaccurate to describe a clavi-coraco-axillary ligament. Such a ligament does not in reality exist, and the collective mass

of the two pectoral muscles is lodged, as embryological research has demonstrated, in a single aponeurotic sheath, complicated by the presence of an intermuscular space. This disposition is very well shown in Fig. 572.

The vasculo-nervous bundle is situated at the level of the superior border of the pectoralis minor, and at a good distance from the clavicle. The suprascapular vein and artery are found at the upper part. We shall find that it is easy to pass the finger behind the clavicle and reach the glands of the supraclavicular fossa nearly under the skin. We notice in Fig. 572

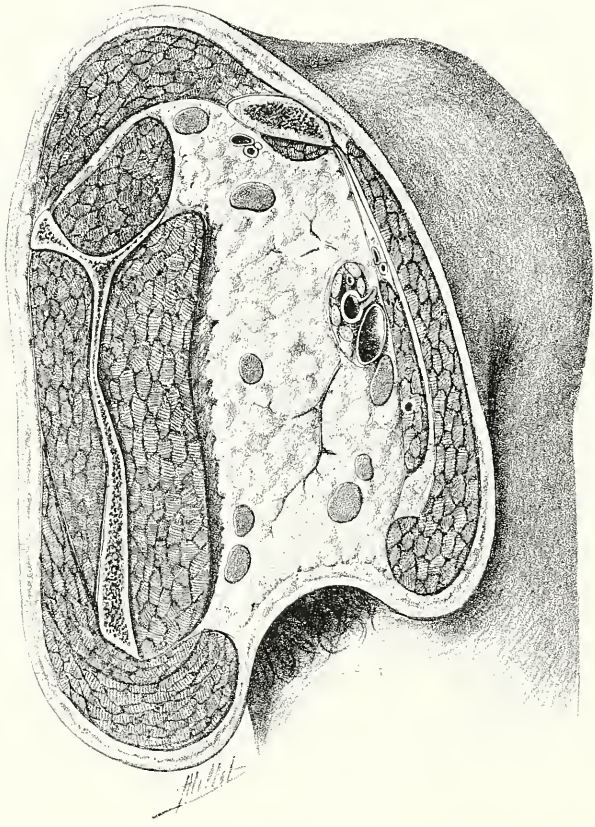


Fig. 572.—Antero-Posterior Section of the Axillary Fossa of the Female at the Junction of the Middle and Outer Thirds of the Clavicle.

the six ganglionic groups of the region. The antero-inferior one receives the lymphatics of the breast. It is connected with the brachial group, which form a tangent to the axillary vein, and receives the lymphatics of the arm. Behind the inferior subscapular or latissimus dorsi group receive the lymphatics of the mammary gland and those of the postero-lateral region of the thorax. The medium subscapular and superior scapular or subclavicular groups anastomose freely with the first groups and the supraclavicular glands.

Traumatic Lesions.

Wounds of the axillary fossa present no peculiarity. When one of the great vascular trunks is wounded, immediate compression must be made, and operation carried out without delay. Suture of the vascular wound is to be preferred to ligature.

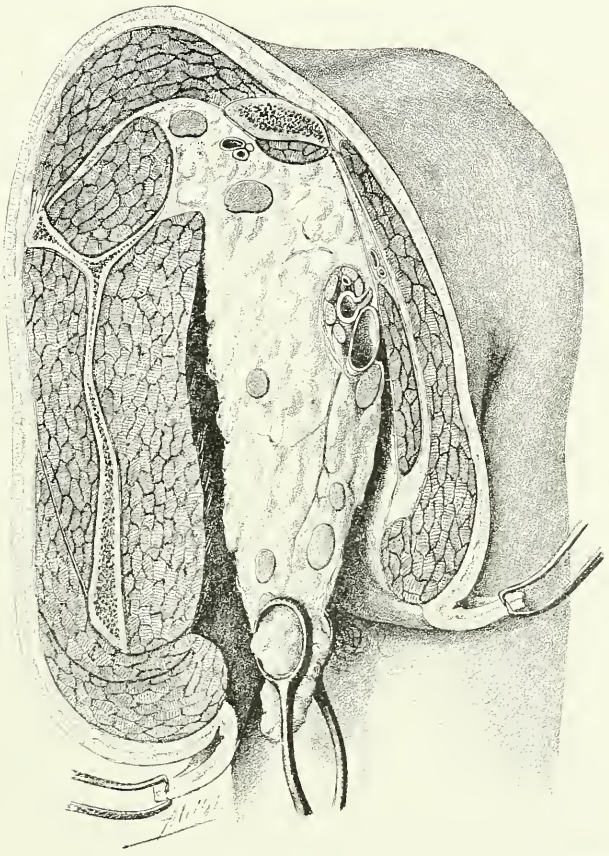


FIG. 573.—EVACUATION OF THE AXILLA: DISSECTION OF ANTERIOR AND POSTERIOR WALLS.

Inflammatory Lesions.

Tuberous abscesses of the axilla may lead to the formation of wreaths of small encysted foci running a subacute course. These abscesses usually pass into a retrogressive stage after some injections of mycolysine. When any fluctuating points persist, the pus is evacuated by small punctures made with the thermo-cautery. Tuberculous glands are of frequent occurrence. Their growth should be combated by administration of phymalose, which sometimes effects their resolution. Cold abscesses of the axilla,

whether encysted or fistulous, are usually consecutive to the evolution of tuberculous glands. Such glands should be extirpated with the surrounding pathological tissues.

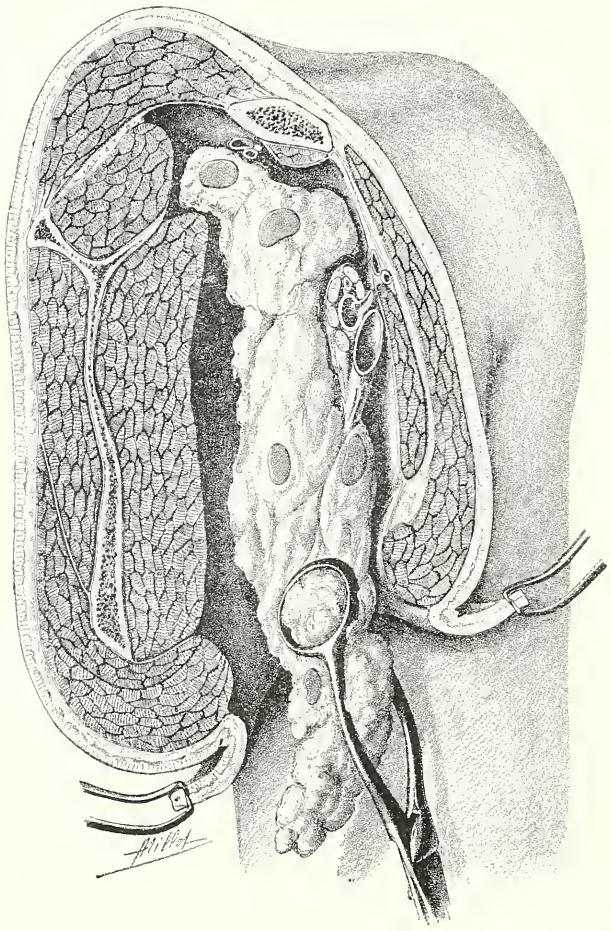


FIG. 574.—EVACUATION OF THE AXILLA: DISSECTION OF ANTERIOR AND POSTERIOR WALLS.

The adipose packet and lymphatic glands are isolated up to the level of the supra-clavicular fossa. It remains to separate the vasculo-nervous bundle by dividing the external mammary vein and artery on the distal side of a forceps.

Malformations: Congenital and Acquired.

Those specially observable are the result of cicatricial bands, which may require autoplastic operations.

Tumours.

There is nothing special to be said about cutaneous tumours of this region. Among the benign tumours sometimes met with are lipoma myxoma, and benign lymphadenoma. Among the malignant are malignan, lympho-sarcoma, sarcomatous adenopathy, and secondary cancer. Tht benign tumours are treated by extirpation. In case of the malignant neoplasms the operation should be supplemented by the use of the thermo-electric bath, by which the walls of the field of operation are kept heated to a temperature of 58° C. (136·4° F.) or 60° C. (140° F.), while taking care not to surpass the latter limit.

Technique of Evacuation of the Axillary Fossa.

Evacuation of the axillary fossa, when dealing with benign lymphadenoma, tuberculous or cancerous glands, should be carried out with a uniform technique, according to the general method which I have termed the "ana-

Fig. 575.—Extirpation of a Considerable Mass of Tuberculous Glands. First stage: Cutaneous incision.

tomical method." Suppose an enormous mass of glands affected by benign lymphadenoma. The operation is carried out in the following manner:

Operation—First Stage.—Incision of skin in the axis of the axillary fossa, passing over the culminating point of the tumour.

Second Stage.—Incision of axillary aponeurosis and retraction of lips of wound with hooked forceps. Exposure of the accessible pole of the glandular mass.

Third Stage.—Isolation of the glandular mass by divulsion, sometimes with blunt-pointed scissors, sometimes with the fingers, beneath the pec-

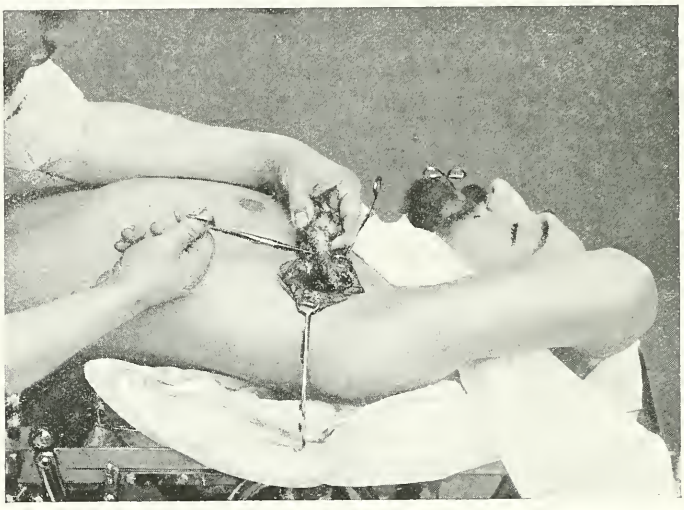


Fig. 576.—Extirpation of a Considerable Mass of Tuberculous Glands. Third stage: Ligature and section of the vascular pedicle.

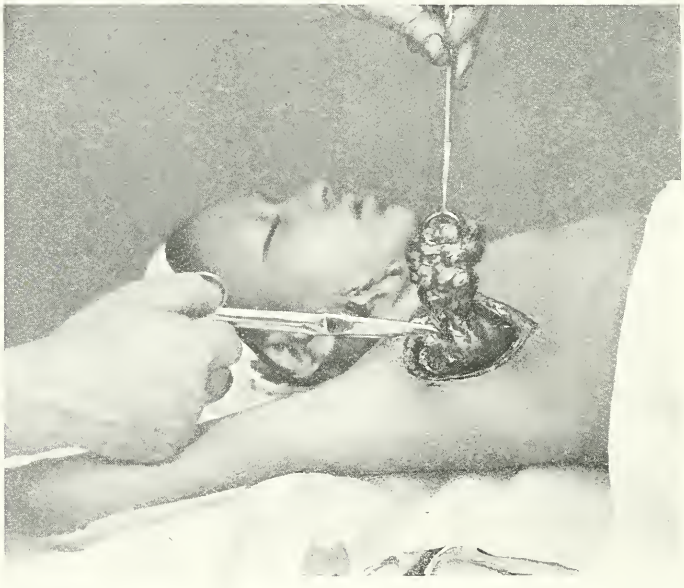


Fig. 577.—Extirpation of Hypertrophied Tuberculous Axillary Glands in the Hindu: Xiphopage, Radica.

toral muscles, and then at its inferior and posterior aspects. The glandular mass, on being drawn out of the wound, leaves the axillary vein exposed.

Fourth Stage.—Forcipressure and section of the external mammary vessels, and freeing of the vasculo-nervous bundle, which is left in contact with the pectoralis minor.

Fifth Stage.—Extirpation of the whole glandular mass of the subclavicular region which has remained adherent to the glands beneath. We have then but to tear through the adhesions which unite the pathological mass to the aponeurosis of the subscapularis muscle, and the whole mass of glands falls into the hand. We seldom have to apply more than two or three ligatures. The field of operation is now a veritable anatomical preparation of the walls of the axillary fossa. The brachial anastomosis of the second intercostal nerve is found to have been divided during the operation.

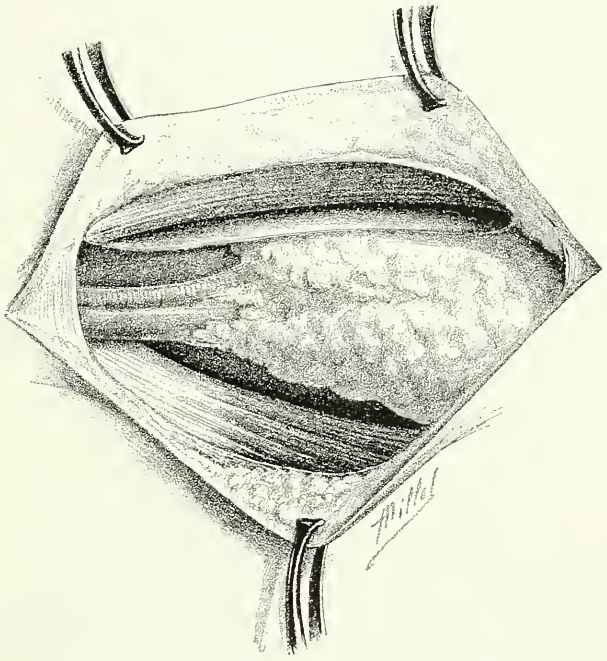


Fig. 578.—Clearance of the Axilla.

After median cutaneous incision of the axillary fossa, the posterior lip of the wound has been dissected back to the border of the latissimus dorsi, and the anterior lip as far as that of the pectoralis major. The cellulo-glandular mass is seen in the middle of the axillary fossa.

Sixth Stage.—Search for supraclavicular glands. When there are any external supraclavicular glands, they can be extirpated after the principal mass, without danger of wounding any important organ, by dissociating the cellular spaces that surround them, and perforating the trapezius so as to reach the superficial groups. This stage of the operation brings the superior wall of the axillary fossa specially into evidence, which is shown in a vertical antero-posterior section to be as extensive as the inferior wall.

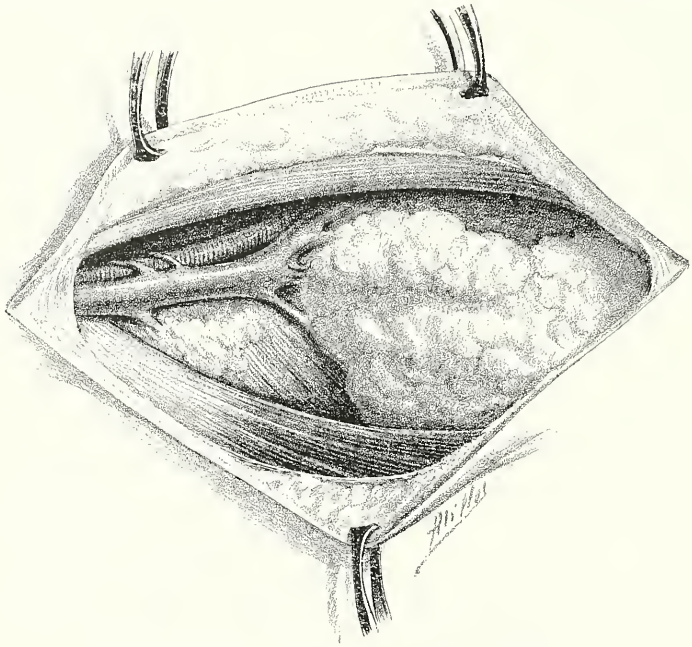


FIG. 579.—CLEARANCE OF THE AXILLA.

The cellulo-glandular mass has been isolated with the index-finger from its adhesions to the walls of the axillary fossa.

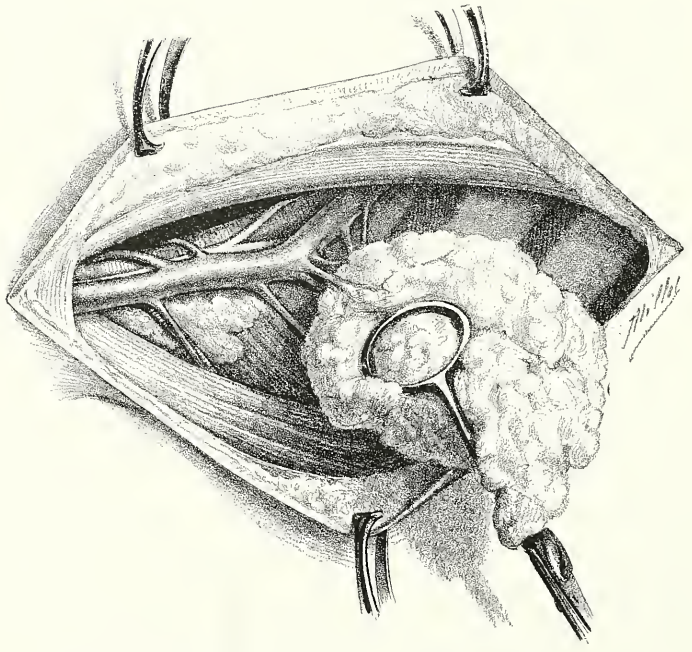


FIG. 580.—CLEARANCE OF THE AXILLA.

The cellulo-glandular mass, when grasped with oval-jawed forceps, is then easily extracted.

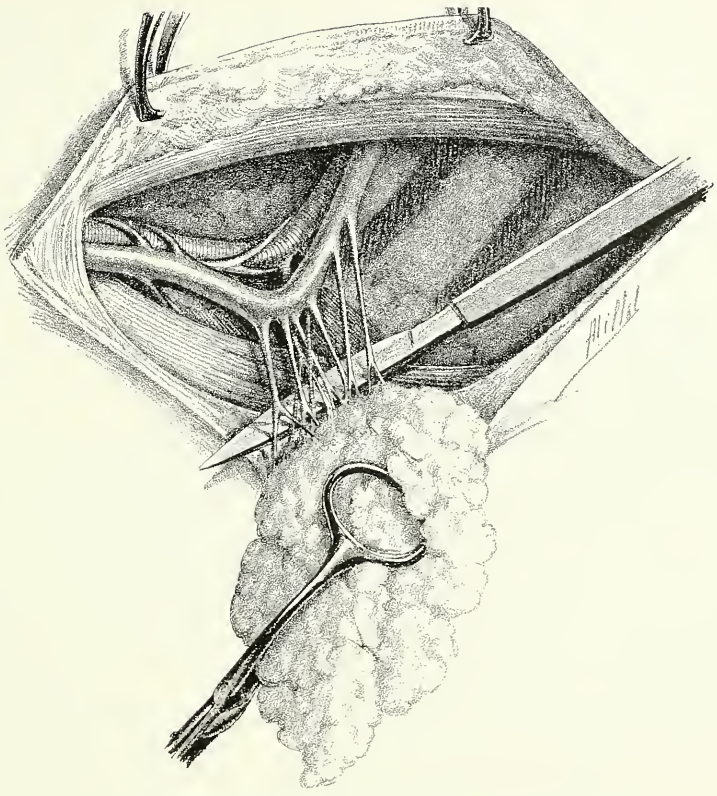


FIG. 581.—CLEARANCE OF THE AXILLA.

The muscular pedicle is isolated with the back of the bistoury, so as to exteriorize the glandular mass.

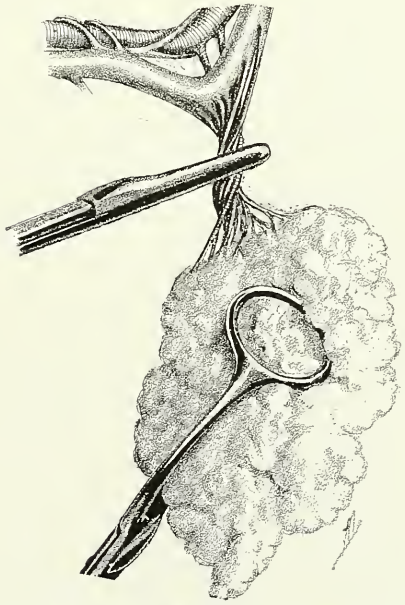


FIG. 582.—CLEARANCE OF THE AXILLA.

Torsion and crushing of the pedicle, which is then tied above the forceps, with care not to include any nerve filaments in the ligature.

Ligature of the Axillary Artery.

1. *Below the Clavicle.*

Operation—First Stage.—Horizontal incision of 7 centimetres parallel to the lower border of the clavicle at a distance of a finger's breadth below the bone, and crossing its middle.

Second Stage.—Incision of outer border of clavicular head of pectoralis major and of the aponeurosis of the delto-pectoral space, and retraction of the soft parts with hooked forceps.

Third Stage.—Exposure of the artery, which is directed obliquely outwards and downwards, and gradually approaches the anterior wall of the axillary fossa. The vein is seen lying in front and to the inner side of the artery.

Fourth Stage.—The artery is exposed by divulsion, and raised from below upwards on a curved forceps, which should pass between it and the vein. The ligature, of silk or catgut, is then passed and tied.

Fifth Stage.—Reunion; drainage.

2. *In the Axillary Fossa above the Origin of the Circumflex Branches.*

Operation—First Stage.—Incision of 7 centimetres at a finger's breadth from the axillary border of the pectoralis major along the prominence formed by the coraco-brachialis muscle. This incision should start from the culminating-point of the axillary fossa.

Second Stage.—Retraction of the lips of the wound with hooked forceps, and exposure of the anterior border of the pectoralis major. This muscle is detached from its operation by divulsion.

Third Stage.—The posterior lamella of this aponeurosis is then incised, and the vasculo-nervous bundle is exposed.

Fourth Stage.—The artery is laid bare by divulsion, and raised on a curved forceps and ligatured.

Fifth Stage.—Reunion; drainage.

Axillary Aneurism.

We here apply in the treatment of arterial or arterio-venous aneurisms the general technique which I have already described in connection with the subject of aneurisms of the neck.

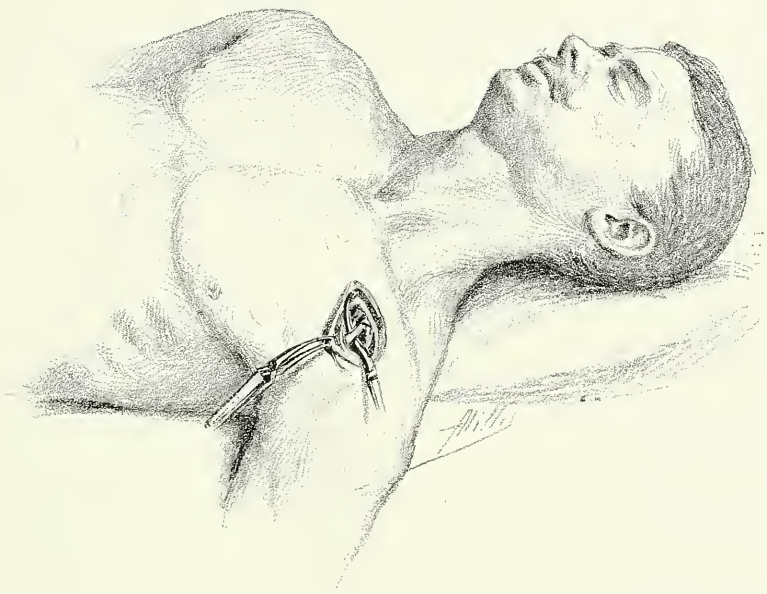


FIG. 583.—LIGATURE OF THE AXILLARY ARTERY BELOW THE CLAVICLE.

General sketch.

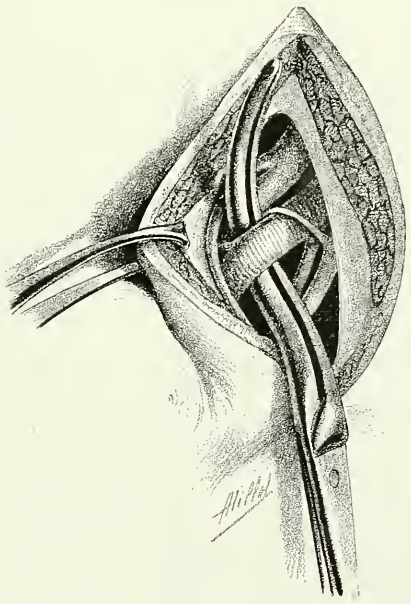


FIG. 584.—LIGATURE OF THE AXILLARY ARTERY BELOW THE CLAVICLE.

The curved forceps, having broken through the clavi-coraco-axillary aponeurosis, is made to draw the axillary artery from without inwards.

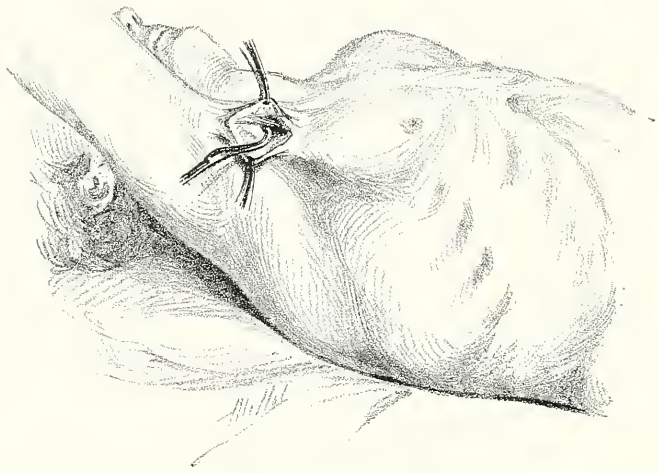


FIG. 585.—LIGATURE OF THE AXILLARY ARTERY IN THE AXILLA.
General sketch.

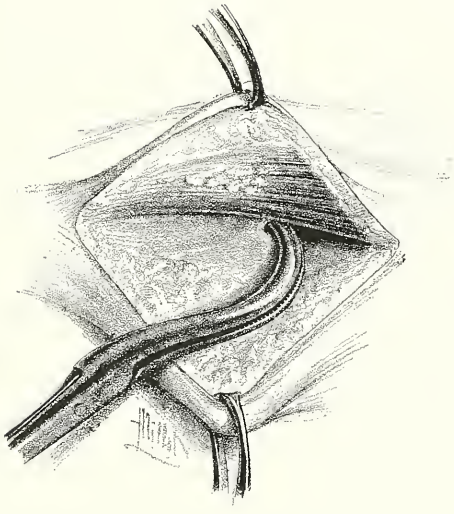


FIG. 586.—LIGATURE OF THE AXILLARY ARTERY IN THE AXILLA.

It is easy to tear through the cellulo-adipose tissue of the axilla with a curved forceps till the brachial extremity of the incision is reached.

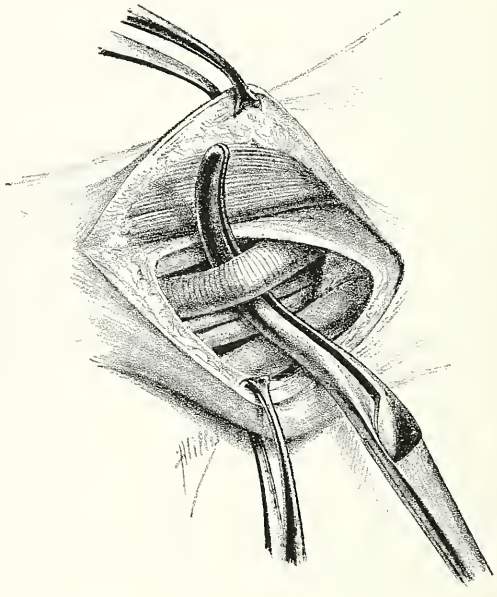


FIG. 587.—LIGATURE OF THE AXILLARY ARTERY IN THE AXILLA.

The curved ligature forceps has been made to draw the axillary artery from within outwards. The coraco-brachialis muscle is seen immediately below the curved forceps.

OPERATIONS ON THE THORACIC WALL AND CAVITIES.

In the first place I will describe the interventions on the pleural cavity, especially empyema, then the operative technique in cases of encysted pleurisy; and, finally, operation on hydatid cysts of the lung by the transpleural route, and on abscess of the liver by transpleuro-phrenic route. I will then pass on to the special technique of pleurotomy for penetrating wounds of the lung and of the heart, and end with the surgery of the mediastinum. The originality of the surgery of the last-named region will be remarked, in connection with which I will study in succession invasion of the superior vena cava, of the arch of the aorta, of the bifurcation of the trachea, and of the hilum of the lung, of the cavity of the pericardium, of the subbronchial portion of the œsophagus, and, finally, of the pericardium and of the heart.

Treatment of Purulent Pleurisy by Author's Method.

Opening of the pleura, or pleurotomy, in empyema is specially practised in purulent pleurisy. Before operating on any case of purulent pleurisy, whether encysted or non-encysted, it is indispensable to verify the diagnosis by radioscopy and radiography, which give images of absolute precision when a sufficient installation is used. The diagnosis should be further confirmed by aspiratory puncture, which is without danger in this region. The pus obtained from the puncture should be immediately subjected to bacteriological examination. The purulent effusions attended with pneumococci are the least rebellious. Streptococcal pleurisies are not rare. We may even find in a state of microbic association the *B. coli*, *B. typhosus*, and *Staphylococcus aureus ;* and in cases of penetrating wound of the thorax or of pulmonary gangrene saprophytic microbes of the most various kinds.

Pleurotomy without Costal Resection.

In simple cases this operation is carried out without costal resection.

Operation—First Stage.—Incision of the soft parts for a distance of 6 to 8 centimetres below the inferior angle of the scapula in the sixth, seventh, or eighth intercostal space.

Second Stage.—Perforation of the intercostal space with blunt scissors, and widening of the orifice by divulsion.

Third Stage: Evacuation of the Pleura.—Insertion of three large india-rubber drainage-tubes of 12 to 15 millimetres in diameter, fixed by a long safety-pin, and absorbent dressing covered by impermeable tissue.

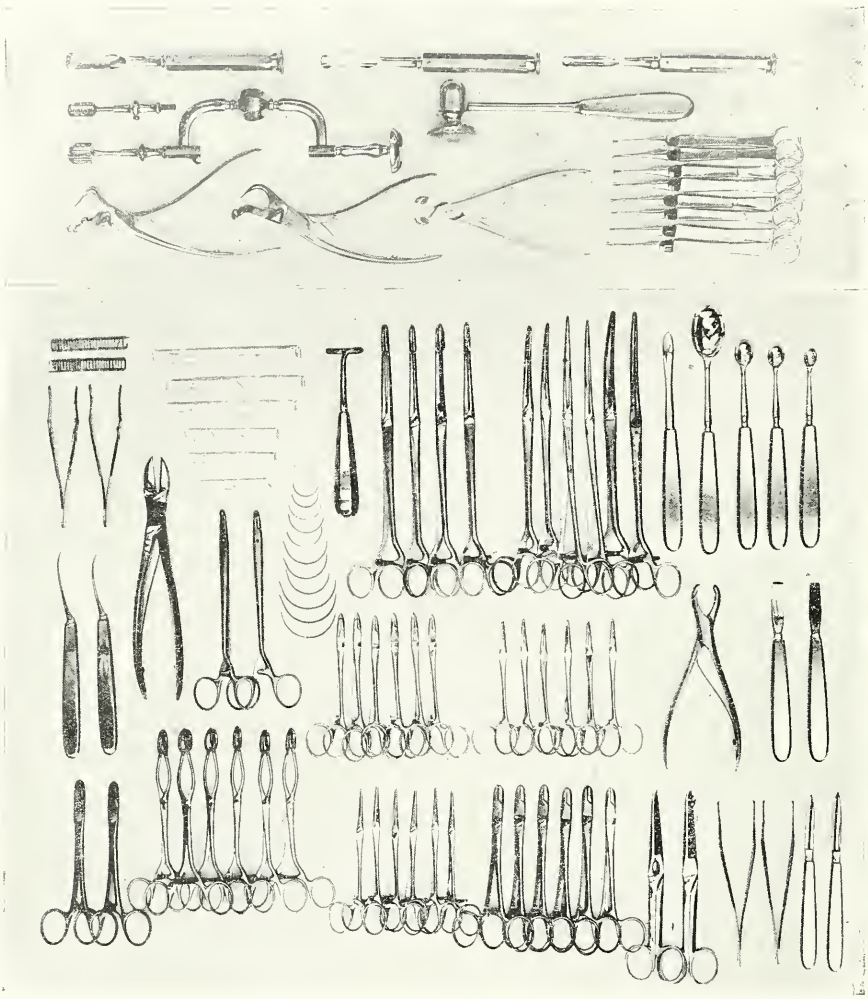


FIG. 588.—INSTRUMENTS FOR OPERATIONS ON THE THORACIC WALL AND CAVITIES.

From below upwards, and from right to left: Two bistouries, two dissection forceps, two strong straight scissors, six artery forceps, six ring-handled forceps with nine oblique claws, six oval-jawed forceps, two forceps for veins. Above these: One straight raspatory, one curved raspatory, one cutting forceps, six Championnière's forceps, six needle-holder forceps, two long forceps with eccentric jaws, one Liston's cutting bone forceps, two needles mounted on handles. Next above: Four curettes, one spatula, six long forceps with curved jaws, four long forceps with oval eccentric jaws, one Doyen's costal raspatory, a number of sorted drainage-tubes, clips, and two clip-forceps. In uppermost compartment: Six hooked forceps, one cutting forceps, two costotome raspatories, one burr of 10 millimetres, four burrs of 10 millimetres mounted on a *trepan à cliquet*, two gouges, and one mallet.

Pleurotomy with Costal Resection and Drainage.

Operation—First Stage.—Cutaneous incision of 7 centimetres in the region of absolute dulness, or rather a little below that zone.

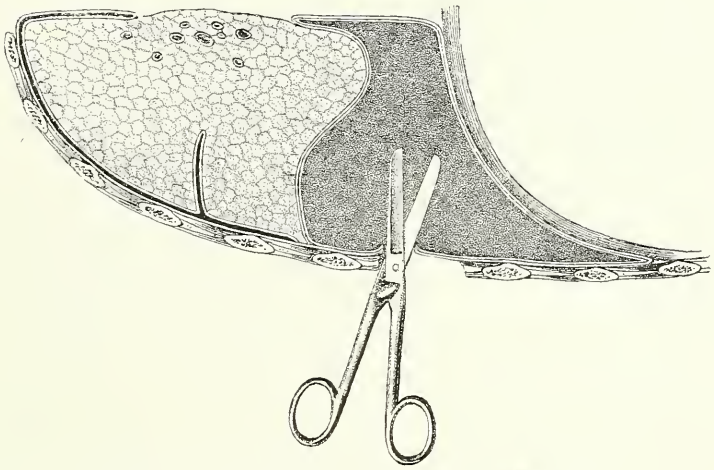


Fig. 589.—Pleurotomy: Doyen's Method.

First and second stages.

Second Stage.—The exposed rib is resected for a length of 4 centimetres. The musculo-serous wound is penetrated with closed scissors. Pus escapes. The orifice is then increased by divulsion.

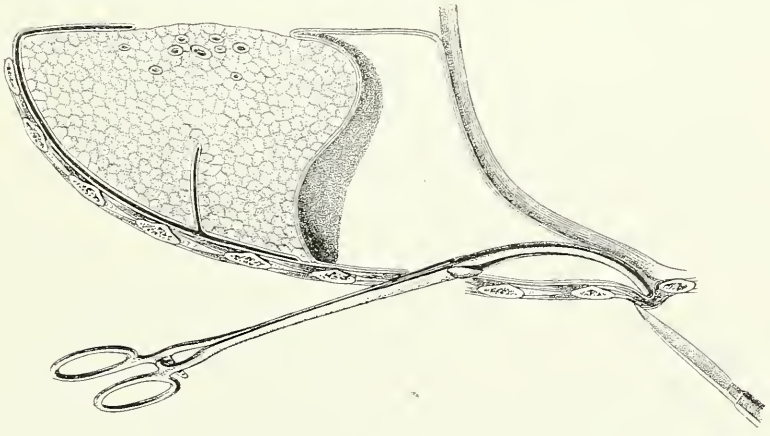


Fig. 590.—Pleurotomy: Doyen's Method.

Third stage: Incision of the integuments over the projection formed by the tip of a long curved forceps.

Third Stage.—A long forceps is introduced into the superior wound. It is made to project at the lowest part of the costo-diaphragmatic sinus.

The integument can then be readily incised over the extremity. The whole of the pus escapes. An intrapleural lavage can be carried out if the state of the patient permit.

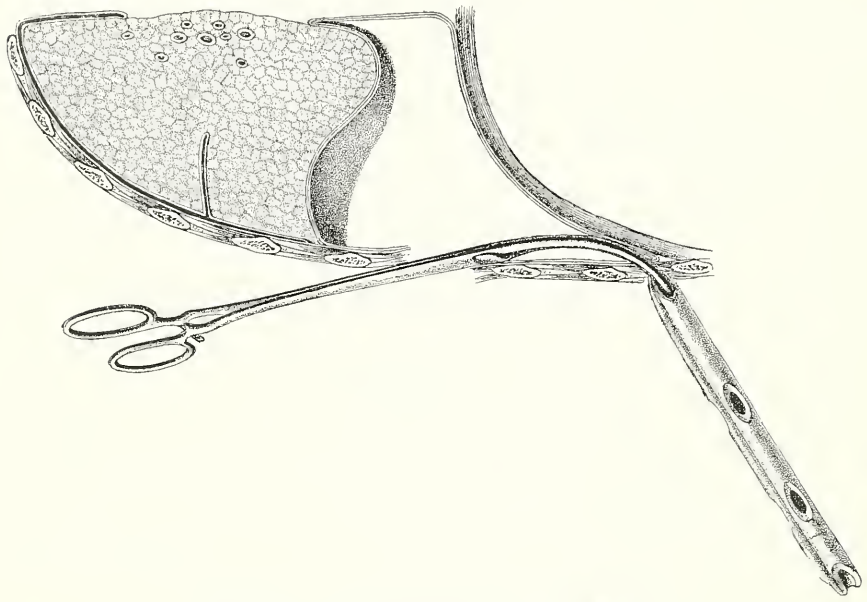


Fig. 591.—Pleurotomy: Doyen's Method.

Fourth stage: The forceps grasp the double drainage-tube opposite the lower incision.

Fourth Stage.—With the same curved forceps we grasp through the inferior wound an india-rubber drainage-tube cut in form of a rifle-bullet.

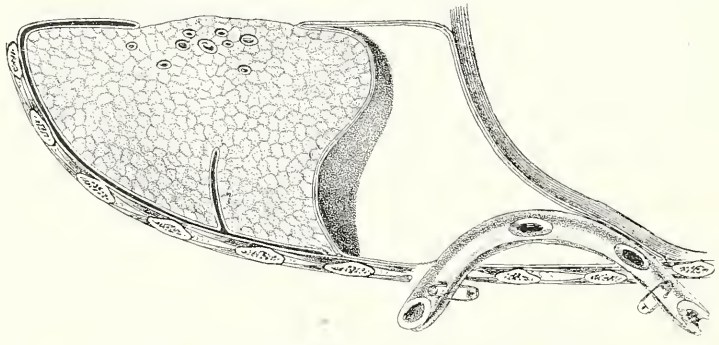


Fig. 592.—Pleurotomy: Doyen's Method.

Fourth Stage: The drainage-tube is fixed with safety-pins.

The tube emerges through the upper wound. It is fixed in this position by two safety-pins. This disposition, which was designed by me a long time ago, secures perfect drainage of the purulent collection, and diminishes

the risk of pleural fistula, which forms so frequent a complication of pleurotomy.

Primary tuberculous pleurisy often remains serous for a certain time before undergoing purulent transformation.

Technique of Costal Resection and of Thoracoplasty.

Costal Resection.

The necessity for rapid conclusion of all interventions on the pleural cavity induced me to construct a special instrumentation for costal resection, and to determine a precise technique. I denude the ribs very rapidly with my costal raspatory, and then divide them with a Liston's forceps. We can also employ a costotome raspatory, which represents a combination of my costal raspatory with a chisel. This instrument enables the operator to complete either a definitive resection of the ribs, or to form a movable hinged shutter. Many varieties of cases may present themselves for operation.

If the intercostal space is very narrow, I denude the rib above with a stroke of the raspatory. I then isolate it by a double to-and-fro movement with the help of my special raspatory over a length of 5 or 6 centimetres, and then resect the denuded segment with a Liston's forceps. In some cases I resect both neighbouring ribs for a length of 5 or 6 centimetres. Two cylindrical drainage-tubes are then introduced through a counter-opening made in the costo-phrenic pleural sinus, so as to secure perfect drainage. When desirable, aspiration is performed with the help of Alvergniat's vacuum tube.

Method of Using the Costotome Raspatory.—The formation of this instrument has been realized by the combination of my costal raspatory with a guillotine knife-blade. The same instrument, with a little modification, can also be used in operations on the ribs, sternum, and vertebral laminæ.

In order to introduce the costal raspatory, it suffices to detach the periosteum as far as to the pleural aspects at either upper or lower margin of the rib involved. The beak of the instrument is then turned round the deep aspect of the rib, and is made to emerge in the other intercostal space; then by a brusque to-and-fro movement the piece of rib is denuded for the necessary distance.

Operation—First Stage: Incision of the Soft Parts.—I have almost completely given up U-shaped in favour of longitudinal incisions, sometimes parallel to the ribs, sometimes oblique or perpendicular to their direction. The lips of the incision are immediately grasped with a number of hooked forceps. Traction on these instruments exposes a field of operation of considerable extent.

Second Stage: Resection of the Ribs.—In cases in which preservation of the pleura is important I strip each rib of its periosteum, and make a subperiosteal resection with my costotome raspatory. If it seems to me necessary to preserve a costal shutter, that instrument enables me to make

a subperiosteal resection of the ribs at the base of the required shutter, and to preserve the intercostal vessels in its thickness. When, on the other

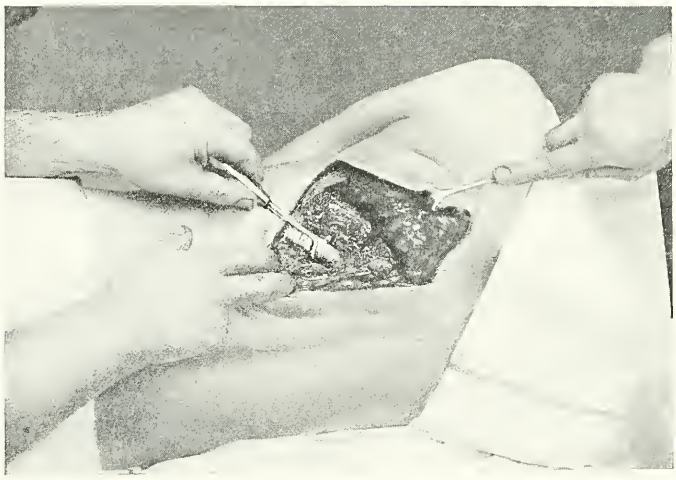


Fig. 593.—Denudation of a Rib with the help of Doyen's Costal Raspatory.

hand, I consider it desirable to resect the whole thickness of the thoracic wall—for example, in operations of thoracoplasty for old fistulous cavities

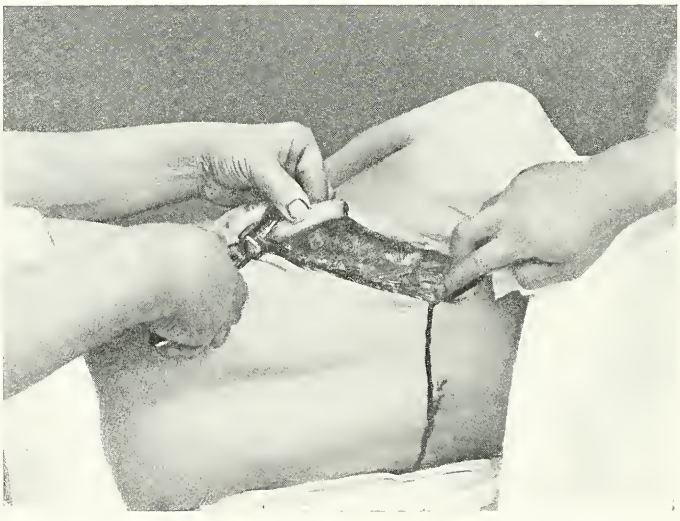


Fig. 594.—Resection of a Rib with Liston's Forceps.

with sclerosed walls—I introduce the costotome rugine beneath the periosteum, and destroy the corresponding portion of the thoracic wall by a

to-and-fro movement. When the multicostal resection is finished, I resect with scissors the whole of the remaining tissues of the thoracic wall over the whole area of the field of operation.

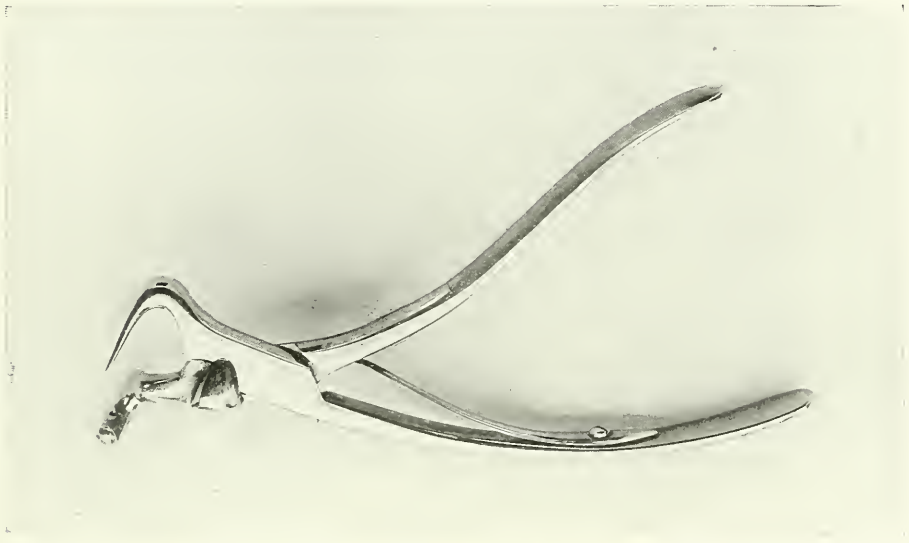


FIG. 595.—DOYEN'S COSTOTOME RASPATORY.

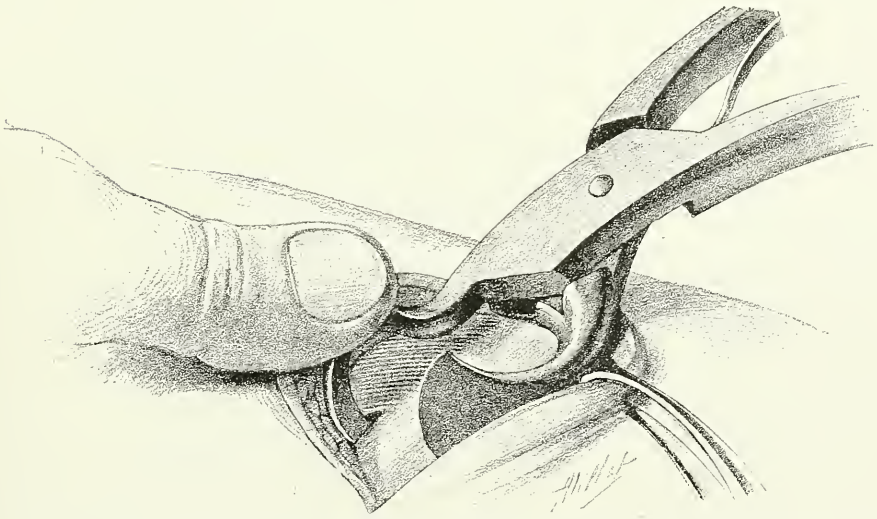


FIG. 596.—INTRODUCTION OF THE HORIZONTAL BRANCH OF THE RASPATORY BENEATH THE UPPER BORDER OF THE RIB.

When the empyema is considerable in quantity, it may be desirable to carry out a multiple and extensive costal resection at the outset. A cutaneous incision of 12 to 15 centimetres in length is made, and three or

four ribs are exposed, which, by the procedure above indicated, are resected in a few moments over the same length without danger of wounding the intercostal arteries. Wound of one of these arteries would require the

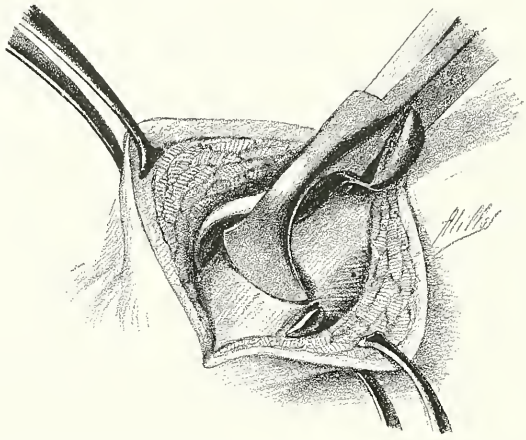


Fig. 597.—First Section of the Rib on the Outer Side.

application of a short-jawed forceps for three to four minutes, and a subsequent ligature. When we know how to manipulate the costotome raspa-

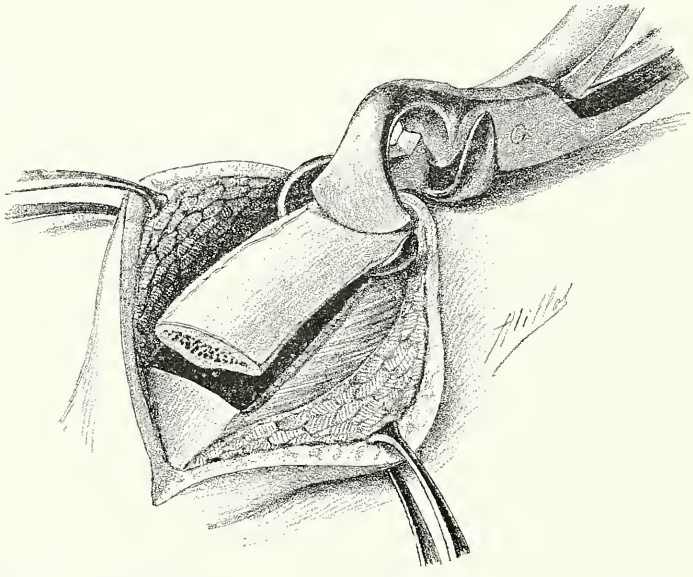


Fig. 598.—The Rugine is then drawn inwards, and the Piece of Rib is divided at its Internal Extremity.

tory, the denudation and resection of each rib requires five to ten seconds. If the patient is not too feeble, we can carry out at the time of operation a lavage with boiled saline solution of 7 per 1,000 (artificial serum) at a

temperature of 39° C. (102·2° F.); otherwise, it is better to be content with evacuation of the pus, and postpone the first lavage till some days later.

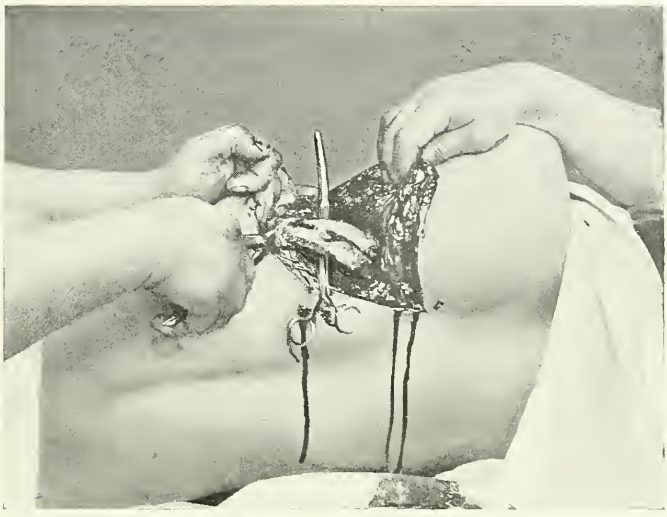


Fig. 599.—Resection of Two Ribs united by an Osseous Bridge of Inflammatory Origin.

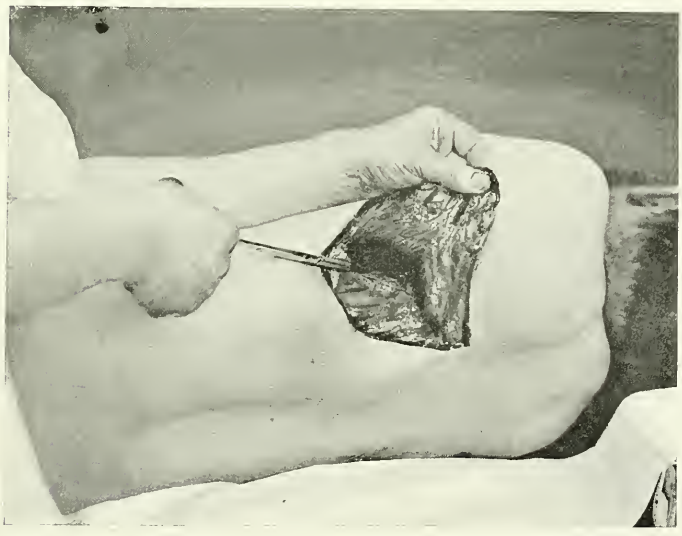


Fig. 600.—Resection of Two Ribs united by an Osseous Bridge of Inflammatory Origin.

Clearing out and tamponing of the purulent focus.

Empyema by filling of the general pleural cavity may give rise to formation of purulent fistulæ, which necessitate ultimate intervention.

Treatment of Pleural Fistula by Author's Method.

Obstinate pleural fistulæ are in many cases maintained by the sclerotic condition of their walls and the rigidity of the thoracic cage. I treat them by extensive costal resection, followed by free opening up, curettage, and

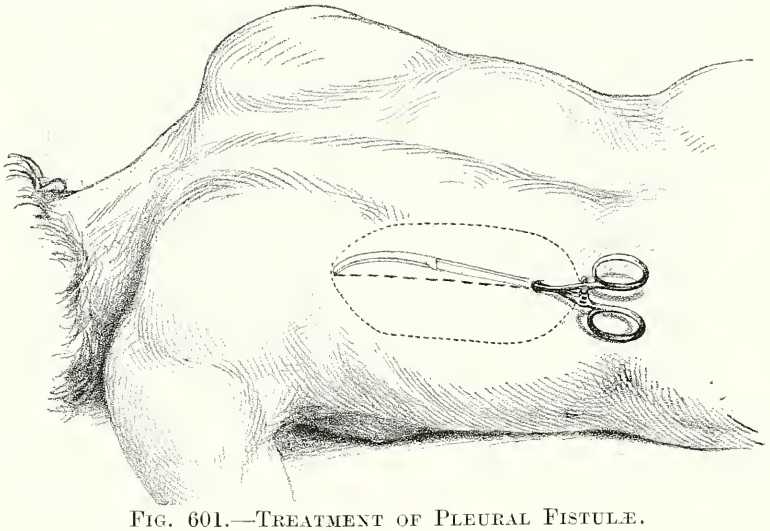


FIG. 601.—TREATMENT OF PLEURAL FISTULÆ.

First stage: A long curved forceps, introduced by the fistulous tract, explores the suppurating cavity in every direction. The dotted line indicates the apparent limits of the focus. In the middle of the enclosed space is seen the tracing of the rectilinear cutaneous incision.

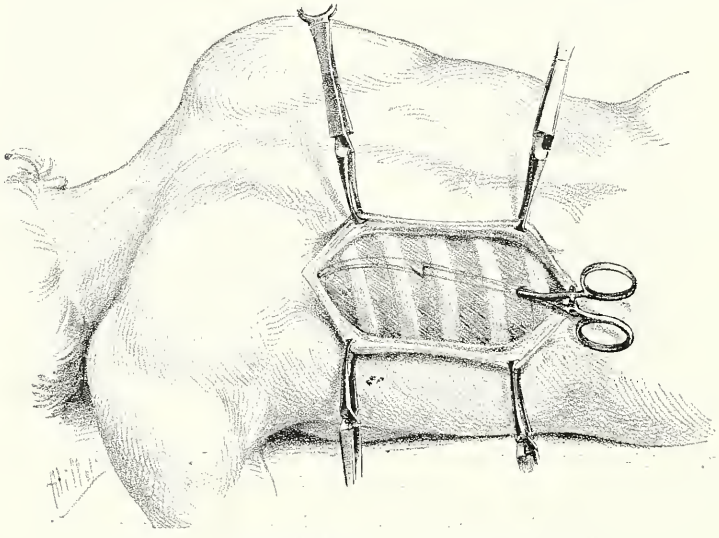


FIG. 602.—TREATMENT OF PLEURAL FISTULÆ.

Second stage: The four hooked forceps expose the extent of the thoracic grill sufficient to carry out the necessary thoracectomy.

tamponing of the fistulous cavity, which should be followed up in all its anfractuosities.

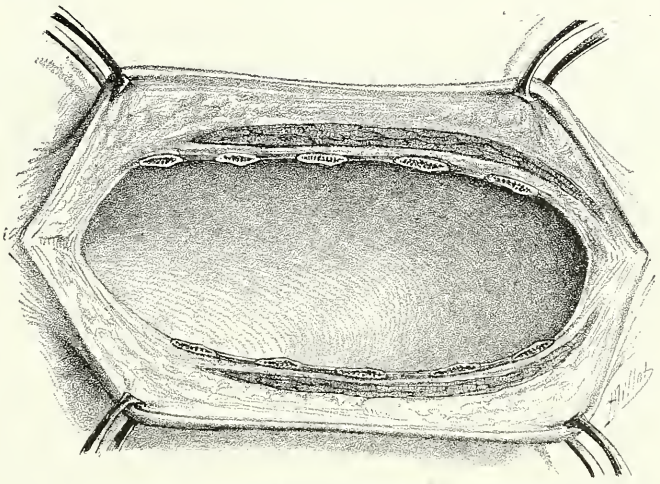


FIG. 603.—TREATMENT OF PLEURAL FISTULÆ.

Second and third stages: It suffices for exposure of the extent of the costal wall corresponding to the purulent focus to retract the lips of the rectilinear cutaneous incision forcibly with hooked forceps. Resection of ribs and exposure of cavity.

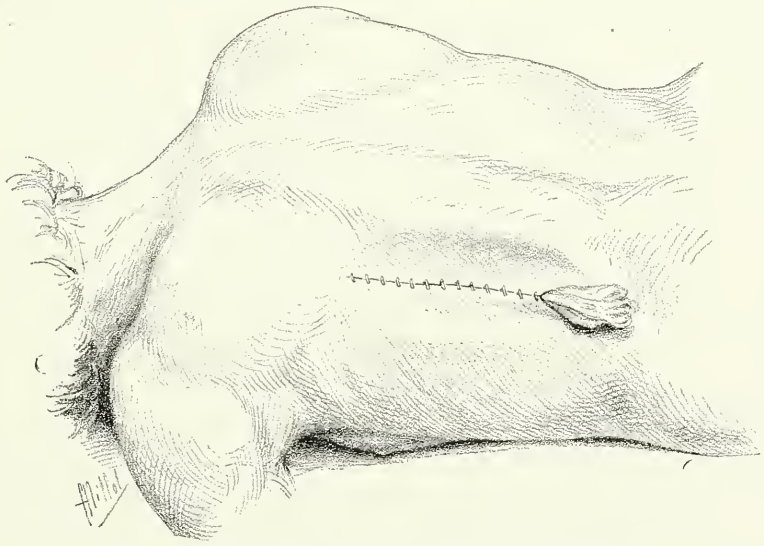


FIG. 604.—TREATMENT OF PLEURAL FISTULÆ.

Sixth stage: After costal resection, suture of skin and aseptic tamponing.

Operation—FIRST STAGE.—Curvilinear incision forming an oval tracing around the opening of the fistula, when such exists. In this case the wall is resected.

Second Stage.—Laying bare the costal grill, which is easily effected by simply drawing the two lips of the cutaneous incision upwards, and then downwards respectively.

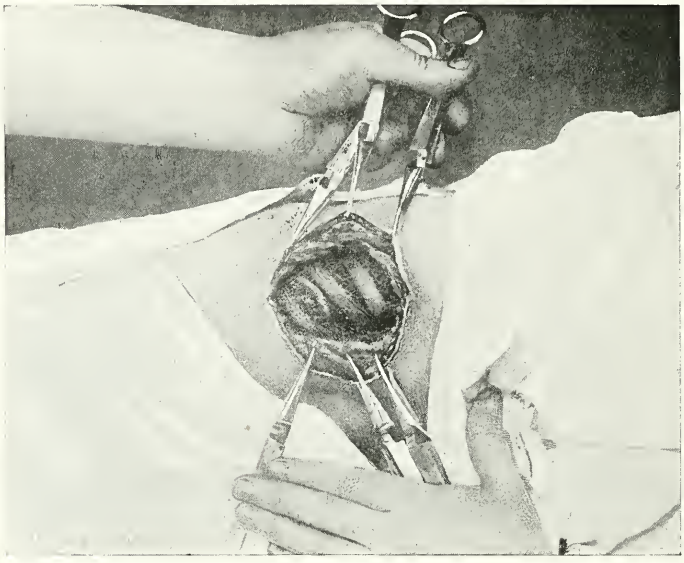


Fig. 605.—Treatment of Pleural Fistula by Doyen's Method.
First stage: After rectilinear incision, exposure of the costal grill.

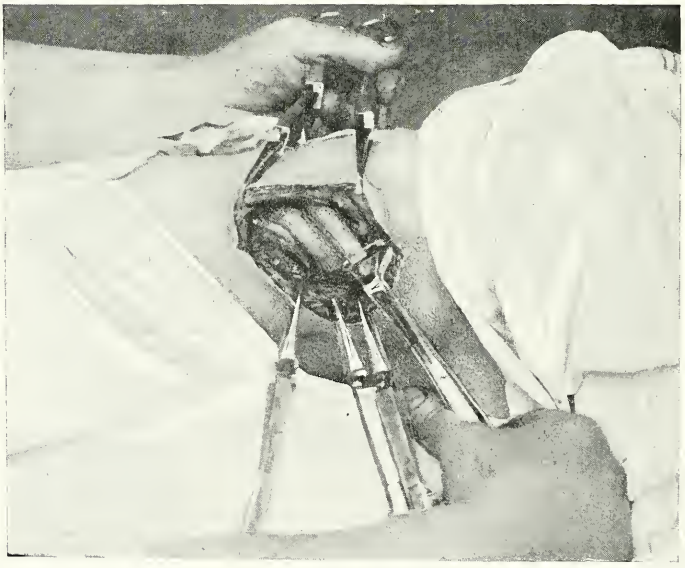


Fig. 606.—Treatment of Pleural Fistula by Doyen's Method.
Second stage: Section action of the costotome raspatory. Section of the outer extremity of the upper rib.

Third Stage.—Denudation of the inferior rib with the costotome raspatory, resection of that rib, and so on with all the ribs corresponding to the wall of the suppurating focus.

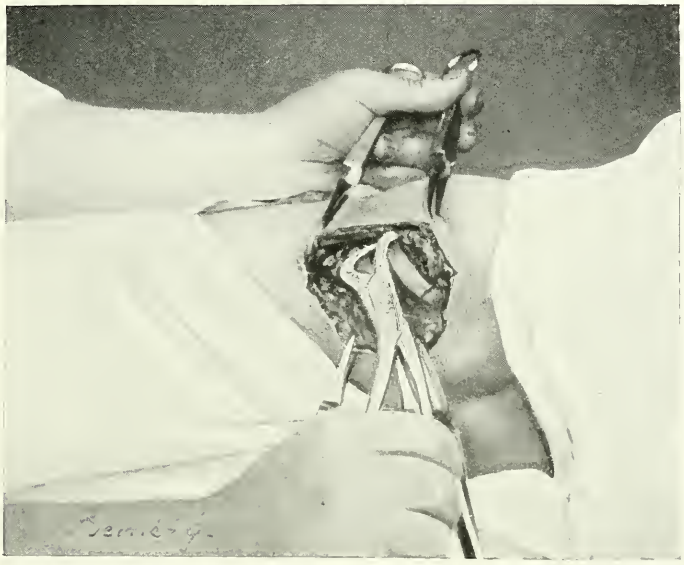


Fig. 607.—Treatment of Pleural Fistula by Doyen's Method.

Second stage: Section action of the costotome raspatory. Section of the inner extremity of the upper rib.

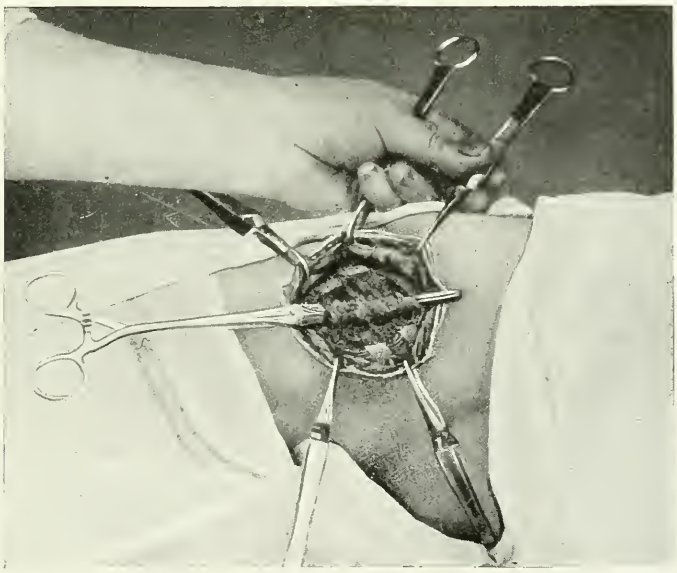


Fig. 608.—Treatment of Pleural Fistula by Doyen's Method.

Third stage: Exploration of the cavity with a curved forceps, which was introduced into the fistulous tract and has been made to perforate its superior extremity.

Fourth Stage.—Cruciform incision or, better, resection of the whole of that portion of the intercostal wall which is left floating by the removal of the ribs; then hæmostasis of the bleeding arteries.

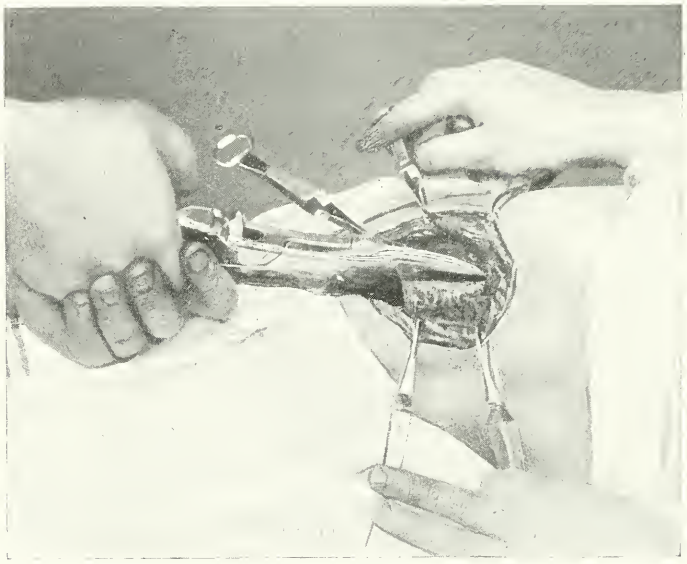


Fig. 609.—Treatment of Pleural Fistula by Doyen's Method.

Fourth stage: Crushing the external wall of the suppurating cavity with Doyen's angiotribe.

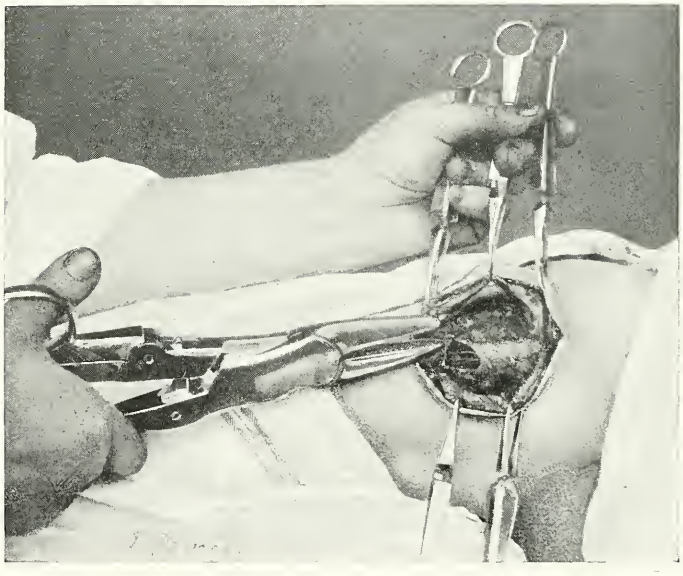


Fig. 610.—Treatment of Pleural Fistula by Doyen's Method.

Fourth stage: Effect of the angiotribe. The crushing, which is repeated on the inner and outer sides, permits resection of the external wall without hæmorrhage.

Fifth Stage.—Exploration, curettage, and toilet of the focus, the anfractuous prolongations of which are laid open by divulsion with long curved forceps or with blunt-pointed scissors.

Sixth Stage.—Aseptic tamponing.

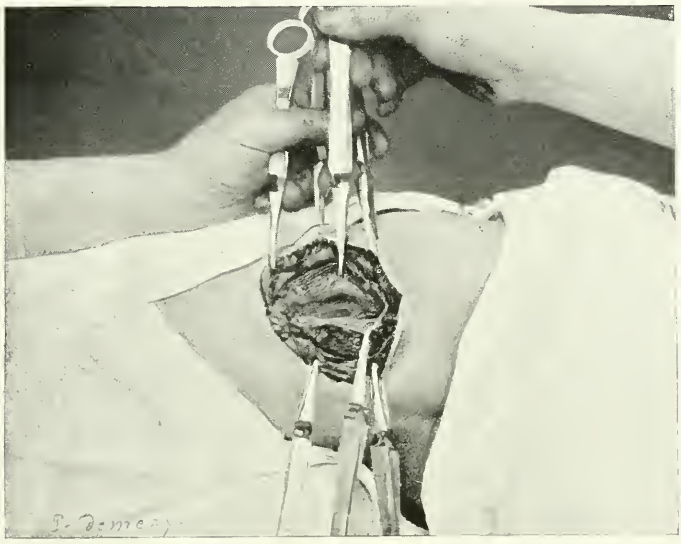


Fig. 611.—Treatment of Pleural Fistula by Doyen's Method.

Fifth stage: Laying open the suppurating cavity.

Encysted Purulent Pleurisy.

Encysted pleurisies, which are most frequently interlobar, may be difficult to localize; but it rarely happens that percussion fails to indicate a dull horizontal zone of two or three fingers' breadth, over which auscultation gives, or has given, positive results.

Anatomical Relations of Interlobar Pleurisy.

In order to fix definitely on the mind of the surgeon the anatomical relations of interlobar pleurisies, I conceived the idea of making vertical antero-posterior sections of human bodies fixed in position and hardened in formol along the right and left mammillary lines. The relations of the interlobar fissures are shown in Figs. 612 and 613. We here see on the right side (Fig. 612) how purulent collections formed in the anterior extremity of the horizontal interlobe may be reached by an incision involving the fourth intercostal space in the mammillary line. If the purulent collection is found in the posterior segment of the fissure, the fifth space should be perforated on the inner side of the scapula. On the left (Fig. 613) it will be necessary to resect the sixth rib in front in order to reach the interlobe opposite the mammillary line, and the fourth rib behind. It will be noticed

in Fig. 614 that interlobar pleurisies developed in the right oblique fissure should be invaded on the anterior axillary line, in a horizontal plane passing through the seventh or eighth rib. The same is the case with the left side.

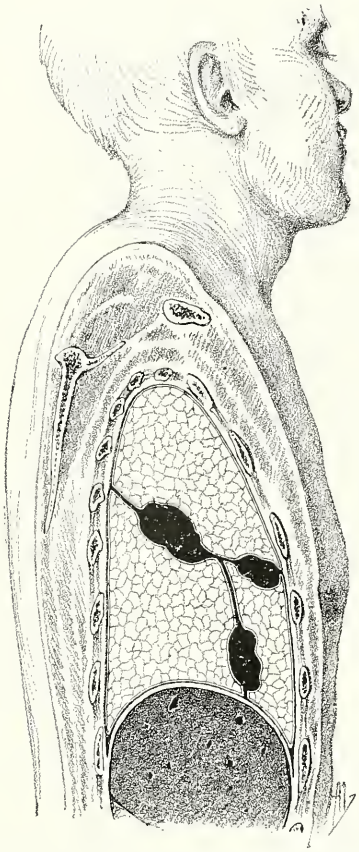


FIG. 612.—ANTERO-POSTERIOR SECTION PASSING THROUGH THE RIGHT MAMMILLARY LINE.

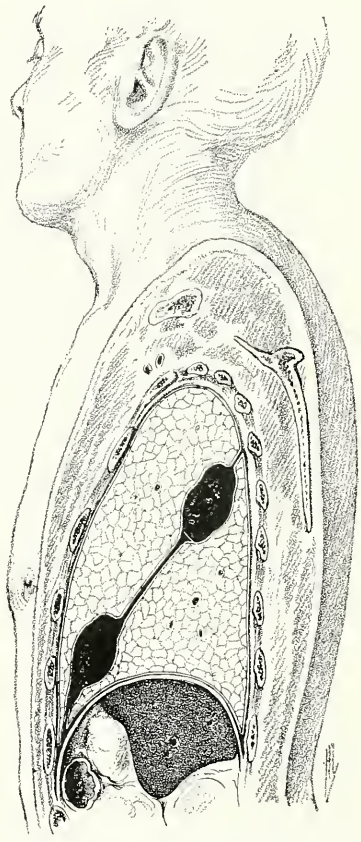


FIG. 613.—ANTERO-POSTERIOR SECTION PASSING THROUGH THE LEFT MAMMILLARY LINE.

Anatomical Relations of the Diaphragmatic Pleura.

The phrenic serous membrane is in relation with the convex aspect of the liver, from before backwards opposite the mammillary line (Fig. 612). On the left side it is related, from before backwards, with the transversed colon, the bulging end of the stomach, and the postero-superior surface of the spleen (Fig. 613).

Interlobar Purulent Pleurisies of the Right Side.

The purulent collections may point either in front or behind; frequently several purulent collections are found encysted in wreath-like arrangement.

Fig. 612 shows that resection of 6 or 7 centimetres of the anterior extremities of the third and fourth ribs exposes the anterior extremity of the middle

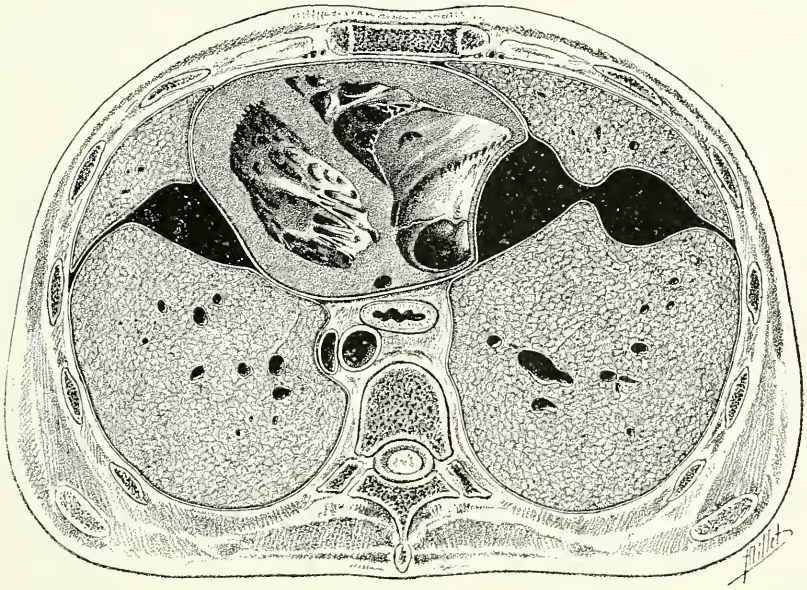


Fig. 614.—Horizontal Section of Thorax passing through the Upper Part of the Ninth Dorsal Vertebra.

On the left side is a juxta-pericardial interlobar empyema; on the right, an interlobar empyema *en bissac* compressing the auricle.

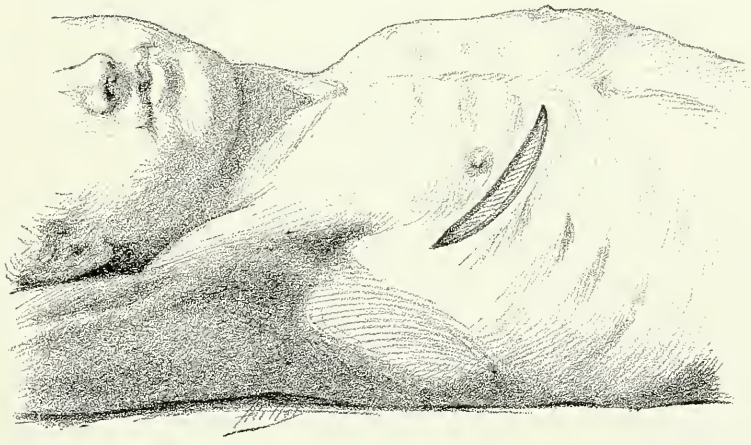


Fig. 615.—Right Interlobar Purulent Pleurisy.

Horizontal inframammary incision.

lobe of the right lung, and permits exploration of the superior and inferior interlobar spaces at the same time. It rarely happens that an exploratory

puncture made at this point by the hand of an expert fails to drop into a full purulent focus. The cutaneous incision is made over the intercostal

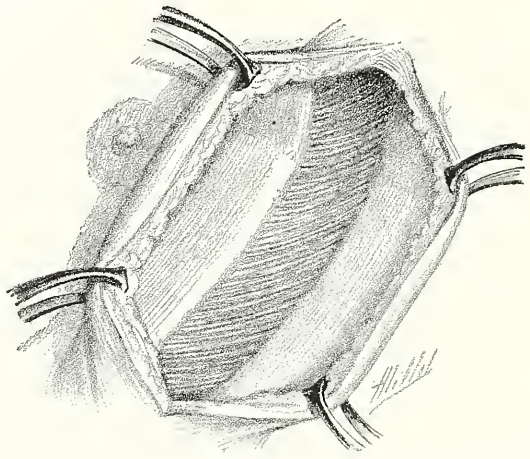


FIG. 616.—RIGHT INTERLOBAR PURULENT PLEURISY.

Retraction of both lips of the wound exposes the third and fourth ribs.

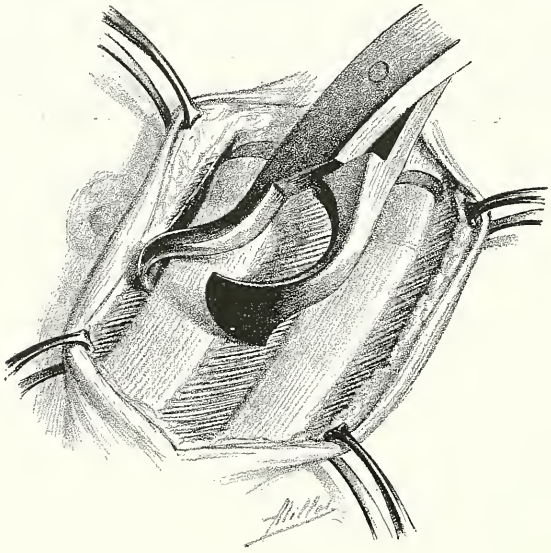


FIG. 617.—RIGHT INTERLOBAR PURULENT PLEURISY.

After division of the costal cartilages, the costotome raspatory decollates the upper border of the third rib.

space, through which the needle was passed, and a blunt-pointed scissors is then made to penetrate in the same direction, and enlarge the orifice by

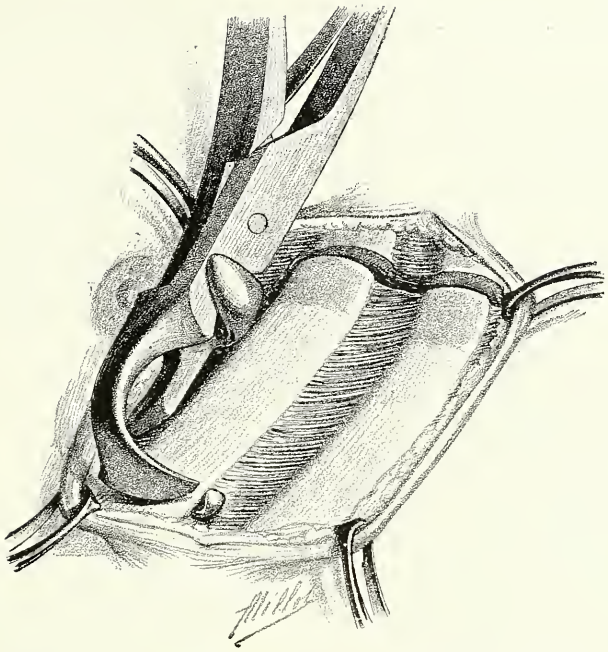


Fig. 618.—Right Interlobar Purulent Pleurisy.

External section of the third rib. We can see the beak of the raspatory, which has perforated the intercostal space.

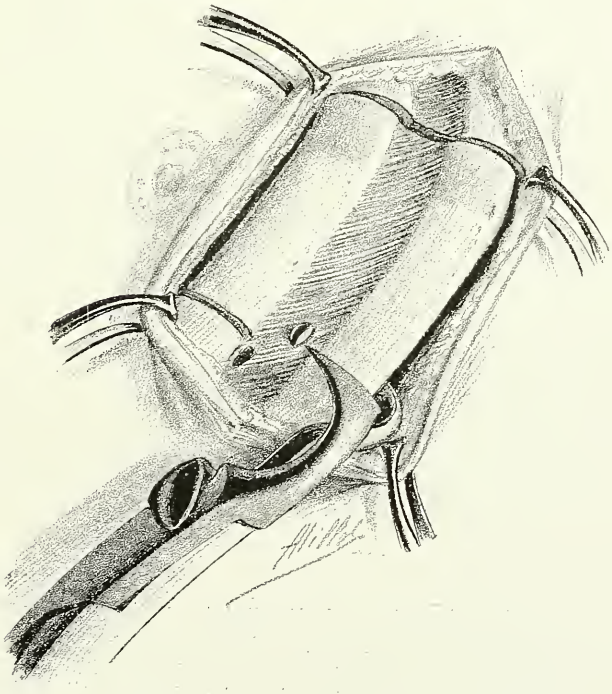


Fig. 619.—Right Interlobar Purulent Pleurisy.

After decollation of the lower border of the fourth rib, section of its external extremity is effected.

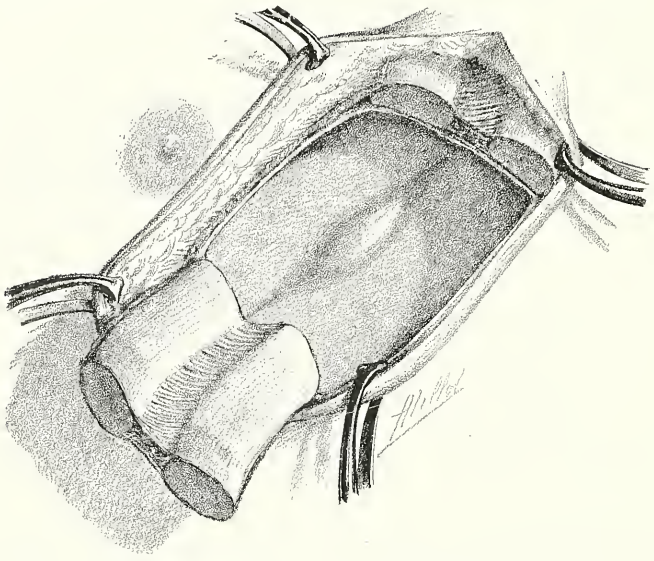


FIG. 620.—RIGHT INTERLOBAR PURULENT PLEURISY.

This osteoplastic shutter is perfectly irrigated by the intact bloodvessels of the third intercostal space. A purulent collection is noticeable, which bulges at the level of the horizontal fissure.

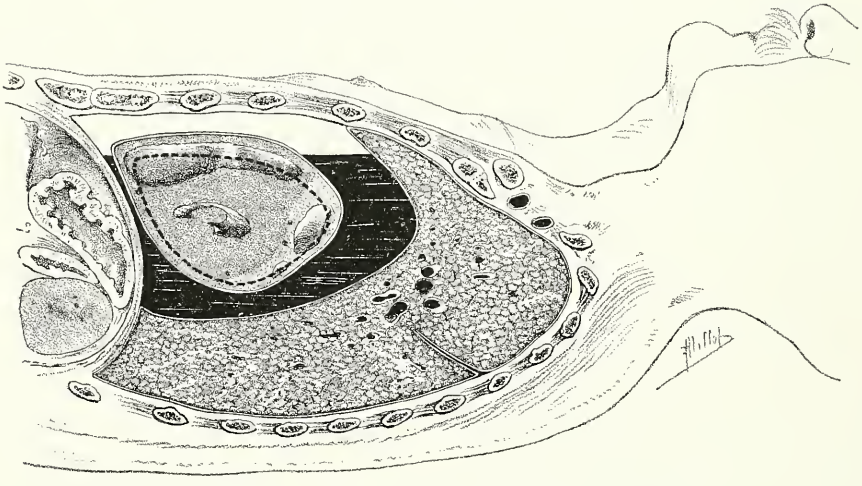


FIG. 621.—LEFT PARASTERNAL SAGITTAL SECTION.

Patient in position of dorsal decubitus. The heart during diastole bulges above the surface of the fluid, which it propels violently against the walls of the cavity at the moment of systole. We can then hear a typical *bruit de clapotement.*

fourth rib, so as to recognize the parietal pulmonary adhesions and search for the encysted purulent collection, with the help of the digital touch. The posterior extremity of the two interlobar spaces may be exposed by resection, near the outer side of the costo-transverse articulation, or a segment of 6 to 7 centimetres of the third and fourth ribs respectively. I

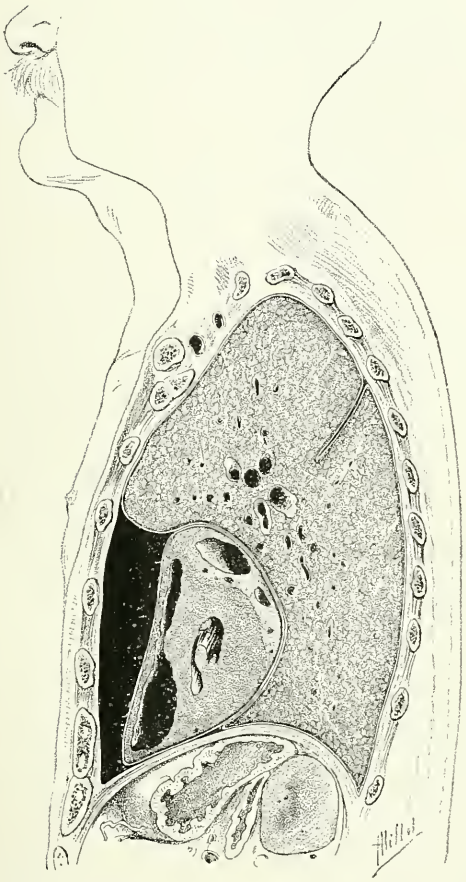


FIG. 622.—LEFT PARASTERNAL SAGITTAL SECTION.

Compression of right ventricle by an empyema of the anterior extremity of the left pulmonary interlobe.

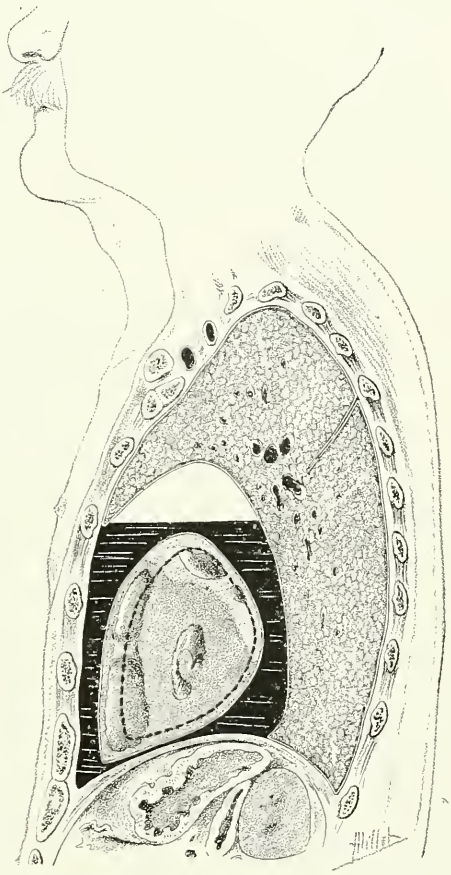


FIG. 623.—LEFT PARASTERNAL SAGITTAL SECTION.

Showing a pyo-pneumothorax of left side, in which the splashing sound could be elicited only when the patient was placed in the position of dorsal decubitus. The dotted line indicates the outline volume of the heart in systole.

have seen a case in which the purulent collection, by bulging against the wall of the right auricle (Fig. 614), had produced very grave symptoms of cardiac compression. These disappeared after surigcal intervention. A puncture nearly always enables us to recognize the focus; if not, we explore the posterior extremities of the two interlobar fissures, or the adhesions will lead us to the encysted foci.

Left Interlobar Purulent Pleurisy.

On the left side the interlobar fissure corresponds in front to the fifth rib. On account of the position of the pericardium, the incision should commence on the vertical nipple-line. The fifth rib should be resected for an extent of about 6 centimetres, after which the procedure should be similar to that above described. Behind, the interlobar interval corresponds to the vertebral extremity of the fourth rib, which must be resected as indicated in cases of right posterior interlobar pleurisy.

In a case of left pyo-pneumothorax, I have heard very distinct splashing when the patient was lying down (Fig. 621). The cardiac contraction produced the projection of the fluid against the chest wall. When the patient stood up, the splashing disappeared (Fig. 622).

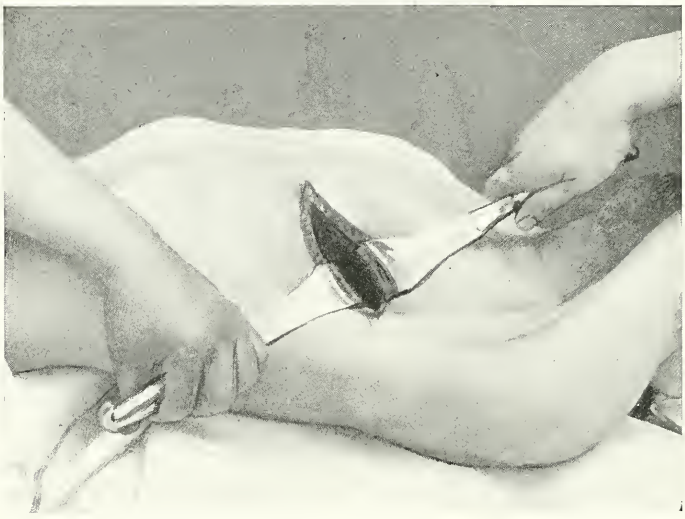


Fig. 624.—Left Interlobar Pleurisy.

Resection of fourth and fifth ribs. Aspect of the wound after toilet of the focus.

I have recently had occasion to operate on a young man of twenty-four years who presented grave symptoms of pericarditis; but I was, in fact, dealing with a case of encysted empyema of the anterior extremity of the left pulmonary interlobar space. Compression of the right ventricle (Fig. 623) had been the cause of the grave cardiac accidents, which disappeared at once after the operation.

Purulent Diaphragmatic Pleurisies.

Encysted pleurisy of the costo-phrenic sinus may be a primary lesion. It is sometimes secondary to a subphrenic suppuration. Incision of such a

focus on the right side had conducted to a posterior diaphragmatic fistula, and thence into a focus of suppurative renal lithiasis. Nephrectomy was carried out at the same séance. A subphrenic focus may also lead into a focus of hepatic suppuration on the point of opening into the bronchial tubes. In a case of pleura-pulmonary fistula of very old standing, I have found the pleural cavity covered with a cretaceous lining of a demi-centimetre in thickness, and which it took several months to eliminate.

The inferior interlobar fissure and the costo-phrenic sinus are easily explored on either side, after resection of 6 to 7 centimetres of the anterior extremities of the fifth and sixth ribs. The incision extends from the scapular line to the anterior axillary line. Retraction with hooked forceps exposes the seventh, eighth, and ninth ribs. It is easy to prepare a

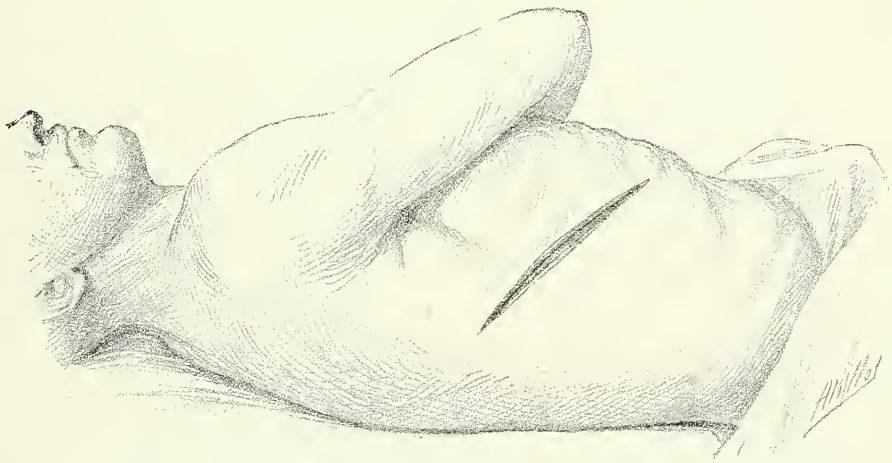


Fig. 625.—Extensive Thoracotomy to facilitate Intervention in the Supra- and Sub-Diaphragmatic Regions.

First stage: Cutaneous incision of 10 centimetres parallel to eighth rib. The middle of this incision corresponds to the vertical mid-axillary line.

thoracic shutter with an external hinge. The subdiaphragmatic region then becomes easily accessible. On raising the lung covered with the thickened diaphragmatic pleura, the whole of the supradiaphragmatic region can be explored as far as the mediastinum. When the purulent collection is subdiaphragmatic, this mode of access is still the method of election. It then suffices to incise the diaphragm and introduce a long curved forceps through the wound, which is made to break down the wall of the abscess. The lips of the wound are separated by my method of divulsion. The cavity is then drained through the transthoracic route by the method of aseptic tamponing. This method of approach is very useful in the treatment of pulmonary fistula consecutive to purulent hepatic collections. It is very easy to explore the diaphragmatic surface of the lung and to suture or extirpate the pulmonary fistulous tract.

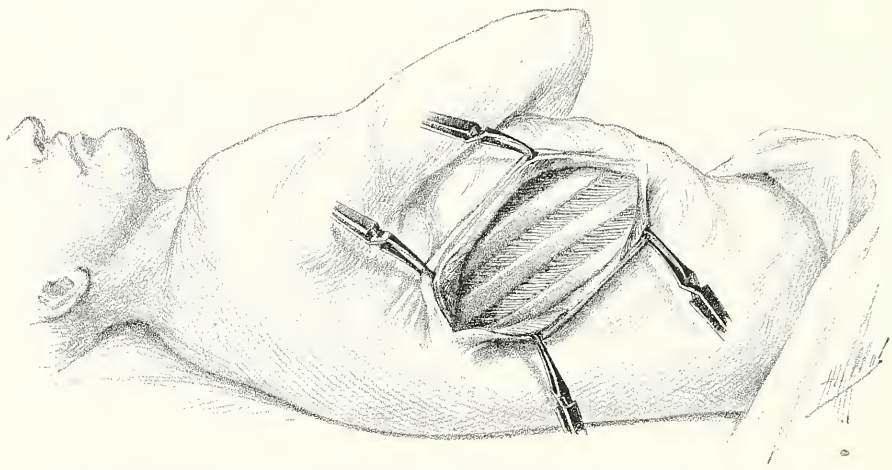


FIG. 626.—EXTENSIVE THORACOTOMY TO FACILITATE INTERVENTION IN THE SUPRA- AND SUB-DIAPHRAGMATIC REGIONS.

By making strong traction on both lips of the cutaneous wound, the seventh, eighth and ninth ribs are readily exposed.

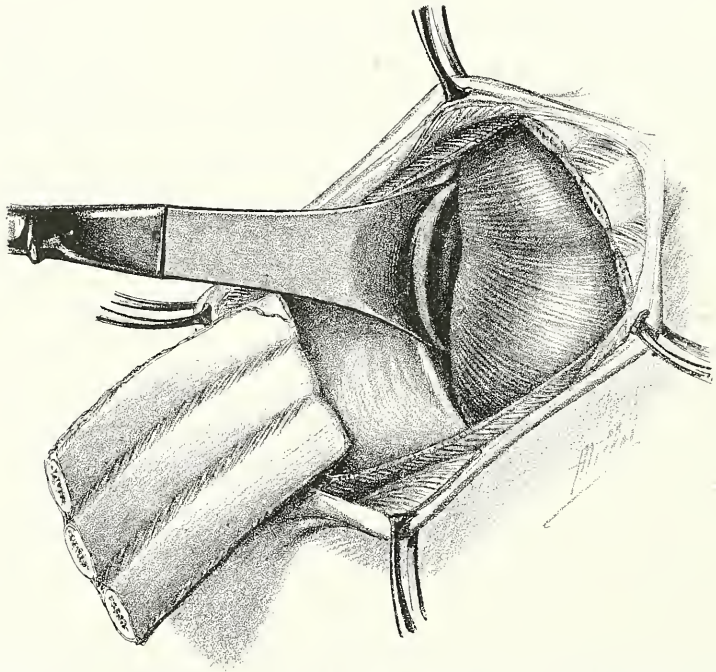


FIG. 627.—EXTENSIVE THORACOTOMY TO FACILITATE INTERVENTION IN THE SUPRA- AND SUB-DIAPHRAGMATIC REGIONS.

The costal shutter has been formed with the help of the costotome raspatory, and opened to the outside. The pleura has been incised. A metallic valve folds back the lung and exposes the supradiaphragmatic region. Suture of a wound of the diaphragm could easily be carried out in this position; it can also be readily incised for the purpose of giving exit to a subphrenic purulent collection.

FIG. 628.—DIAPHRAGMATIC PLEURISY.

Intervention is required for the suppression of the suppurating cavity.

FIG. 629.—DIAPHRAGMATIC PLEURISY.

Action of Doyen's raspatory for pleuricostal resection.

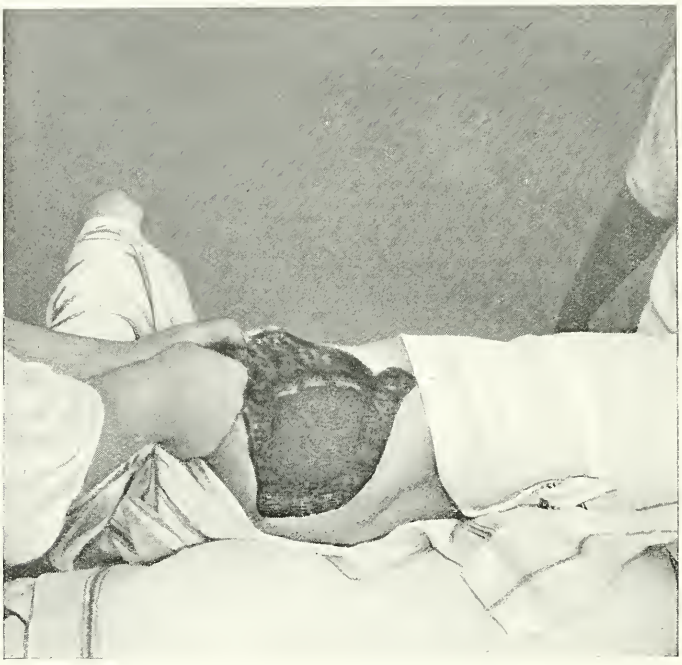


FIG. 630.—DIAPHRAGMATIC PLEURISY.
After the costal resection, the cutaneous flap is about to be replaced.

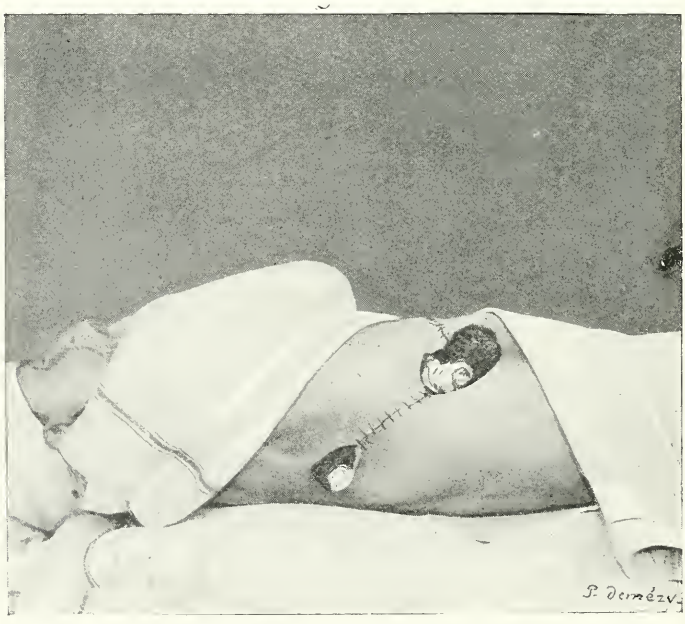


FIG. 631.—DIAPHRAGMATIC PLEURISY.
Suture of skin; aseptic tamponing.

Tumours of the Thoracic Wall.

These tumours are sometimes enchondromata, but in most cases sarcomata, especially in case of children. When the tumour has originated on the thoracic wall, or in case of a subcutaneous growth that has perforated, the great risk of the operation is a free opening of the pleura. I have carried out extensive resection of the thoracic wall successfully on some cases of sarcoma in which no pleuro-pulmonary adhesions were present, and without using either the pneumatic chamber or the casket for pulmonary hyperpressure, thanks to the following technique:

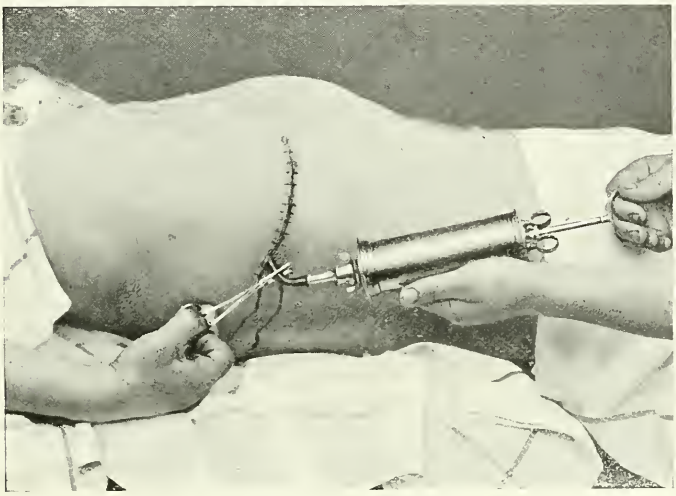


Fig. 632.—Resection of a Tumour of the Thoracic Wall.
Aspiration of air from the pleural cavity after cutaneous suture.

Operation—First Stage.—Exposure of the tumour up to its outermost limits and denudation of the ribs which have to be resected.

Second Stage.—Rapid resection of the segment of the thoracic wall; thanks to the use of the costotome raspatory. It has happened, especially in case of an infant, that the sudden entrance of air into the pleural cavity, particularly on the left side, was followed by immediate syncope. For such cases I have devised the following artifice: The cutaneous wound was immediately closed with clawed forceps, beneath which were then applied two long curved forceps with elastic jaws. Artificial respiration was immediately established, while an assistant aspirated the air from the pleural cavity with a flexible tube and (for want of a vacuum cylinder) a large syringe.

Third Stage.—When the respiratory rhythm had been re-established, I united the lips of the wound with points of interrupted suture, leaving in at the posterior extremity of the incision a large india-rubber tube closed with a continuous-pressure forceps, which I have used several times daily for aspiration of the fluids from the pleural cavity.

OPERATIONS ON THE LUNG.

The surgery of the lung requires on the part of the surgeon an unequalled manual dexterity, together with great presence of mind. The sole means of not risking the death of the patient "under the knife" is to know how to terminate the operation in a few moments.

Surgery of the lung is indicated—

1. In wounds of the lung.
2. In hydatid cysts.
3. In abscess of the lung, and in localized bronchiectasis.

Imperfectly localized lesions, such as pulmonary gangrene, bronchiectasis, or tuberculous cavities, may be invaded surgically, but with much less chance of success. The operation is almost without serious danger when the lesion is localized and wholly aseptic; as, for example, in case of non-suppurative hydatid cyst. The prognosis is much more grave in case of a suppurating lesion, and especially when we have to deal with gangrenous cavities or with multiple and fœtid bronchiectases. Tuberculous cavities can be profitably attacked only when they are well localized. Resection of a cancerous lung has hitherto given no lasting result.

Wounds of the Lung.

Wounds of the lung inflicted by stabbing or cutting instruments or by firearms, nearly always produce considerable hæmorrhage. It

FIG. 633.—WOUND OF LUNG BY CUTTING INSTRUMENT, WHICH ENTERED THE THIRD INTERCOSTAL SPACE IN THE PARASTERNAL LINE.

The requisite cutaneous incision reaches from the second to the fifth rib.

is necessary to intervene as early as possible when the wounded person presents the signs of internal hæmorrhage.

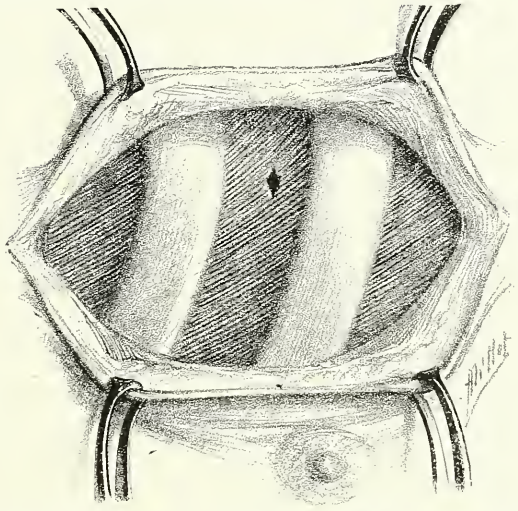


Fig. 634.—Wound of Lung by a Cutting Instrument, which entered the Third Intercostal Space in the Parasternal Line.

The hooked forceps retract the skin sufficiently to permit the formation of a thoracic shutter.

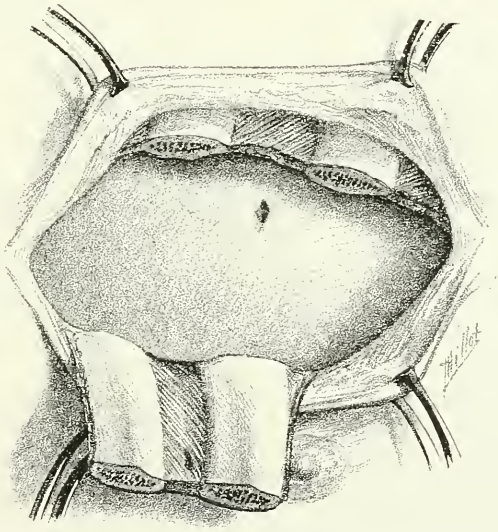


Fig. 635.—Wound of Lung by a Cutting Instrument, which entered the Third Intercostal Space in the Parasternal Line.

The thoracic shutter, which is hinged externally, has been thrown back. The wound of the parietal pleura is clearly seen.

Operation—First Stage.—Incision of 8 to 10 centimetres over the wounded intercostal space.

Second Stage.—Denudation of the rib above and below the wound, respectively; these ribs are then resected for a length of 5 to 6 centimetres.

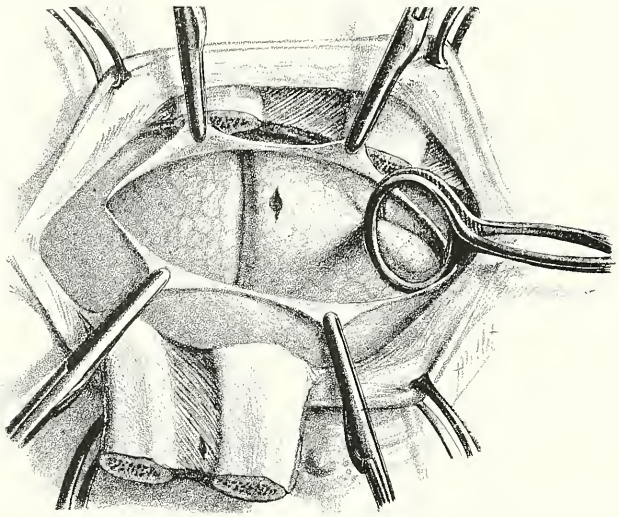


Fig. 636.—Wound of Lung by a Cutting Instrument, which entered the Third Intercostal Space in the Parasternal Line.

The parietal pleura has been divided, and the wound of the lung is seen near the horizontal fissure. An oval-jawed forceps is used to exteriorize the middle lobe of the lung.

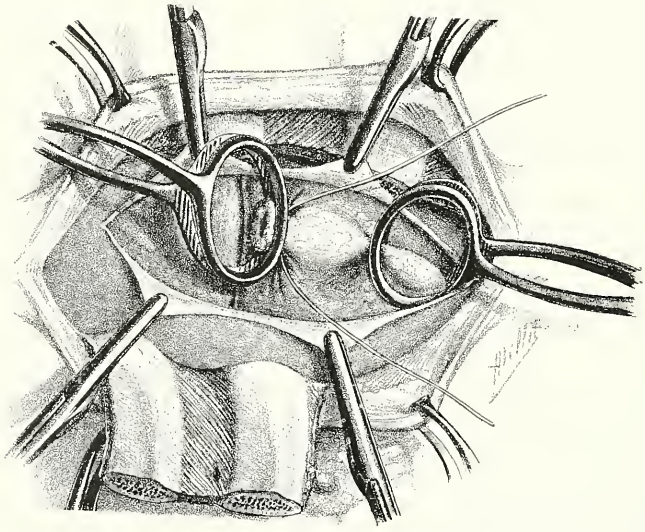


Fig. 637.—Wound of Lung by a Cutting Instrument, which entered the Third Intercostal Space in the Parasternal Line.

The wounded pulmonary tissues have been grasped *en masse* with oval-jawed forceps. It is easy to ligature the pedicle thus formed, instead of invaginating the small wound with a purse-string suture.

Third Stage.—Wide opening of the pleural cavity by divulsion. It is rare to have to tie an intercostal artery; the blood contained in the

pleura is then evacuated. The lung often presents itself between the lips of the wound. If this does not happen, it is seized with a ring-handled forceps and drawn out through the wound. The lips of the wound are also grasped with a ring-handled forceps, and a catgut ligature is applied *en masse*. If there be hæmorrhage from an important vessel, this is tied after enlarging the pulmonary wound by divulsion ; a continuous suture is then applied. In some cases the hæmorrhage can be arrested by passing a catgut ligature into the depth of the wound and then tying it externally.

The wound may be a perforating one; this peculiarity is the rule in wounds with hard-nosed bullets which traverse the thorax from one side to the other. In such cases the posterior pulmonary wound can be treated like the anterior. The drawing of the lung out through the wound requires, in some cases, enlargement of the cutaneous incision, and a supplementary costal resection.

Fourth Stage.—Suture of the wound. Aspiration by vacuum in order to prevent evolution of a purulent pleurisy.

Hydatid Cysts of the Lung.

We should suspect the presence of hydatid cyst of the lung when a patient who is still fairly young presents symptoms of chronic pleurisy

Fig. 638.—Wound of the Pulmonary Parenchyma.

When the wound is of small extent, a purse-string suture suffices. Result of the suture.

without inflammatory developments. I have often made that diagnosis without puncture from the history of the slowly progressive course of the affection, and determination of the presence of a thin pulmonary stratum at the level of the focus of deep-seated dulness.

Operation—First Stage.—Curvilinear cutaneous incision following the course of the fifth or sixth rib.

Second Stage.—Exposure and resection of two or three neighbouring ribs, for a length of 6 to 8 centimetres.

Third Stage.—Opening of the pleura and exposure of the lung.

Fourth Stage.—Puncture of the cyst. Evacuation of the contents and suture of the wall of the cavity to the lips of the cutaneous wound.

Fifth Stage.—Tamponing and flat dressing.

The operation lasts scarcely eight to ten minutes. In a case of voluminous hydatid cyst of the lung, there are no symptoms of suffocation at the moment of opening the pleura, for the cyst bulges through the opening made by the incision.

Abscess of the Lung—Localized Bronchiectasis.

Abscess of the lung is seen as a sequel of some forms of infective pneumonia. I have also operated in many cases of localized bronchiectasis.

Radioscopic and radiographic exploration should be carefully carried out. I have always determined for myself the localization of the lesion by percussion and auscultation, and taken care to verify the diagnosis under chloroform. Operation should be carried out as quickly as possible, for the patient may present an appearance of apparent death as soon as the pleura is opened; when this accident is produced the respiratory rhythm is re-established only after tamponing the wound. My operations have always been very rapidly performed, and I have never seen a case of grave suffocation.

Operation—First Stage.—Parietal incision of 12 to 15 centimetres in length, along the course of the rib that overlies the pulmonary lesion. It may be necessary to keep the arm raised in order to draw up the inferior angle of the scapula.

Second Stage.—Exposure and resection of three or four ribs for a length of 10 to 12 centimetres, and resection of the intercostal wall. The lung may be found adherent, or it may retract within the wound.

1. *The lung is Adherent.* The surface is explored with the index-finger, and the lung is perforated with blunt-pointed scissors, which are passed into the cavity and then made to enlarge the orifice by divulsion. Exploration is then carried out with the index-finger, the septa, if such exist, are torn through, and the pleural cavity is tamponed.

2. *There are no parietal adhesions.* The hand is plunged into the thorax, recognizes the indurated portion of the lung, and draws it into the wound. The focus is perforated in the way above indicated; it is then tamponed, and the lung is rapidly sutured to the lips of the cutaneous wound.

In case of multiple bronchiectasis, the lung may be opened up with extensive snips of the scissors to a very considerable length in a few seconds, and we can then content ourselves with treating the wound so made by tamponing. I have never observed any alarming loss of blood result from this procedure. If some vessels bleed, large ring-handled forceps may be left in position, or ligatures may be applied. Copious lavages should be forbidden on account of the danger of passage of the fluid into the bronchi. We should be content with tamponing the cavity with compresses soaked in a 20 per cent. oxygenated water; sprayings with a corresponding solution can also be carried out.

Invasion of Tuberculous Cavities.

Surgical intervention is rarely indicated in a case of tuberculosis of the lung. Cases of tuberculous cavity complicated with pulmonary gangrene are beyond the resources of surgery. I have intervened in many of these cases, but the patients were unable to survive till the repair could be

completed. On the other hand, I have carried out with complete success a resection of the middle lobe of the right lung in a tuberculous case, in which

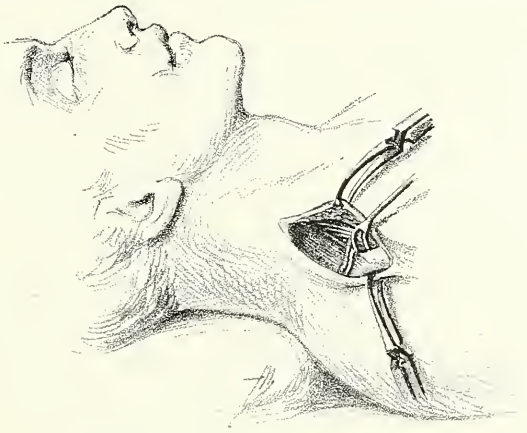


Fig. 639.—Invasion of the Pleural Cul-de-Sac at the Level of the First Intercostal Space.

General sketch.

I had been guided to the seat of the lesion by a tuberculous intercostal fistula. The cicatrization took place without any incidental complications.

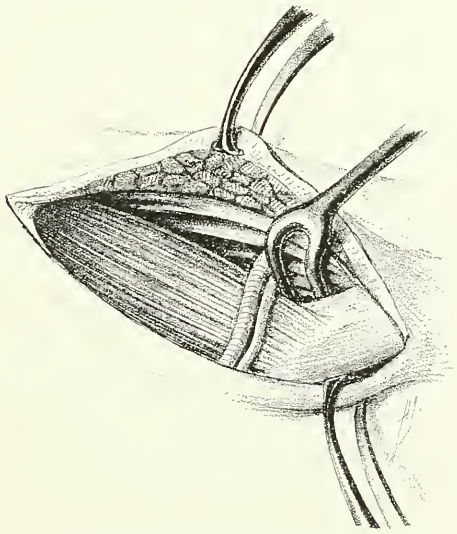


Fig. 640.—Invasion of the Pleural Cul-de-Sac at the Level of the First Intercostal Space.

Exposure of the anterior scalenus muscle at the level of the first rib. The posterior scapular artery and brachial plexus are drawn away with a retractor.

I was on the point of intervening, fifteen years ago, in a case of a vomica which was placed tangentially to the superior pleural *cul-de-sac* in a patient

who was in a grave condition, and whose general and local condition had been considerably ameliorated. There remained but a cavity in the right

FIG. 641.—INVASION OF THE PLEURAL CUL-DE-SAC AT THE LEVEL OF THE FIRST INTERCOSTAL SPACE.

Exposure of the pleural dome. General sketch.

apex, which yielded five or six sputa daily, rich in Koch's bacilli, and so superficially placed that the auscultatory focus was supraclavicular. The

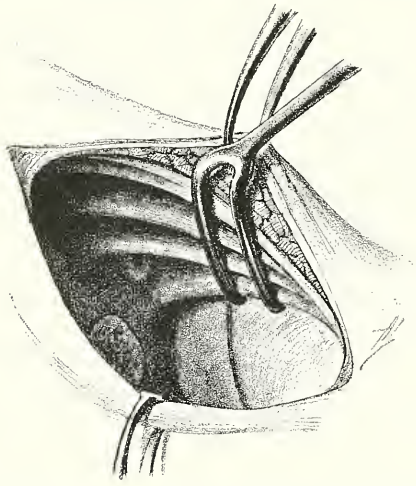


FIG. 642.—INVASION OF THE PLEURAL CUL-DE-SAC AT THE LEVEL OF THE FIRST INTERCOSTAL SPACE.

Resection of the scalenus muscle; a great part of the first rib has exposed the second rib, with the pleural dome in front.

general condition of the patient had improved progressively, and the operation was adjourned. The patient is now in perfect health.

The following is a description of the technique which I had proposed to myself to employ :

Operation—First Stage.—Vertical incision of 6 or 7 centimetres along the anterior border of the trapezius, and ending at the level of the clavicle.

Second Stage.—Exposure of first rib and insertion of anterior scalenus, which are crossed by the posterior scapular artery. The artery emerges on its inner side between the roots of the brachial plexus.

Third Stage.—Division of first rib 2 or 3 centimetres beneath the insertion of the anterior scalenus, taking care not to wound the subjacent radicle nerve trunk. Division of anterior scalenus and resection of first rib as low down as possible.

Fourth Stage.—Exposure of pleural *cul-de-sac* and second rib, by retracting the radicle trunks of the brachial plexus towards the inner side.

Fifth Stage.—Incision and toilet of the cavity. Tamponing of the wound.

Transpleural Invasion of the Liver.

Abscesses and hydatid cysts of the liver, which push up the diaphragm considerably, may open into the pleura or into the bronchi. The perforation of the diaphragm takes place at the level of the extraperitoneal portion

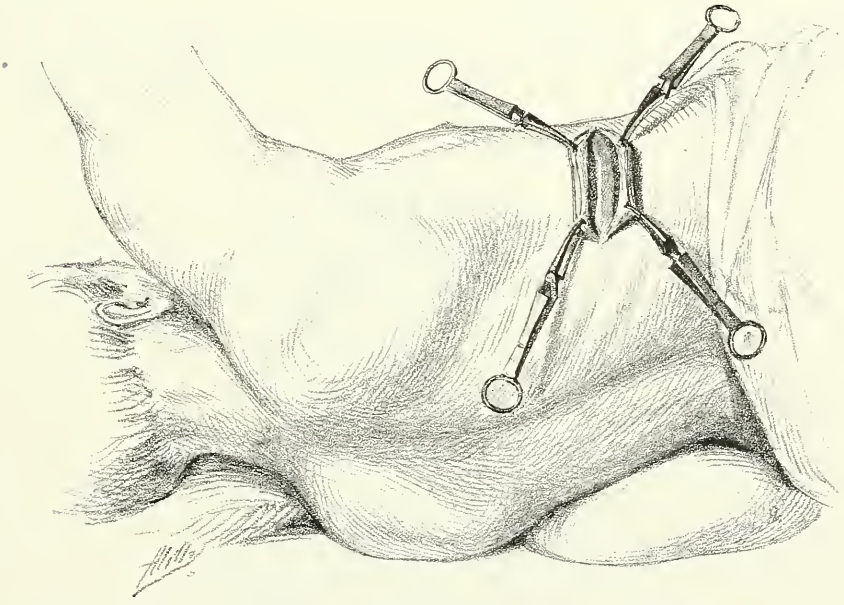


Fig. 643.—Transpleural Invasion of the Liver.

General sketch. First stage: Incision of 12 centimetres along the ninth rib at the mid-axillary plane.

of the superior surface of the liver. Diagnosis of the abscess or cyst is easily made with the help of radioscopy and radiography. I have seen many cases in which the diaphragm had been pushed up above the horizontal level of the nipples.

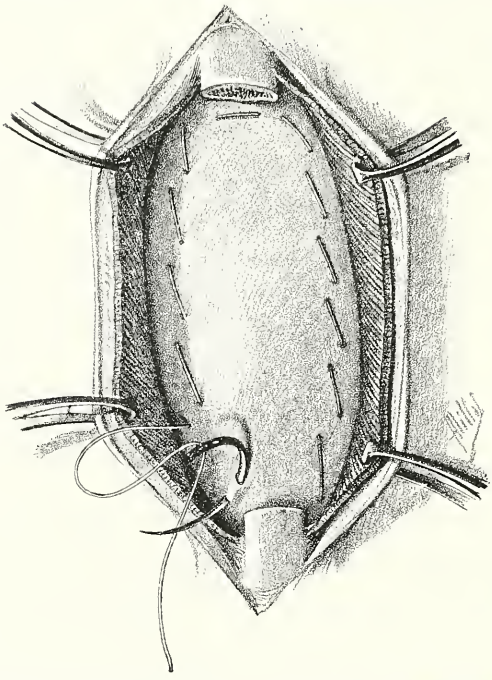


FIG. 644.—TRANSPLEURAL INVASION OF THE LIVER.

Third stage: Continued suture involving the parietal pleura, diaphragmatic pleura and diaphragm.

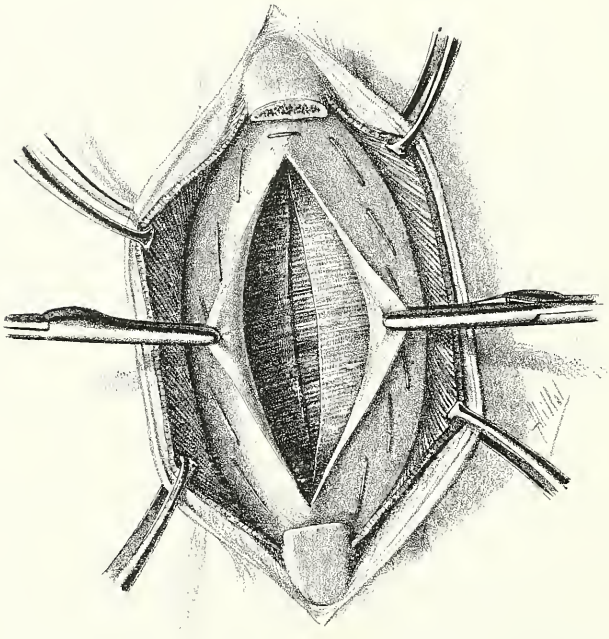


FIG. 645.—TRANSPLEURAL INVASION OF THE LIVER.

Third stage: We can then incise the parietal pleura without fear of provoking an operative pneumothorax. We then incise the diaphragmatic pleura and diaphragm.

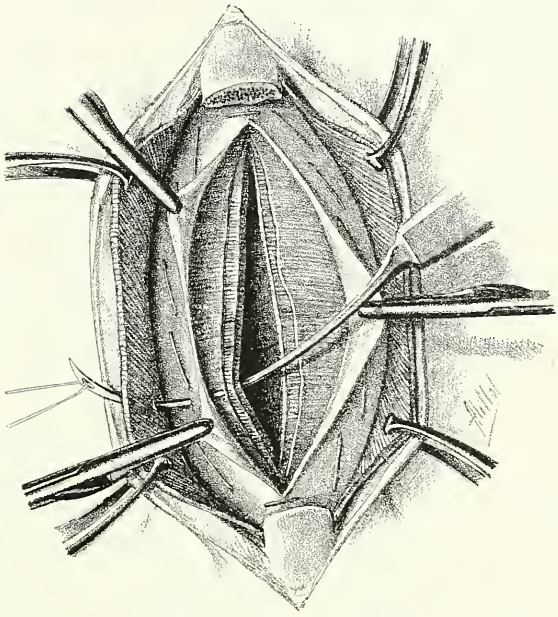


FIG. 646.—TRANSPLEURAL INVASION OF THE LIVER.

Fourth stage: We detach the diaphragmatic peritoneum with care, and then raise carefully in succession with a mounted needle from the deep to the superficial strata of the wound, the diaphragm, diaphragmatic pleura, parietal pleura, intercostal muscles, and latissimus dorsi.

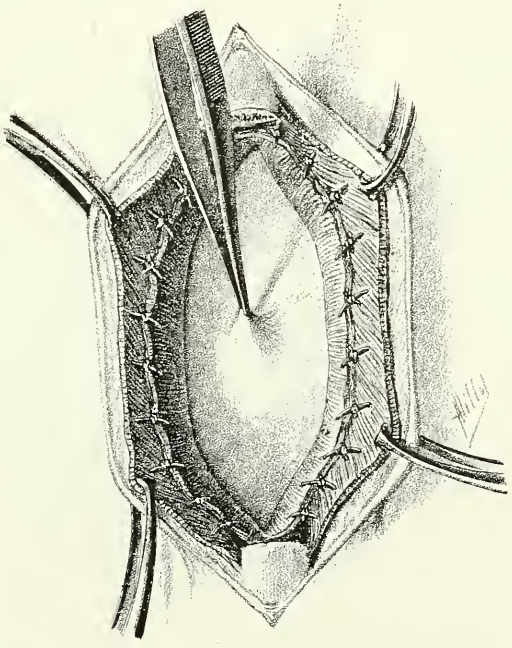


FIG. 647.—TRANSPLEURAL INVASION OF THE LIVER.

Fourth stage: We lift up the parietal peritoneum. There is no danger of infecting the pleural cavity if we have carefully inserted the points of interrupted suture which unite the diaphragm, the two pleural lamellæ, and the superficial muscles.

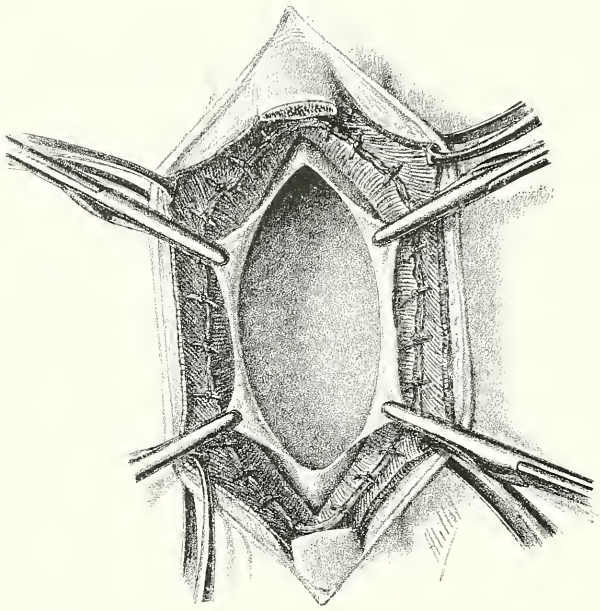


FIG. 648.—TRANSPLEURAL INVASION OF THE LIVER.

Fourth stage: The parietal peritoneum has been incised. The lips of the serous wound are grasped with four Champonnière's forceps.

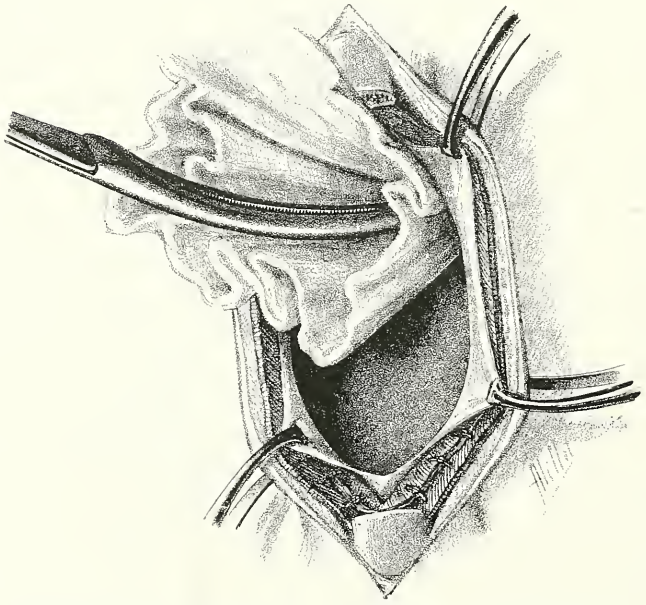


FIG. 649.—TRANSPLEURAL INVASION OF THE LIVER.

Fifth stage: A compress is introduced with a long forceps between the peritoneum and the liver.

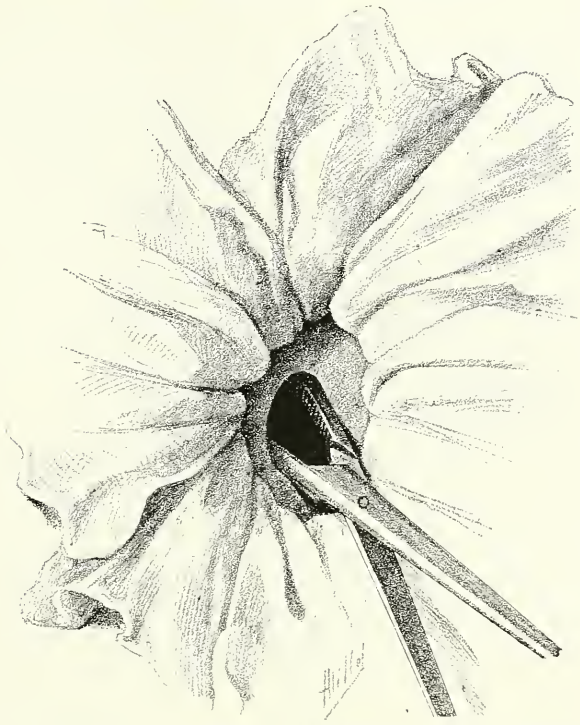


FIG. 650.—TRANSPLEURAL INVASION OF THE LIVER.

Fifth stage: The peritoneal cavity is protected with a corona of compresses. The purulent collection is penetrated with a long curved forceps, which is then made to enlarge the orifice of the exploratory puncture by divulsion.

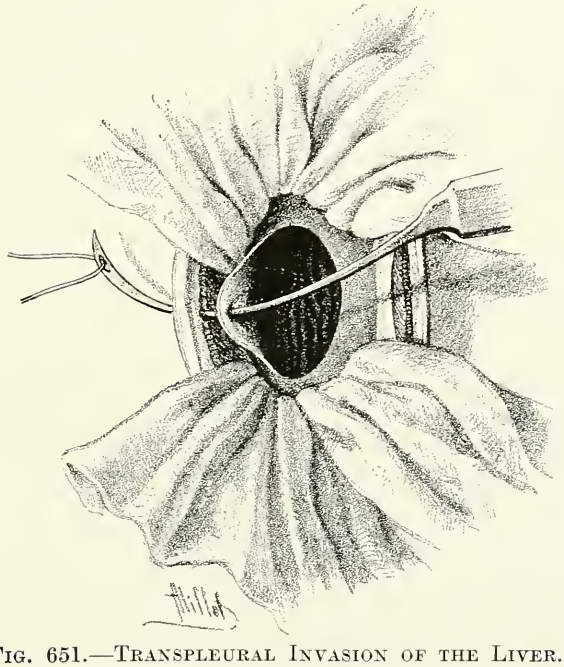


FIG. 651.—TRANSPLEURAL INVASION OF THE LIVER.

Sixth stage: Marsupialization of the sac, the margins of which are united by interrupted suture to the opening in the parietal peritoneum and that of the cutaneous wound.

If the cavity has already opened into the respiratory passages, radiography may give some indications for localizing the fistulous tract. In those cases in which there may be doubts regarding the subphrenic localization of

FIG. 652.—TRANSPLEURAL INVASION OF THE LIVER.

Seventh stage: Partial union of parietal wound with interrupted suture, and tamponing of the sac.

the pathological cavity, I have recognized by extremely exact auscultation during forced movements of inspiration and coughing a characteristic hepatic gurgling sound. All hepatic collections that project beneath the diaphragm should preferably be invaded from that side.

1. TRANSPLEURAL INVASION OF ENCYSTED HEPATIC COLLECTIONS.

Operation—FIRST STAGE: CUTANEOUS INCISION.—Incision of 12 centimetres, parallel to the ninth intercostal space, the median point of which corresponds to the intersection of the mid-axillary line.

SECOND STAGE: INCISION OF THE SOFT PARTS.—The cellular tissue is now incised, and then the muscles down to the bone, exposing the ninth and tenth ribs. The soft parts are then retracted with hooked forceps.

THIRD STAGE: COSTAL RESECTION AND CLOSURE OF PLEURAL CAVITY.—Resection of ninth rib only, or of both ninth and tenth, with the costotome raspatory. The pleura is usually opened, for we take no care to preserve it. Air does not penetrate into the pleural cavity, as the diaphragmatic pleura is kept closely applied to the parietal by the subphrenic hypertension. The two pleural leaflets are united by a circular suture, which also involves the diaphragm (Fig. 647).

Fourth Stage: Incision of the Diaphragm and Peritoneum.—The diaphragm is immediately incised, and sutured to the superior and inferior margins of the wound, so as to insure the more perfect closure of the pleural cavity. The peritoneum is exposed. We rarely find any adhesions between the convex aspect of the liver and the inferior surface of the diaphragm. The peritoneum is now incised.

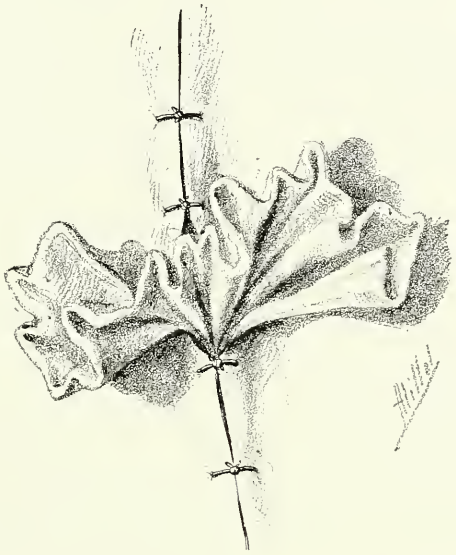


Fig. 653.—Transpleural Invasion of the Liver.

Seventh stage: The suture has been completed. One intrahepatic plug has been left in the wound, and two juxta-hepatic.

Fifth Stage: Exploration and Exposure of the Sac.—Care must be taken before puncturing the liver to protect the peritoneal cavity with compresses introduced between the liver and diaphragm, which are held in position with a hooked forceps. The surface of the liver is now examined with the fingers and we perceive a special sensation—of exaggerated tension, fluctuation, or abnormal depressibility. At this special point we penetrate the substance of the liver with a long curved, slender forceps. In some cases the cystic cavity is placed at a considerable depth. In every instance the instrument, on approaching the sac, encounters a layer of resisting sclerosed tissue. Then a slight effort suffices to effect penetration of the focus, and the pus or hydatid fluid immediately appears on the outside. The patient is then turned towards that side, and the orifice is enlarged by divulsion. When sufficient precaution is taken, not a drop of the fluid passes into the peritoneal cavity. When dealing with a hydatid cyst, we must proceed to search with a ring-handled forceps in the depths of the sac for any remaining portion of the vesicles of the principal cavity. When the sac has been completely evacuated, it is filled with long plugs of sterilized gauze; the toilet of the field of operation is then made, and the peritoneal compresses

are replaced with others introduced less deeply, and the presence of which will provoke the formation of adhesions around the wound.

Sixth Stage: Marsupialization of the Suppurating Cavity.—The margins of the hepatic wound are now fixed to the circumference of the parietal incision with several points of suture.

Seventh Stage: Tamponing of the Sac and Partial Reunion of the Extremities of the Cutaneous Wound.—Tamponing of the hepatic cavity is now carried out, after which the extremities of the cutaneous wound, above and below, are partially united. At the end of three or four days the hepatic plugs are removed, and the peritoneal ones after a further interval of several days. The cavity is treated by tamponing only, and no lavage is resorted to till after the tenth day. Supervision of the process of repair is carried out by examination of the cavity with the help of the light of one of the small electric lamps used in bronchoscopy or laryngoscopy.

Complications of Operation.—The gravity of operation is much more serious in a case where the hepatic collection has opened into the bronchial tubes. In such cases the sac contains fœtid pus, and it is almost impossible to prevent the development of a purulent pleurisy. Whenever a fall of temperature does not take place after the intervention, we should suspect the presence of another purulent collection. A long curved forceps must be cautiously introduced into the cavity already opened, and made to explore its walls with great care; it may then happen that the experience of a special sensation comes to reveal the presence and location of a neighbouring sac.

2. Transpleural Invasion of Hepatico-Pulmonary Fistulæ.

Operation—First Stage.—Cutaneous incision as in the procedure above described.

Second Stage.—Denudation of the eighth, ninth, and tenth ribs.

Third Stage.—Resection of the eighth, ninth, and tenth ribs, in such a way as to establish a wide opening into the pleural cavity. Retraction of the lung is not to be feared, as there are necessarily extensive parietal and diaphragmatic adhesions.

Fourth Stage.—Search for the pulmonary fistula. This will surely be found by following the convexity of the diaphragm. It is generally located near the junction of the right and middle leaflets of the central cordiform tendon. The pulmonary adhesion being detached, the pulmonary fistula is provisionally closed by grasping with a large curved forceps.

Fifth Stage.—The phreno-hepatic fistula is expanded by divulsion, in such a way as to avoid opening the peritoneum, and the toilet of the cavity is carried out. The diaphragm is then incised outside the fistula, so as to permit the formation of a wide opening into the substance of the liver. If the peritoneum is opened at the moment of carrying out this procedure, compresses are placed between the diaphragm and liver before enlarging the hepatic wound.

Sixth Stage.—The pulmonary orifice is then sutured, before which it is often necessary to resect the margins. In certain cases it is possible to suture the circumference of the opening of the pulmonary fistula to the parietal pleura at the level of the superior border of the incision. The field of operation is treated by tamponing.

Seventh Stage.—We may endeavour, in a case in which the lung has remained sufficiently pliant, to carry out the complete suture of the skin and then provoke complete expansion of the lung, and its adherence to the parietal pleura, by making a vacuum in the pleural cavity with the aid of the aspirator.

OPERATIONS ON THE MEDIASTINUM.

The mediastinum includes the interpulmonary region. It is easy to see on examination of a series of horizontal sections of the thorax that the surgical invasion of the organs contained in the mediastinum can be rationally undertaken only through the anterior route.

I will here arrange the operations on the mediastinum in three categories:

1. Operations on the superior stage, which is attacked by resection of the manubrium.

2. Operations on the intermediate stage, which require the formation of a sterno-chondral shutter. This stage begins at the level of the first intercostal space, and is limited below by the bi-mammillary line.

3. Operations on the inferior stage—that is to say, on the pericardium, heart, and the subbronchial portion of the œsophagus.

1. Invasion of the Superior Stage.

This intervention enables us to reach the vestiges of the thymus gland, dermoid cysts of the mediastinum, and all retro-sternal cellulo-glandular tissue, both the innominate venous trunks and the superior vena cava, the thoracic portions of the innominate, common carotid, and left subclavian arteries, the thoracic portion of the trachea, and, beneath the trunk of the left innominate vein, the sternal angle of the arch of the aorta.

Suprasternal Route.

I performed this operation twenty years ago at the residence of the patient, with Dr. Verut of Charly. The tumour displayed, at every movement of deglutition, the ascent which characterizes all thyroid growths, and its pressure caused the development of symptomatic asthma. It seemed to be a retro-sternal goitre. The operation was carried out with the following technique.

Operation—First Stage.—Vertical cutaneous incision on the right of the trachea, carried downwards and outwards towards the clavicle, as in ligature of the brachio-cephalic trunk.

Second Stage.—Division of the sternal head of the sterno-mastoid muscle, and exploration of the upper portion of the mediastinum, where the index-finger encountered a doughy non-pulsatile tumour, the superior pole of which was exposed with the help of a retractor.

Third Stage.—Exploratory puncture of the tumour with a Pravaz syringe. A little sebaceous matter escaped from the small orifice.

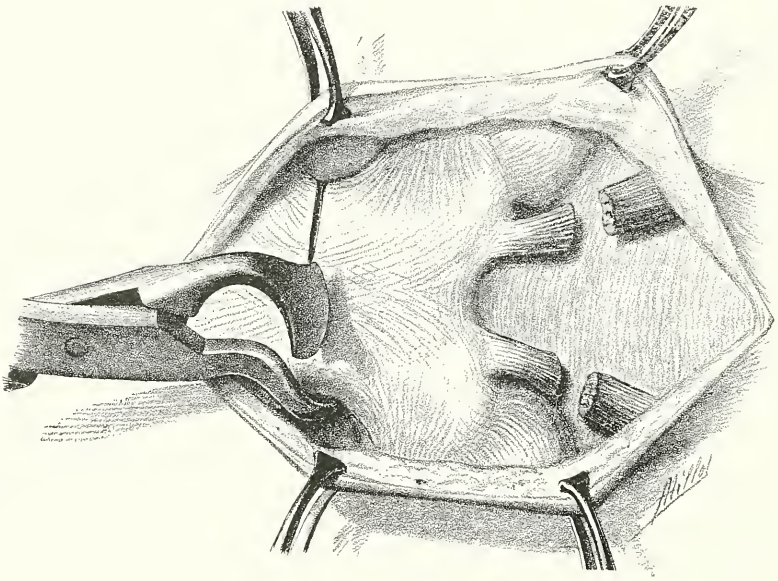


Fig. 654.—Extirpation of Manubrium.

The sternal heads of both sterno-mastoid muscles have been divided. Division of constricted part of manubrium at the level of the first intercostal space.

Fourth Stage.—The diagnosis of a dermoid cyst having now been assured, the capsule is seized with clawed forceps, and drawn upwards; then incised, evacuated, and sutured to the margins of the cutaneous incision. Recovery took place after prolonged suppuration of the cavity. The cicatrization would readily have been hastened by resection of the manubrium, followed by extirpation of the wall of the cyst. The patient would never consent to this.

Trans-Sternal Route.

Operation—First Stage: Cutaneous Incision.—A vertical incision of 8 or 10 centimetres in length is made along the middle third of the sternum.

Second Stage: Division of the Soft Parts.—The right and left lips of the wound are respectively retracted with hooked forceps, and the surface of the sternum is laid bare with a raspatory. The sternal heads of the sterno-mastoid muscles are then divided.

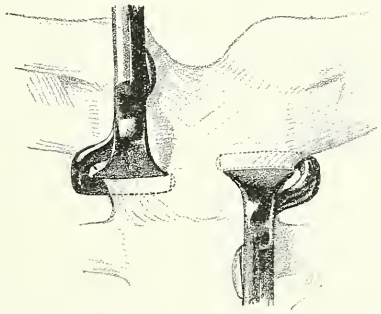


Fig. 655.—Manubrium too wide for Division by the Two Lateral Applications of the Costotome Raspatory.

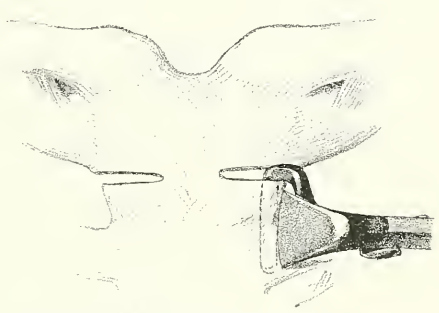


Fig. 656.—Manubrium too wide for Division by the Two Lateral Applications of the Costotome Raspatory.

Mode of introducing the costotome raspatory for the third section.

Third Stage: Extirpation of Manubrium.—The section of the constricted portion of the manubrium opposite the first intercostal space can be carried out either with an ordinary bone forceps or with a craniectomy chisel and mallet, or with the costotome raspatory as represented in Fig. 654. When

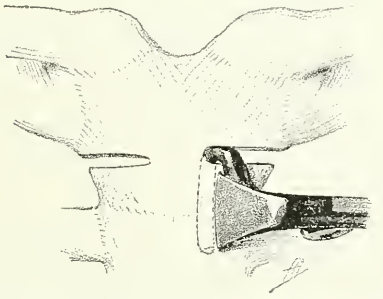


Fig. 657.—Manubrium too wide for Division by the Two Lateral Applications of the Costotome Raspatory.

The costotome raspatory has been pressed to the extremity of the loss of substance produced by the second section.

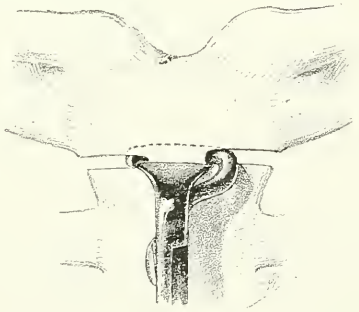


Fig. 658.—Manubrium too wide for Division by the Two Lateral Applications of the Costotome Raspatory.

The costotome raspatory has been rotated through 90°, and now proceeds to complete the division of the manubrium.

the pedicle of the manubrium is unusually wide, an osseous bridge is still left after the first two sections (Fig. 655), which must be divided by a third application of the costotome. The instrument is introduced into the fissure already

made in the left side of the sternum, as illustrated in Fig. 656, and the section is thus completed in the series of stages represented in Figs. 657, 658.

Figs. 659, 660 illustrate the division of the first right costal cartilage. There now remains but the division of the cartilage of the first rib of the left side. The manubrium is then definitively extirpated.

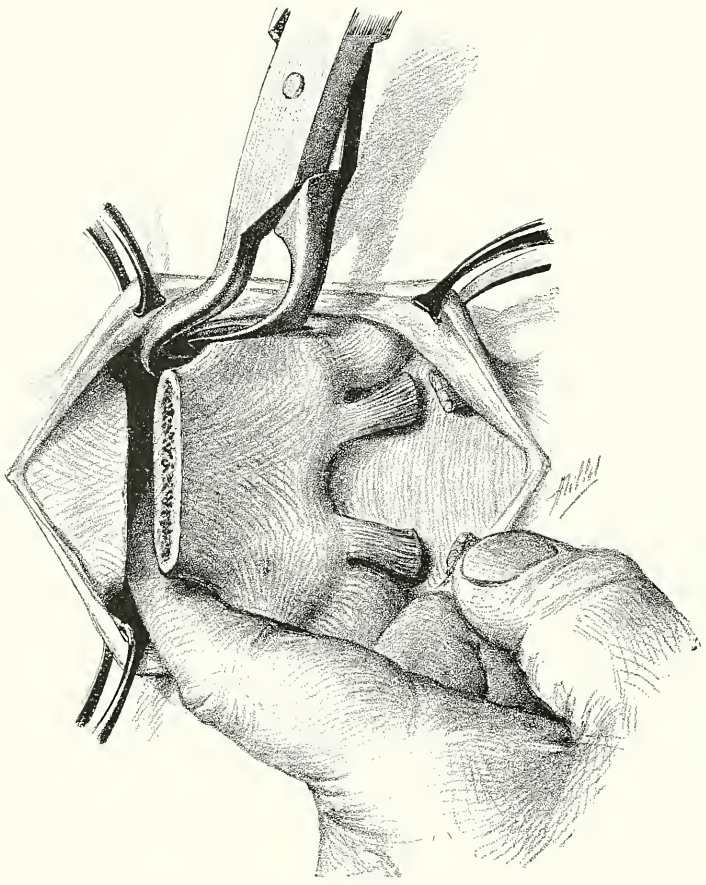


Fig. 659.—Manubrium too wide for Division by the Two Lateral Applications of the Costotome Raspatory.

The transverse section of the sternum has been carried. Division of the first chondro-sternal articulation.

Fourth Stage.—The retro-sternal cellulo-glandular tissue is fully exposed. It is at this level that tumours of the aberrant thyroid glandules are found to develop—especially of the aortic glandule; also tumours of the thymus glands and dermoid cysts of the mediastinum. On completing the extirpation of all the subjacent cellulo-adipose tissue, and the resection of the cervico-pericardial aponeurosis, we discover in the bottom of the wound, from above downwards; the thoracic portion of the trachea, the brachio-cephalic arterial trunk, the respective origins of the common carotid and

subclavian arteries of the left side, both innominate venous trunks and the superior vena cava surrounded with a number of large lymphatic glands, and invested below by the upper end of the pericardium, the sternal flexure of the arch of the aorta. By this route we can secure access to the aneurisms of the great arterial trunks, with the object of carrying out my method of incomplete ligature on the proximal side of the sac.

If we then retract, as represented in Fig. 663, the brachio-cephalic trunk and trachea on one side, and the left common carotid and subclavian arteries on the other, the thoracic portions of the œsophagus and the left pneumogastric nerve are exposed.

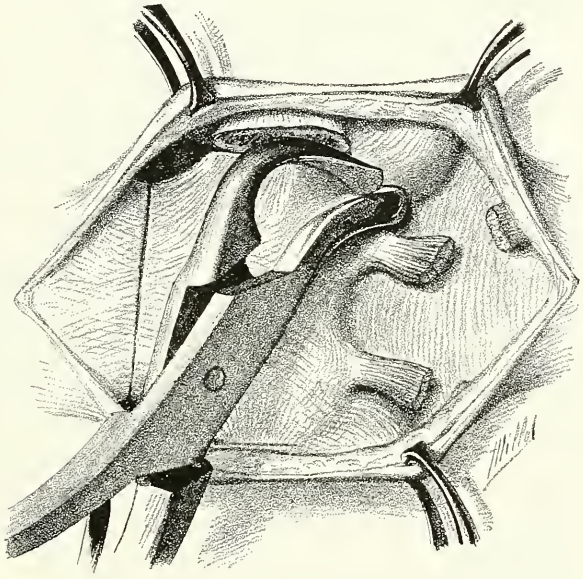


Fig. 660.—Manubrium too wide for Division by the Two Lateral Applications of the Costotome Raspatory.

Division of the right sterno-clavicular articulation.

Fifth Stage.—Partial suture of the skin, tamponing of the wound. Here the procedure of resection of the manubrium sterni deserves some minutes' attention. This operation may be either temporary or definitive. When intended to be temporary, it suffices to divide the sternum transversely at the lower limit of the manubrium, and the cartilages of the first ribs vertically, on their respective sides. The sterno-clavicular articulations are left intact as they serve for hinges. We can thus raise the manubrium from below upwards, while dislocating the sterno-clavicular articulations. By this manœuvre we secure access to the upper portion of the mediastinum.

I consider, however, that definitive resection of the manubrium is to be preferred to temporary, as it gives much more light and facilitates all manœuvres in the depths of the space.

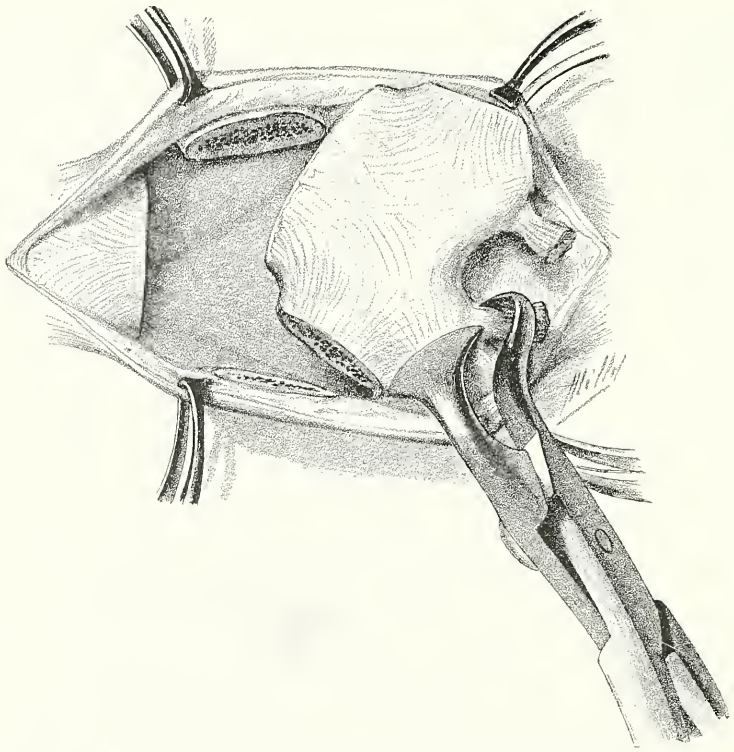


FIG. 661.—MANUBRIUM TOO WIDE FOR DIVISION BY THE TWO LATERAL APPLICATIONS OF THE COSTOTOME RASPATORY.

Division of left sterno-clavicular articulation and luxation of the manubrium sterni, which is now held in place by some ligaments only.

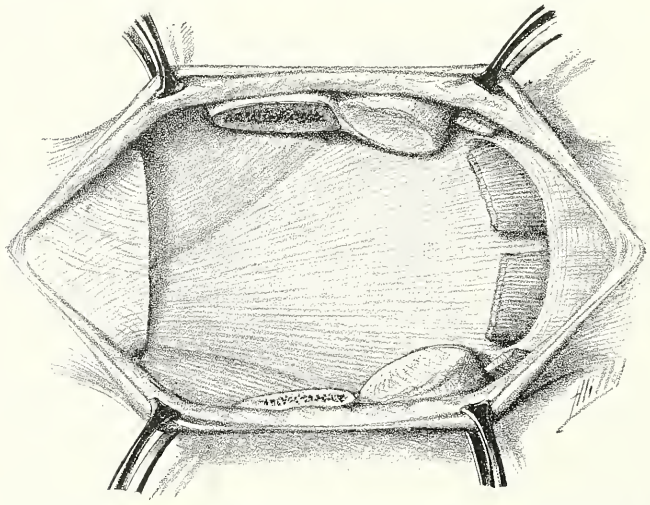


FIG. 662.—ANATOMY OF THE SUPERIOR STAGE OF THE ANTERIOR MEDIASTINUM.

First plane: Above, the sterno-thyroid muscles; in the intermediate space, the cervico-pericardial aponeurosis; on the right, the anterior margin of the right lung; on the left, the anterior margin of the left lung.

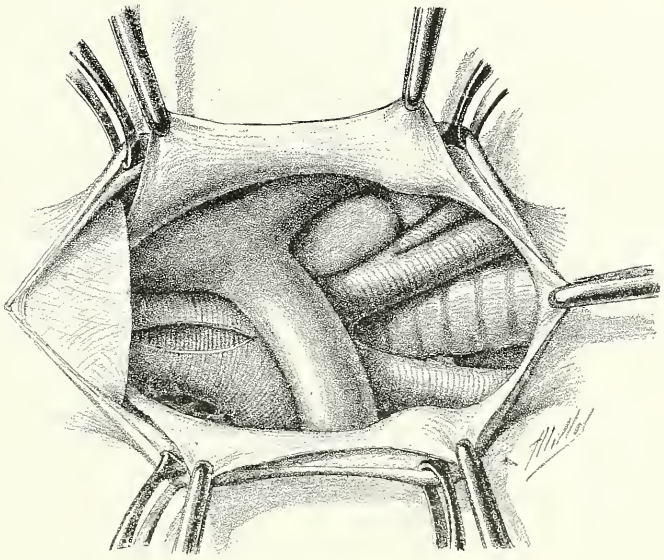


FIG. 663.—ANATOMY OF THE SUPERIOR STAGE OF THE ANTERIOR MEDIASTINUM.

Second plane: After incision of the cervico-pericardial aponeurosis we observe, ranged in succession from before backwards, the vena cava superior, left innominate vein, origin of right innominate vein, the intrapericardial portion of the arch of the aorta (the pericardium has been incised), the brachio-cephalic arterial trunk, the origin of the common carotid and subclavian arteries of the left side, the thoracic portion of the common carotid of that side, and, in the deepest part, the thoracic portion of the trachea, with a hypertrophied lymphatic gland to the right.

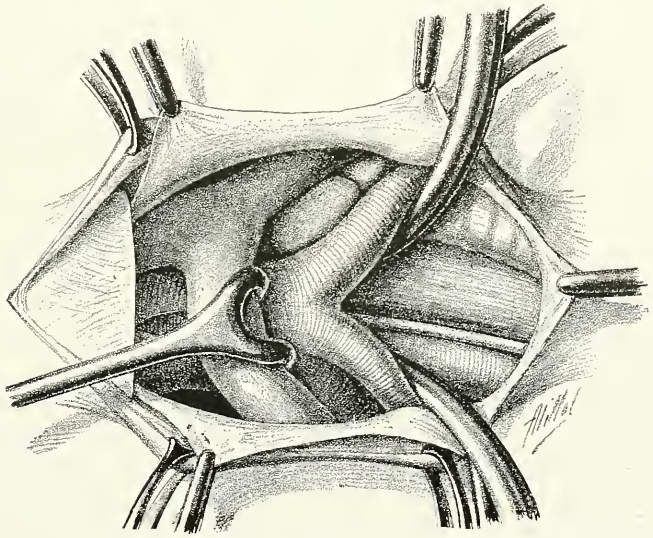


FIG. 664.—ANATOMY OF THE SUPERIOR STAGE OF THE ANTERIOR MEDIASTINUM.

On retraction of the bloodvessels and the trachea we expose the suprabronchial portion of the œsophagus, and the left pneumogastric nerve and subclavius muscle.

2. Invasion of the Intermediate Stage of the Mediastinum.

(1) Median Route.

Invasion of the intermediate stage of the mediastinum enables us to reach the upper portion of the pericardium, which invests the origin of the aortic arch. We can expose the bifurcation of the trachea by the same route, by retracting the aorta, with its pericardial covering, to the left side, and the superior vena cava to the right. On drawing the arch of the aorta to the right side, the pulmonary artery will be brought into view on the left side of that vessel.

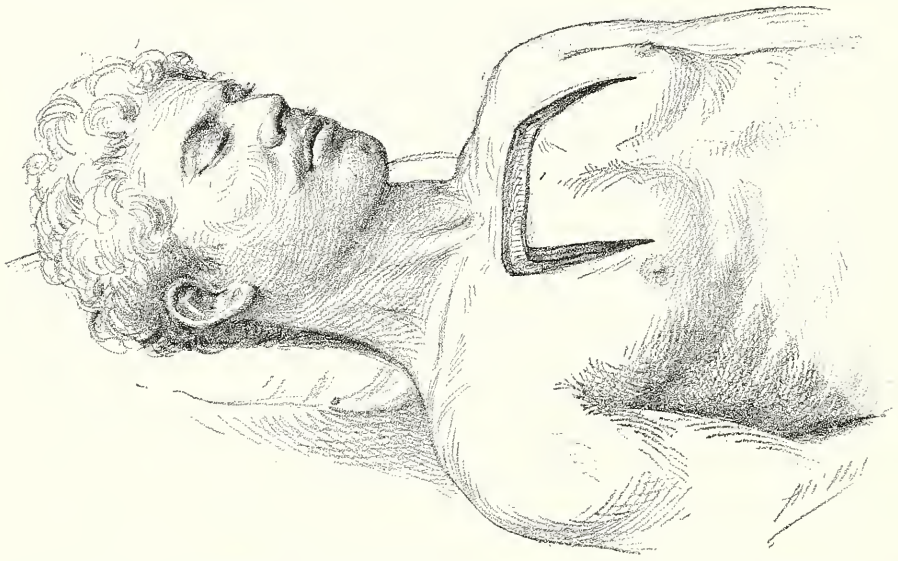


Fig. 665.—Intervention in the Intermediate Stage of the Mediastinum.

First stage: Anterior incision. General sketch.

By operating along the left border of the sternum instead of in the middle line, we can also bring into view, while passing between the triangularis sterni and the costal cartilage, the extrapericardial portions of the pulmonary veins and the branches of the pulmonary artery.

Operation—First Stage.—Cutaneous incision in the form of an inverted **U**, beginning on either side of the level of the bimammillary line, and at two fingers' breadth from the border of the sternum. The transverse incision passes across the middle of the manubrium, and is made to join the upper extremities of the two vertical incisions.

Second Stage.—Division of the soft parts down to the bones, and exposure of the pedicle of the manubrium, and the second and third costal cartilages.

Third Stage.—Division of the pedicle of the manubrium sterni by one of the varieties of the technique above indicated, and section of the second

and third costal cartilages of each side with the costotome raspatory. The internal mammary artery is laid bare in the first intercostal space, on each side of the manubrium, and ligatured both above and below.

Fourth Stage.—The chondro-sternal shutter is turned down with the fingers; the sternum fractures readily at the level of the third intercostal space.

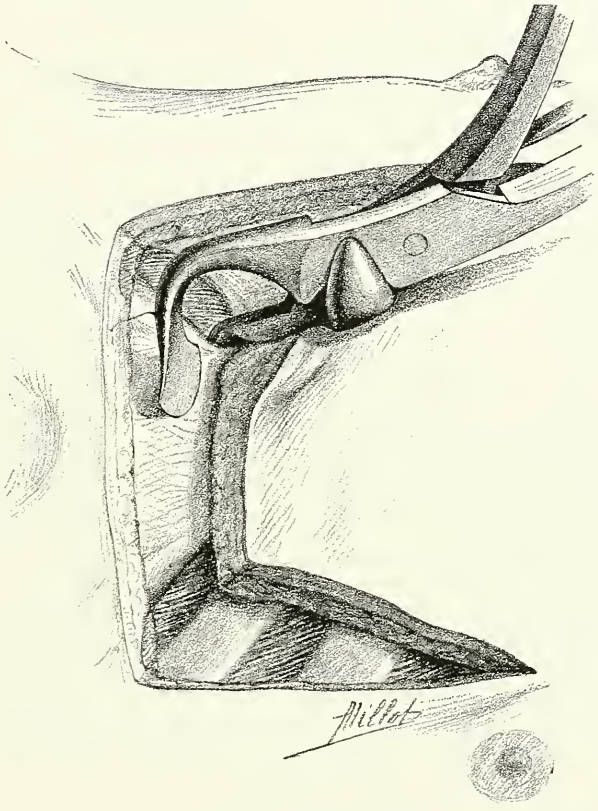


Fig. 666.—Intervention in the Intermediate Stage of the Mediastinum.

Second and third stages: Section of soft parts reaching down to the skeleton; exposure of manubrium and second and third costal cartilages; section of margin of manubrium.

Fifth Stage.—We then expose the vestigial remains of the thymus gland, which is located in the substernal cellular tissue, the development of which is found to vary greatly. After removal of the cellulo-fatty layer, we expose the pericardium, and lying in contact with the ribs, the anterior margins of the pleuræ, the direction of which is approximately vertical. At the upper part of the wound is seen, between the pleuræ and above the pericardium, the cervico-pericardial aponeurosis passing down to its attachment to the latter structure, which takes place along a line directed obliquely from above downwards and from left to right. If we now incise this aponeurosis vertically in the middle line, we expose the arch of the aorta,

which is covered with the pericardium. Here we can carry out incomplete ligation as a remedy for aneurismal dilatation of the arch of the aorta, at its origin, by making a small incision in the pericardium, and passing through it and beneath the artery a curved forceps for the purpose of drawing the ligature through (Fig. 669). If we wish to carry out any procedure on the pulmonary artery, we draw the aorta covered with its pericardial investment to the right side with a small retractor. We thus expose the seat of bifurcation of the pulmonary artery. It is at this point that the vessel should be incised for the removal of clots in a case of pulmonary embolism, as has been

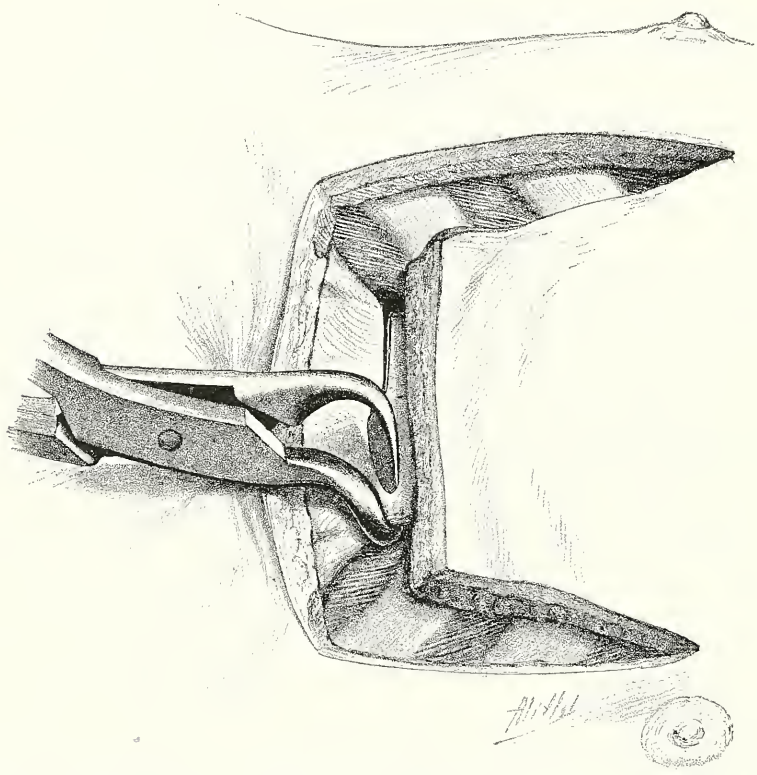


Fig. 667.—Intervention in the Intermediate Stage of the Mediastinum.

The section of the manubrium on the right side is completed with the costotome raspatory.

attempted by Trendelenburg. On the other hand, if we draw the aorta to the left side, we expose the bifurcation of the trachea at a greater depth, which can here be transversely incised and sutured afterwards; for instance, in a case of the presence of a foreign body in the left bronchus where the same has passed beyond the range of direct tracheoscopy.

Sixth Stage.—The intervention is concluded by incomplete suture of the upper part of the flap, leaving two orifices for tamponing, one at the lower extremity of each of the two vertical incisions.

(2) Left Lateral Route.

When our object is not to approach the aorta, pulmonary artery, or trachea, but to reach the bifurcations of the great arterial and venous trunks which are situated in the hilum of the lung, it is better to open the mediastinum at one or the other border of the sternum.

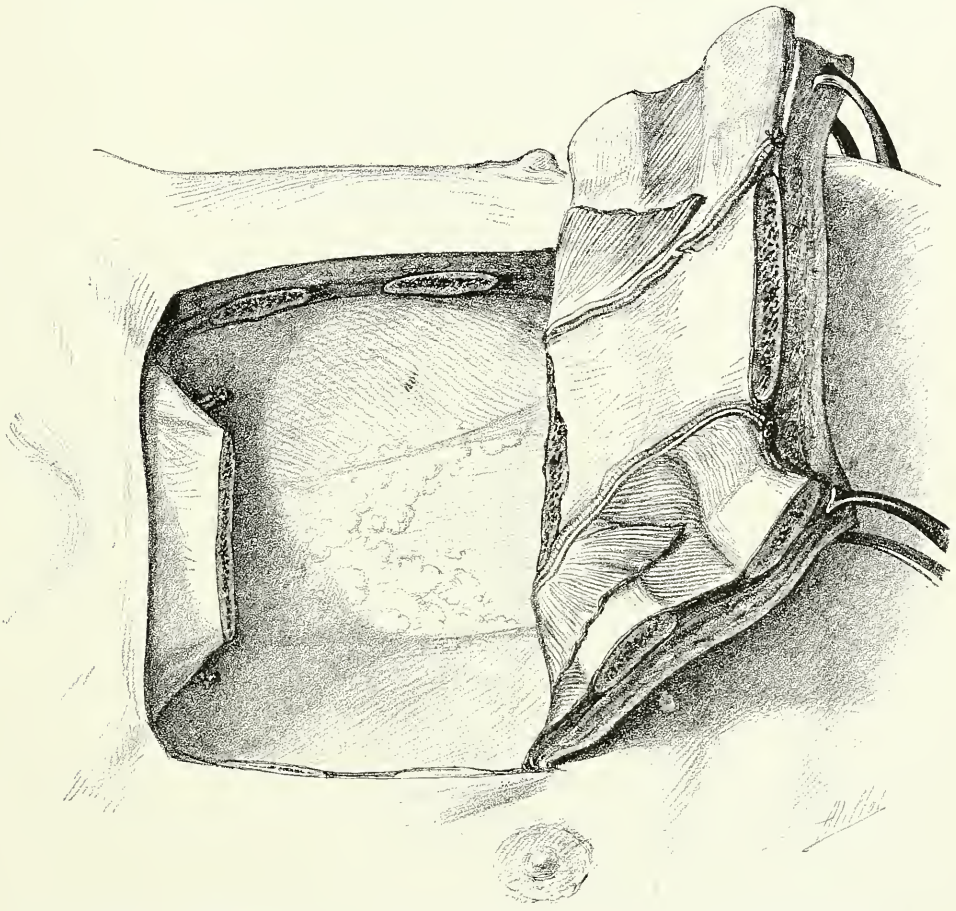


Fig. 668.—Intervention in the Intermediate Stage of the Mediastinum.

Fourth stage: The osteo-cutaneous shutter is here turned back, and we are enabled to see the anterior border of the pleura on each side, with the interpleural stratum of cellulo-adipose tissue.

Operation—First Stage.—Vertical incision of about 12 centimetres, reaching from the sterno-clavicular articulation to the cartilage of the fourth rib.

Second Stage.—Division of the attachments of the pectoralis major muscle; exposure of the first four costal cartilages and the corresponding intercostal spaces.

Third Stage.—Section of the second and third cartilages at their sternal attachment; incision of the soft parts of the first intercostal space as high as possible, and of the third as low as possible, for a length of about 5 or 6 centimetres.

Fourth Stage.—The shutter is folded back in such a way as to fracture the anterior extremities of the second and third ribs at a distance of about 2 or 3 centimetres from their chondral attachment. We thus expose the internal mammary artery and the triangularis sterni muscle.

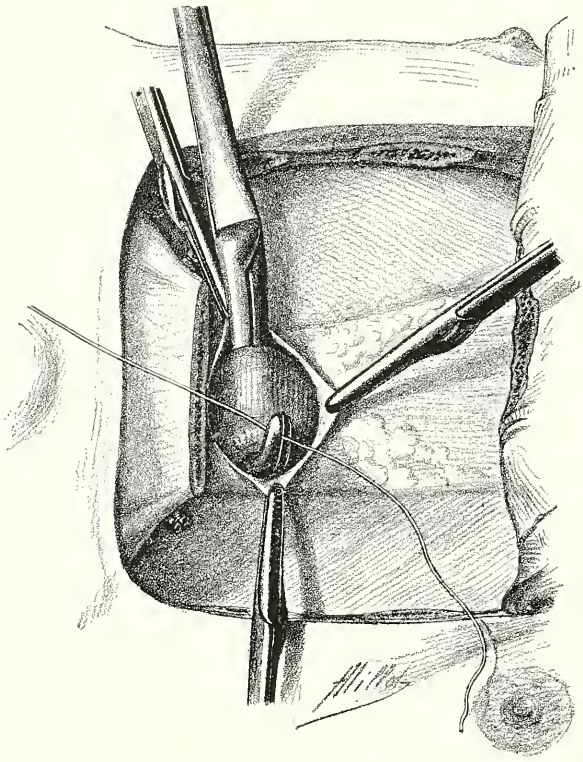


Fig. 669.—Intervention in the Intermediate Stage of the Mediastinum. Incomplete ligature of the arch of the aorta for aneurism of its third portion.

Fifth Stage.—The internal mammary vessels and triangularis sterni muscle are drawn inwards with a hooked forceps, and the interpleuro-pericardial space is opened up with the finger.

Sixth Stage—A. *Intrapericardial Route.*—The pericardium is incised, and the termination of the pulmonary veins in the left auricle exposed. We can suture a wound of the intrapericardial portion of the pulmonary veins by using a curved needle mounted on my needle-holder forceps with eccentric jaws, as represented in Fig. 209, Vol. I.

B. *Extrapericardial Route.*—When we want to carry out an operation on the vessels of the hilum of the lung, we must first proceed to the decollation of the interpleuro-pericardial space. We then retract forcibly with a vaginal

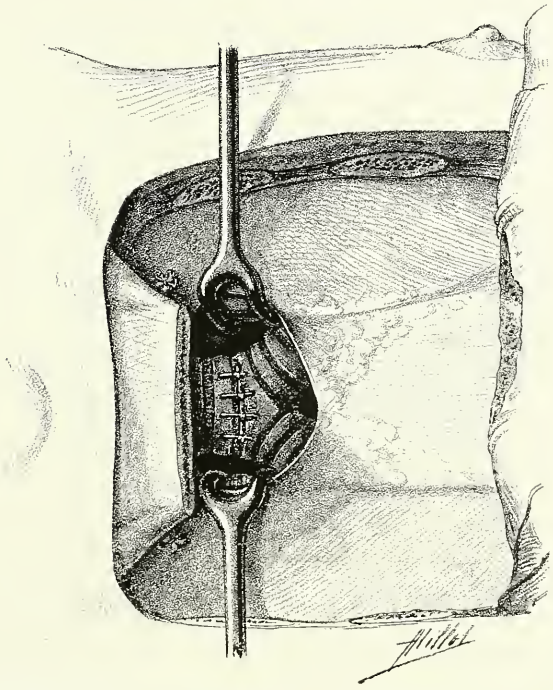


FIG. 670.—INTERVENTION IN THE INTERMEDIATE STAGE OF THE MEDIASTINUM.
Suture of the trachea at the level of its bifurcation after extraction of a foreign body.

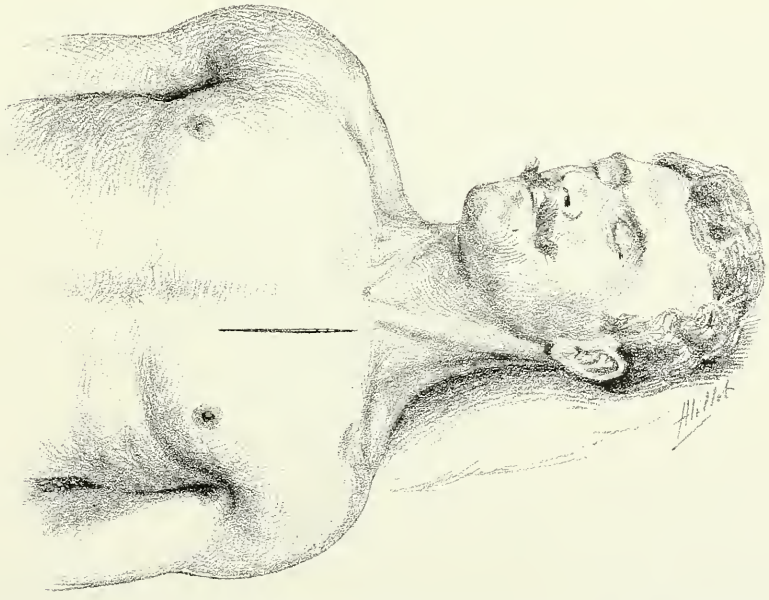


FIG. 671.—OPERATIONS ON THE INTERMEDIATE STAGE OF THE MEDIASTINUM BY THE LEFT LATERAL ROUTE.

First stage: Cutaneous incision extending from the sterno-clavicular articulation to the cartilage of the fourth rib. General sketch.

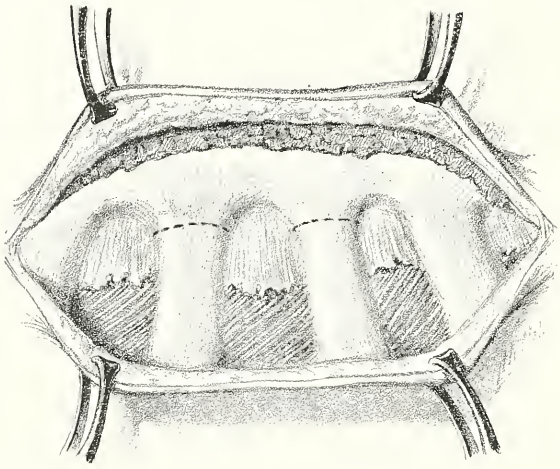


Fig. 672.—Operations on the Intermediate Stage of the Mediastinum by the Left Lateral Route.

Second stage: Here the hooked forceps are made to retract the edges of the wound sufficiently to permit the formation of a costal shutter inclusive of the second and third ribs, which will be divided according to the technique already described.

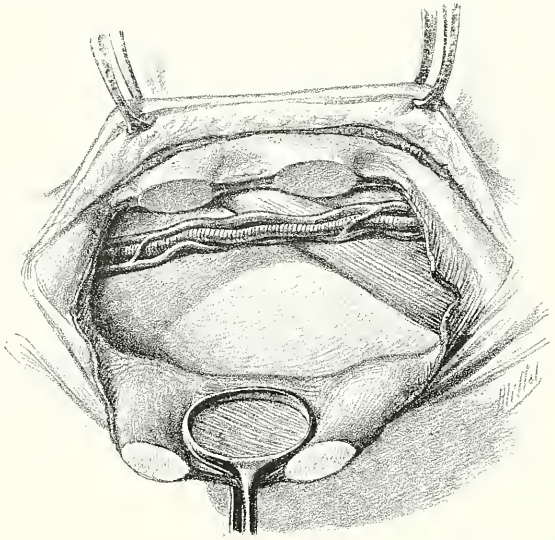


Fig. 673.—Operations on the Intermediate Stage of the Mediastinum by the Left Lateral Route.

Third and fourth stages: A forceps with oval jaws is used to hold back the costal shutter. The internal mammary vessels and triangularis sterni muscle have been exposed. The left anterior pleural sinus is seen in contact with the hinge of the chondro-costal shutter.

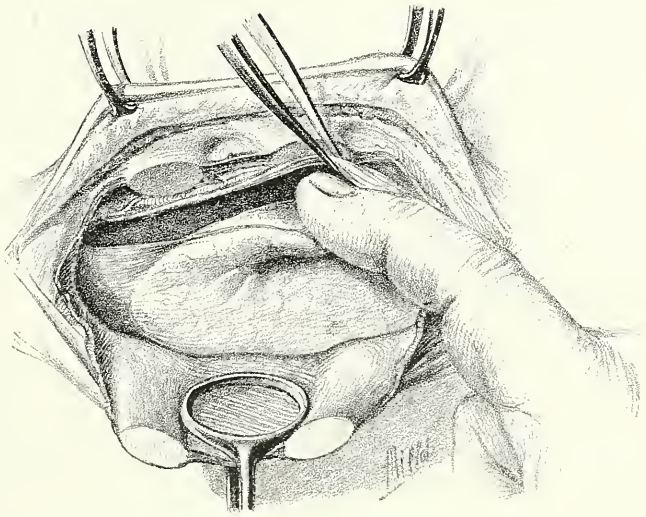


FIG. 674.—OPERATIONS ON THE INTERMEDIATE STAGE OF THE MEDIASTINUM BY THE LEFT LATERAL ROUTE.

Fifth stage: The finger is introduced beneath the triangularis sterni muscle, and made to open up the interpleuro-pericardial space, which is sufficiently loose in its attachments. This manœuvre should be carried out with great caution in order to avoid laceration of the parietal pleura.

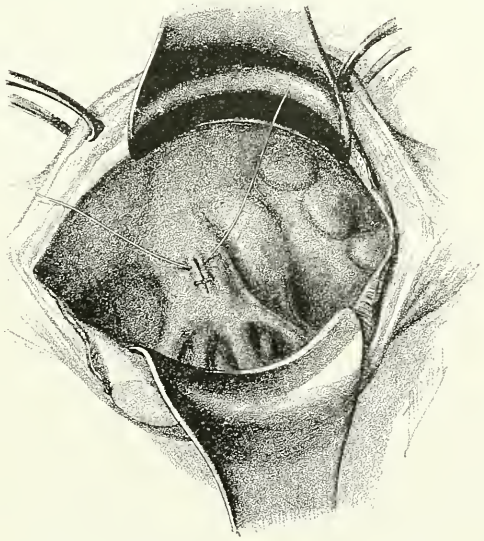


FIG. 675.—OPERATIONS ON THE INTERMEDIATE STAGE OF THE MEDIASTINUM BY THE LEFT LATERAL ROUTE.

Extrapericardial route. The decollation has been pursued into the interpleuro-pericardial space as far as the hilum of the lung. Two vaginal valve specula are used to fold back the pericardium to the right side and the pleura to the left. Suture of a small extrapericardial wound of the left inferior pulmonary vein. Above, the left superior pulmonary vein will be recognized; also the left branch of the pulmonary artery and the peribronchial lymphatic glands.

valve speculum, the pericardium towards the middle line, and the left lung and pleura to the outside. We thus expose at the bottom of the wound,

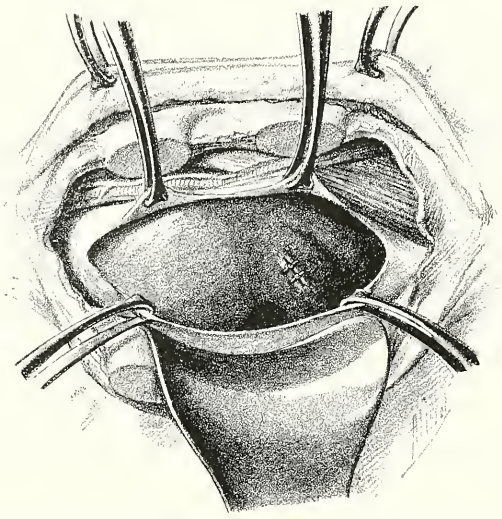


FIG. 676.—OPERATIONS ON THE INTERMEDIATE STAGE OF THE MEDIASTINUM BY THE LEFT LATERAL ROUTE.

Sixth stage: A metallic valve has been introduced into the interpleuro-pericardial space, and used to draw aside the left lung. The pericardium was then incised; it is here held with four hooked forceps. At the bottom of the wound is seen the intrapericardial portions of the pulmonary veins. This figure shows the suture of a small intrapericardial wound of the inferior pulmonary vein.

and in the following order from below upwards, the left inferior pulmonary vein, left superior pulmonary vein, left branch of pulmonary artery, and peribronchial lymphatic glands (see Fig. 675).

EXTIRPATION OF EMBOLI OF THE PULMONARY ARTERY.

This is the route of election when we have to intervene with the pulmonary artery in cases of embolism of that vessel. By modifying the fifth stage of the preceding operation (extrapericardial manœuvre), in adjusting the internal retractor more superficially, we expose the bifurcation of the pulmonary artery.

The incision of the coats of the pulmonary artery should be made in a horizontal direction, at the seat of its bifurcation, and be prolonged equally on each of its branches. This incision is the only one that enables us with certainty to remove coagula from both the main trunk and the branches. The artery is sutured with a duplex continued silk suture.

3. Invasion of the Inferior Stage of the Mediastinum.

Operations on the Heart.

Puncture of the Pericardium.

(1) **Exploratory Puncture by the Median-Juxta-Xiphoid Route.**—The pericardium can be punctured in this way, without either wounding peritoneum or pleura, by making the trocar to penetrate the integuments at the left margin of the xiphoid appendix, and directing the point from below upwards. By maintaining this direction, it enters the pericardial cavity from below, without any danger of wounding the cardiac muscle. The distance which separates the internal mammary vessels and pleura from the left border of the sternum at the level of the fifth and sixth intercostal spaces is very variable—contrary to what has been affirmed by certain authors.

(2) **Trans-Sternal Route.**—The pericardium can also be punctured by the trans-sternal route.

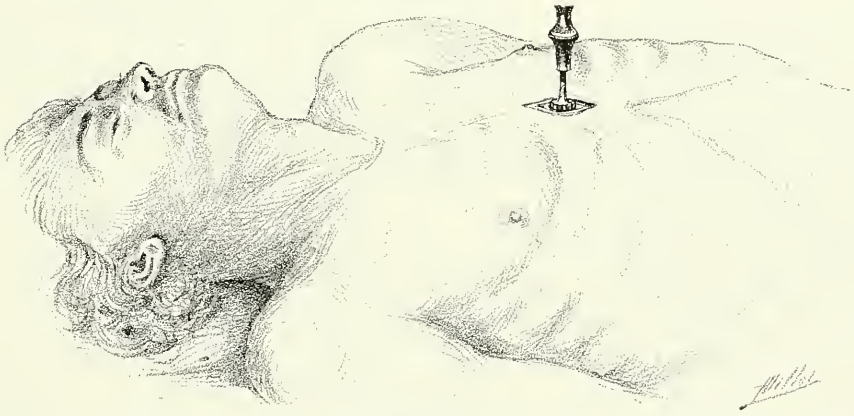


Fig. 677.—Puncture of the Pericardium by the Trans-Sternal Route.

Perforation of the sternum with a cylindro-spherical burr of 20 millimetres. General sketch.

Operation—First Stage.—Vertical median incision of 5 centimetres, the middle of which is situated opposite the fifth costal cartilages.

Second Stage.—Exposure of the surface of the sternum with the raspatory.

Third Stage.—Perforation of the sternum with the *trepan à cliquet*, flat drill, and cylindro-spherical burr of 16 or 20 millimetres.

Fourth Stage.—Toilet of the wound and exposure of the pericardium, which is seized with a clawed forceps at the moment of puncture.

Fifth Stage.—The serous membrane can be exteriorized to a sufficient degree to enable us to carry out the suture.

Sixth Stage.—Tamponing of the wound.

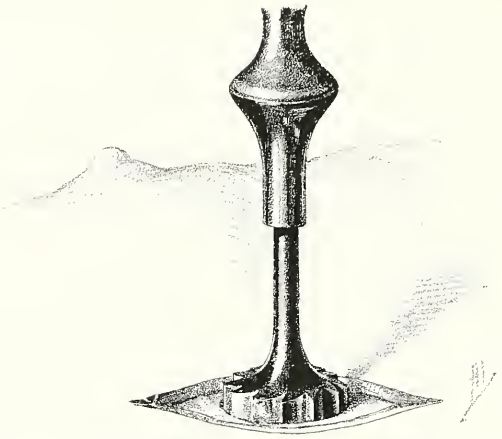


FIG. 678.—PUNCTURE OF THE PERICARDIUM BY THE TRANS-STERNAL ROUTE.
The burr, when it penetrates, is incapable of wounding the pericardium.

Destruction of Pericardial Adhesions.

When precise indications of cardiac symphysis exist, we can attempt the direct destruction of the adhesions by pericardiotomy. The operation is carried out through the trans-sternal route.

Operation—FIRST STAGE.—Vertical median incision of 7 or 8 centimetres, extending from the level of the fourth costal cartilage to the xiphoid appendix.

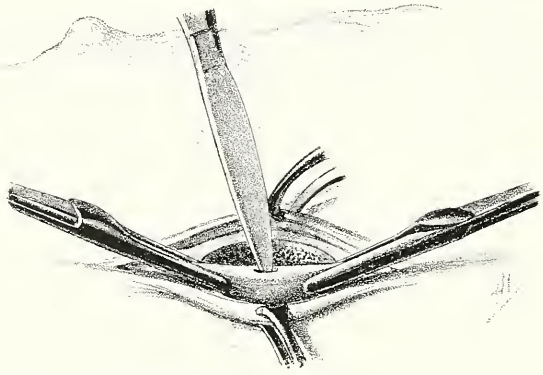


FIG. 679.—PUNCTURE OF THE PERICARDIUM BY THE TRANS-STERNAL ROUTE.
The pericardium is punctured after being grasped with two forceps.

SECOND STAGE.—Exposure of the sternum.

THIRD STAGE.—Double median perforation of the sternum, with the *trepan à cliquet* and burr of 20 millimetres; the upper opening at the level of the fourth costal cartilages, and the lower at some millimetres from the base of the xiphoid appendix. The sternum is then resected between those

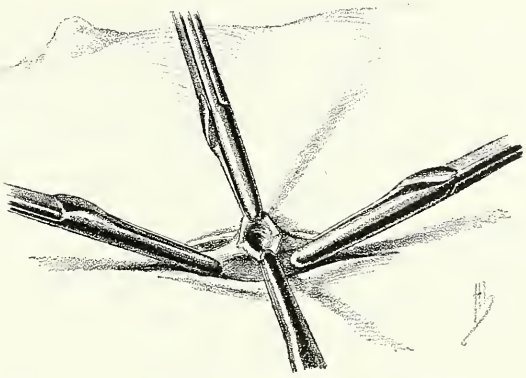


FIG. 680.—PUNCTURE OF THE PERICARDIUM BY THE TRANS-STERNAL ROUTE.
The small opening made in the pericardium can be readily sutured.

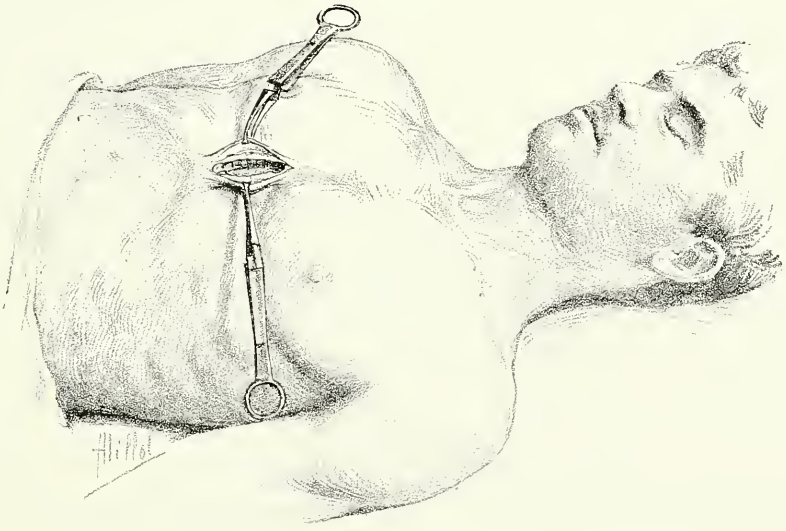


FIG. 681.—DESTRUCTION OF PERICARDIAL ADHESIONS.
First, second, and third stages. General sketch.

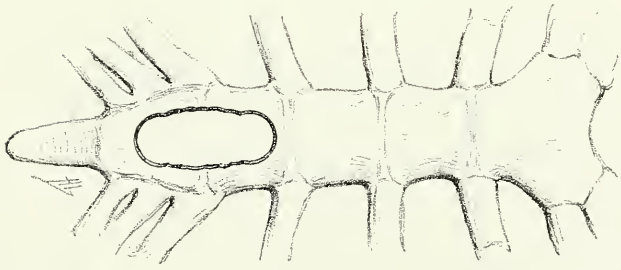


FIG. 682.—DIAGRAMMATIC SKETCH SHOWING THE EXTENT OF THE RESECTION NECESSARY TO EFFECT CARDIOLYSIS BY THE TRANS-STERNAL ROUTE.

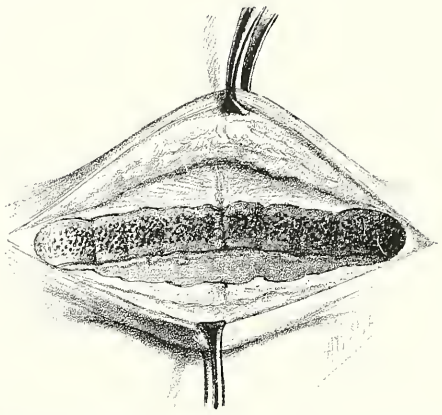


FIG. 683.—DIAGRAMMATIC SKETCH SHOWING THE EXTENT OF THE RESECTION NECESSARY TO EFFECT CARDIOLYSIS BY THE TRANS-STERNAL ROUTE.

Third stage: The interpleuro-pericardial and prepericardial strata of cellular tissue have been separated by the finger for the purpose of exposing the pericardium.

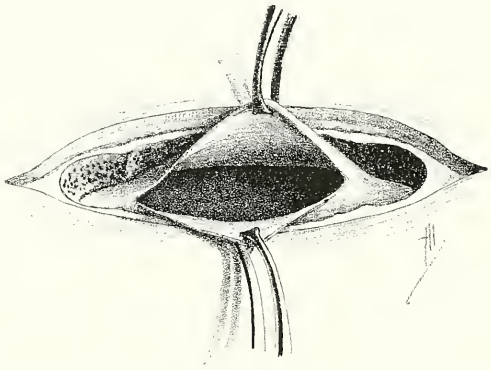


FIG. 684.—DIAGRAMMATIC SKETCH SHOWING THE EXTENT OF THE RESECTION NECESSARY TO EFFECT CARDIOLYSIS BY THE TRANS-STERNAL ROUTE.

Fourth stage: The pericardium has been incised. It will be easy to introduce the finger through that orifice into the pericardial cavity.

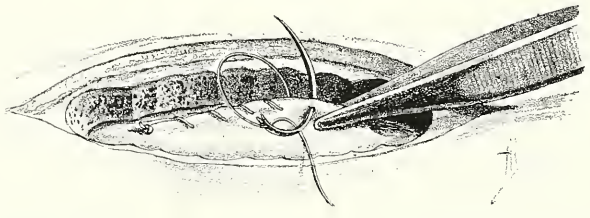


FIG. 685.—DIAGRAMMATIC SKETCH SHOWING THE EXTENT OF THE RESECTION NECESSARY TO EFFECT CARDIOLYSIS BY THE TRANS-STERNAL ROUTE.

Sixth stage: Suture of the pericardium.

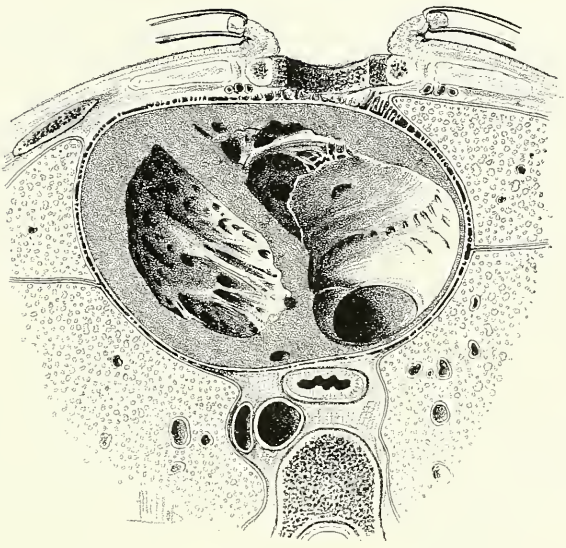


FIG. 686.—HORIZONTAL SECTION OF THE THORAX PASSING THROUGH THE BIMAMMILLARY LINE.

A portion of the sternum has been resected. The condition of pericardial symphysis has been indicated diagrammatically.

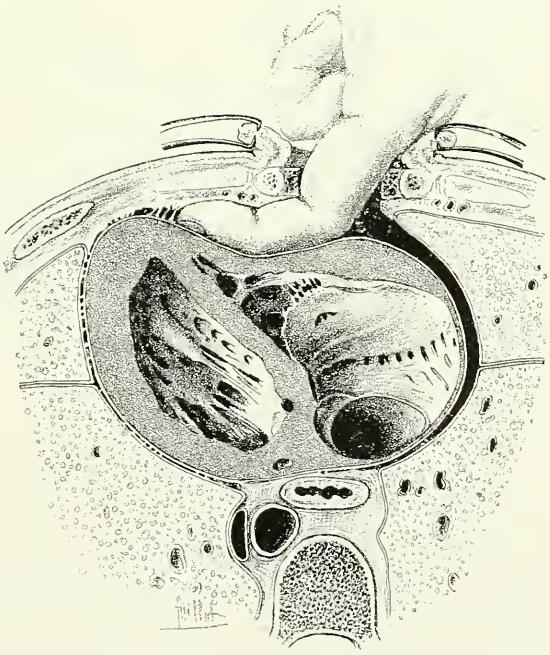


FIG. 687.—HORIZONTAL SECTION OF THE THORAX PASSING THROUGH THE BIMAMMILLARY LINE.

The index-finger has been introduced into the pericardial cavity, and is employed in tearing through the adhesions.

two orifices with the gouge-forceps. The perforation of the sternum can be completed much more rapidly by the electric instrumentation and with a cylindro-spherical burr of 12 millimetres, which is made to act as a mortising instrument, as in evacuation of bony tissues.

Fourth Stage.—The pericardium is grasped with clawed forceps. It is then incised and the serous margins drawn to the outside of the cutaneous wound.

Fifth Stage.—Introduction of the index-finger into the pericardium and destruction of the pericardial adhesions.

Sixth Stage.—Toilet and suture of the pericardium. Tamponing or suture of the cutaneous wound.

The diagnosis of cardiac symphysis is one of great delicacy. It seems to be desirable to recall in this connection the observation cited on p. 400, in which an erroneous diagnosis of cardiac symphysis was made by one of our best clinicians.

OPERATIONS ON THE CARDIAC MUSCULAR TISSUE.

Wounds of the Heart.—The interventions of urgency in cases of cardiac traumatism have produced a certain number of successful results. I have seen a young soldier succumb from purulent pericarditis, in a provincial

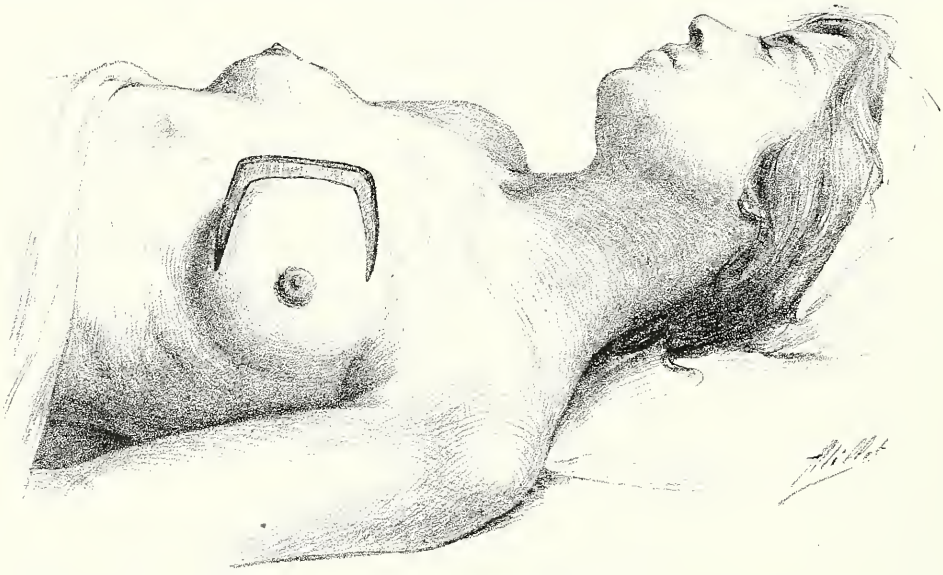


Fig. 688.—U-shaped Incision with External Hinge for Rapid Exposure of the Precordial Region.

General sketch.

military hospital, eight days after an attempt at suicide. The projectile was a small leaden bullet, and had lodged in the outer wall of the left

ventricle, which it had not perforated. Extraction would have been possible, and that patient would have been saved if he had fallen into the hands of an experienced surgeon, who would have operated before the invasion of septic pericarditis.

The earliest possible intervention should be the rule of practice in a case of penetrating wound of the precordial region. I must here point out the fact which I have always observed, that the course of the projectile is often extrapericardial, notably so in cases of suicidal wounds with revolver bullets, even when the orifice of entrance is situated in the precordial region. The projectile, which has been fired off in an oblique direction from without,

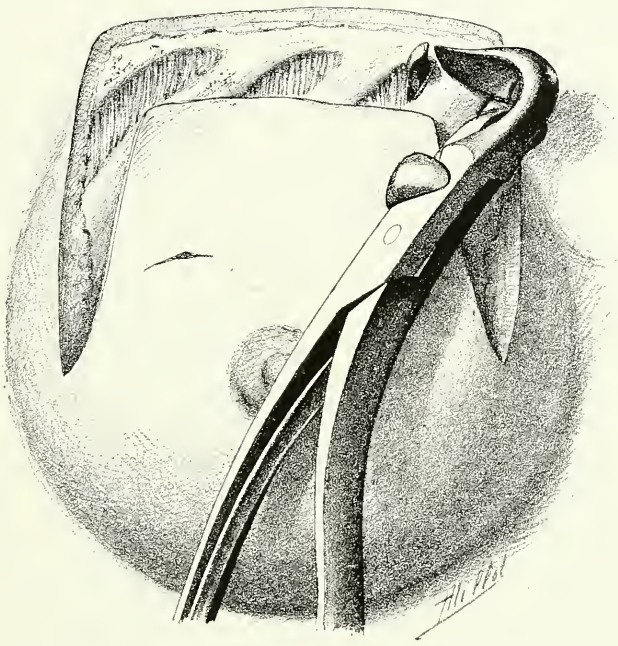


FIG. 689.—U-SHAPED INCISION WITH EXTERNAL HINGE FOR RAPID EXPOSURE OF THE PRECORDIAL REGION.

Formation of the chondro-cutaneous shutter; division of third costal cartilage. The orifice of the perforating wound made with a cutting instrument is seen on the inner side of the nipple.

glances over the pericardium and penetrates the lung. Accordingly, it is necessary that the intervention should be commenced in such a way as to provide for simultaneous exploration of wounds of the heart and lung.

Operation—FIRST STAGE.—A U-shaped incision is rapidly traced in such a way as to map out a shutter with external hinge, which circumscribes the cutaneous opening of the perforating wound.

SECOND STAGE.—Division of the muscles and exposure of the costal cartilages and ribs.

THIRD STAGE.—Division of the sternum and of the third, fourth, and fifth costal cartilages with the costotome raspatory.

Fourth Stage.—Incision of the third and fourth intercostal spaces, and division of the outer branches of the **U**, of the third rib above and the fifth below, care being taken to preserve the intercostal arteries. The shutter is then folded back to the outside, and the intervening rib is broken in the process of displacement.

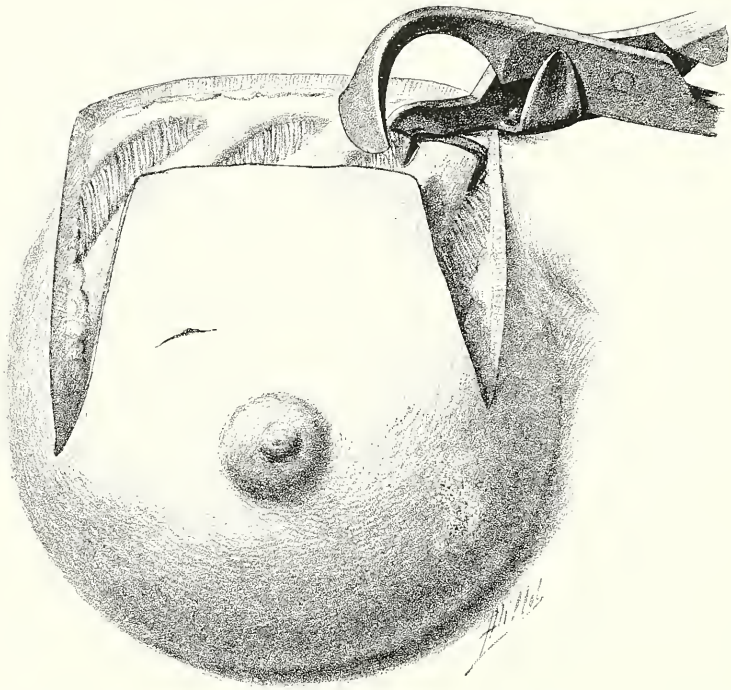


Fig. 690.—**U**-shaped Incision with External Hinge for Rapid Exposure of the Precordial Region.

Disengagement of the crotchet of the costotome raspatory, which is then introduced beneath the next rib

Fifth Stage.—Exposure near the margin of the sternum of the internal mammary vessels, of the digitations of the sternum itself and the pericardium. The latter structure is incised at the seat of perforation, and its toilet is then made by sponging with compresses, and we then immediately proceed to suture of the wall of the heart with No. 3 silk. Two deep points of suture are inserted and moderately tightened; then three superficial ones.

Sixth Stage.—Toilet and suture of the pericardium.

Seventh Stage.—Reunion of the wound. A wick of gauze is left at the lower angle.

OPERATIONS ON THE SUBBRONCHIAL PORTION OF THE ŒSOPHAGUS.

The thoracic portion of the œsophagus is very difficult to reach, especially in its lower two-thirds. The attempts made to carry out this procedure by the posterior or lateral route necessitates considerable destruction of tissue and very laborious decollation of pleura. Indeed, they have served at most but to demonstrate the almost complete impossibility of carrying out any useful manœuvre at so great a depth.

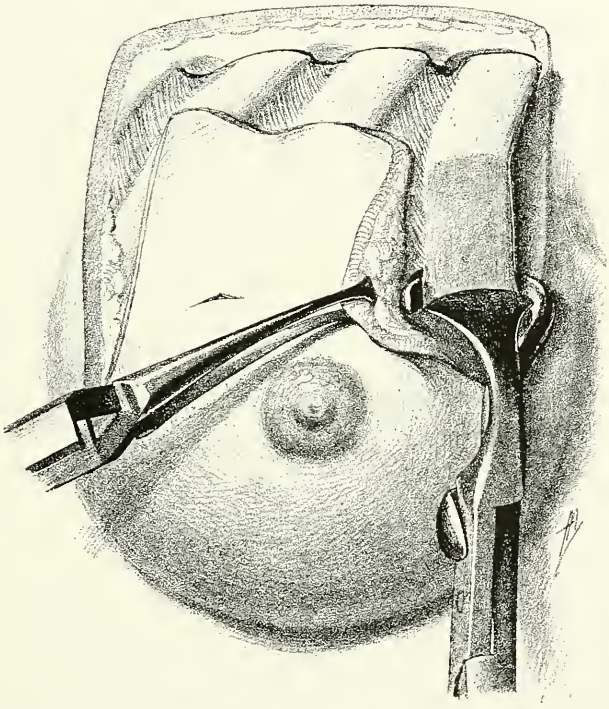


FIG. 691.—U-SHAPED INCISION WITH EXTERNAL HINGE FOR RAPID EXPOSURE OF THE PRECORDIAL REGION.

Division of the third rib in the plane of the hinge, taking care to preserve the intercostal artery.

Such is not the case when we proceed by the anterior mediastinal route. The œsophagus can be reached from the front either through the pericardium or by interpleuro-pericardial passage. I now proceed to describe those two procedures in succession.

1. *Transpericardial Anterior Œsophagotomy.*

Position of the Patient.—The patient is placed in the position of dorsal decubitus, the head being turned towards the light, and the body is then rotated downwards through an angle of 10 or 15 degrees. The surgeon takes his place at the left side.

Operation—First Stage: Incision of the Integuments.—The incision which affords most light is that in the form of an inverted **U**, disposed symmetrically. It should commence immediately below the level of the

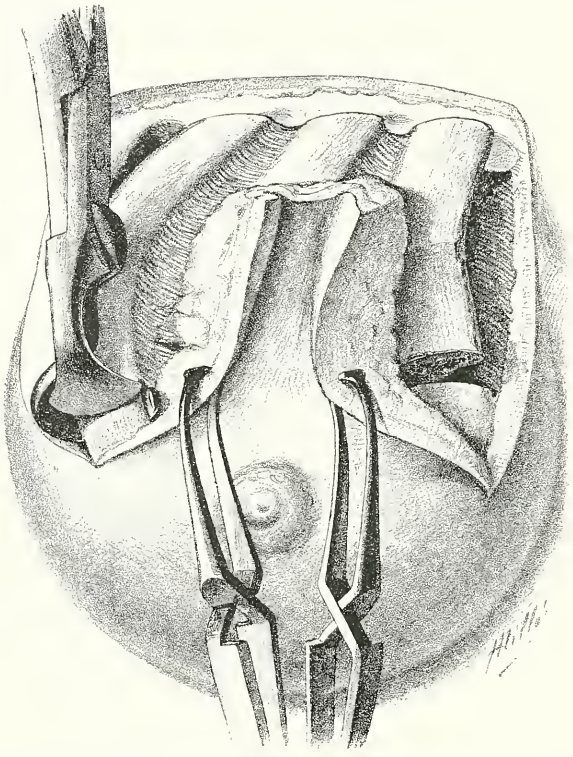


Fig. 692.—**U**-shaped Incision with External Hinge for Rapid Exposure of the Precordial Region.

Division of the fifth rib at the lower part of the same shutter.

sixth costal cartilage of the right side, and pass vertically upwards, at a distance of 4 or 5 centimetres, from the border of the sternum to end immediately above the cartilage of the third rib. The incision is then continued in the horizontal direction, and is made to end symmetrically on the left side.

I prefer this incision, as it provides for the mobilization of a broad sterno-chondral shutter with an inferior diaphragmatic hinge, which is copiously irrigated by the anastomosis of the branches of the epigastric and internal mammary arteries.

Second Stage: Formation and Mobilization of the Flap.—It is very easy, with a little precaution, to pass with the curved raspatory from below upwards in the left side beneath the cartilages of the sixth, fifth, fourth, and third ribs in succession. The thickness of the triangularis sterni muscle preserves the pleural *cul-de-sac* from being wounded below, in those cases in which it approaches the xiphoid cartilage more nearly than usual. With the special object of avoiding injury to the pleural *cul-de-sac*, I recommend the following technique: After division of the sterno-chondral articulation of the fifth costal cartilage, its sternal extremity is grasped and raised, while taking

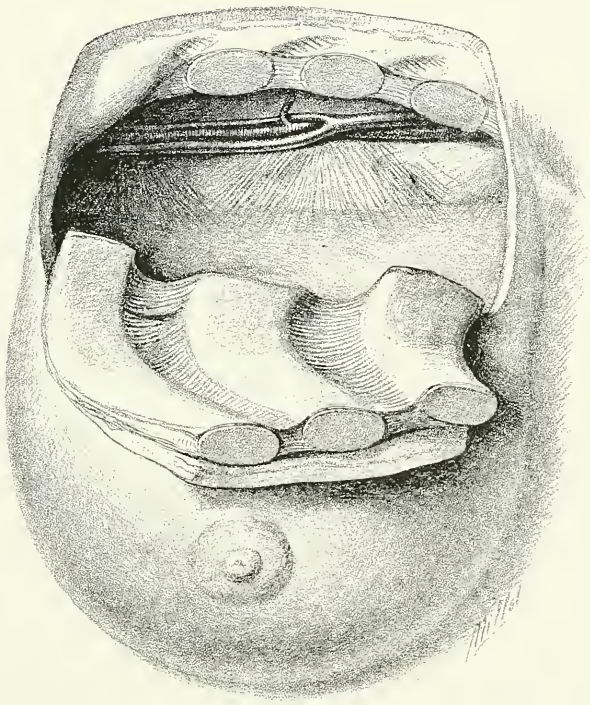


Fig. 693.—U-shaped Incision with External Hinge for Rapid Exposure of the Precordial Region.

The shutter is folded back with fracture of the fourth rib. Exposure of the internal mammary vessels, triangularis sterni muscle, and pericardium.

great care to strip its posterior surface; it is then divided at the chondro-costal articulation, and the periosteum is incised. Injury to the pleura is prevented by introducing the left index-finger beneath the chondro-costal grill. When the intervening intercostal tissues have been divided, elevation of the shutter may be commenced. The process of decollation is continued with the finger beneath the sternum, which is divided in the second intercostal space with a strong bone-forceps or by some other procedure. The shutter is then further raised, and the endothoracic fascia is detached with the fingers and pressed towards the right side; vertical section of the third,

fourth, fifth, and sixth right costal cartilages and tissues of the intermediate spaces now permits the folding back of the shutter.

Third Stage: Invasion of the Œsophagus.—The pericardium is rapidly divided in the middle line along its whole altitude, and the heart is grasped by an assistant, whose hands are covered with thread gloves drawn over the india-rubber ones. The heart is now drawn upwards and to the right side, and the projection of the œsophagus, beneath the serous membrane, is immediately recognized in the middle line. In most cases a sound can be introduced, which obviates all hesitation. The serous membrane

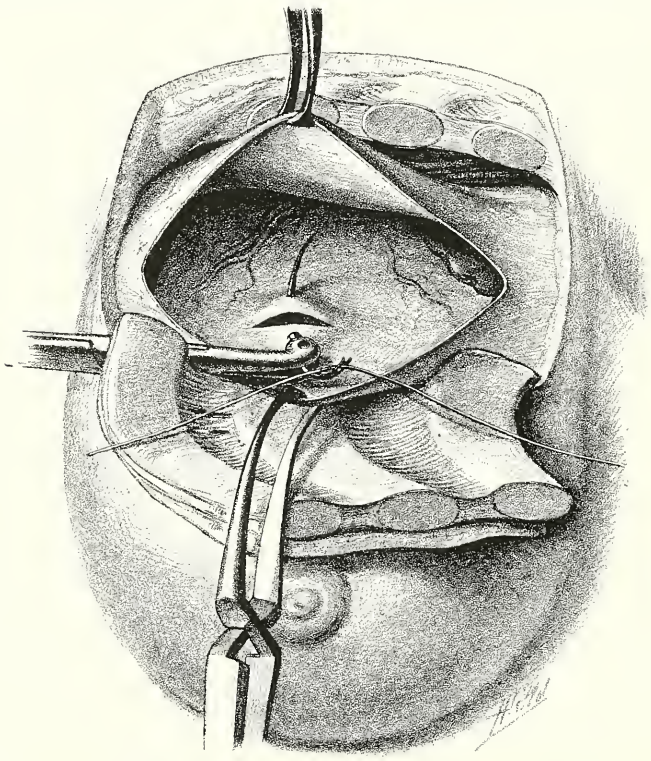


Fig. 694.—U-shaped Incision with External Hinge for Rapid Exposure of the Precordial Region.

The pericardium has been laid open. Suture of a small wound of the right ventricle.

is then grasped at that point with clawed forceps, and divided with scissors. The œsophagus can be readily stripped, with the help of clawed forceps, taking care to avoid the pneumogastric nerves. A pointed foreign body which has perforated the œsophageal wall and produced an abscess behind the pericardium, can be readily removed by this procedure in a very little time, while it would have been impossible by direct œsophagoscopy.

Fourth Stage: Reparation.—When the operation has been performed with the object of extracting a foreign body, the œsophagus is sutured, and then the posterior and anterior lamellæ of the pericardium respectively;

taking care to leave a wick of gauze in front to maintain subsequent drainage. The thoracic shutter is now restored to its orginial position, and perfect adaptation of the edges of the cutaneous wound is secured.

2. *Interpleuro-Pericardial Anterior Œsophagotomy.*

The same position of the patient is adopted, and the section and mobilization of the shutter are carried out in the way above described.

Third Stage: Invasion of the Œsophagus.—The prepericardial cellular tissue should be torn through along the middle line down to the proper fibrous tunic of the pericardium, which is of whitish colour and very resisting. This membrane is now gradually detached towards the left side by scratching the pericardium with a blunt instrument or compress. In this way the interpleuro-pericardial space is reached, where the decollation can be proceeded with without difficulty in the living subject. The phrenic nerve is preserved by leaving it on the side of the pleura. It may be necessary to tie, after their division, both ends of the superior diaphragmatic arteries, which I have sometimes found of fairly large calibre in the living subject. We soon reach the posterior surface of the pericardium, where we expose the left pneumogastric nerve, and then the œsophagus. The decollation of the pericardium may even be pursued as far as the surface of the diaphragm.

I have tried this operation with the object of extirpating a cancer of the œsophagus in this region, the position of which had been verified by direct œsophagoscopy. I was readily able to expose the pedicle formed by the left pulmonary veins, and to touch the seat of bifurcation of the trachea by passing the finger from below upwards. I then isolated the œsophagus, but the cancer extended from the aortic constriction of the œsophagus down to the cardia, at the level of which large nodules could be felt through the diaphragm. The conditions were such that the operation could not possibly be completed. The patient succumbed in consequence of the formation of a left pneumothorax, consecutive to the decollation of the interpleuro-pericardial space, which allowed the mediastinal pleura to follow the lung in its retraction. No perforation of the pleura had taken place.

OPERATIONS ON THE DORSAL SPINE.

Traumatic Lesions.

The dorsal part of the rachidian canal is rarely penetrated by pointed or cutting instruments. We may, however, be called upon to extract the point of a knife which has been broken off by contact with a vertebral lamina. When dealing with a gunshot wound, inflictedwith a weapon of but mediocre power (a small leaden bullet), we are guided to the position of the

projectile by following the course of the wound; we can also call in the auxiliary aid of radiography. The operative technique presents no peculiarity.

Fractures of the dorsal vertebræ are of rare occurrence, because this portion of the spinal column is supported by the chondro-costal grill, which provides an auxiliary influence and corroborates that furnished by the posterior convexity of the dorsal region in prevention of every tendency to backward bending of the body in this region. It is also for this reason that in certain falls, when the thighs or pelvis are immobilized, and the trunk is thrown backwards—or even forwards—fracture takes place at the level of the upper lumbar vertebræ. When the person thus injured is not killed on the spot, the surgeon may be called upon to intervene, either immediately after the accident, or after the lapse of an interval—perhaps of several weeks. The result of immediate intervention is usually deplorable, as the extent of the injury is so considerable; the spinal cord escapes complete division only in exceptional cases, so that even if the patient happens to survive, the paralysis is irremediable. We can obtain good results only in cases in which the traumatism is limited to a displacement of the fractured laminæ or vertebral bodies of sufficiently slight degree to produce simple compression of the cord.

Inflammatory Lesions.

We sometimes meet with cases of osteomyelitis of the vertebral laminæ. The lesions are usually tuberculous. The intervention varies with the topography of the lesions, and may have to be very extensive.

Malformations : Congenital and Acquired.

The best treatment of scoliosis is that by orthopædic methods and those of rational gymnastics, for an account of which we refer the reader to the special treatises.

The treatment of gibbous spine or Pott's disease of the dorsal vertebræ consists in most cases of prevention of further development of the deformity, and improvement of the general condition. The existing tuberculous infection should be combated by combined administration of mycolysine and phymalose.

Tumours.

Tumours of the posterior rachidian region are pretty rare. I will just mention here a case of voluminous sarcoma of the spinous processes of the dorso-lumbar region which had recurred many times, and yielded completely to a new mode of procedure combined with antineoplastic vaccination.

Laminectomy.

This operation is performed with the help of my *scie à curseur*, or with my craniectomy chisel, or with a rachitome.

Operation—First Stage.—Vertical median incision of the requisite length.

Second Stage. — Denudation of the vertebral laminæ on each side. It will be found that while in the cervical region it is easy enough to introduce the costotome raspatory between two adjacent laminæ, its introduction between adjacent dorsal laminæ can be effected only through a narrow notch, which is situated at the base of each spinous process.

Third Stage.—Division of the laminæ on each side, either with the costotome raspatory, or with the mallet and craniectomy chisel. The spinous processes are completely extirpated. When we want to form an osteoplastic shutter, it will be necessary to make a U-shaped cutaneous incision.

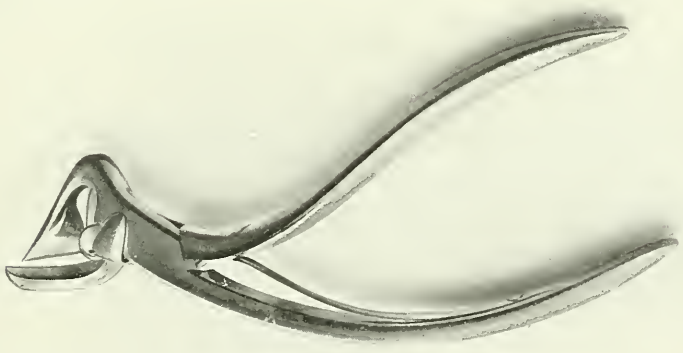


Fig. 695.—Author's Rachitome.

Fourth Stage.—The lamina involved is now resected, when we are dealing with a case of compression; or the dura mater can be retracted, and the posterior nerve-roots and posterior aspect of the bodies of the vertebræ examined. It is through this route that we can divide the dorsal posterior nerve routes for relief of the gastric crises of tabes. We can also attack and drain tuberculous abscesses of the vertebral bodies by this posterior route.

In a case of spinal compression associated with gibbosity, we must

ascertain whether the compression is produced by an osseous projection or by inflammatory thickening of the tissues within the spinal canal.

Fifth Stage.—Suture of wound ; drainage. Aseptic tamponing is resorted to in some cases.

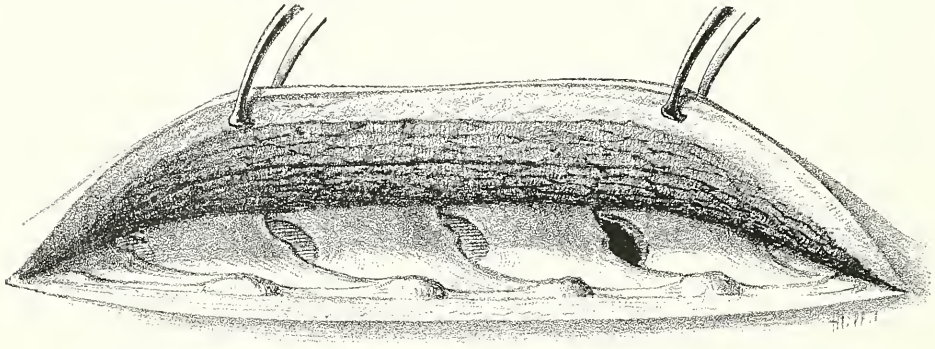


Fig. 696.—Dorsal Laminectomy involving the Sixth, Seventh, Eighth, and Ninth Vertebral Laminæ.

The spinal groove has been denuded with the bistoury. The musculo-cutaneous lip of the wound is then sufficiently retracted with two hooked forceps. The lowermost interlaminar space has been enlarged with the costotome raspatory.

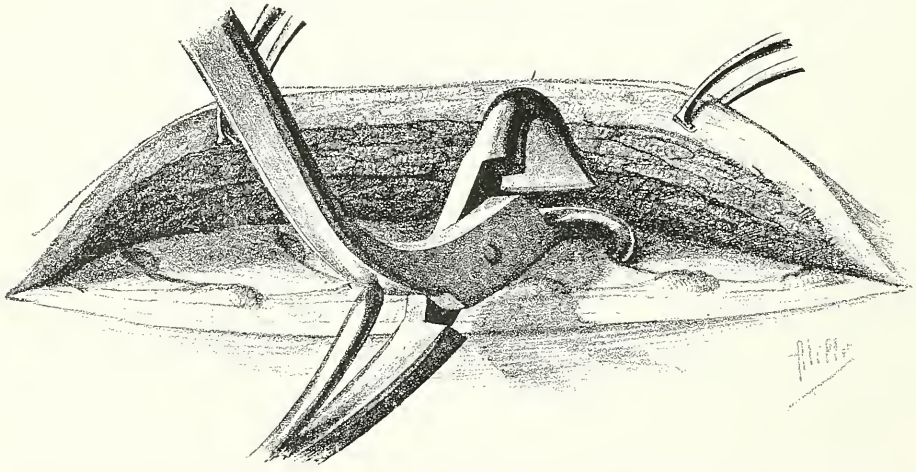


Fig. 697.—Dorsal Laminectomy involving the Sixth, Seventh, Eighth, and Ninth Vertebral Laminæ.

Division of vertebral lamina with the rachitome. The hook of the instrument has been introduced through the interlaminar space, which it penetrates without risk of wounding or compressing the spinal cord.

Laminectomy is not a difficult operation when we adopt a good technique. It must, however, always remain an exceptional one, as occasions for its performance very seldom arise. In cases of fracture of the spine it rarely

produces a good result, because it seldom happens that the osseous displacement is not accompanied with complete crushing of the cord. In cases of

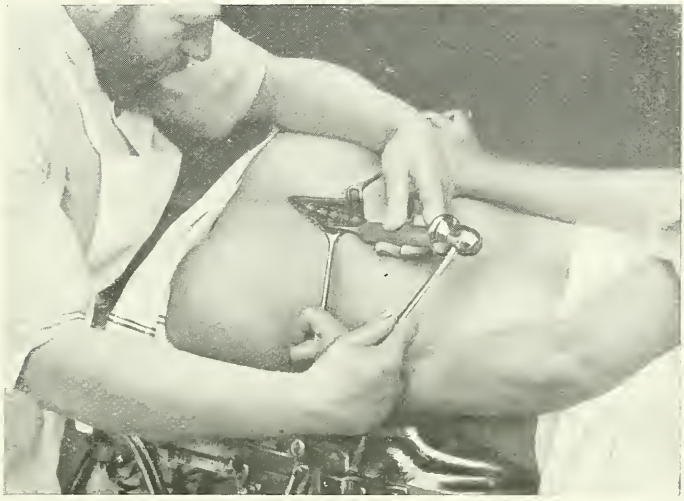


FIG. 698.—LAMINECTOMY OF LOWER DORSAL VERTEBRÆ.
Division of laminæ on left side with the mallet and craniectomy chisel.

FIG. 699.—LAMINECTOMY OF LOWER DORSAL VERTEBRÆ.
Same stage of operation. Division of laminæ on right side.

gunshot or punctured wounds, it rarely happens, too, that the lesion of the cord is limited to a condition of simple compression, which the operation could completely remove. In cases of tuberculous pachymeningitis, it is

easy indeed to remedy the condition and symptoms of compression, but the extent of the lesions present rarely lends itself to production of a complete

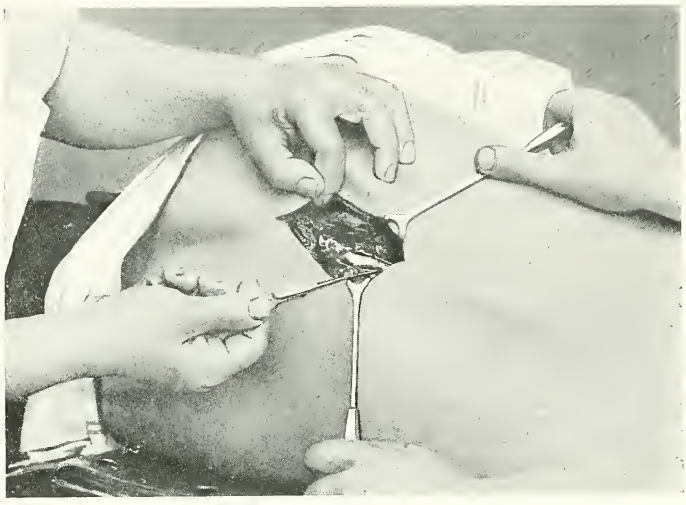


FIG. 700.—LAMINECTOMY OF LOWER DORSAL VERTEBRÆ.
Exposure of dorsal dura mater and spinal cord.

cure. I referred but casually to division of the posterior spinal nerve roots in the visceral crises of tabes; such an operation can only add to the previously considerable lesions produced by sclerosis of the posterior columns of the cord.

OPERATIONS ON THE SHOULDER.

Traumatic Lesions.

Wounds of the shoulder are either extra-articular or penetrating, and may be complicated by the production of osseous lesions or the introduction of foreign bodies. The diagnosis of complex lesions of the shoulder is made with the help of radiography, which also facilitates the extraction of foreign bodies. The interpretation of radiographic proofs is always a sufficiently delicate task, especially in cases of luxation complicated with fracture. In my own experience I have noticed that post-traumatic deformations of the shoulder consecutive to fractures and unreduced dislocations have continued to be as frequent as before the introduction of radiography. It is true, indeed, that at the present day there is but little teaching of the surgical affections of the limb, while the study of the same is very much neglected by our junior surgeons, who display far too inordinate an appetite for laparotomies.

Luxations of the Shoulder-Joint.

1. *Recent Luxations.*

General anæsthesia is procured by the use of ethyl chloride. General anæsthesia is indispensable, in order to remove the reflex muscular contraction which would otherwise obstruct the efforts of the surgeon.

Fig. 701.—Reduction of a Dislocation of the Right Shoulder by the Author's Method.

First stage: Application of the hand.

Reduction by the Author's Procedure.—The patient is anæsthetized in the position of dorsal decubitus. In a case in which it had not been possible to

have recourse to the assistance of radiography, the local examination is now completed, and we make sure of the non-existence of fracture. The luxated arm is then grasped by the surgeon, who draws it directly towards himself, while securing the counter-extension, by the use of the right foot

FIG. 702.—REDUCTION OF A DISLOCATION OF THE RIGHT SHOULDER BY THE AUTHOR'S METHOD.

Second stage: Disengagement of the head of the humerus and upward traction of the surgical neck.

in case of a left shoulder, and of the left foot in case of a right. The foot is applied in the axillary fossa, as indicated in the figure. A band is passed around the surgical neck of the humerus, and is drawn on by an assistant, who is placed beside the head of the patient. When the surgeon considers the degree of extension sufficient, he suddenly brings down the arm to the

side of the patient's body, and slips away his foot at the precise moment at which the head of the humerus slips into the glenoid cavity. This manœuvre requires scarcely twenty to thirty seconds.

The following are details of the procedure:

FIG. 703.—REDUCTION OF A DISLOCATION OF THE RIGHT SHOULDER BY THE AUTHOR'S METHOD.

Third stage: Reduction; the arm is restored to a position parallel to the side of the patient's body.

FIRST STAGE.—The patient is anæsthetized in the position of dorsal decubitus. He is placed on a rigid table, at the level of the hip of the operating surgeon. The arm is held horizontally, in the position of abduc-

tion to a right angle with the trunk, and the hand is adjusted around the surgical neck of the luxated humerus.

Second Stage.—In case of the right shoulder, the surgeon grasps the wrist between the palms of both hands, and extends the arm in a direction

Fig. 704.—Reduction of a Dislocation of the Right Shoulder by the Author's Method.

The reduction has been effected; the flexed forearm is placed in front of the body.

perpendicular to the axis of the patient's body, while he makes counter-extension with his unbooted foot in the axillary fossa, which is protected with an intervening pad formed by a sterilized compress. As the head of the humerus becomes disengaged, the assistant endeavours to draw it towards the glenoid cavity by maintaining energetic traction in a direction parallel

to the axis of the patient's trunk, on the band which has been adjusted around the surgical neck of the humerus.

Third Stage.—Suddenly the head jumps into the glenoid cavity. The surgeon gives the order, "Let go," and slips his foot towards the scapula.

Fig. 705.—Reduction of a Dislocation of the Right Shoulder by the Author's Method.

Left side. Second stage: Disengagement of the displaced head and upward traction on the surgical neck.

while he brings down the patient's arm to the side of the body. Obviously a certain amount of physical vigour is requisite for the successful reduction of luxations of the shoulder by this procedure. It is, however, the safest, and at the same time the surest, method of all.

When the luxation has been reduced, the forearm is flexed and placed across the front of the thorax, with the right hand close to the left axilla. The surgeon then assures himself of the re-establishment of the anatomical outlines of the circumference of the shoulder, and the freedom of movement of the arm. A Mayor's bandage should be applied, which is then retained for a fortnight. Rational massage is also used.

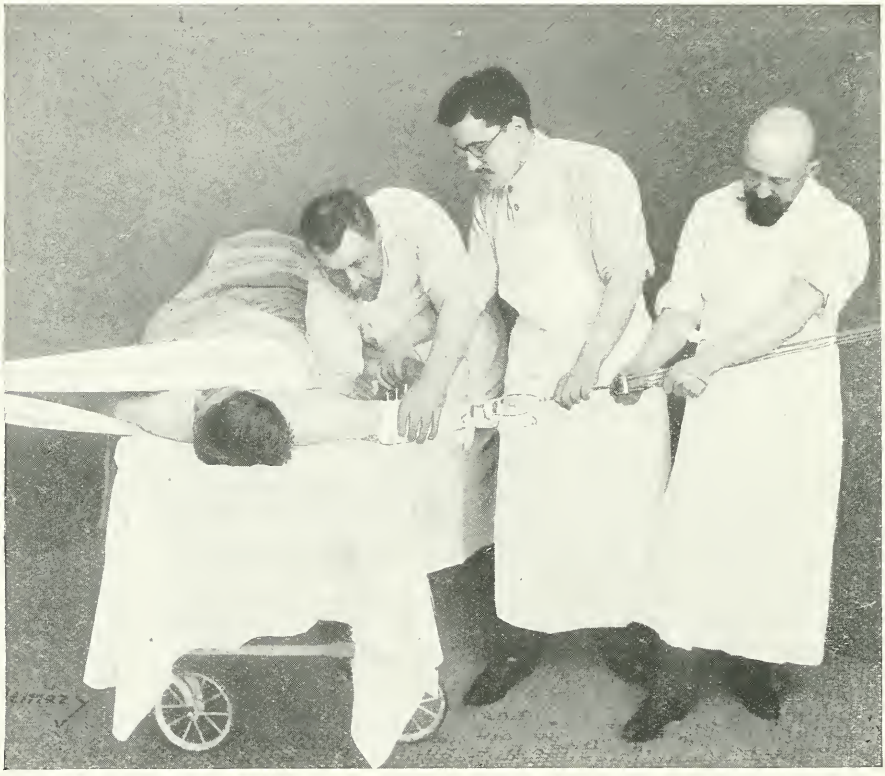


Fig. 706.—Reduction of Old-Standing Luxation.

First stage: The assistant is ready to open the forceps.

In case of a luxation of the left humerus, the reduction is effected in the same manner, but the surgeon makes the counter-extension with his right foot.

The upward traction on the surgical neck of the humerus, the reduction, the verification of the normal function of the joint, and the application of the bandage—all are carried out as above described. Thus the reader can appreciate the simplicity of this procedure, which I devised many years ago. I have had many opportunities of utilizing it in practice, and have never experienced a single failure.

2. *Luxations complicated with Fracture of Surgical Neck of the Humerus.*

The employment of general anæsthesia enables us to procure reduction in some cases by making direct pressure on the head of the humerus, while an assistant makes extension of the arm in the direction above indicated. In other cases we may act directly on the displaced head through a small cutaneous incision.

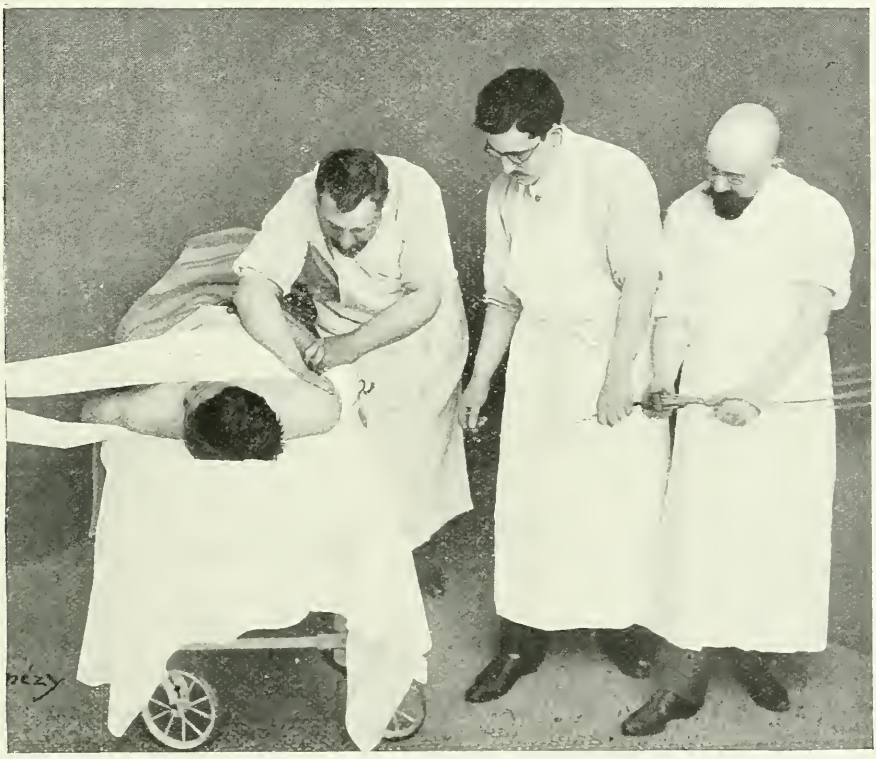


Fig. 707.—Reduction of Old-Standing Luxation.

Second stage: The surgeon suddenly brings the liberated arm to the side of the patient, while he pushes the head of the humerus upwards with his right hand.

3. *Old-Standing Luxations.*

We regard as old a luxation which has been neglected for more than a fortnight. The reduction of these luxations of long-standing becomes more difficult in direct proportion to the length of the period which has elapsed since the occurrence of the traumatism. Adhesions have been formed around the seat of injury, and the lacerated opening made in the capsule at the time may have cicatrized so fully as to oppose the restoration of the luxated head of the bone to its normal position. As soon as the diagnosis

has been definitely confirmed by radiography, reduction should be attempted. General anæsthesia is always necessary.

Operation—First Stage: Mobilization of the Pseudoarthrosis.—The patient is placed at the edge of the table, and the scapula is firmly held by the hands of a vigorous assistant. The surgeon then practises the movements of abduction and circumduction successively till the displaced head of the bone has become thoroughly mobilized.

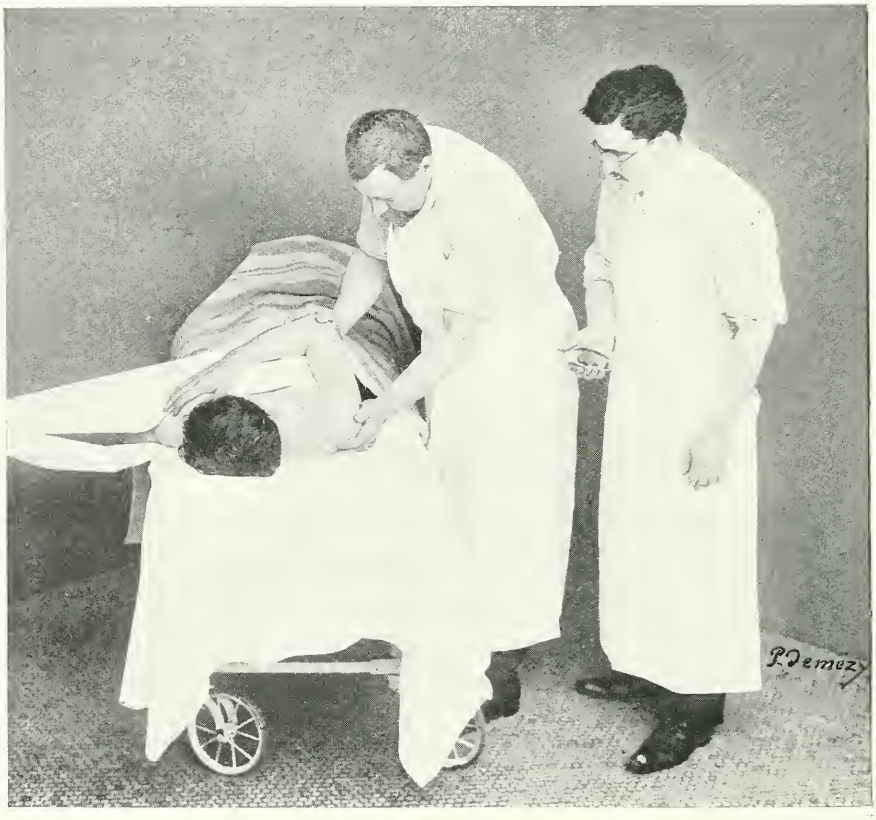


Fig. 708.—Reduction of Old-Standing Luxation.

The reduction has been effected.

Second Stage: Reduction.—The reduction is attempted by the procedure above described. The method has been successful in cases of luxation that were unrecognized for an interval of three months and even more. When the reduction by the simple efforts of the surgeon proves impossible, we at once proceed to reduction with the help of pulleys.

Third Stage: Reduction with the Assistance of Mechanical Traction.—It is necessary to arrange two points of firm support—for example, two rings fixed in the wall at the level of the table on which the patient is placed. Counter-extension is maintained with the help of a drawsheet. Extension is carried out with a bandage. Two pulleys, of the form

used for suspension in cases of scoliosis, are adjusted for use; also a number of metallic S-shaped hooks, a dynamometer, and a Collin's spring forceps.

The patient is placed on the table and anæsthetized. The band for counter-extension, which is formed of six or eight doubles of the roller bandage used for the body, of 25 centimetres in width, is placed under the axilla in such a way that the two ends meet after passing beyond the opposite shoulder, one above and the other below it. We then bind them tightly together with the cordelette. The crotchet of the pulley is then inserted between the two parts of the band, and its other extremity is hooked on the ring, which is secured to the opposite wall. For the purpose of counter-extension we apply a body bandage, folded in two at its middle, above the bend of the elbow; the two ends are crossed behind, and again passed round the limb over the bend of the elbow, which is held at a right angle, in such a way that the outer end passes on the inside, and the inner end on the outside, of the upper part of the forearm. The two ends are then bound together with a cordelette. A metallic S-shaped crotchet is then hooked on between them, after which we arrange in order the dynamometer, the forceps, and—in the ring of the right branch of the latter—the crotchet of the second pulley, the other extremity of which is connected with the second iron ring.

The pseudarthrosis has been previously mobilized. An assistant draws on the cord of one of the pulleys till it appears sufficiently stretched. The surgeon watches the outward displacement of the head of the humerus. When this appears to have cleared the plane of the glenoid cavity—take the case of a right arm—the surgeon, who stands between the arm and body of the patient, pushes the surgical neck of the humerus towards the acromion process with his right hand, while the principal assistant keeps the forearm flexed and prepares himself to detach the escapement forceps. The surgeon then grasps the luxated arm in his left hand and give the successive orders, "Attention," "Let go." At this precise moment the assistant who has charge of the escapement forceps detaches the apparatus, and the surgeon suddenly brings down the arm thus liberated to the side of the trunk, while pushing the head of the humerus upwards with his right hand.

Arthrotomy.

Arthrotomy is seldom resorted to before the lapse of a good many weeks after the accident. The best incision to be adopted is the inter-pectoro-deltoid incision, which eliminates the danger to the circumflex nerve. This incision can be prolonged downwards, or even upwards towards the acromion, as far as may be considered necessary.

Operation—First Stage.—Vertical cutaneous incision, reaching from the anterior border of the acromion process to the margin of the axilla.

Second Stage.—Exposure of the traumatic focus and mobilization of the head of the humerus. The raspatory and blunt-pointed scissors are used to break down the resistant fibrous bands.

Third Stage.—Reduction, reunion, and drainage.

Extirpation of the Displaced Head of the Humerus.

Extirpation of the head of the humerus is indicated only in cases of luxation complicated with fracture which has been imperfectly united. In this procedure we separate the displaced head of the humerus from the diaphysis, at the plane of fracture, with the mallet and MacEwen's osteotome. We then grasp it with a strong forceps, and detach it from its adhesions.

Operation—First Stage.—Incision as above described.

Second Stage.—Exposure of the head of the humerus at the most accessible position.

Third Stage.—Isolation and mobilization of the upper extremity of the humerus, with the help of the raspatory and blunt-pointed scissors, made to act by divulsion.

Fourth Stage.—Osteotomy of the vicious callus with the mallet and MacEwen's chisel, and extirpation of the head of the humerus with Farabœuf's forceps.

Fifth Stage.—Reunion of skin and drainage. If the development of infectious complications is dreaded, the wound is left open and treated by tamponing.

Inflammatory Lesions.

Acute Inflammatory Lesions.

Extra-Articular Phlegmons.

Subcutaneous and subdeltoid phlegmons may undergo resolution if treated in time with mycolysine. If pus has collected, a small incision at the most dependent point, followed by drainage for some days, will be found sufficient treatment.

Suppurative Arthritis.

Suppurative arthritis of the shoulder-joint may be consecutive to a penetrating wound, or it may be met with in cases of epiphysiary osteomyelitis, or it may be one of the complications of a general infection. The cases of acute suppuration and those of osteomyelitis are usually caused by the presence of the *Staphylococcus aureus*, metastatic arthritis by that of the streptococcus. The action of the phagogenic colloids of mycolysine may prove sufficient to bar the progress of the infection, so it is desirable to administer one or two subcutaneous injections at the earliest possible date. If pus has collected, we make an incision, either anteriorly along the interpectoro-deltoid groove, or posteriorly below the tip of the acromion process.

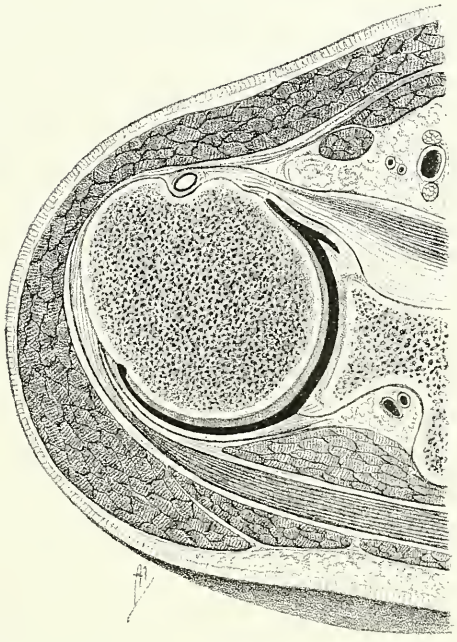


FIG. 709.—HORIZONTAL SECTION OF THE SCAPULO-HUMERAL ARTICULATION.

The articular cavity is seen to be prolonged posteriorly to a considerable distance.

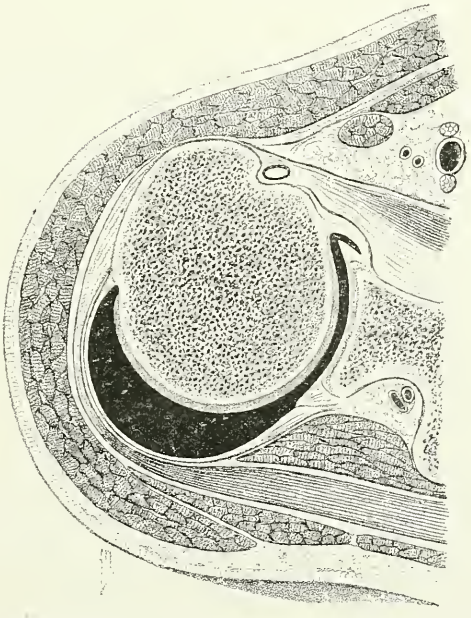


FIG. 710.—SUPPURATIVE ARTHRITIS OF THE SHOULDER-JOINT.

The arm is placed spontaneously in the position of internal rotation, and the distended capsule is readily reached from behind.

Subacute and Chronic Inflammatory Lesions.

Tuberculosis.

The acromion process is often attacked by tuberculosis. We also meet with primary tuberculous arthritis of the scapulo-humeral articulation. At the commencement, the tuberculous infection is treated by the combined administration of mycolysine and phymalose. The treatment should be graduated according to the patient's powers of toleration. If a purulent collection forms, it is evacuated by puncture, and the immunizing injections are continued. When the suppuration is abundant, or if a fistula has already formed, the performance of an operation becomes indispensable.

1. **Extra-Articular Lesions.**—Subcutaneous tuberculous gummata should be completely extirpated. The wound is then treated with aero-cauteriza- and tamponing. If a deep-seated tract is found leading towards the acromion process, the carious portion of the bone is thoroughly extirpated, and aero-cauterization is then adopted.

When a fistula has already formed, the practice should be the same; the seat of the disease is attacked between two curvilinear incisions, and the whole tract is extirpated.

2. **Articular Lesions.**—When the joint has been invaded, it rarely happens that the whole of the upper epiphysis is not infiltrated with the tuberculous products. If the immunizing treatment has wholly failed, we then have recourse to resection.

Malformations: Congenital and Acquired.

Congenital Malformations.

Partial atrophy of the scapula and head of the humerus produces a considerable degree of deformity of the contour of the shoulder, with an asymmetry which is determined by the shortening of the width of the acromio-rachidian space. The osseous deformity is readily demonstrable by radiography.

The effect is accentuated in those cases by the exaggerated projection of the external extremity of the clavicle. In some instances we can improve both the form of the shoulder and the movements of the arm by operation. This intervention consists of resection with the osteotome of all abnormal and exuberant osseous projections which obstruct the movements of the humerus in elevation and abduction of the limb.

Acquired Deformities.

Paralytic Luxation.

I will specially refer here to paralytic luxation. This deformity demands the employment of an orthopædic apparatus, furnished with artificial muscles.

Simple ankylosis or ankylosis following fractures of the head of the humerus, consolidated in awkward positions, require excision of the head of the humerus should all other treatment fail.

Tumours.

Benign Tumours.

Exostosis.

All exostoses must be removed with the mallet and osteotome.

Malignant Tumours.

Osteo-Sarcoma of the Shoulder.

Osteo-sarcoma of the shoulder—that is to say, sarcoma which simultaneously attacks the head of the humerus and the adjacent portion of the scapula—must be treated by interscapulo-thoracic disarticulation. This operation may be productive of permanent cure when the lesion is definitely localized. When the neoplasm is limited to the postero-inferior portion of the scapula, we may try either partial or total resection of that bone, with conservation of the humerus in its integrity. The field of operation is then treated by thermic electro-coagulation, or by the use of the thermo-electric bath.

General Operative Technique of the Scapulo-Humeral Region.

Anatomical Considerations.—If we make a horizontal section of the axillary fossa, passing through the scapulo-humeral articulation, the deltoid crescent will be noticed on the outer portion of the divided surface. The

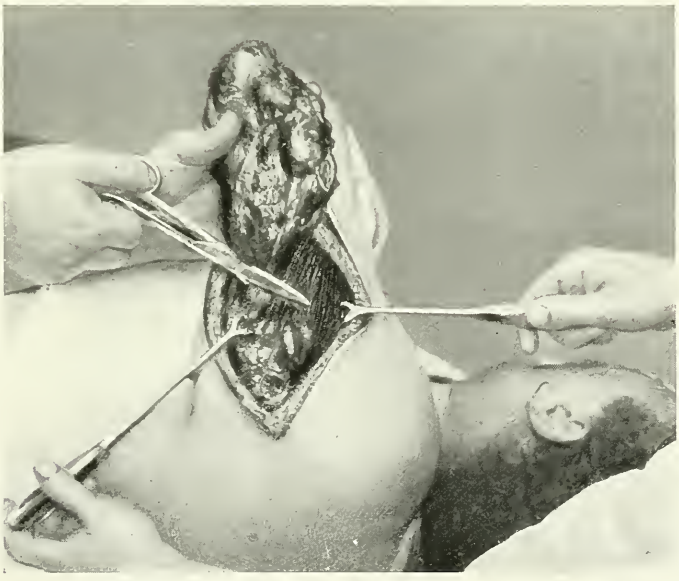


Fig. 711.—Lipoma of the Axillary Fossa.

Division of its deltoid attachments.

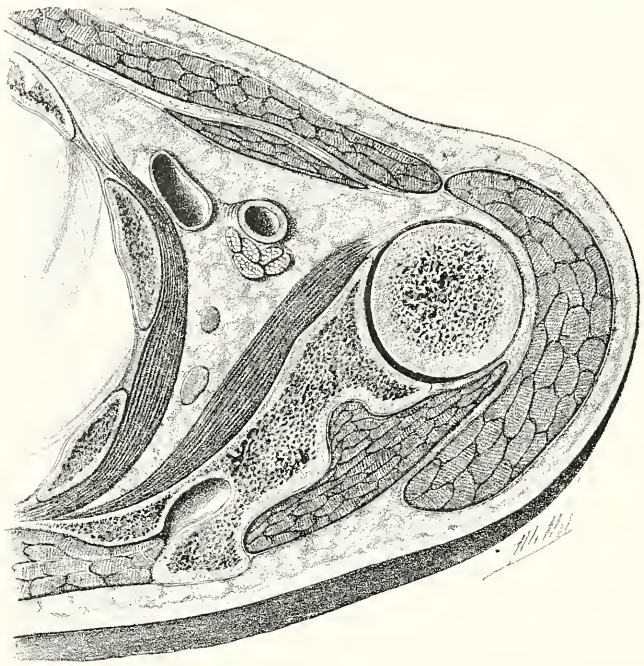


FIG. 712.—HORIZONTAL SECTION OF THE AXILLARY FOSSA PASSING THROUGH THE SCAPULO-HUMERAL ARTICULATION.

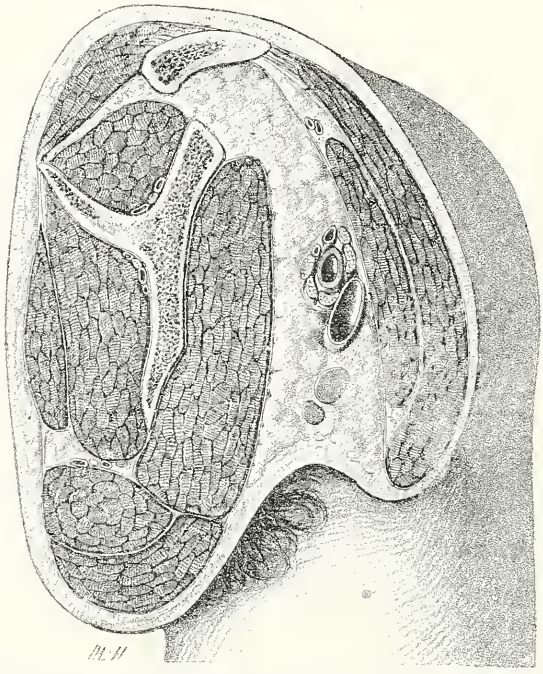


FIG. 713.—ANTERO-POSTERIOR SECTION OF THE AXILLARY FOSSA PASSING AT A FINGER'S BREADTH TO THE INNER SIDE OF THE CORACOID PROCESS.

section of the axillary fossa is of triangular outline. In front we recognize the greater and lesser pectoral muscles, which cover anteriorly the cellulo-adipose tissue of the axilla and the contained vasculo-nervous bundle. The internal boundary of the fossa is formed by the serratus magnus muscle and the chest wall, the postero-external by the subscapularis muscle and the scapula itself. The section passes obliquely through the spine of the scapula, which projects between the supraspinatus on the outside, and the infraspinatus internally.

The disposition of the fibres of the deltoid muscle is well shown in vertical sections. Fig. 713 shows an antero-posterior section of the axillary fossa, passing at a finger's breadth to the inner side of the coracoid process.

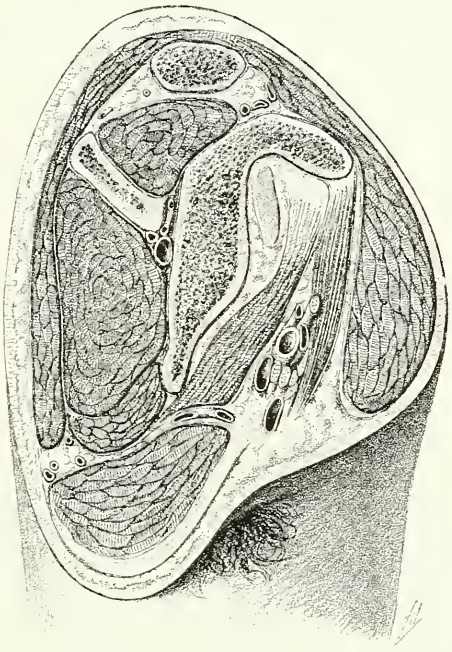


Fig. 714.—Antero-Posterior Section of the Prominence of the Shoulder passing through the Coracoid Process.

Above is seen the trapezius, which descends from the clavicle towards the spine of the scapula; beneath it lies the supraspinatus. In the infraspinous fossa is seen the infraspinatus, superficial to which is placed a median fasciculus of the trapezius, passing to its insertion on the spine of the scapula. Beneath are the teres major and latissimus dorsi. In front are the pectoral muscles, major and minor, which, in accordance with their embryological development, are enclosed in the same aponeurotic sheath (Fig. 713). The axillary adipose tissue surrounds the lymphatic glands and the vasculo-nervous muscle, in which we recognize, above and in front of the artery, the musculo-cutaneous nerve; beneath this, the median nerve embracing the artery; then the musculo-spiral, the circumflex, and ulnar nerves. The secondary vessels are—in the interpectoral groove, the thoracic branch

of the acromio-thoracic; the supraspinous and infraspinous vessels; and the muscular branches of the infrascapular artery, which are destined for the supply of the teres major and the latissimus dorsi. This section clearly demonstrates the fact that there is no aponeurosis attached to the subcu-

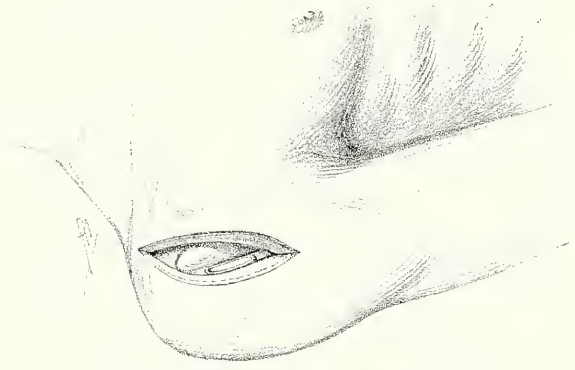


FIG. 715.—RESECTION OF RIGHT SHOULDER-JOINT.

General sketch.

taneous fascia. Thus, the famous structure known as the "suspensory ligament" of the axilla is proved to owe its origin to an error of dissection, and appears as such when we remove the pectoralis major and its anterior aponeurotic leaflet.

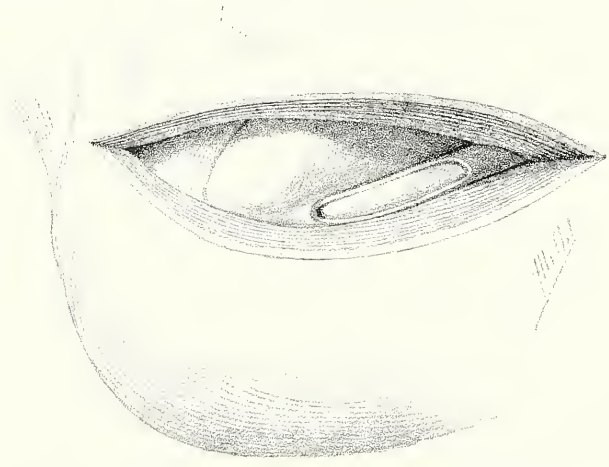


FIG. 716.—RESECTION OF RIGHT SHOULDER-JOINT.

First stage: Deltoid incision. At the bottom is seen the bicipital groove.

If we now make another vertical antero-posterior section, passing through the coracoid process, we bring into view the whole extent of the deltoid muscle, which invests the prominence of the shoulder. Beneath the deltoid are found the clavicle and supraspinatus muscle; then, in order, the infraspinatus, teres minor and teres major. Beneath the coracoid process we

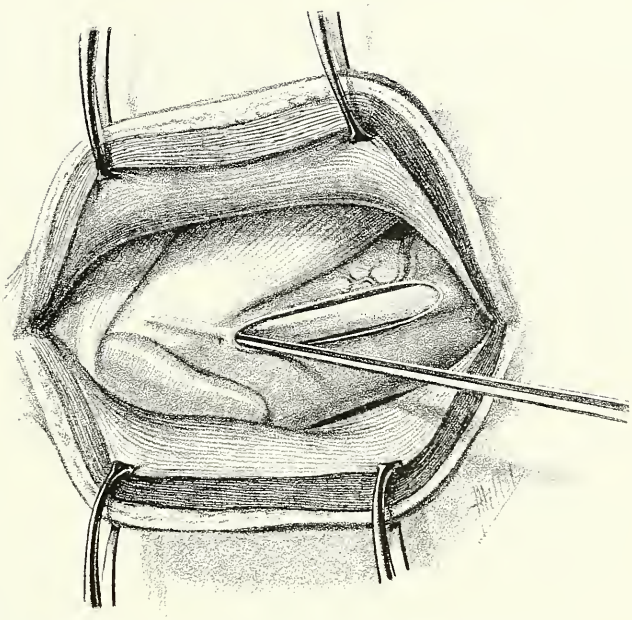


FIG. 717.—RESECTION OF RIGHT SHOULDER-JOINT.

Second stage: A grooved director is used to explore the bicipital groove

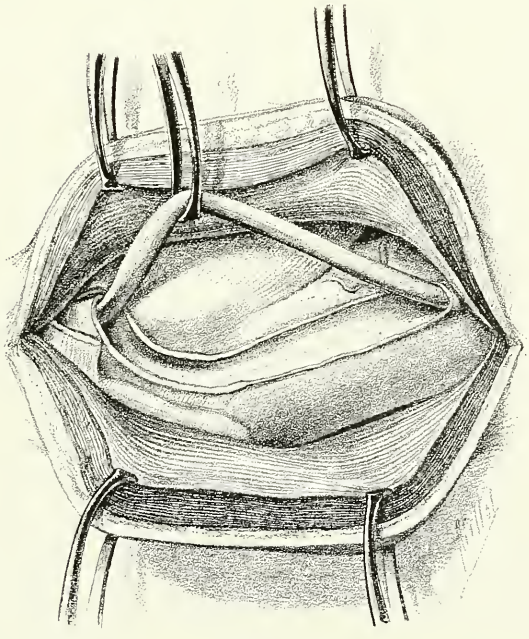


FIG. 718.—RESECTION OF RIGHT SHOULDER-JOINT.

Third stage: The long tendon of the biceps is drawn to one side with a hooked forceps.

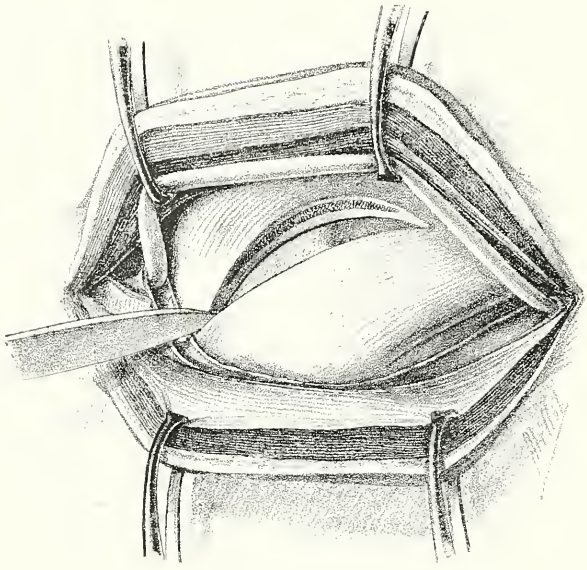


FIG. 719.—RESECTION OF RIGHT SHOULDER-JOINT.
Third stage: Anterior incision of capsule.

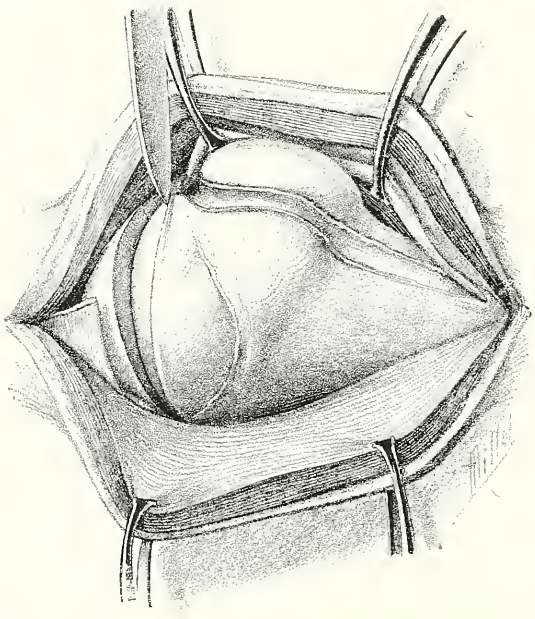


FIG. 720.—RESECTION OF RIGHT SHOULDER-JOINT.
Fourth stage: Posterior incision of capsule.

recognize, from before backwards, the attachment of the coraco-brachialis, pectoralis minor, and coraco-humeral ligament. Above the artery lies the musculo-cutaneous nerve, while beneath it are seen the median nerve in front and the musculo-spiral posteriorly.

Ways of Access to the Scapulo-Humeral Articulation.

1. **By a Vertical Extra-Coracoid Incision**—First Stage.—Incision of 7 centimetres, extending from the clavicle to the surgical neck of the humerus, and placed at equal distances from the acromion and clavicle. This incision should divide, at a single stroke, the skin, subcutaneous cellular tissue, deltoid aponeurosis, and deltoid muscle.

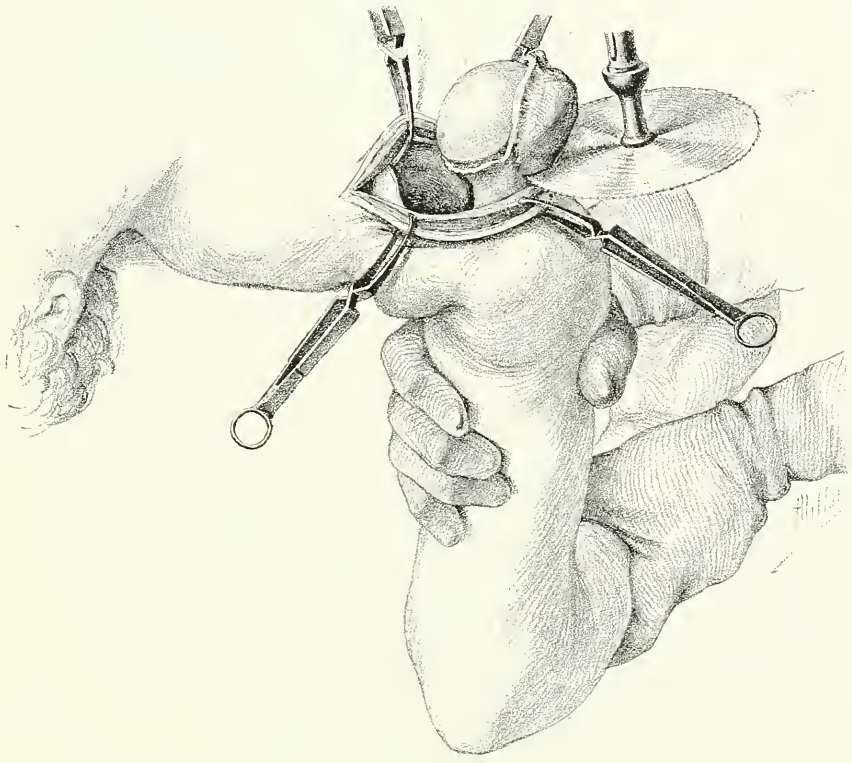


Fig. 721.—Resection of Right Shoulder-Joint.

Fourth stage: Division of the surgical neck of the humerus with the electric saw.

Second Stage.—We grasp the lips of the musculo-cutaneous wound with hooked forceps, and identify, from without inwards, the sub-deltoid serous bursa, bicipital groove, lesser tuberosity of the humerus, and insertion of tendon of subscapularis muscle; higher up, the coraco-humeral ligament; below, the circumflex vessels. We recognize the greater and lesser tuberosities of the humerus with the finger.

Third Stage.—We incise the sheath of the tendon of the biceps, which is then drawn inwards with a hooked forceps.

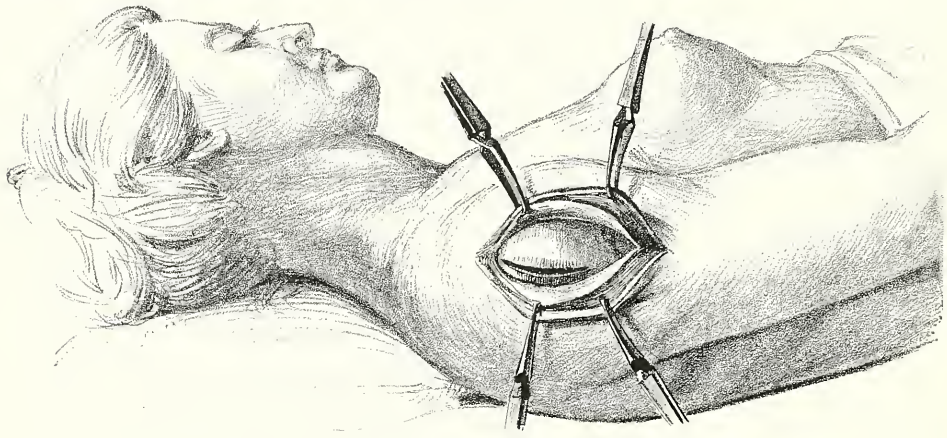


Fig. 722.—Subacromial Arthrotomy.

After retraction of the deltoid muscle the capsule is divided at the back.

Fourth Stage.—The assistant flexes the forearm on the arm, and places it in contact with the trunk in the position of external rotation. The tendon of the subscapularis muscle can then be readily divided, and the anterior capsular attachments, on the inner side of the lesser tuberosity.

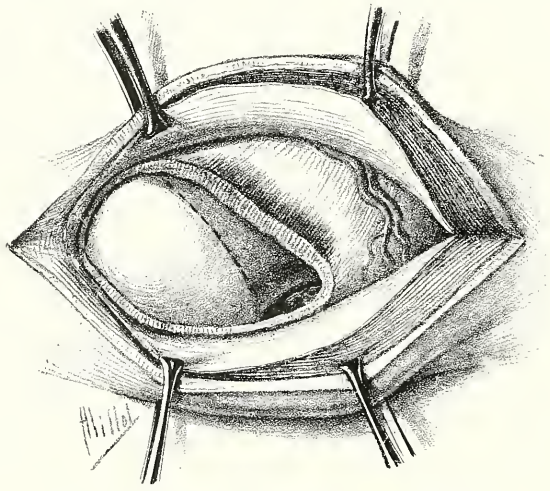


Fig. 723.—Subacromial Arthrotomy.

The arm having been placed in a position of forced internal rotation, the head of the humerus can be easily resected.

Fifth Stage.—The assistant places the limb in the position of internal rotation after extending the forearm. It is then easy to divide the posterior attachments of the capsule.

2. **By the Subacromial Route.**—The articulation can be opened, through the posterior part of the capsule, by making a vertical incision, beginning at the top of the acromion process of the scapula.

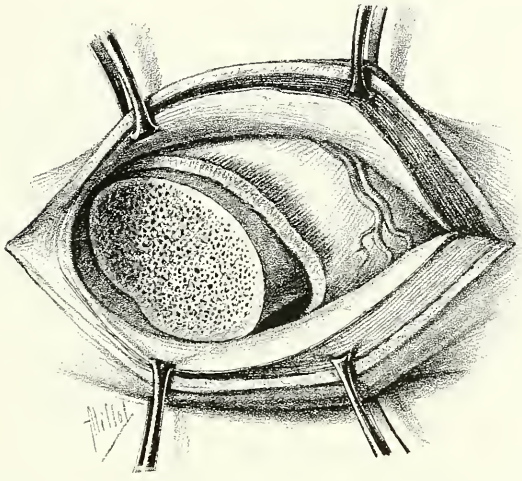


Fig. 724.—Subacromial Arthrotomy.
After resection of the head of the humerus.

First Stage.—The arm is placed in longitudinal contact with the trunk, in a position of extreme internal rotation. A vertical incision is made on

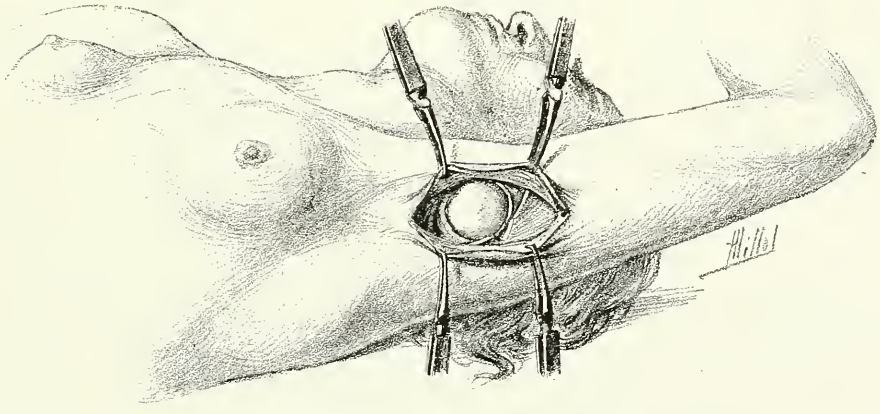


Fig. 725.—Resection of Head of Humerus through Axillary Route.
General sketch.

the prominence of the shoulder, beginning at the level of the tip of the acromion process, and ending about 6 or 7 centimetres lower down. The deltoid muscle and its deep aponeurosis are incised in succession.

Second Stage.—Incision of the capsule of the joint behind the great tuberosity, and division of the tendons of the infraspinatus and teres minor muscles.

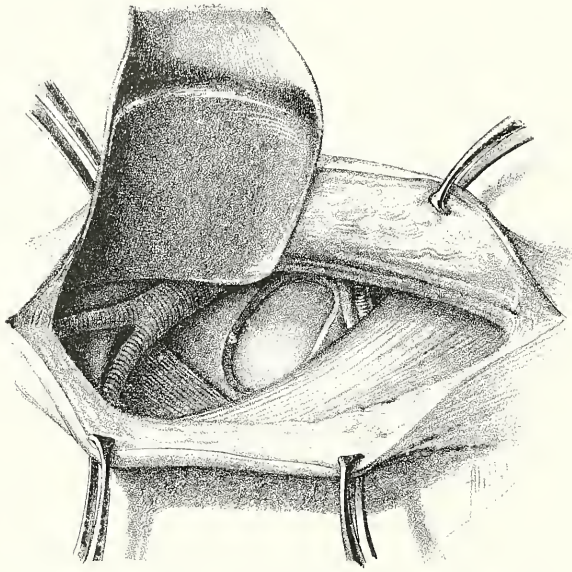


Fig. 726.—Resection of Head of Humerus through Axillary Route.

The articular capsule has been divided between the axillary and circumflex vessels.

Third Stage.—Exposure of the head of the humerus, which can be resected with a mallet and osteotomy chisel. The subacromial route is

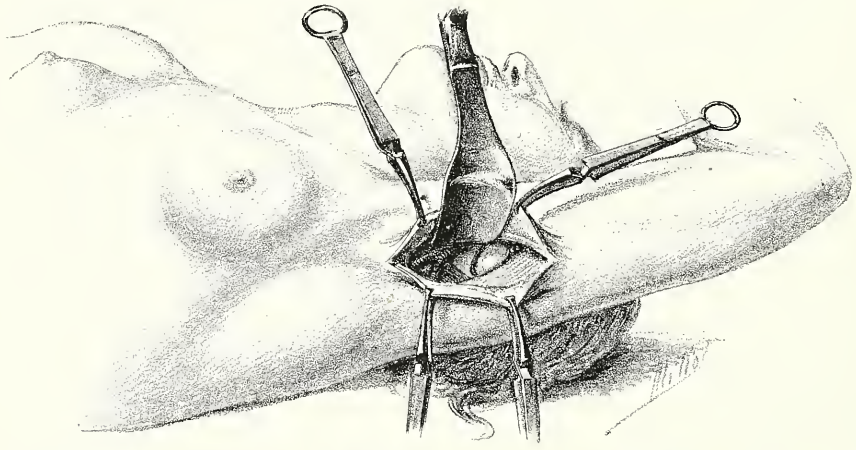


Fig. 727.—Resection of Head of Humerus through Axillary Route.

Luxation of head of humerus to outside of articular cavity. General sketch.

indicated when the intervention is on account of acute suppurative arthritis. It drains at the lowest point, after a simple arthrotomy or a resection of the

head of the humerus. While the patient is lying down, the drainage of the joint is perfectly assured.

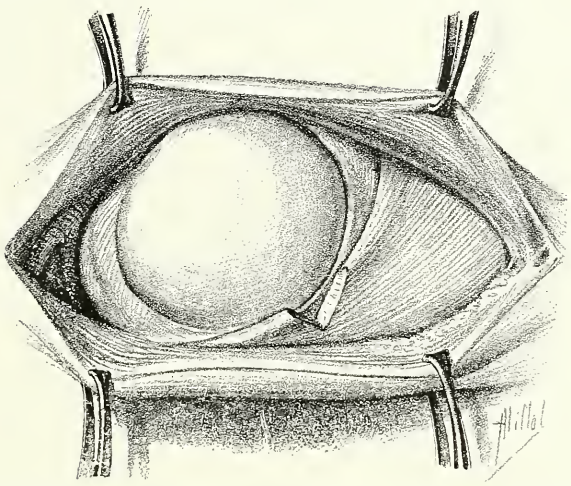


Fig. 728.—Resection of Head of Humerus through Axillary Route.

The forcible luxation sometimes necessitates division of the inferior gleno-humeral ligament.

3. **By the Axillary Route**—First Stage.—The arm is placed in a position of extreme abduction and external rotation. A cutaneous incision of

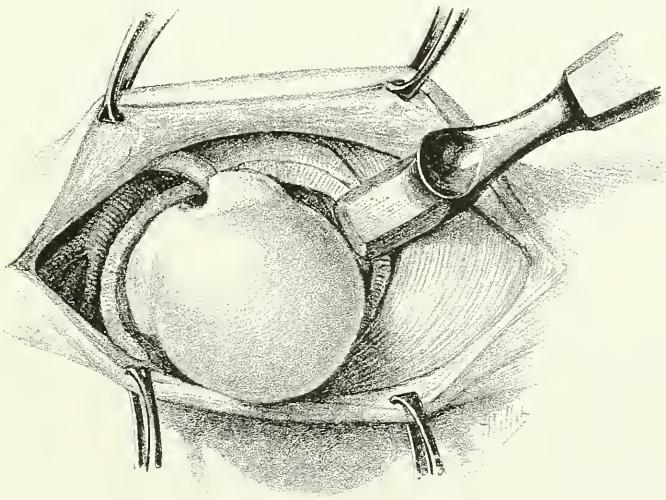


Fig. 729.—Resection of Head of Humerus through Axillary Route.

Resection of head of humerus in the plane of the anatomical neck.

8 centimetres is then made, parallel to the lower border to the great pectoral muscle, and with its middle point opposite the apex of the axillary fossa.

Division of subcutaneous fascia, retraction of the lips of the wound, and detachment of the cellulo-adipose tissue with blunt-pointed scissors, taking

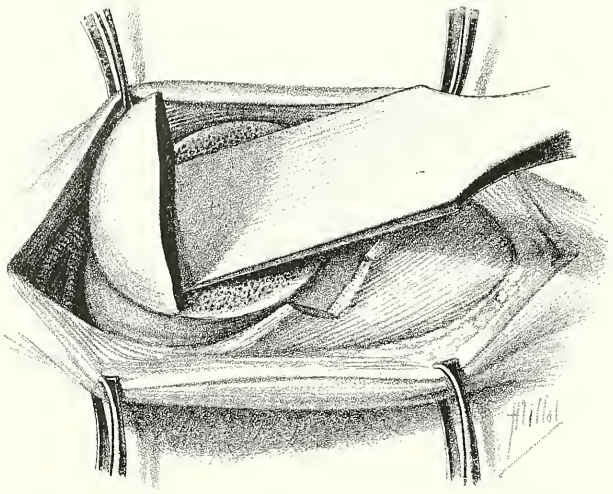


Fig. 730.—Resection of Head of Humerus through Axillary Route. Separation of the head of the humerus from the plane of the anatomical neck.

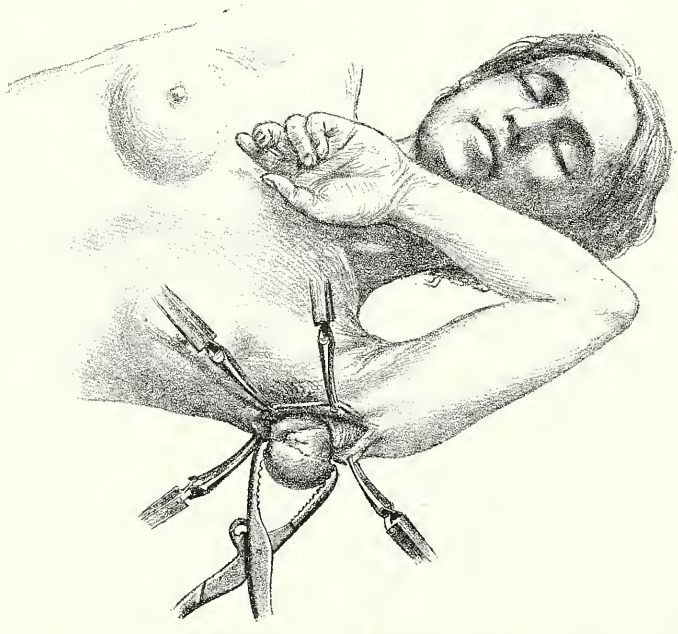


Fig. 731.—Resection of Head of Humerus through Axillary Route. Division of the humerus through the plane of the surgical neck.

care to proceed at the posterior aspect of the vasculo-nervous bundle, which is drawn aside with a retractor.

Second Stage.—Incision of the articular capsule, and exposure of the humeral socket. In Figs. 728 and 730 a triangular notch may be observed on the inferior aspect of the gleno-humeral ligament, which was very highly developed in that subject.

Third Stage.—Exposure of the head of the humerus, which can be resected, either through the anatomical neck with mallet and chisel, or through the surgical neck after luxation to the outside of the wound.

Resection of the Scapula.

First Stage.—Curvilinear incision beginning at the acromion process, and directed along the spine of the scapula, then downwards to end at its inferior angle.

Second Stage.—Exposure of the inferior angle of the scapula, which is detached from its muscular connections, and liberation of the body of the bone from below upwards, till its only fixed part is that in the neighbourhood of the shoulder-joint.

Third Stage.—Detachment of the acromion from the glenoid cavity, then from the coracoid apophysis, and ablation of the whole diseased body of the bone.

Fourth Stage.—Verification of the hæmostasis. Reunion and drainage.

Interscapulo-Thoracic Disarticulation.

I now proceed to place before the reader the manual details of this operation, as carried out by me for the first time in 1903. That case has been registered by the cinematograph.

First Stage.—Anterior incision, reaching from the base of the coracoid process in the axillary fossa, and carried down to the neighbourhood of the inferior angle of the scapula.

Second Stage.—Division of greater and lesser pectoral muscles, and section of the clavicle with a small saw with movable back.

Third Stage.—The arm is brought close to the patient's trunk. The knife is plunged into the upper part of the initial incision, and carried downwards along the anterior margin of the deltoid muscle, then backwards, taking care to preserve enough skin to provide for complete reunion of the wound. The musculo-cutaneous flap is dissected up from before backwards, taking care at the same time not to involve the neoplasm. The course of the incision must vary according to the size and shape of the growth.

Fourth Stage.—The arm is then raised, and we proceed to expose the inferior angle of the scapula and complete the section of all the muscular attachments of the scapula. The assistant elevates the arm progressively, and with it the mass of the neoplasm. The knife completes the division of the muscular attachments behind and above, and the scapula is detached with the arm, which is now attached to the trunk by the vasculo-nervous bundle only.

Fifth Stage.—The vasculo-nervous bundle, pediculized between the fingers of the left hand, is grasped with two long forceps with curved jaws, and divided on the distal side of the forceps.

Sixth Stage.—The artery, vein, and all other bleeding vessels are ligatured separately. Toilet of wound, reunion, and drainage. The operation is completed in some minutes, without loss of blood, and, as the cinematographic film proves, without the necessity of applying a single ligature before the ablation of the limb. The wound unites in eight or ten days. I shall now return to a further examination of the principal stages of the above procedure. The technique which I have devised is, indeed, far superior to any of the procedures which had previously been described. The operation is carried out with a minimum displacement of the limb, and the hæmostasis is reduced to the strictly necessary.

Interscapulo-Thoracic Amputation with Large Deltoid Flap.

First Stage: Supraclavi-Pectoro-Axillary Incision.—The anterior incision should begin above the clavicle at the anterior border of the trapezius muscle, pass along the anterior limit of the axillary fossa, and then be carried backwards to the inferior angle of the scapula. This incision

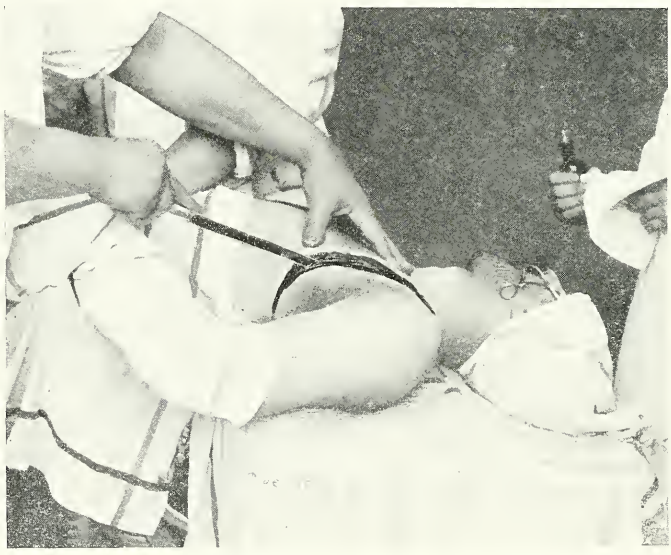


Fig. 732.—Interscapulo-Thoracic Disarticulation.

First stage: Supraclavi-pectoro-axillary incision.

presents the form of a crescent, the concavity of which is directed backwards. Its outline can be made to vary according to the configuration of the neoplasm, which is sometimes very voluminous. The surgeon should have foreseen, at the time of commencing the operation, the form and dimensions of the deltoid flap which will serve to close the wound.

FIG. 733.—INTERSCAPULO-THORACIC DISARTICULATION.

First stage: Ligature of acromio-thoracic artery and muscular vessels after division of the pectoral muscles.

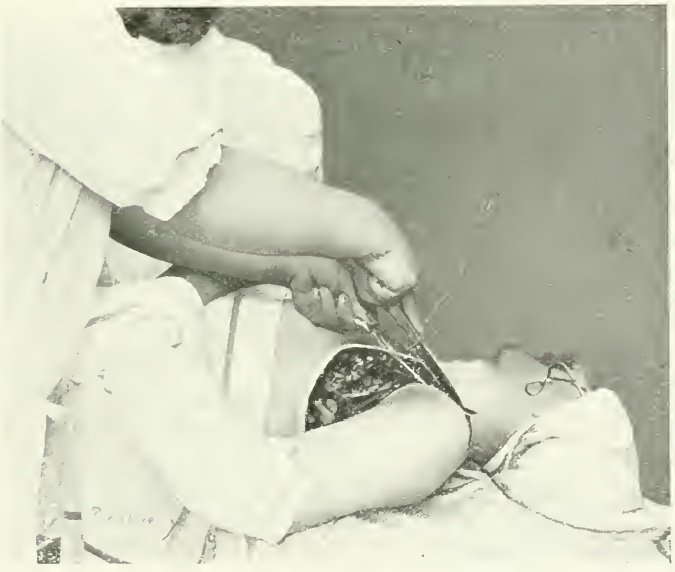


FIG. 734.—INTERSCAPULO-THORACIC DISARTICULATION.

Second stage: Division of the clavicle with a small saw with movable back, which is guided with a curved forceps.

FIG. 735.—INTERSCAPULO-THORACIC DISARTICULATION.

Third stage: The operator has commenced to form the deltoid cutaneous flap, the arm being in a position of moderate abduction.

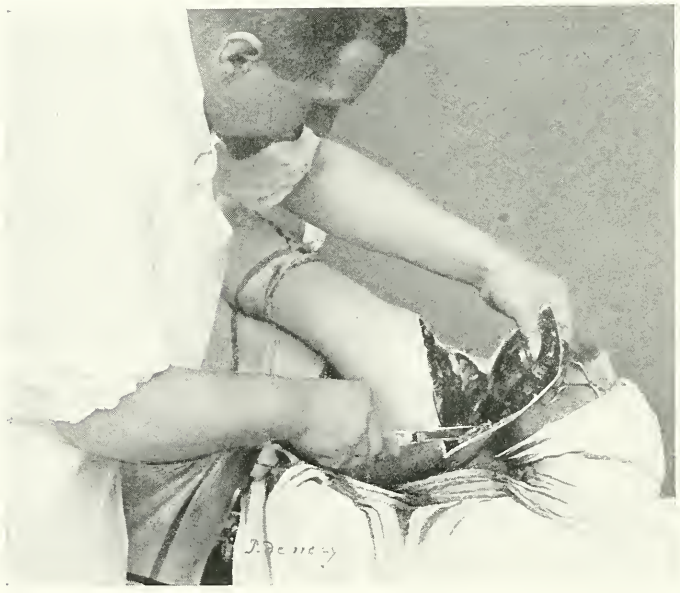


FIG. 736.—INTERSCAPULO-THORACIC DISARTICULATION.

Third stage: Dissection of deltoid flap, while the arm is gradually raised by the assistant.

FIG. 737.—INTERSCAPULO-THORACIC DISARTICULATION.

Fourth stage: Liberation of scapula from its last muscular attachments, while the assistant forcibly draws the arm upwards.

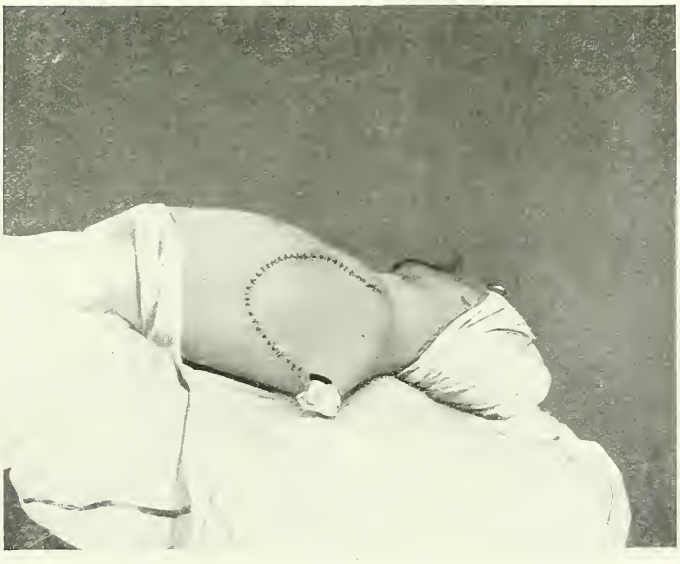


FIG. 738.—INTERSCAPULO-THORACIC DISARTICULATION.

Sixth stage: Aspect of suture. The posterior angle of the wound is drained.

Second Stage: Division of Pectoral Muscles and of Clavicle.—The section of the greater and lesser pectoral muscles is carried out on reintroducing the knife into the wound. With the left index-finger the operator can make sure that the division of the muscles has been completed.

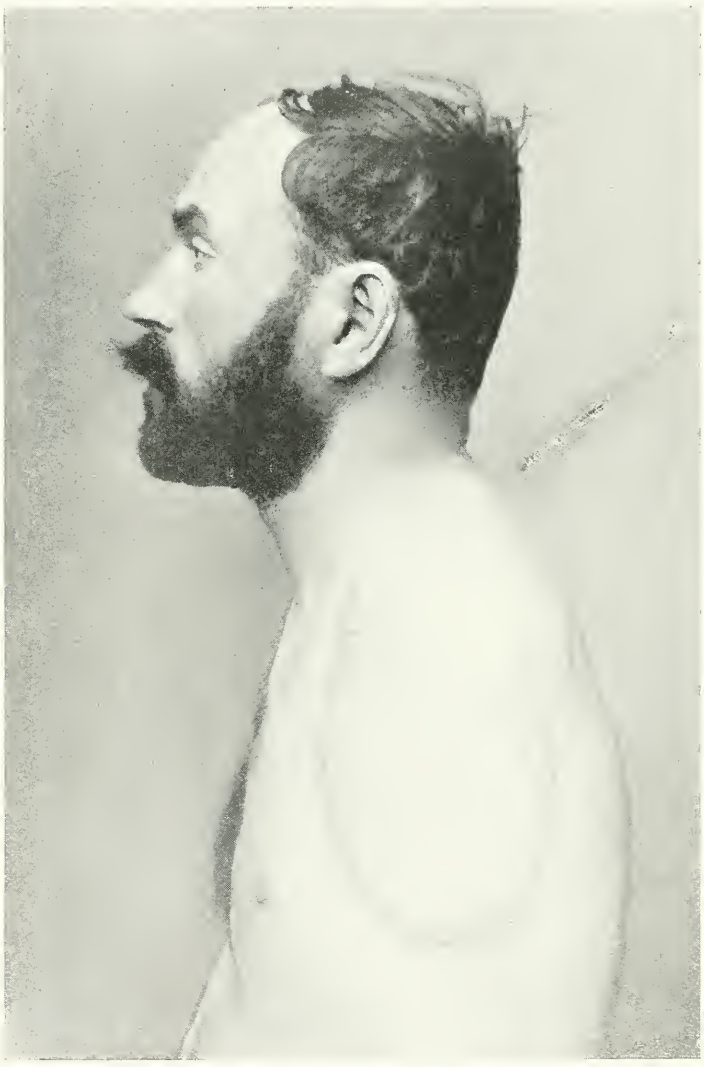


Fig. 739.—Interscapulo-Thoracic Disarticulation.

Appearance of cicatrix six months after the operation.

A curved forceps is then immediately placed beneath the clavicle, at the level of the superior extremity of the cutaneous incision, and this bone is divided with a small saw furnished with a movable back. During the first two stages of this operation the arm is held in the horizontal position, with a slight degree of abduction.

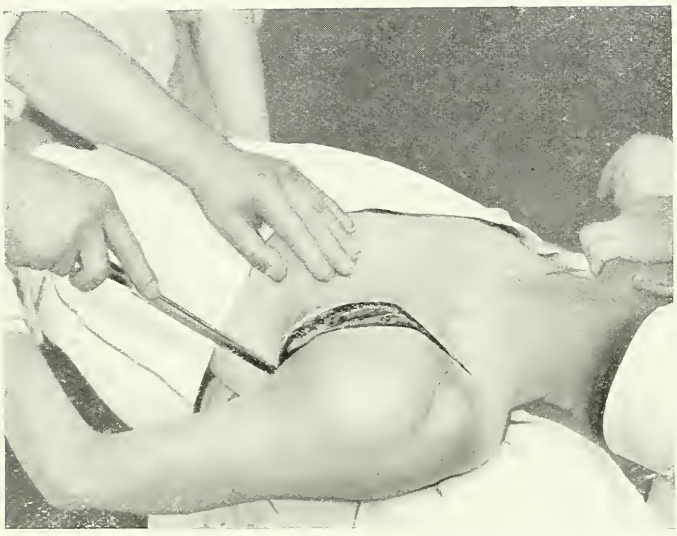


FIG. 740.—INTERSCAPULO-THORACIC AMPUTATION, WITH LARGE POSTERIOR SCAPULAR FLAP.

Operation. First stage: Anterior supraclavi-pectoro-axillary incision.

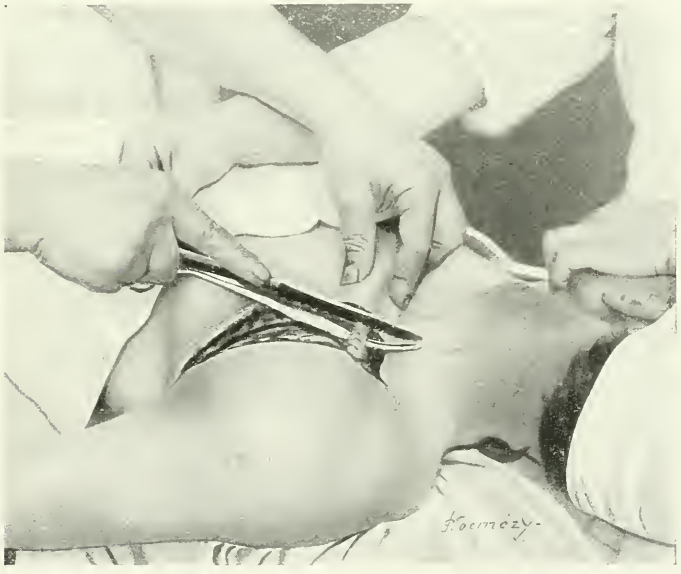


FIG. 741.—INTERSCAPULO-THORACIC AMPUTATION, WITH LARGE POSTERIOR SCAPULAR FLAP.

Division of the clavicle with the saw at the inner end of its external third.

FIG. 742.—INTERSCAPULO-THORACIC AMPUTATION, WITH LARGE POSTERIOR SCAPULAR FLAP.

Third stage: Posterior cutaneous incision along the external border of the scapula.

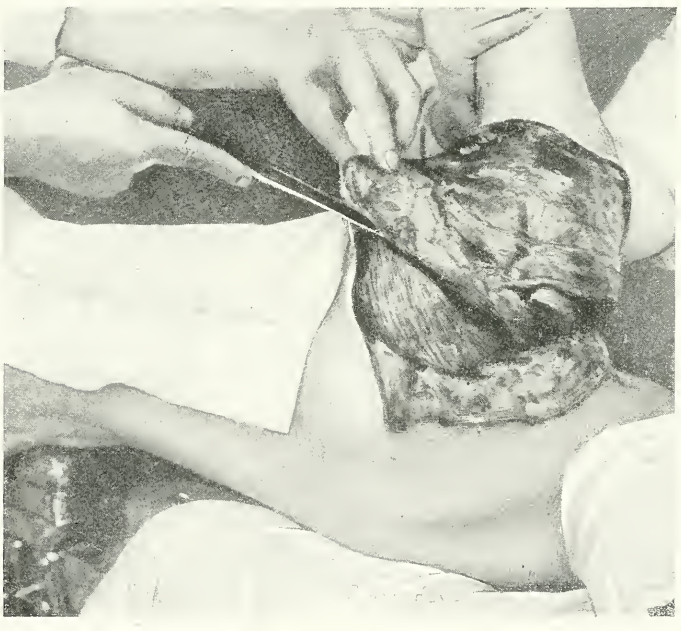


FIG. 743.—INTERSCAPULO-THORACIC AMPUTATION, WITH LARGE POSTERIOR SCAPULAR FLAP.

Fourth stage: After dissection of the posterior scapular flap we free it from its muscular attachments.

Third Stage: Formation of Deltoid Flap.—The arm is made to approach the side. The surgeon plunges the knife into the superior extremity of the first incision, then makes it follow the anterior border of the deltoid muscle and pass below the level of its inferior attachments, and finally directs it towards the posterior extremity of the first incision. We thus obtain a single flap in the form of an epaulette, the outline of which is clearly seen in Fig. 738. The dissection of this flap is very easy, for we are usually dealing with an osteo-sarcoma—that is to say, with a subperiosteal tumour which is separated from the subjacent soft parts by very loose cellular tissue. The dissection is continued over the posterior aspect of the scapula, and the flap is raised. Nothing now remains but to free the scapula from its muscular attachments.

Fig. 744.—Interscapulo-Thoracic Amputation, with Large Posterior Scapular Flap.

Aspect of completed suture.

Fourth Stage: Liberation of the Scapula.—The arm is then raised and drawn forcibly upwards by an assistant. The knife now frees the inferior angle of the scapula, and divides the latissimus dorsi, rhomboids, and levator anguli scapulæ; and, on continuation of the ascending traction of the limb, the serratus magnus muscle, which is the last to present itself. The assistant still continues to maintain the upward traction of the arm, and we now see brought into view, as the sole remaining bond of union between the upper limb and trunk, the vasculo-nervous bundle, which still remains wholly intact.

During the course of this operation we have but a few jets of blood, which come from the circumflex and muscular arteries. Of course, we must always be prepared to tie, or apply forcipressure to, an artery of abnormal size at whatever stage of the operation it may happen to be divided.

Fifth Stage: Pediculization of the Vasculo-Nervous Bundle.—The vasculo-nervous bundle is fully exposed as soon as the upper limb has come to be separated from its muscular and aponeurotic attachments. We then sponge it with a compress, and, as a measure of security, grasp it with two long curved forceps, which are adjusted in juxtaposition, and divide it beyond them. We can then grasp the artery and vein separately with a forceps, and tie each on the proximal side.

Sixth Stage: Ligature of Vessels; Reunion of Wound.—If the artery and vein have been grasped separately with the forceps, they are carefully tied with silk or catgut ligatures. When the forcipressure has first been applied *en masse*, the artery and vein are then isolated individually between the forceps and the heart, then grasped separately, and tied after removal of the curved forceps. We then carry out, in succession—ligature of the bleeding vessels, toilet of the wound, and reunion. When the surgeon is gifted with a precise *coup d'œil*, the deltoid flap should adapt itself exactly to the outline of the thoracic wound. Some points of interrupted silk suture are then arranged, and clips are applied in the intervals. A wick of gauze and a drainage-tube, or the latter alone, are placed in the posterior commissure of the flap.

Interscapulo-Thoracic Amputation with Posterior Scapular Flap.

This operation differs from the preceding one only in the detail of the formation of the autoplastic flap—that is to say, in the third stage. When the tumour has invaded the acromio-deltoid region, it is impossible to provide a sufficient amount of healthy tissues from the external aspect of the shoulder for the formation of the requisite extent of flap. Accordingly, on completion of the two first stages of the operation, the arm is raised by an assistant, and the knife is made to join the two extremities of the anterior incision almost in a direct line. This variety of the third stage enables us to carry out the operation in the most varied cases—that is to say, to modify the outlines of the external and posterior flaps according to the configuration and extent of the neoplasm.

Resection of the Shoulder.

Resection of the shoulder is carried out in cases of ankylosis, either simple or complicated by the presence of a vicious formation of callus; also in cases of tuberculous arthritis. The anterior route is usually chosen.

Operation.—The arm is held in the position of external rotation, in contact with the trunk.

First Stage.—The bistoury is made to penetrate at an equal distance from the acromion and coracoid processes, and passed down to the bone. It is then made to divide the tissues vertically through a distance of 8 centimetres.

Second Stage.—The lips of the wound, inclusive of the substance of the deltoid muscle, are retracted with hooked forceps, and the incision of

the capsule is completed, if necessary. The tendon of the biceps is not involved in the incision. It is grasped with a hooked forceps and drawn inwards. The head of the humerus is then dislocated by the manœuvre of

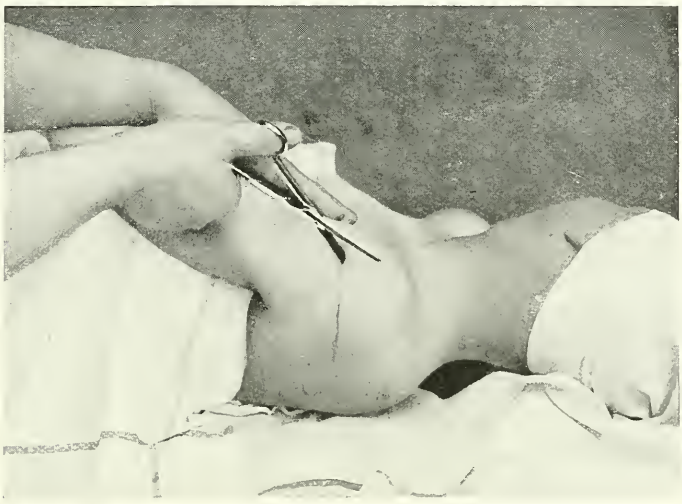


Fig. 745.—Resection of Shoulder-Joint.

First stage: Division of the soft parts.

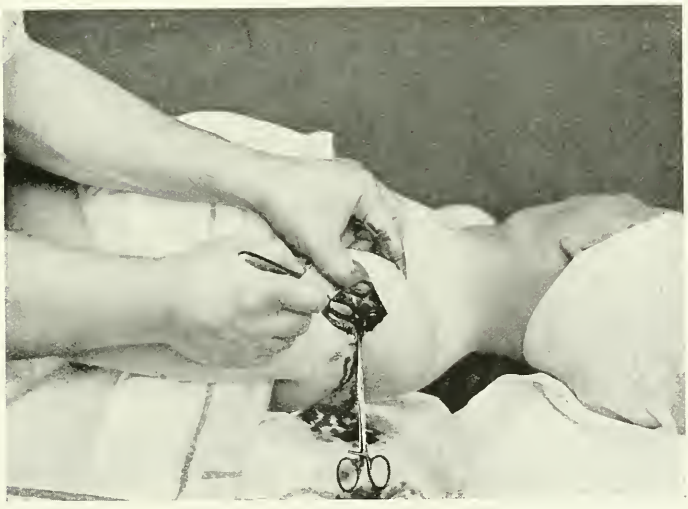


Fig. 746.—Resection of Shoulder-Joint.

Second stage: Denudation of the bicipital groove with the raspatory.

an assistant, who brings the patient's elbow backwards (downwards as regards the plane of the operation-table), and then pushes it forcibly upwards in order to luxate the head of the humerus through the wound.

Third Stage.—The luxation of the head of the humerus through the wound is facilitated by dividing the capsular attachments all around the

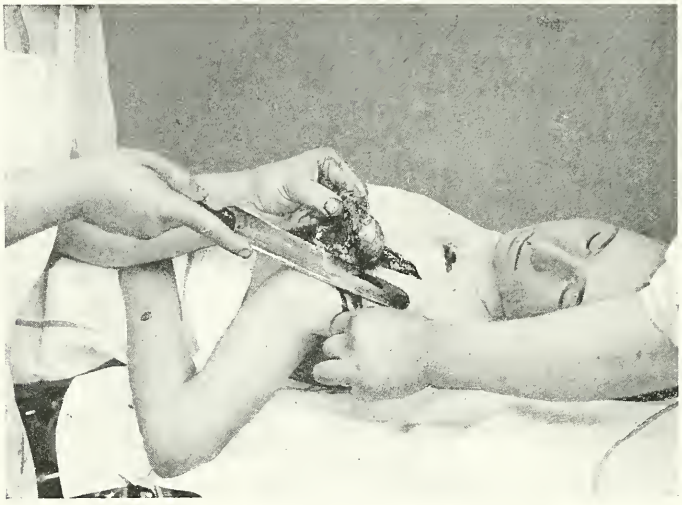


Fig. 747.—Resection of Shoulder-Joint.

Third stage: Luxation of head of humerus. Division of surgical neck with saw with movable back.

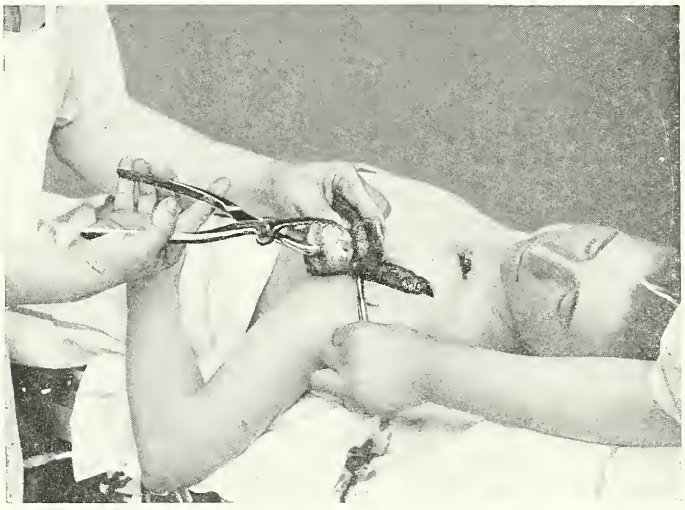


Fig. 748.—Resection of Shoulder-Joint.

Third stage: Ablation of head of humerus.

anatomical neck. A long curved forceps is then placed between the head of the humerus and the margins of the wound, for the purpose of protecting

the soft tissues, and the surgical neck of the bone is then divided, either with a saw worked with the hand, or with a circular saw.

Fourth Stage.—When we are dealing with articular tuberculosis, it is often necessary to resect the glenoid cavity, either with a bone forceps or with mallet and chisel. We then draw out the remnants of the capsule through the wound with curved forceps, and remove all fungosities with clawed forceps and curved scissors.

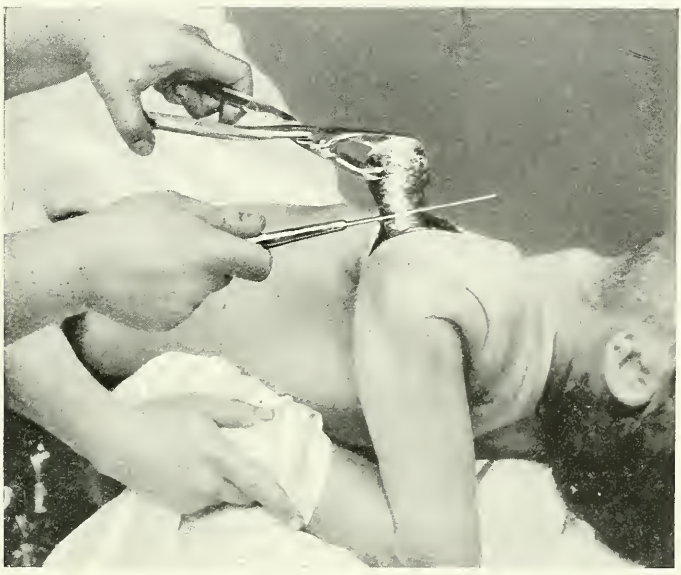


Fig. 749.—Removal of the Head of a Humerus affected with Tuberculous Osteitis.

Fifth Stage.—Immediate reunion of the wound may be carried out, with the precaution of drainage, when we are dealing with a case of ankylosis without any accompanying inflammatory action. In case of an infective lesion, or of a tuberculous arthritis, the cavity should be treated by aero-cauterization and tamponing.

Consecutive Atrophy of the Deltoid Muscle.

One of the tardy complications of most traumatic lesions of the shoulder-joint, such as the operation of resection or osteotomy, is atrophy of the deltoid muscle. This condition may supervene after a simple contusion, as well as after carefully conducted surgical operations in which the circumflex nerve has been preserved in perfect integrity.

OPERATIONS ON THE UPPER LIMB.

Traumatic Lesions.

Wounds of the arm may be reunited at once if aseptic; if not, they should be tamponed. When the wound has been reunited at first and afterwards becomes inflamed, it must be opened up, tamponed, and treated with continuous irrigation. When the wound was infected at first, and in case of involvement of tendons or nerves, the use of immediate suture is impracticable. When cicatrization has taken place, it may be carried out with all the precautions necessary for the realization of perfect asepsis.

Rupture and Hernia of Muscles.

This accident involves the biceps in most cases; in rarer cases the triceps is engaged.

When the diagnosis has been made immediately after the occurrence, a case of *muscular rupture* may be operated on by incision, evacuation of the clots, and suture of the torn muscle. When an interval has elapsed before recognition of the nature of the lesion, we must decide as to whether the procedure of suture is desirable. The muscular fibres should be approximated by application of a continued suture of fine silk. The edges of the aponeurotic incision are then united with a continued suture.

When a *muscular hernia* has to be treated by operation, the protruding portion must, in nearly every case, be removed by resection. The muscle is then united with a continued suture of fine silk, after which the divided aponeurosis is similarly treated.

Rupture of Tendons.

This lesion is treated by interrupted suture made with fine silk, either immediately or tardily applied.

Fracture of the Humerus.

When the fracture has taken place through the surgical neck, or through the middle or inferior third of the shaft of the humerus, the best way of securing perfect reduction is by applying extension at the elbow, and counter-extension at the side of the trunk in the same way as I have already recommended for reduction of old-standing luxations of the scapulo-humeral articulation (see above description). When the reduction has been completely effected, a plaster splint is applied on the inner side of the arm which involves three-fourths of its circumference, and is adjusted beneath the axilla, so as to secure counter-extension; while it bends rectangularly at the elbow, which it encloses with the adjacent upper third of the fore-

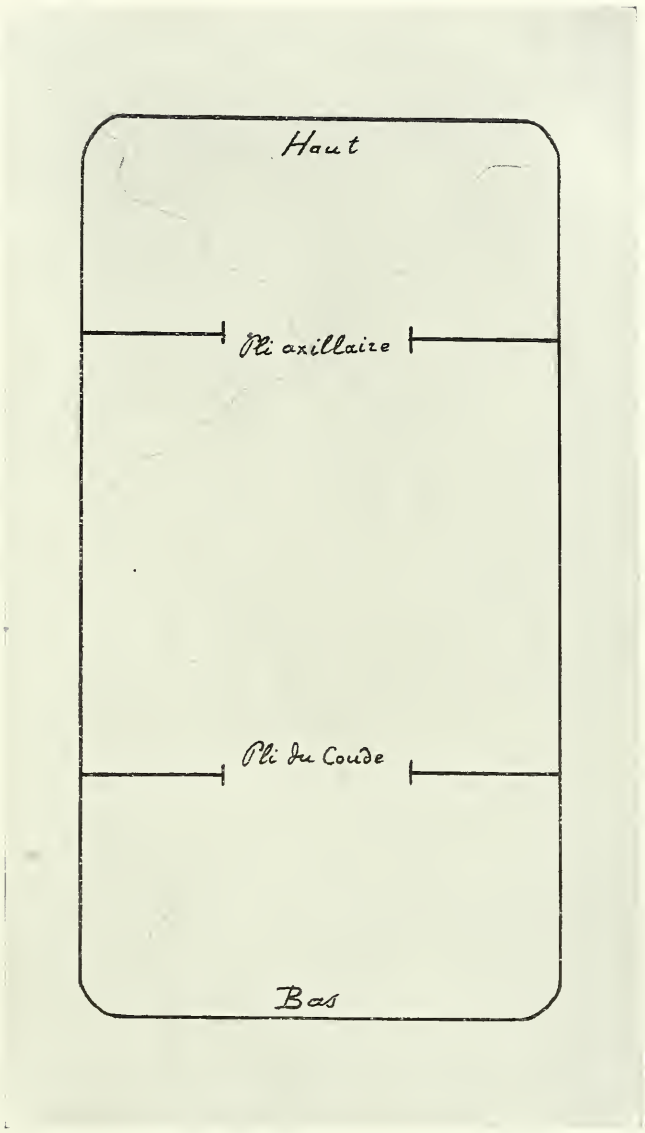


FIG. 750.—TREATMENT OF FRACTURE OF THE ARM.

Sixteen folds of tarlatan are adjusted, of the width of the circumference of the arm, and of the length of the distance from the axilla to the wrist. The outlines of the axillary and cubital folds are respectively represented. The intermediate or brachial portion of the apparatus is about 5 centimetres longer than the distance from the border of the axillary fold to the bend of the elbow. The apparatus is stitched along the wavy line shown in the figure. The four lateral incisions necessary for the adjustment are then made. The apparatus should then be fully soaked in a menstruum of warm water, in which an equal quantity of modelling plaster has been thoroughly mixed.

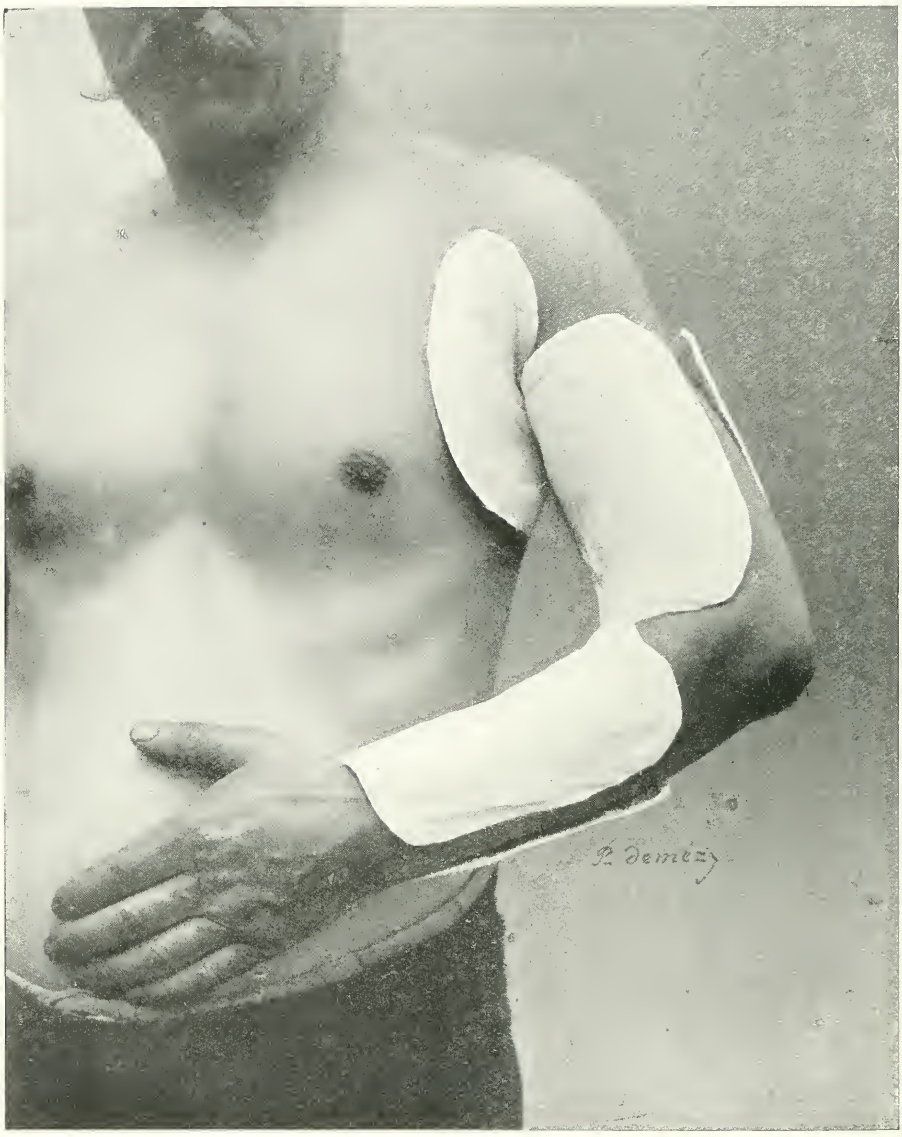


FIG. 751.—APPEARANCE OF THE PLASTER APPARATUS USED FOR FRACTURE OF THE ARM.

The projecting angles have been rounded off with scissors. Sterilized compresses are applied to protect the axillary fold and bend of the elbow from too direct contact. The thoracic fold is fixed in position by the application of a spica bandage, the brachial and antibrachial sections with a roller bandage.

FIG. 752.—LATERAL VIEW OF THE SAME APPARATUS.

The symmetry of the thoracic portion is seen, which is made to take a point of support on the thorax and beneath the axillas respectively, so as to provide a counter-extending force, which maintains the arm in a position of slight abduction. This position provides against possible outward displacement of the superior fragment under the influence of the tonicity of the deltoid muscle. The anti-brachial segment of the apparatus should reach nearly to the wrist.

FIG. 753.—APPEARANCE OF THE APPARATUS DIRECTLY AFTER REMOVAL.

The upper fold, which was adapted to the axillary borders, is clearly shown; also the thoracic crescent, the horns of which appeared rounded off in the preceding figure, but from this point of view necessarily seem angular. The brachial and antibrachial folds envelop a little more than three-fourths of the circumference of the arm and forearm respectively.

arm. This apparatus can be prepared and adjusted very readily. Its outline will be that of a rectangle, the breadth of which will equal the circumference of the arm at the middle, and the length that of the upper limb from the shoulder to the wrist. It is made with fourteen or sixteen thicknesses of book-muslin. Towards the upper end of this splint, two lateral incisions are made perpendicular to its longitudinal axis, which respectively involve, one on either side, about a third of the total width. This extremity is folded back at the axilla. The length of the humerus is measured along the apparatus, from the level of the lateral notches, and two similar ones are made at that distance from the first pair. A sterilized compress is now applied at the axilla with a gauze bandage, and another at the bend of the elbow. The apparatus, saturated with plaster, is now applied, care having been taken to turn back the upper end in the direction of the axillary fossa, and to fold the lower end around the upper part of the forearm. The intermediate portion is folded around the arm, and the apparatus is then fixed in position with a linen bandage. Care must be taken that the extension and counter-extension have not varied during the procedure. When the plaster is nearly dry, the extension and counter-extension are suppressed, and the elbow is brought to a certain distance from the side of the trunk. The forearm should be held in a sling, and in such a position as to retain the arm separated from the trunk by an angle of about 20 degrees. After the lapse of a few days, the apparatus can be forcibly pressed towards the body at the axillary fold, so as to bring the arm to the vertical position.

This apparatus is the only one which enables the surgeon to secure a perfect reduction. It appears to me to be superior to any of the others, and notably so to that of Hennequin, which is applied in a vertical position of the humerus, and is accordingly subject to the danger of permitting, in cases of fracture situated a little below the tuberosities, a swaying of the superior fragment outward.

Fracture of the lower extremity of the humerus, juxta-articular and intra-articular, will be described with those of the elbow.

Complicated Fractures.

When there has been extensive fracturing of the humerus, it will be well to tampon the wound, and establish continuous irrigation, the injured limb being placed in a curved iron-wire splint lined with cotton wadding and impermeable taffetas. A subcutaneous injection of 10 or 20 c.c. of mycolysine should always be administered.

The plaster apparatus is applied only after all danger of septicæmic complications has been removed. A window can always be readily constructed in the appropriate position for access to the wound. This is cut out with the saw when the apparatus has become thoroughly hardened, the wound having been previously covered with compresses, over which are adjusted, first, a layer of gummed taffetas, then some turns of a roller bandage. The compresses applied to the wound should always be narrow

enough to permit their ready removal through the window made in the plaster apparatus.

When the seat of a complicated fracture presents no evidence of infection, we can content ourselves with the application of an aseptic dressing and subsequent adjustment of a plaster apparatus.

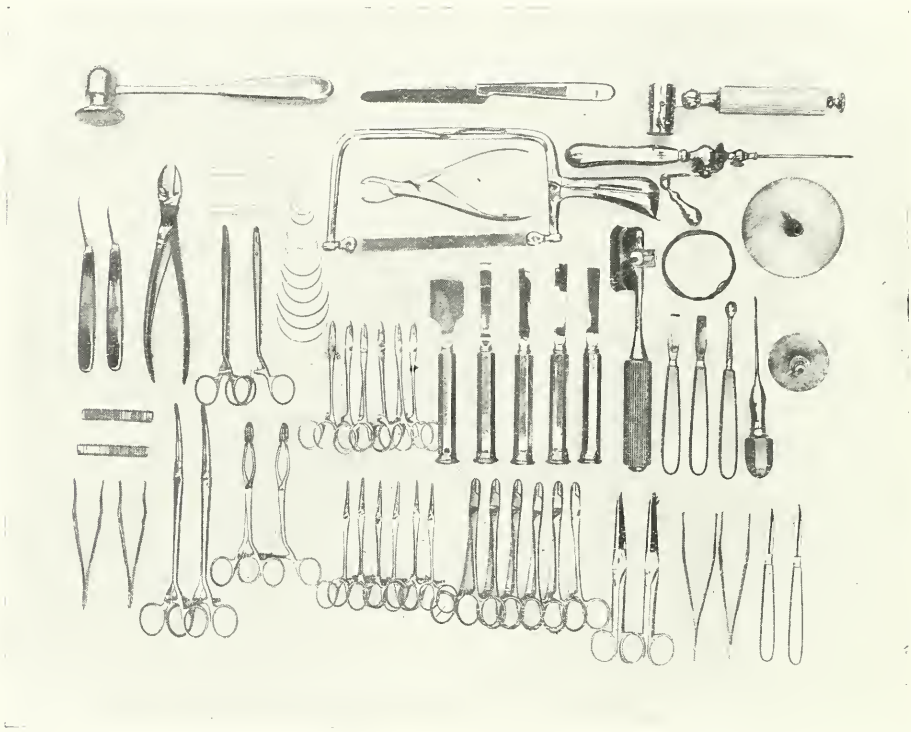


FIG. 754.—INSTRUMENTS REQUIRED IN THE SURGICAL TREATMENT OF PSEUDARTHROSIS.

From below upwards and from right to left: Two bistouries, two dissecting-forceps, two scissors, six artery forceps, six Championnière's forceps, two forceps with oval jaws, two long curved forceps, Michel's clips and two clip forceps; circular saw, perforator, curette, flat and curved raspatories, Doyen's *scie à curseur*, five straight chisels; six needle-holder forceps, series of curved needles, two forceps with eccentric jaws, Liston's forceps, two needles mounted on handles; circular saw of 50 millimetres diameter, maillechort thread, *saw à chantourner ;* series of drainage-tubes, Doyen's *perforator à cliquet*, saw-bearing handle, saw with movable back, mallet. Six Doyen's curved forceps should be added.

Pseudarthrosis of the Humerus.

Pseudarthrosis consequent on fracture of the humerus is not of very rare occurrence.

Operation—FIRST STAGE.—External incision, followed by exposure of the seat of pseudarthrosis, taking care to avoid the musculo-spiral nerve.

SECOND STAGE.—Isolation and revivification of the osseous extremities with the saw.

Third Stage.—Oblique perforation of the adjacent ends of the fragments, and reunion of the same with metallic suture. The free ends of the latter may be left long, so as to reach near the surface of the skin. This artifice facilitates their ultimate removal.

Fourth Stage.—Reunion, drainage.

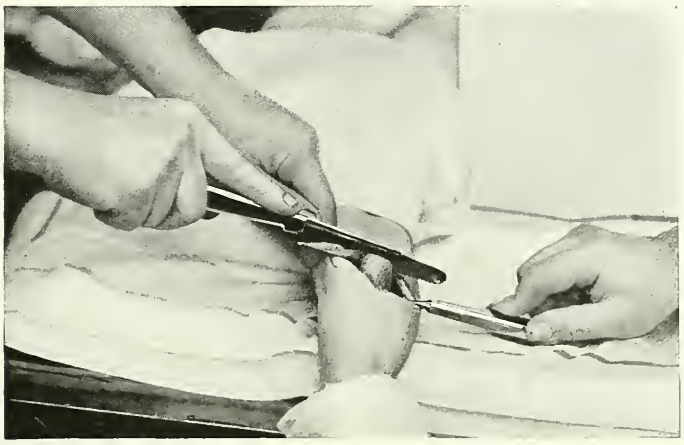


Fig. 755.—Pseudarthrosis of Humerus.
Revivification of lower fragment with saw with movable back.

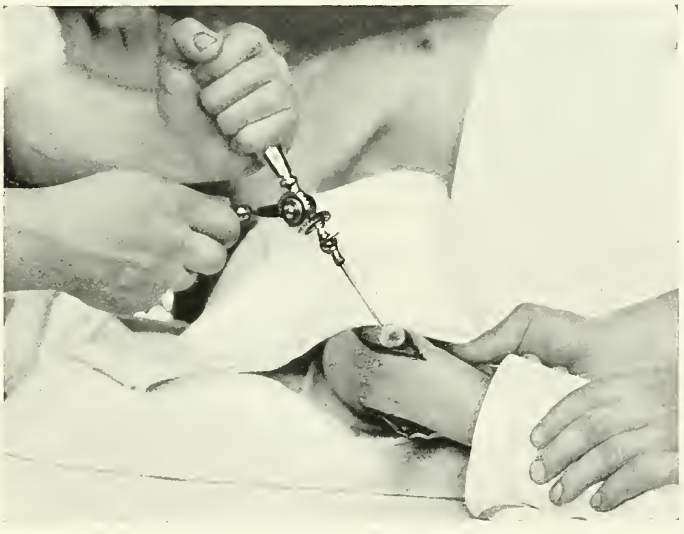


Fig. 756.—Pseudarthrosis of Humerus.
Perforation of superior fragment for passage of metallic suture.

Painful Callus.

The involvement of the musculo-spiral nerve, or even of a nerve branch of less importance, may call for the resection of an exuberant callus. This

must be carried out with the aid of the mallet and chisel. An Esmarch's bandage is applied above the level of the field of operation, so as to prevent this delicate procedure from being obstructed by the difficulty of a continuous oozing of blood. It should be applied high up, close to the axillary border.

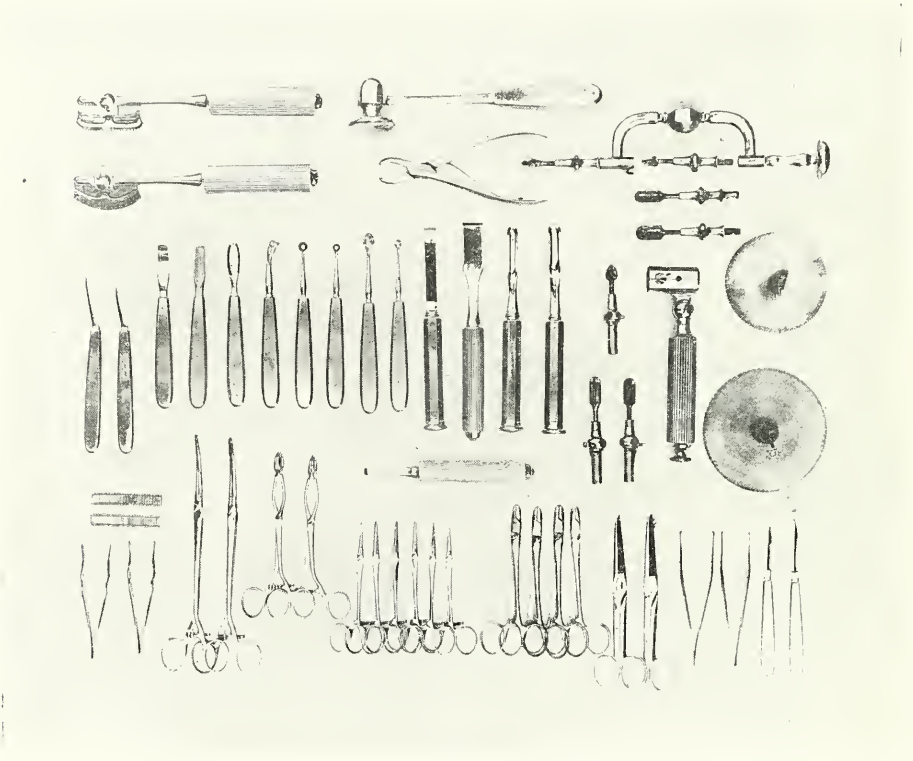


Fig. 757.—Instruments required for Osseous Evacuation of the Humerus.

From below upwards and from right to left: Two bistouries, two dissecting-forceps, two scissors, four artery forceps, six Championnière's forceps, two forceps with oval jaws, two long curved forceps, two clip-forceps, a number of nickel clips; two circular saws of 6 and 8 centimetres diameter respectively, saw-holder handle, two cylindro-spherical burrs, cylindro-conical burr, two curved cold chisels, two straight chisels, series of curettes, various types of raspatory, two needles mounted on handles, two mounted cylindro-spherical burrs, *trepan à cliquet ;* gouge-forceps, mallet, two models of Doyen's *scie à curseur.* Ten Doyen's hooked forceps should be added.

Inflammatory Lesions.

Phlegmons require treatment by the hypodermic administration of mycolysine, and the subsequent adoption, if necessary, of precocious incision.

Osteomyelitis of the humerus may be propagated along the diaphysis without reaching either shoulder or elbow-joint. My teaching on this head

is that, whether the case be operated on in the acute stage or at the remote period of fistulæ and sequestra, osseous evacuation must always be carried out.

Osseous Evacuation of the Humerus.

Osseous evacuation of the humerus is carried out according to the general technique already described in the first volume of the present work. I prefer the employment of electric instrumentation in this procedure.

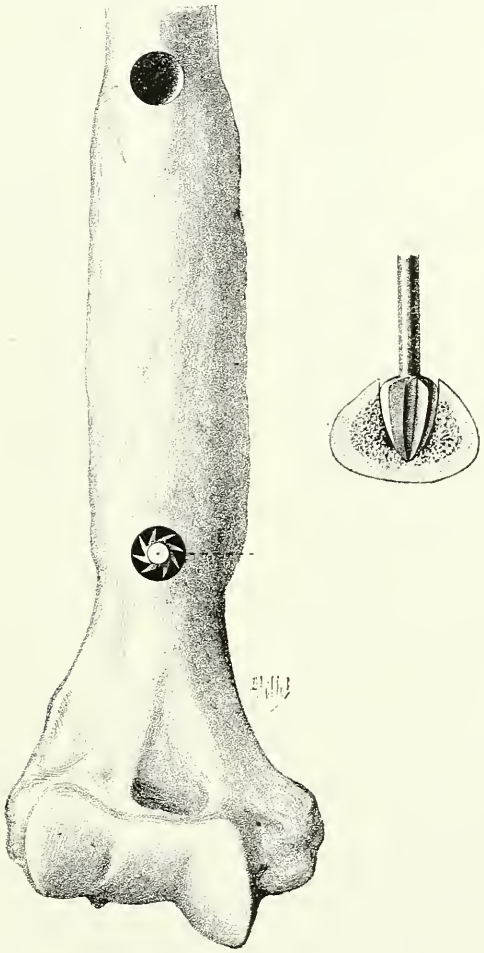


Fig. 758.—Evacuation of the Humerus.

Diagrammatic figure. Perforation of the bone with the cylindro-spherical burr at the upper and lower limits of the pathological swelling.

1. *Electrical Instrumentation.*

The operation is carried out sometimes at the middle of the affected bone, sometimes near one of the epiphyses, sometimes over its whole length.

When the affection which calls for this procedure is one of old standing, there will be habitually found a fusiform swelling, which may be used as a guide to the extent over which the operation should be carried out. Then it must be borne in mind that the employment of electrically worked instruments for the purpose of osseous evacuation requires from the surgeon the possession of both considerable muscular strength and great manual dexterity.

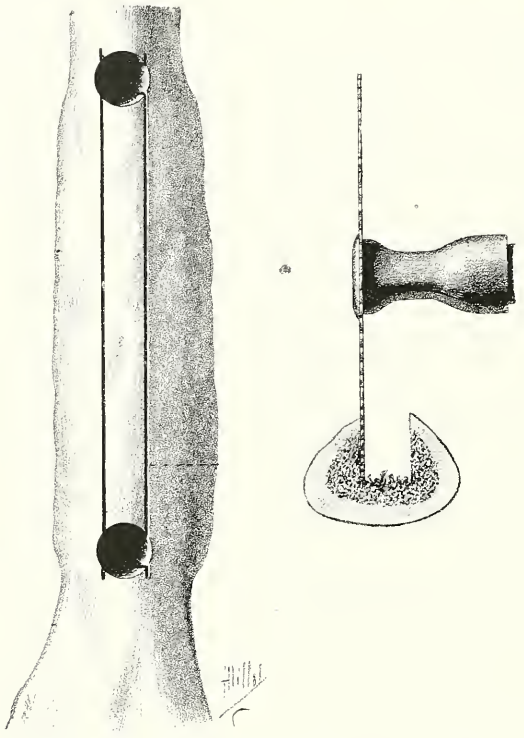


Fig. 759.—Evacuation of the Humerus.

Double longitudinal section of the bone with the circular saw, providing for exposure of the cavity of the medullary canal.

Operation—First Stage.—Longitudinal antero-external incision, after application of the elastic bandage, between the axillary fossa and the acromion process. Exposure of the requisite extent of the surface of the bone with a raspatory.

Second Stage.—Perforation of the humerus at the upper and lower limits of the segment which is about to be evacuated with a cylindro-conical drill, which is worked by the electric motor. The drill penetrates to the medullary canal in a few seconds. The diameter of the orifices can be increased by using the burr as a mortising instrument for hollowing out their margins.

Third Stage.—Two parallel sections are then made with the circular saw tangential to those orifices, and reaching to the central axis of the bone.

Fourth Stage.—The osseous bridge thus marked out is then mobilized with the mallet and gouge. The instrument should be made to act successively from above downwards and from below upwards in the orifices hollowed out with the burr. The medullary cavity is thus laid open without vibration of the bone, and without danger of fracture. The medullary cavity is immediately explored with the curette. If pus appears, some is withdrawn for bacteriological examination, and—when tuberculosis is suspected—for inoculation on the guinea-pig. When sequestra are present, they are exposed by sponging, and those which can be mobilized are carefully extracted. In the case of a hydatid cyst, the membrane and as many as possible of the daughter cysts are also extracted.

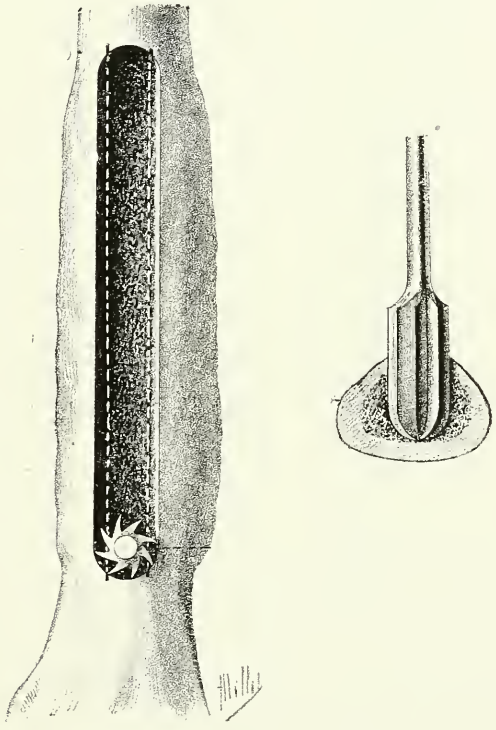


Fig. 760.—Evacuation of the Humerus.

Rasping of the medullary cavity with the cylindro-spherical burr used as mortising instrument.

Fifth Stage.—We now proceed to the evacuation and rasping down to a smooth surface of the whole of the diseased cavity with the cylindro-spherical burr of 12 millimetres diameter. The instrument is first made to widen the gutter which has been formed with the saw. We then reach progressively the whole extent of the circumferential wall of the diseased medullary canal by inclining the head of the instrument alternately from one side to the other. Whether the bone has been rarefied or eburnated

by the disease, nothing can resist the action of the mortising burr when employed in the way which I have devised when the operator knows how to manipulate it.

The walls of the osseous pathological cavity are thus made smooth and clear to that degree that, after having dislodged the osseous sand by irrigation and sponging out the cavity, it is very easy to judge whether we have reached far enough, and attained the compact bone structure. Fig. 761 shows respectively how the mortising burr should be inclined when we want

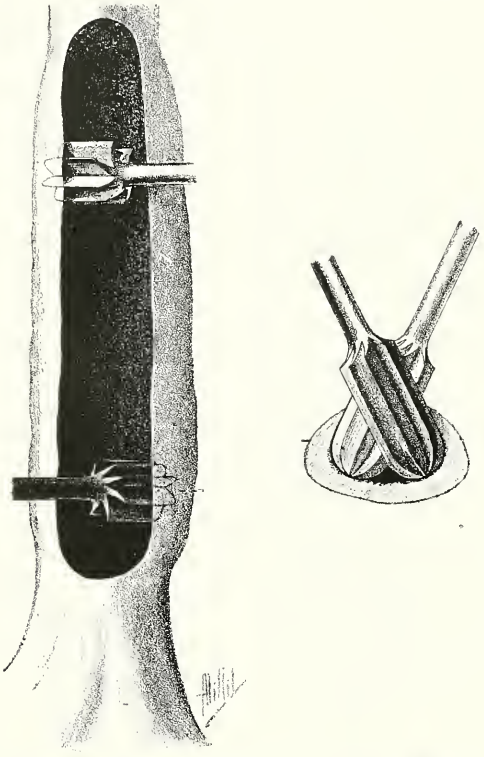


Fig. 761.—Evacuation of the Humerus.

Inclination of burr, first to right and then to left, so as to diminish the resistance of the diaphysis.

to diminish the solid thickness of the bone. Fig. 762 shows how we can evacuate a very resistant bone extensively without further widening of the orifice originally made to open into the medullary cavity.

This procedure enables us to carry out the most extensive osseous evacuations without risk of fracture of the affected bone.

Sixth Stage.—Verification of the field of operation, extirpation and curettage of fistulous tracts, antiseptic tamponing. Only in exceptional instances have we to ligature some small vessels.

2. *Manual Instrumentation*

The operation thus carried out differs in the second and third stages only.

Second Stage.—The humerus is perforated with the *trepan à cliquet* and the same cylindro-conical burr of 12 millimetres diameter which forms an item of the electrical instrumentation. When the bone is a large one, we immediately enlarge each of the two orifices with a cylindro-spherical burr of 16 or 20 millimetres diameter, mounted on the *trepan à cliquet*.

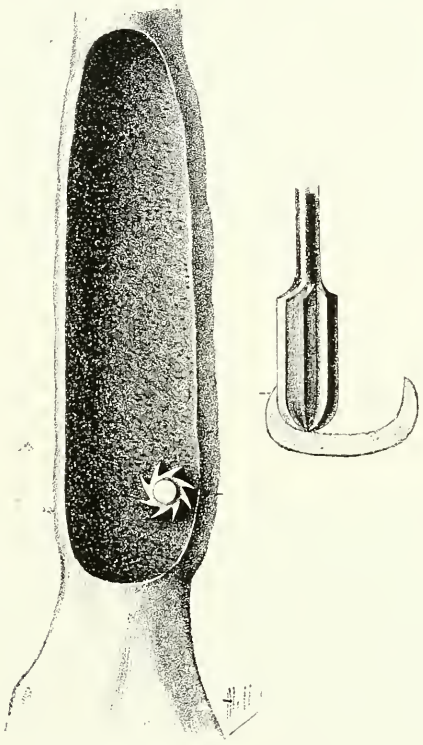


Fig. 762.—Evacuation of the Humerus.

Vertical action of the burr when we want to form an infundibuliform cavity.

Third Stage.—The two vertical sections are then made tangential to those orifices with the help of a *scie à curseur* with convex cutting edge. The other stages of the operation are proceeded with in the way above described.

Subsequent Care of the Case.

The external dressings should be changed every day. The deep-seated dressing is removed sometimes between the third and eighth day, either in progressive stages or at once. The compress is moistened with warm oxygenated water diluted to 1 in 20; it then swells up, and becomes gradually

FIG. 763.—EVACUATION OF HUMERUS WITH ELECTRICAL INSTRUMENTATION.

Second stage: Perforation of the bone with the cylindro-spherical burr at the upper extremity of the diseased portion.

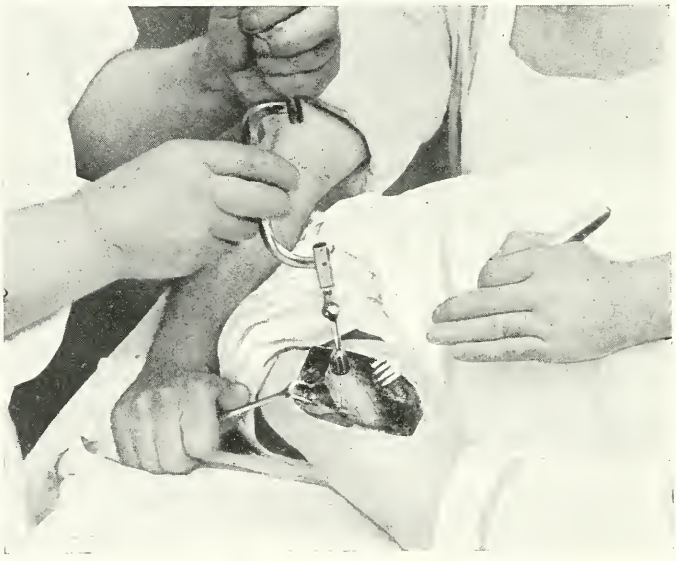


FIG. 764.—EVACUATION OF HUMERUS WITH MANUAL INSTRUMENTATION.

Second stage: Enlargement of the superior orifice which has just been pierced with the *trepan à cliquet* and conical drill.

FIG. 765.—EVACUATION OF HUMERUS WITH MANUAL INSTRUMENTATION.

Enlargement of inferior orifice with *trepan à cliquet* and cylindro-spherical burr of 16 millimetres diameter. The diseased medullary segment is thus destroyed.

FIG. 766.—EVACUATION OF THE HUMERUS WITH ELECTRICAL INSTRUMENTATION.

Third stage: Second longitudinal section with circular saw. Opening up of the diaphysis by the extirpation of a longitudinal osseous bridge.

FIG. 767.—EVACUATION OF THE HUMERUS WITH ELECTRICAL INSTRUMENTATION.

Fourth stage: Opening of the medullary canal. Action of the gouge at the level of the superior orifice. Mobilization of the diaphysary osseous bridge for definitive resection.

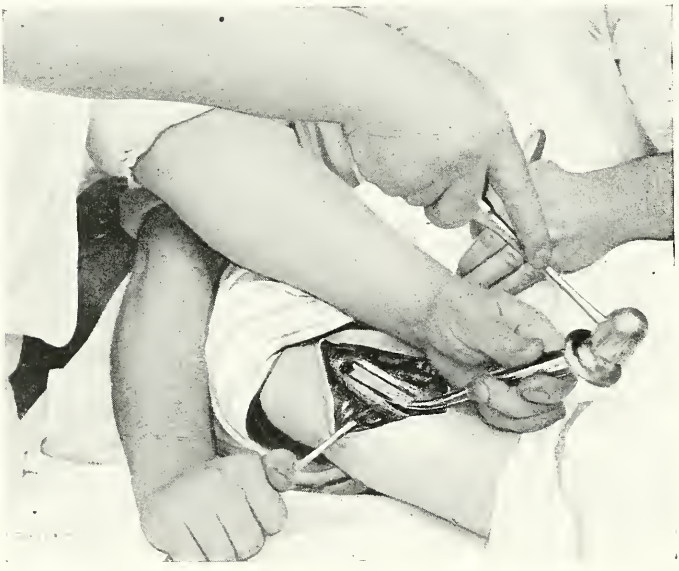


FIG. 768.—EVACUATION OF THE HUMERUS WITH ELECTRICAL INSTRUMENTATION.

The diaphysary osseous bridge, which is now adherent only in the vicinity of the inferior orifice, is completely mobilized with the help of the mallet and gouge.

detached from the underlying surface. When completely removed, the tamponing is renewed, but less tightly. Small projecting osseous lamellæ may be removed at certain points. The process of cicatrization is completed in two, three, or four months, the period varying with the extent of the field of operation and the degree of vitality of the tissues involved. The tamponing should be repeated till the deep granulations have reached the level of the surface of the wound.

Fig. 769.—Evacuation of the Humerus with Electrical Instrumentation.

Fifth stage: Rasping out the pathological cavity with the cylindro-spherical mortising burr.

When the cicatrization has been completed, the patient should be still kept under observation, lest a small fistula should form. When we are satisfied that the process of healing is definitive, the whole of the cicatricial tissue which is adherent to the bone should be extirpated; the skin can then be mobilized in such a way as to secure a linear reunion of the edges of the wound.

Varnishing the Bony Tissue.

It has been proposed to varnish the wall of the osseous cavity with antiseptic preparations of various kinds. We have recommended for this purpose a paste of proteol (casein formate) and paraffin. Ultimate elimination of those foreign matters is, however, almost the rule.

Tuberculosis of the Humerus.

Tuberculosis of the humeral diaphysis is rarely met with. The procedure of osseous evacuation is carried out as in a case of osteomyelitis.

Hydatid Cysts of the Humerus.

The sole case which I have had the opportunity of observing and operating on was one in which nearly the whole of the diaphysis was involved. The operation, which was carried out according to my usual technique of osseous evacuation, enabled me to obtain complete cicatrization without compromising the solidity of the shaft of the humerus.

Operations on the Arteries.

Aneurisms.

Aneurisms of the brachial artery and arterio-venous aneurisms are treated by extirpation of the sac, with ligature of the affected vessel above and below, or by suture of the vascular orifices.

Tumours of the Arm.

We have little to enumerate in this connection but muscular sarcoma and osteo-sarcoma. When the former has been recognized at an early date, it should be treated by electro-coagulation; the same is to be said of osteo-sarcoma. Amputation should be adopted only as a last resource. The diagnosis should always be confirmed by radiography.

Disarticulation of the Shoulder-Joint.

This amputation should be carried out with the formation of a racket-shaped flap, the outline of the cutaneous incision varying according to the state of the integument affected by the traumatism or invaded by the neoplasm.

Operation.—The patient is anæsthetized in the position of dorsal decubitus, the shoulder which is to be operated on being placed opposite the light. Immediate forcipressure of the vessels can be dispensed with when we have a reliable assistant to compress the subclavian artery.

Left Side—*First Stage.*—The arm is held close to the patient's side. The knife is plunged between the acromion and coracoid processes, and made to penetrate the cavity of the articulation; a longitudinal incision of 10 centimetres is then made, and the knife is carried around, below, and then behind, the border of the deltoid, till reaching a point on the posterior aspect of the arm at a level of 4 or 5 centimetres above the axillary border. The assistant raises the arm as the knife is carried backwards and then upwards.

Second Stage.—The arm is removed from the side of the trunk. The surgeon, who stands close to the lower part of the patient's body, then moves towards the head, and, plunging the knife in the direction of the

axillary fossa, proceeds to continue his incision in racket outline to the point at which the anterior longitudinal incision had ended.

Third Stage.—The knife is passed outwards and backwards, and divides everything down to the bone. On the inside the great pectoral muscle is carefully divided, and the axillary vessels, when exposed, are grasped with long curved forceps. The knife passes immediately below and completes the circular section.

Fourth Stage.—The posterior lip of the outlined stump is detached from the articulation, and the knife is plunged in the direction of the coracoid apophysis, the blade invading the capsule of the joint, and the arm is forcibly rotated inwards. The knife is now moved to and fro, as if to reach the head of the humerus, while the assistant rotates the arm outwards, so as to present a succession to the cutting edge the whole extent of the anterior half of the articular capsule.

The head of the humerus is now exposed, and the assistant brings the elbow backwards and makes it to project in the wound.

Fifth Stage.—The knife passes between the head of the humerus and the glenoid cavity, dividing all opposing tissues, and ends by section of the remaining fibro-muscular tissues at the back.

Sixth Stage.—Separate ligature of artery and of vein. Reunion and drainage.

When there appears to be a danger of infection, tamponing is carefully carried out, and the cutaneous margins are but reunited in part, at the upper portion of the racket outline.

Right Side—*First Stage.*—The longitudinal incision is carried down in the direction of the axillary fossa for a distance of 5 or 6 centimetres.

Second Stage.—The arm is raised and held at some distance from the patient's body. The surgeon stoops and passes the knife, point upwards, into the axillary fossa, so as to reach the first incision and continue it behind, rejoining the original anterior incision, as the assistant lowers the arm to the outside in order to facilitate the completion of the flap.

Third Stage.—Division of the great pectoral muscle at the inner side of the wound, forcipressure of the vessels, and immediately beyond the forceps, division of the whole of the remaining tissues down to the bone, first at the inside, then behind, and lastly on the outside.

Fourth Stage.—The posterior lip of the stump is raised in order to expose the articular capsule, and the disarticulation is carried out, as above described, by rotation from within outwards. The rest of the operation is conducted according to the same technique.

Amputation of the Arm.

The methods of carrying out this procedure which yield the best results are those of circular incision with formation of a cutaneous cuff, and formation of two flaps of equal size and form. In cases of traumatism with infection, the *circular method*, with cutaneous cuff, and followed by simple tamponing, is the procedure of election. That of the formation of two

flaps, anterior and posterior, of equal dimensions is suited only to the cases in which the field of operation is aseptic, and the edges of the wound can be reunited throughout.

Circular Amputation.

The procedure of circular amputation, with the formation of a cutaneous cuff, and treatment with open tamponing without the application of any

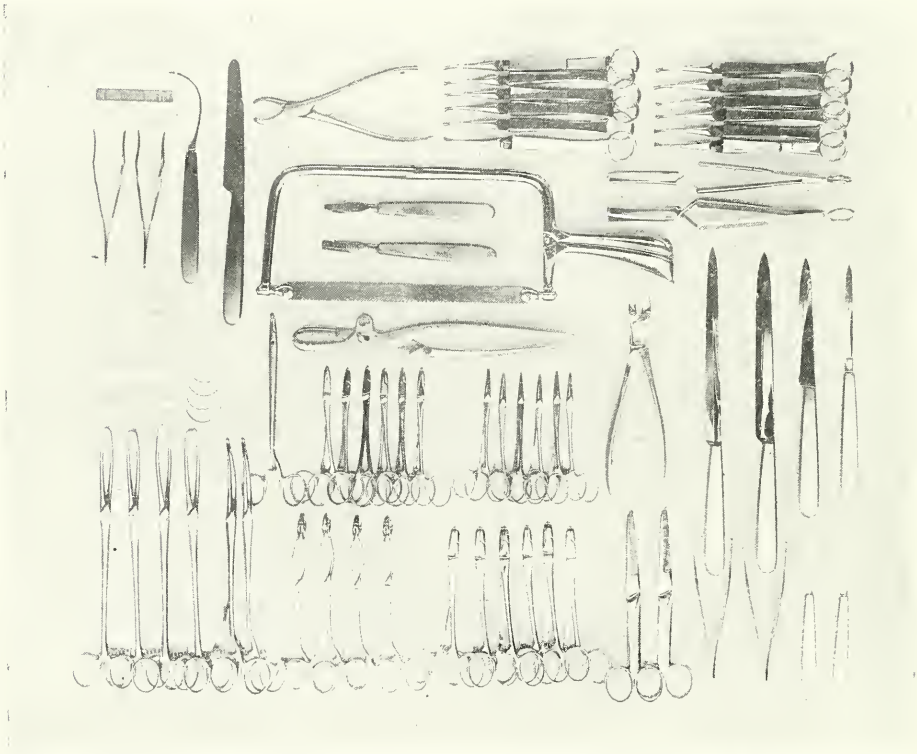


FIG. 770.—INSTRUMENTS REQUIRED FOR THE OPERATIONS OF AMPUTATION AND DISARTICULATION OF THE ARM.

From below upwards and from right to left: Two bistouries, two dissection-forceps, two strong scissors, six artery forceps, four forceps with oval jaws, two long curved forceps, four Museux's forceps; knife of 12 centimetres for disarticulation of the wrist, a knife of 16 centimetres, two knives of 18 centimetres, one Liston's forceps, six Champonnière's forceps; six needle-holder forceps, one needle-holder with eccentric jaws, assorted needles, drainage-tubes; two straight tractors, resection saw, straight raspatory, curved raspatory; twelve hooked forceps, gouge-forceps, saw with movable back, mounted needle, Michel's clips, clip forceps.

sutures, is the only one which is suitable for grave cases of infection—such, for example, as diffuse streptococcal phlegmon consecutive to crushing of the structures around the elbow-joint.

The arm is held in the horizontal position, in full light, and the surgeon

FIG. 771.—AMPUTATION WITH TWO EQUAL FLAPS THROUGH THE MIDDLE OF THE ARM IN A CASE OF ULCERATING SARCOMA OF THE FOREARM.

Circumferential movement of the knife for section of the deep muscles around the humerus.

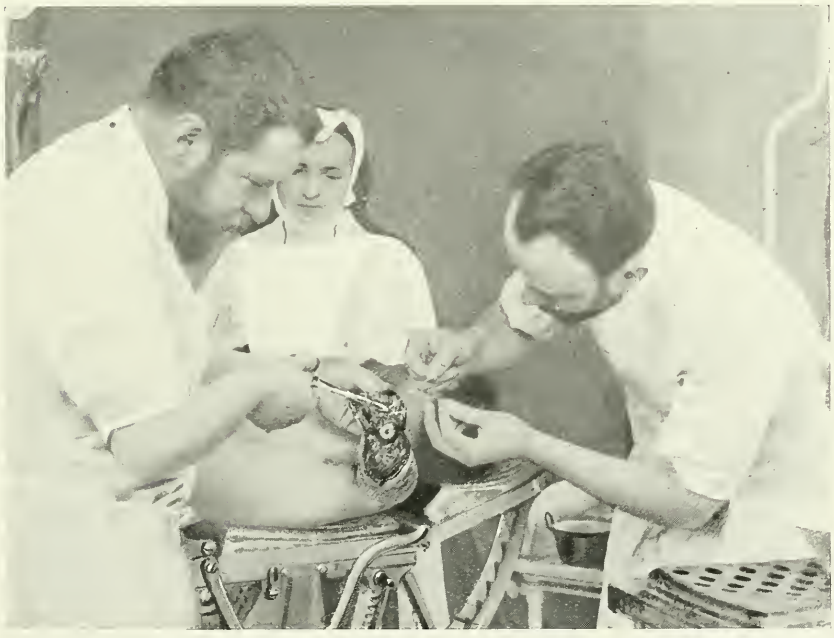


FIG. 772.—AMPUTATION WITH TWO EQUAL FLAPS THROUGH THE MIDDLE OF THE ARM IN A CASE OF ULCERATING SARCOMA OF THE FOREARM.

The humerus has just been divided, and the two musculo-cutaneous flaps are distinguishable. Ligature of the brachial artery.

is so placed that his right arm is also turned towards the source of illumination, natural or artificial. The subclavian artery is carefully compressed.

Operation.—The skin must be divided at a lower level than that of the section of the bone.

First Stage.—The surgeon stoops and passes the knife first beneath the arm and then above it, carrying out the circular division of the integument in such a way as to complete it as nearly as possible in a single sweep. The movement must be repeated so as to complete the division of the cellular tissue down to the aponeurosis.

Second Stage.—Dissection of the cuff. When there happens to be œdema of the subcutaneous tissue it will be necessary, in order to be able to dissect up the cutaneous cut, to make an anterior vertical longitudinal incision of 6 to 8 centimetres in extent, according to the diameter of the limb. As the cuff is gradually raised, it is grasped in succession with three or four hooked forceps.

Third Stage.—Superficial circular division of the muscles, with care to skim lightly over the position of the vessels, if there is no assistant compressing the subclavian artery. The artery is then secured with forceps, and the circular division of the tissues is completed down to the bone.

Fourth Stage.—The bone is rapidly divided with a saw, and with light movements so as to avoid any splintering. Hæmostasis; tamponing; suture.

Amputation with Formation of Flaps.

When the affected region is aseptic, flap amputation is the procedure of election. It may be carried out in the deltoid region, or in the middle or lower third of the arm.

Position of the Surgeon.—The surgeon should place himself so that his left hand is next the upper extremity of the limb which has to be operated on. If he operates with the right hand and has to deal with a left arm, this limb must be placed in the position of abduction, with the operator standing on its inner side; in case of a right arm, he stands on its outer side. In either case an assistant must be told off to hold up the flaps. In an urgent case, in which the surgeon is obliged to operate alone and has to raise the flaps himself, it will be necessary for him to place himself on the contrary, on the outer side of a right arm, and on the inner side of a left—that is to say, in such a position that his left hand is next the upper extremity of the limb. In such a case the limb which has to be removed is supported by an assistant, who is usually a layman. I have many times been obliged to operate in this way in remote villages in cases of gaseous or diabetic gangrene.

Intradeltoid Amputation.

First Stage.—Right arm. The surgeon forms a small external deltoid flap by transfixion. This is held up by an assistant with two hooked forceps.

Second Stage.—He then immediately passes the knife on the inner

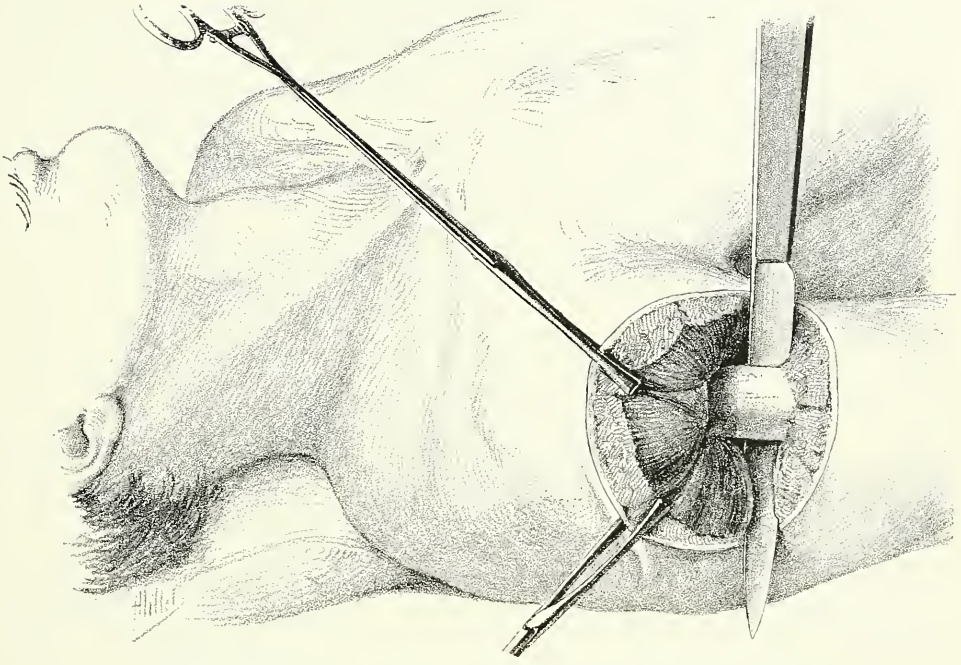


FIG. 773.—INTRADELTOID AMPUTATION OF RIGHT ARM.

Second stage: The external (deltoid) flap is held up with two Museux's forceps. The knife has been passed through on the inner side of the humerus.

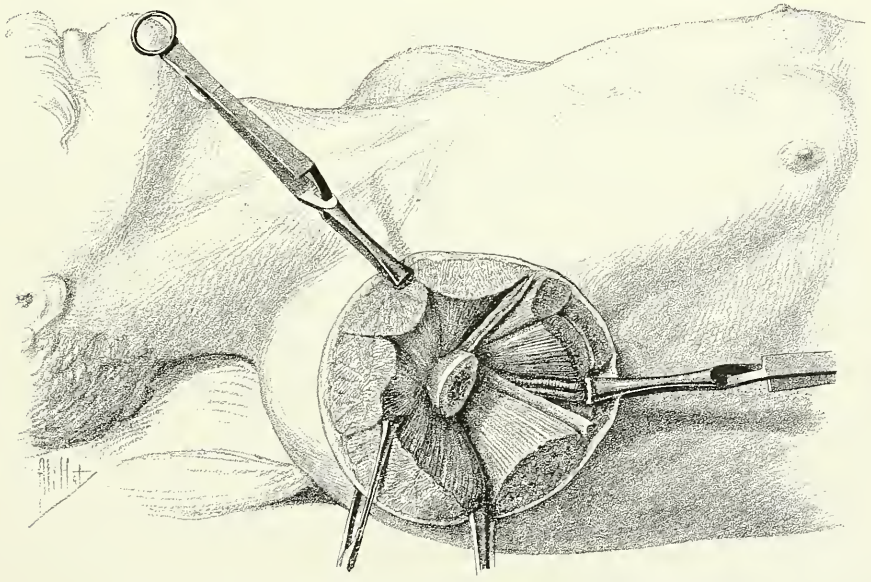


FIG. 774.—INTRADELTOID AMPUTATION OF RIGHT ARM.

Fourth stage: Infundibuliform wound resulting from the intradeltoid amputation of the arm with small flaps. A tractor forceps is used to secure the provisional hæmostasis of the brachial artery.

side of the humerus, and proceeds to the formation of the internal flap. Finally, the artery is divided. When there is no assistant to compress the

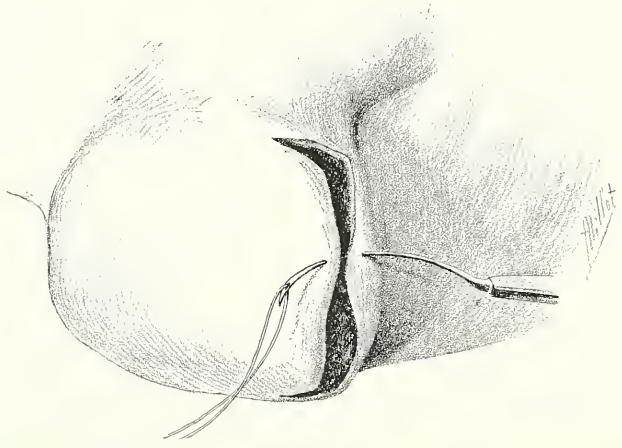


Fig. 775.—Intradeltoid Amputation of Right Arm.

Fifth stage: Reunion of the wound. Placing of a point of median suture. The remaining portion of the margins of the cutaneous wound will be united with clips.

subclavian artery, we can readily expose the vessel before dividing it by scratching gently with the edge of the knife through the surrounding tissues. A forceps is then applied and the division of the soft tissues is completed.

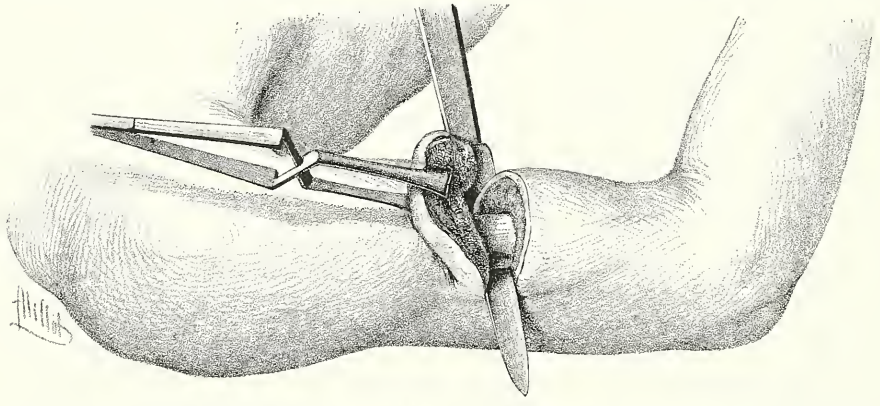


Fig. 776.—Amputation of the Arm at its Middle with Two Equal Flaps.

Second stage: A tractor forceps grasps the anterior flap, which does not involve the vasculo-nervous bundle.

Third Stage.—Section of the bone with a saw worked by the hand.

Fourth Stage.—Separate ligature of artery and vein. Forcipressure and ligature of all bleeding vessels, muscular and subcutaneous, and resection of the nerves.

Fifth Stage.—Suture of the skin wound, and drainage.

Amputation through the Middle of the Arm.

Two flaps of equal dimensions are formed, the length of each corresponding to two-thirds of the diameter of the limb at the seat of amputation.

First Stage.—Formation of antero-external flap, which does not include the vessels.

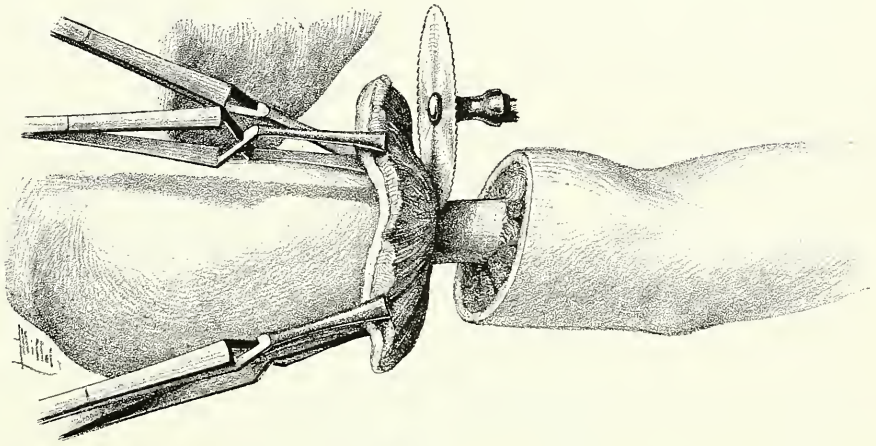


Fig. 777.—Amputation of the Arm at its Middle with Two Equal Flaps.

With the help of three tractor forceps we can secure temporary hæmostasis, while at the same time folding back musculo-cutaneous flaps so far as to secure division of the humerus without inconvenience. Section of the bone with the circular saw is here represented.

Second Stage.—This flap is raised with a hooked forceps. the posterior flap is formed, and the artery is secured by forcipressure.

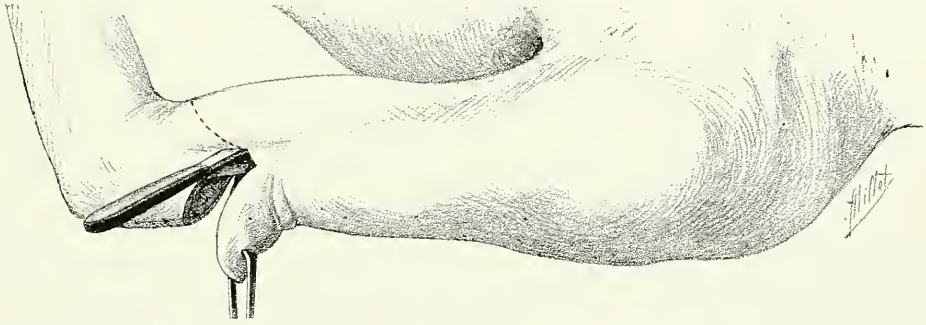


Fig. 778.—Amputation of Arm through Inferior Third with Equal Flaps.

Formation of anterior flap, which includes the vasculo-nervous bundle.

Third Stage.—Division of the bone with saw with movable back.

Fourth Stage.—Hæmostasis, suture, and drainage.

Amputation through Inferior Third of Arm.

First Stage.—Division of posterior flap by transfixion. This flap is then grasped with a tractor forceps furnished with six claws.

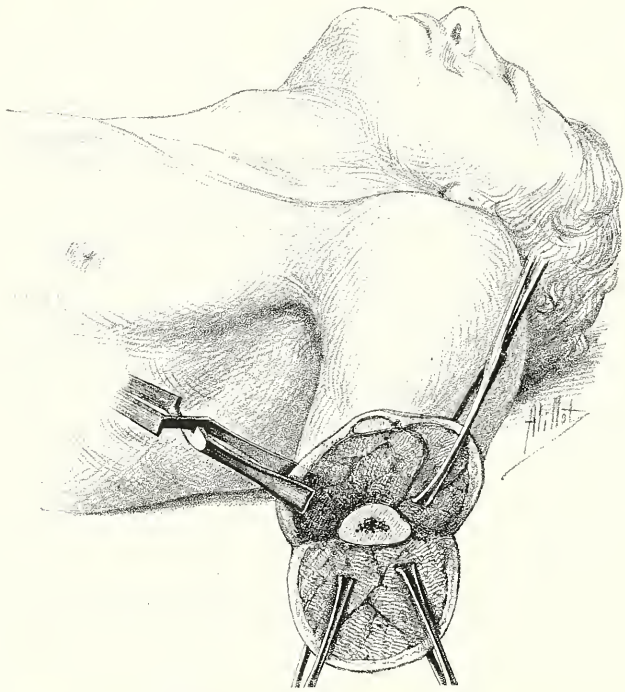


Fig. 779.—Amputation of Arm through Inferior Third with Equal Flaps.

Appearance of wound after amputation. Provisional hæmostasis has been secured by the application of the antero-internal tractor forceps.

Second Stage.—Formation of anterior flap by transfixion. The fingers of the left hand hold up the anterior muscles and secure the retraction of the skin, and serve at the same time to maintain hæmostasis. When the artery is divided, it is at once seized with the claws of another forceps.

Third Stage.—Retraction of the flaps and division of the bone.

Fourth Stage.—Hæmostasis and resection of nerves.

Fifth Stage.—Reunion and drainage.

OPERATIONS ON THE ELBOW-JOINT.

Traumatic Lesions.

There is nothing special to be pointed out in connection with wounds of the soft parts in this region, the complications of which are treated according to their quality and degree.

Fracture of the Elbow.

Fractures of the elbow, caused by direct violence, are of very frequent occurrence. They are often comminuted. Fractures of the olecranon process are likely to be accompanied by a rather considerable separation of the fragments.

1. *Fracture of the Inferior Extremity of the Humerus.*

Fracture of the lower extremity of the humerus is, whether comminuted or non-comminuted, of all fractures the only example in which everything that has been said of the advantages of massage and of the inconvenient results of immobilization should always be carefully remembered. The diagnosis is confirmed by radiography, and the arm is secured in a splint; but the injured limb should undergo every day during the first week, and with every possible care that can be focussed on the process, a séance of methodical massage, with passive movements of the forearm on the arm, embracing those of flexion, extension, pronation, and supination. In fact, the displacement of a single small fragment involving the epicondyle and trochlea suffices to form a projection abutting into the cavity of the elbow-joint, which effectively obstructs all freedom of movement, and sometimes leads even to complete ankylosis.

It is only by the daily use of passive mobilization and methodic massage that we can compel the return of the osseous fragments, to the position which alone is compatible with the exercise of the normal movements of the limbs.

Ankylosis.—When ankylosis has supervened, whether complete or partial, we must have recourse to an arthrotomy, with resection of the structures, which limit the movements of the joint. When there has been extensive splintering about the joint, the resulting ankylosis is often complete, and, as in cases of tuberculosis, the extremities of the bones must be resected—from above the condyle in case of the humerus, and below the head of the radius in the forearm (see below).

2. *Fracture of the Olecranon.*

The only rational treatment of fracture of the olecranon process, as for that of the palate, is immediate osseous suture.

Operation—First Stage.—Posterior median incision and toilet of the traumatic focus.

Second Stage.—Double osseous suture. We can in some of these cases, as in those of fracture of the patella, apply a complete circular suture, enclosing the fragments circumferentially.

Third Stage.—Reunion, drainage.

A simple plaster apparatus suffices for the subsequent immobilization, which should last for three weeks. The joint can be set free at that date if union by first intention has taken place.

Luxation of the Ulnar Nerve.

Luxation of the ulnar nerve is a very painful accident, and demands an autoplastic operation. The epitrochlear groove may be reconstituted by suturing two fibro-periosteal flaps of suitable lengths over the ulnar nerve.

Inflammatory Lesions.

Hygroma of the Serous Bursa over the Olecranon.

Operation.—Complete extirpation of the pouch through a posterior longitudinal incision; reunion; drainage.

Phlegmon of the Elbow.

Treatment by hypodermic injection of mycolysine should be adopted, to be followed, when indicated, by an early and free incision.

Osteomyelitis.

Under the influence of the same medication, staphylococcal osteomyelitis may also be resolved. When pus has formed, the articulation should be opened by a double vertical incision, one on the inner and the other on the outer side of the olecranon, special care being taken when making the former to avoid injuring the ulnar nerve.

Suppurative Arthritis.

The indications are the same in all cases of suppurative arthritis of the elbow, whatever may have been the nature or origin.

Subacute Plastic Arthritis.

Early arthrotomy is likewise indicated in cases of subacute plastic arthritis, of which the clinical type is gonorrhœal arthritis. It must be remembered during our endeavours to secure simple resolution, that those cases have a distinct tendency towards ankylosis. Nevertheless, we should

not have recourse to arthrotomy till after having tried to bring about resolution by the intensive administration of mycolysine, both by the mouth and hypodermically.

Tuberculous Arthritis.

Cases of tuberculosis of the elbow-joint should be treated by conservative methods—immobilization, application of heat, internal use of salines, and administration of phymalose. In case of failure or aggravation, it will be necessary to have recourse to resection (see below).

Luxation of the Elbow-Joint.

Reduction of luxations of the elbow, whether complete or partial, is as a rule easily effected in recent cases. The diagnosis should always be confirmed by radiography.

Luxation of the head of the radius may be reduced by simple pressure with the thumb. This pressure should be applied at the moment of placing the forearm in a position of pronation.

Luxation of Both Bones backwards.

Reduction by the Author's Method.

1. **Without Anæsthesia.**—The surgeon stands opposite to the patient, who is seated, and makes gentle traction on the wrist with the right hand, while he makes brusque percussion on the upper end of the forearm with the ulnar border of the left hand. The reduction is immediate. The relations of the bones should always be verified by the use of the X rays.

2. **Under General Anæsthesia.**—When the attempt at reduction without anæsthesia has failed, the patient is placed on a mattress on the floor, and an anæsthetic administered. When the insensibility is complete, the surgeon adjusts the arm in a position of moderate abduction, then stands on the inner side of the injured arm, and places the sole of his unbooted foot in contact with the limb a little above the elbow. Extension is now applied at the wrist, with the limb at an obtuse angle. This procedure of counter-extension is carried out with the left foot in case of a left arm, and with the right foot in case of a right arm.

The coracoid process is thus made to clear the trochlea, and the reduction is complete. The surgeon perceives the vibratory shock. At the very moment at which this is felt the foot of the surgeon should be withdrawn, the forearm is placed in the position of semiflexion, and the integrity of the movements of the joint is ascertained.

The other luxations of the elbow-joint are of exceptional occurrence. They are all readily reducible by the same procedure. A splint is applied during a period of eight days; after this, massage and passive motion.

FIG. 780.—LUXATION OF A BACKWARD LUXATION OF THE LEFT ELBOW.

Counter-extension is maintained with the left foot of the surgeon, while he makes extension with both hands. The reduction is effected without much effort.

FIG. 781.—LUXATION OF A BACKWARD LUXATION OF THE LEFT ELBOW.

When the reduction has been carried out, the surgeon draws back his foot and flexes the forearm on the arm. He then verifies the range of movement of the injured joint.

Old-Standing Luxations.

Old-standing luxations of the elbow-joint require treatment by arthrotomy; more especially the sigmoid cavity of the olecranon will in such cases be found filled with fibro-cellular tissue after an interval of two or three weeks. This newly formed fibroid tissue necessarily obstructs the reproduction of the normal movements of the joint in cases of tardy reduction. I described those special items of procedure as far back as 1886.

At that date I performed an arthrotomy, with oblique section of the tendon of the triceps. Since then I have come to prefer the preservation of that tendon. The procedure will be afterwards described in connection with the technique of arthrotomy of the elbow-joint.

Malformations: Congenital and Acquired.

Congenital Deformities.

Synostosis of the Arm and Forearm.

The only case of this kind that I have met with was treated by resection of the elbow, which gave an excellent functional result.

Congenital Luxations—Cubitus Valgus—Cubitus Varus.

In most of these cases the treatment consists of arthrotomy, with orthopædic resection of osseous projections, which occasion the deformity, and limit the movements of the affected limb.

Acquired Deformities.

Vicious Cicatrices.

Vicious cicatrices of the integuments of the elbow can, in almost every case, be remedied by cutaneous transplantation. The cicatrix is extirpated throughout the whole extent and thickness, and the exposed area is then bridged over with a cutaneous flap cut from the surface immediately above the anterior superior spine of the ilium. The operation is carried out in three stages, the first and second of which are separated by an interval of ten or twelve days, and the second and third by one of four or five days.

Operation—First Stage.—Extirpation of the whole cicatrix throughout its entire thickness; dissection of the cutaneous bridge in the lower anterior lumbar region, and adjustment of the elbow and forearm in the wound. Suture of the cutaneous bridge to the upper and lower borders of the wound formed by ablation of the vicious cicatrix.

Second Stage.—After an interval of ten or twelve days, when the cutaneous bridge has become firmly adherent at the bend of the elbow, the two pedicles should each be partially detached, leaving, however, an

undivided portion of skin of 4 or 5 centimetres in width at each side, in order to secure the vitality of the adherent graft. We then immediately revivify the corresponding margins of the wound of the elbow, and unite with points of interrupted suture.

Third Stage.—After another interval of four or five days, we complete the detachment of the cutaneous bridge and the reunion of the grafted flap to the integument of the bend of the elbow. It is easy to arrange the same so that the newly grafted patch of skin may become completely united to the whole of the circumferential margin of the wound without either dragging or exuberance.

In a subsequent section of the present work will be found represented a corresponding grafting of cutaneous flaps on the surface of the forearm, wrist, and back of hand respectively, which has in every case been followed by a perfect *restitutio ad integram* in regard to both motility and sensibility.

Tumours.

There is little to recall in this connection, except the sufficiently rare occurrence of osteo-sarcoma in the vicinity of the elbow.

Technique of Operations on the Elbow-Joint.

Arthrotomy of the Elbow-Joint.

Arthrotomy of the elbow-joint may be indicated, either for the evacuation of an articular effusion or the reduction of a neglected luxation.

1. *Simple Arthrotomy.*

First Stage.—Longitudinal incision of 6 or 8 centimetres, passing along the outer border of the olecranon process.

Second Stage.—Division of the soft parts down to the bone, with exposure of the head of the radius and external border of the greater sigmoid cavity, evacuation of the contents of the articular cavity, and toilet of the synovial membrane with small pieces of sterilized gauze. Tamponing is then carried out in case of arthritis of the plastic purulent or obviously infectious variety. On the other hand, when dealing with a case of aseptic synovial effusion, suture should always be resorted to, with or without drainage.

2. *Arthrotomy for Neglected Dislocation.*

I have pointed out the fact in connection with neglected dislocations that, after the lapse of two or three weeks, the sigmoid cavities will be found obliterated by organized exudates. The exudates will also be sufficiently resistant to present an unconquerable obstacle to the return of the movements of the joints. In such a case it will accordingly be found necessary not merely to replace the bones, but to re-establish the greater sigmoid cavity—at least, in its original form.

This should be carried out with a very wide exposure of the interior of the joint. One of two varieties of technique may be adopted:

1. **Arthrotomy with Oblique Division of the Triceps Tendon**—First Stage.—Oblique incision, in the form of a bayonet wound, commencing at the inner border of the triceps tendon, at a distance of 6 or 7 centimetres above the tip of the olecranon process, and passing along the outer border of the latter, to terminate opposite the radius at a distance of 1 centimetre above its upper extremity.

Second Stage.—Oblique section of tendon of triceps, from above downwards and from within outwards, and opening of the articulation.

Third Stage.—The articulation is explored and the greater sigmoid cavity fully exposed to view. This cavity is freed from the fibro-cellular tissue with which it is filled; the cicatricial bands which oppose satisfactory reduction are resected, though the bones are placed in the normal position of contact.

Fourth Stage.—Suture, either continued or interrupted, of the triceps tendon with fine silk.

Fifth Stage.—Reunion and drainage.

In young subjects the reunion is perfect in six or eight days, and the movements of the joints may be commenced after the fifteenth day.

2. **Arthrotomy without Division of the Triceps Tendon**—First Stage.—Vertical incision along the outer border of the triceps tendon and olecranon, commencing at about 6 or 7 centimetres above the line of the articulation, and ending about 3 or 4 centimetres below the head of the radius.

Second Stage.—The incision is made to reach the bone. The elbow is then supported in the extended position, and the tendon of the triceps is detached from the olecranon with the help of the bistoury and clawed forceps, the edge of the former being made to shave the bone closely, while the surgeon raises and retracts the border of the tendon as the liberation proceeds.

Third Stage.—When the detachment of the tendon has been completed, which can be readily effected while completely preserving its connection with the periosteum and antibrachial aponeurosis, the forearm is flexed and the tendon is displaced towards the epitrochlea, care being taken to free completely the groove which contains the ulnar nerve. The osseous extremities are thus completely mobilized.

Fourth Stage.—Restoration of the greater sigmoid cavity with the curved raspatory and ablation of projecting osseous fragments, when the luxation had been complicated with fracture. Reduction is then carried out. The forearm is replaced in the extended position.

Fifth Stage.—Suture of the brachial aponeurosis at the margin of the tendon of the triceps.

Sixth Day.—Reunion of skin, and drainage of wound.

A compressive dressing is then applied, and the joint is kept in the semiflexed position, but without any immovable apparatus.

The first of these procedures, with its oblique division of the tendon of the triceps, produces less damage to the articular structures than does the second, which necessitates the complete detachment of that tendon from the olecranon process. But this procedure should be adopted only in cases in which we are quite sure that resection will not be necessary.

The second procedure is to be preferred in all cases in which resection is absolutely necessary, whether of the olecranon alone or of one or both of the other epiphysary extremities—that is to say, in all cases of ankylosis of the elbow-joint in which there has been luxation complicated with fracture, or merely fracture which had been unrecognized and accordingly unreduced.

Resection of the Elbow-Joint.

The general technique of this operation is the same in all cases, whatever may have been the nature of the original lesion—congenital malformation, inflammatory or traumatic ankylosis, imperfect union of fracture, or tuber-

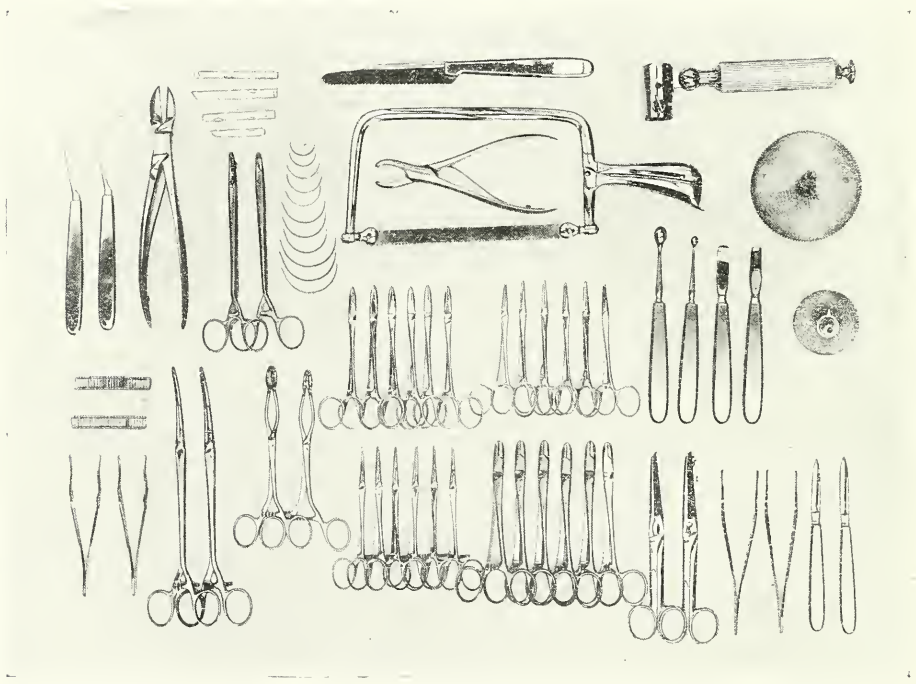


Fig. 782.—Instruments required in Resection of the Elbow-Joint.

From below upwards and from right to left: Two bistouries, two dissecting-forceps, two scissors, six artery forceps, six six-toothed forceps, two forceps with oval jaws, two long curved forceps, two clip-forceps and a series of nickel clips; a circular saw of 60 millimetres, straight raspatory, curved raspatory, two curettes, six Championnière's forceps, six needle-holder forceps, two needle-holder forceps with eccentric jaws, a series of curved needles of various sizes, two needles mounted on handles, circular saw of 10 centimetres diameter, saw with revolving blade, gouge-forceps, removable saw-handle, saw with movable back, drainage-tubes. Ten author's hooked forceps are added.

culous disease. The operation is carried out with the help of the bistoury and clawed forceps. The bistoury shaves the bone better than

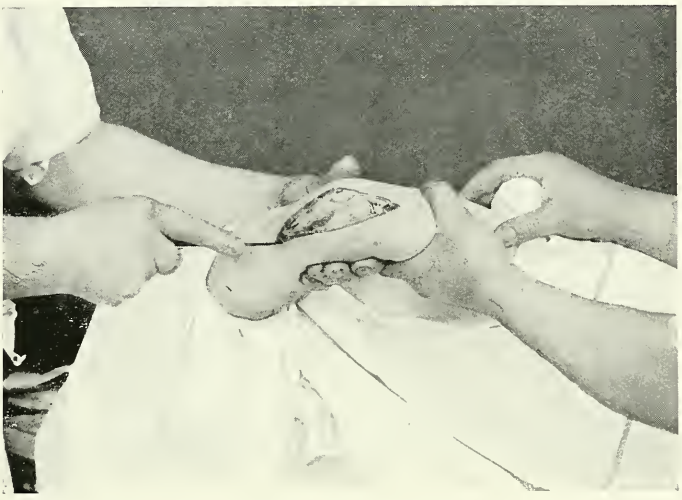


FIG. 783.—RESECTION OF ELBOW-JOINT.

First stage: Posterior longitudinal incision. Exposure of triceps tendon.

FIG. 784.—RESECTION OF ELBOW-JOINT.

Second stage: Dissection of outer lip of triceps tendon with bistoury and clawed forceps. Exposure of olecranon process.

the raspatory—notably so in detachment of the triceps tendon from the olecranon—and when we are dealing with tuberculous fungosities, it readily

passes them by, leaving the adherent masses to be removed with the resected epiphysis.

FIG. 785.—RESECTION OF ELBOW-JOINT.

Second stage: Separation of periosteal attachments of triceps tendon from olecranon with raspatory. Opening of articulation.

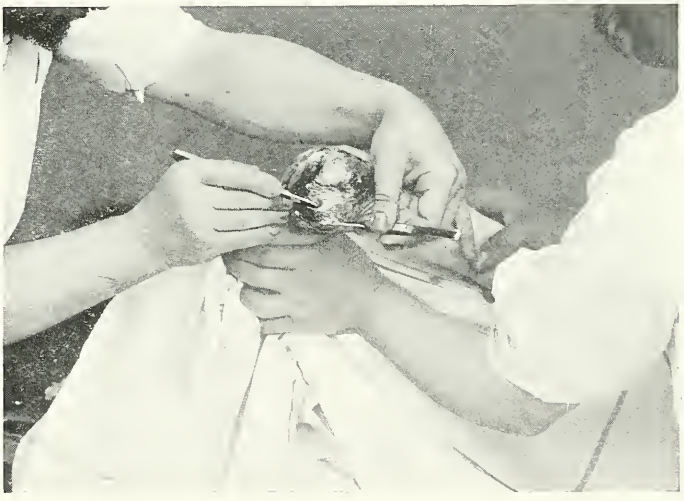


FIG. 786.—RESECTION OF ELBOW-JOINT.

Second stage: Disengagement of ulnar nerve with bistoury and clawed forceps. When freed from its fibro-osteal groove, the nerve is drawn inwards.

The first stage of this operation differs from that of arthrotomy for old-standing luxation only in the postero-external incision (see above).

Operation.—Preventive hæmostasis by application of elastic bandage.
First Stage.—Postero-external vertical incision, commencing at the

Fig. 787.—Resection of Elbow-Joint.

Third stage: Exposure of articulation in the position of forced flexion, and luxation of the osseous extremities to the outside of the wound.

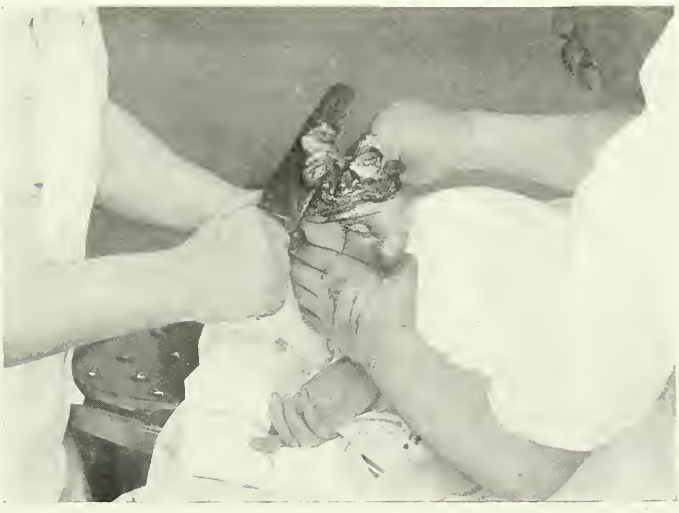


Fig. 788.—Resection of Elbow-Joint.

Fourth stage: Resection of articular extremity of humerus with saw with movable back.

outer border of the triceps tendon, and 6 or 7 centimetres above the tip of the olecranon process, descending along the outer border of the tendon,

passing by the head of the radius, and ending about 3 or 4 centimetres below the latter.

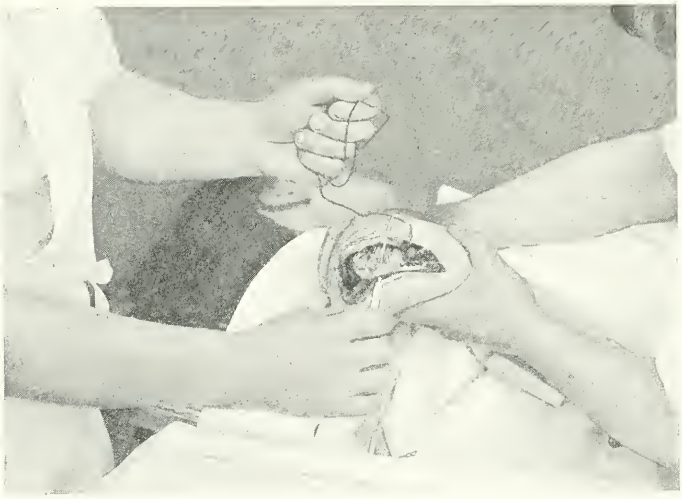


FIG. 789.—RESECTION OF ELBOW-JOINT.

Fifth stage: Reunion of the lips of the triceps tendon and of those of its external periosteal expansions.

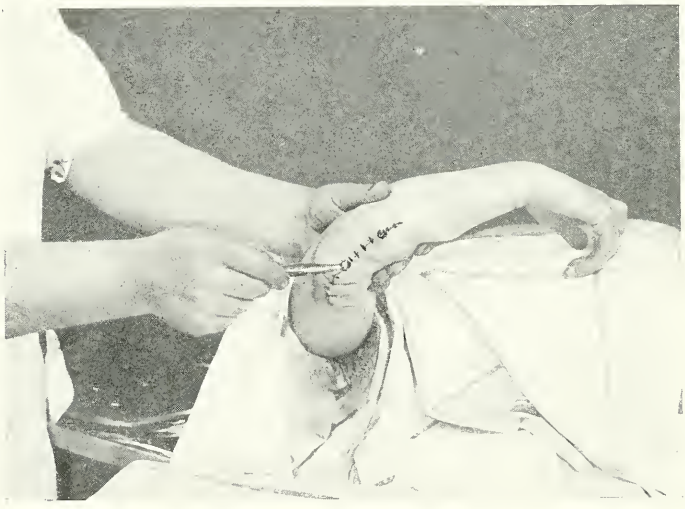


FIG. 790.—RESECTION OF ELBOW-JOINT.

Fifth stage: Reunion of skin with interrupted suture and deep drainage.

SECOND STAGE.—The incision is carried down to the bone. The tendon of the triceps is grasped with a hooked forceps, and carefully detached

from the olecranon with a bistoury, while the forearm is held in the extended position. In this procedure the surface of the bone should be laid completely bare, without loss of substance of the tendon, which retains its connection inferiorly with the anticubital aponeurosis and the periosteum of the ulna. The tendon of the triceps is gradually raised from without inwards, and detached from the olecranon till the inner border of the latter is reached. The forearm is then flexed and the ulnar nerve is lifted out of its groove and drawn inwards.

Third Stage.—The articulation, after complete exposure, is placed in a position of forcible flexion, the osseous extremities are separated and luxated through the wound.

Fig. 791.—Resection of Elbow-Joint.

The compressive dressing is applied in the position of semi-flexion, and the elastic bandage is removed.

Fourth Stage.—Resection of humerus. The inferior extremity of the humerus is cleared on its anterior aspect with the bistoury; the soft parts are then retracted with a long forceps, and the section is then made above the epicondyle with a saw with movable back.

Fifth Stage.—Resection of bones of forearm. The anterior aspect of bones of the forearm are cleared with bistoury at their articular ends till the neck of the radius is completely exposed; the soft parts are then protected by application of a long curved forceps, and the section is made with a saw with movable back.

Sixth Stage.—Examination of field of operation, and removal of any remaining tuberculous fungosities which may have been left. Antiseptic tamponing.

When dealing with a case of tuberculous arthritis, it will be found advantageous to postpone the reunion to the sixth or eighth day, or even to treat the part after operation as an open wound throughout. In a case of simple ankylosis, the tendon of the triceps can be sutured to the brachial aponeurosis; the wound is then drained below and to the outer side, and the skin is sutured with a view to immediate reunion. The dressing is applied in the semiflexed position, and no splint is used.

Disarticulation of the Elbow-Joint.

Disarticulation of the elbow-joint is merely an operation for the lecture-theatre. The stump left after disarticulation of the elbow-joint is one of the worst possible, inasmuch as the operation is carried out at a point which presents an extensive osseous surface to be covered, while the only available soft parts are the skin and aponeuroses.

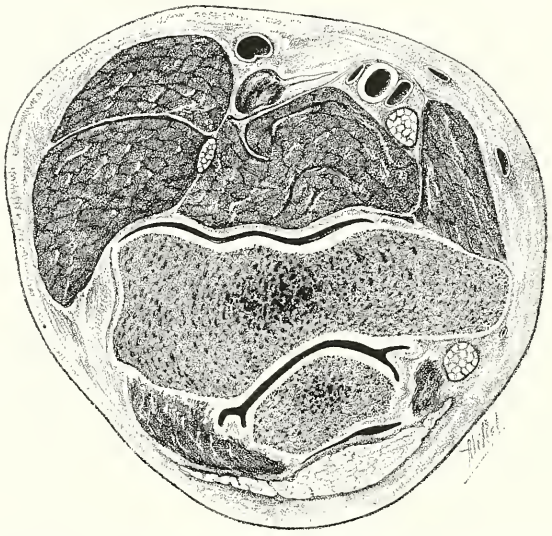


Fig. 792.—Horizontal Section of the Elbow-Joint at the Level of the Epicondylo-Epitrochlear Line.

Farabœuf's elliptical incision is the best one for this operation, which should reach down to the middle of the anterior aspect of the forearm, and should at once involve the anterior muscles as well as the skin. But this operation is impracticable in most of the cases with which we have to deal. For instance, in a case of voluminous malignant tumour of the forearm, the skin and, even still more unavoidably, the muscles must necessarily be sacrificed. When we are called upon to treat a case of traumatism which necessitates complete ablation of the forearm, there is rarely sufficient healthy integument left to cover the extremity of the humerus. Accordingly, we are obliged to amputate through the lower end of the diaphysis, immediately above the epicondyle and epitrochlea—a

procedure which demands, if the circular method is adopted, the formation of a cutaneous cuff, the lower margin of which is traced with the knife in the plane of the cupola of the radius.

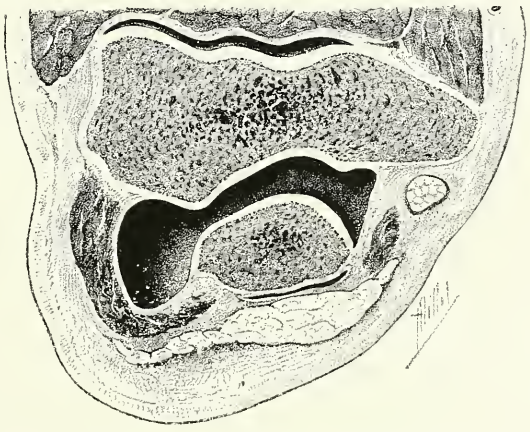


Fig. 793.—Arthritis of the Elbow-Joint.

The purulent collection points in the epicondylo-epitrochlear groove, where it causes a bulging of the integument.

Operation.—Compression of the brachial or subclavian artery. An assistant retracts the cuff or flaps. The arm is placed at a right angle to the side of the trunk, and turned towards the light. The surgeon stands

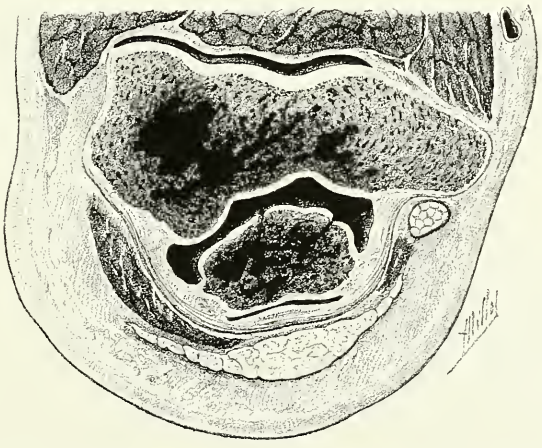


Fig. 794.—Pathological Thickness of Capsule.

at the side of the patient's body in case of the right elbow, and beside the head in the case of the left, so that he can grasp with his left hand the forearm which has to be removed.

By Circular Incision—*First Stage.*—Division of the skin in a plane 3 or 4 fingers' breadth below the bend of the elbow.

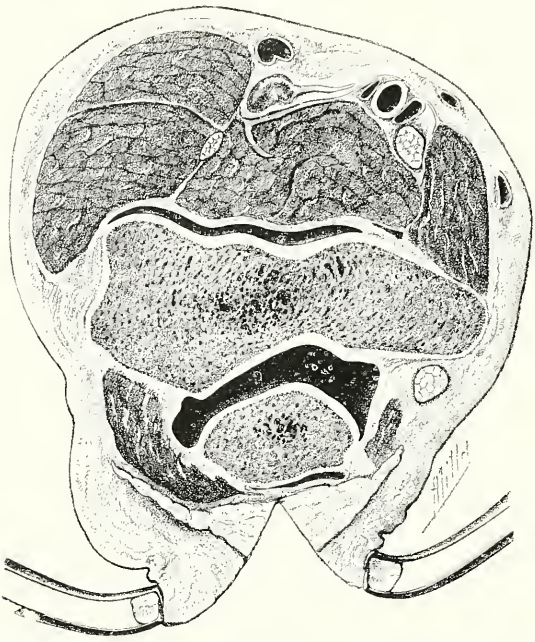


Fig. 795.—Resection of the Elbow. First Stage: Longitudinal Incision of the Skin and Triceps Tendon.

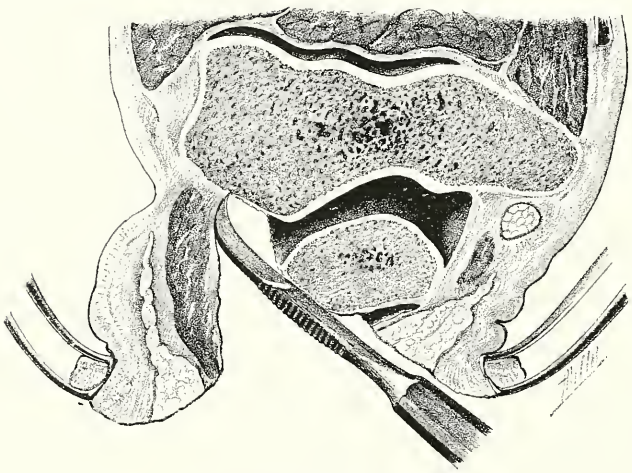


Fig. 796.—The Same.

Second stage. When there is no tuberculous periarthritis, the periosteum is easily detached with the raspatory.

Second Stage.—Circumferential retraction, mobilization of the skin, and dissection of the cuff, which is then held with hooked forceps.

Third Stage.—Opening of the articulation. The knife is carried around in the intra-articular plane, and made to divide all the soft tissues down to the bone; the point is then presented, and made to open the radio-humeral interstice transversely, and then pass over the tip of the coronoid process and opposite the trachea, tracing a line formed like a circumflex accent. In case of a left elbow the line is traced in the opposite direction.

Fourth Stage.—Disarticulation. The knife is made to penetrate between the condyle of the humerus and cupola of the radius dividing the external lateral ligament and the muscles, with the edge directed towards the olecranon, which it is thus made to reach as if the surgeon wished to remove

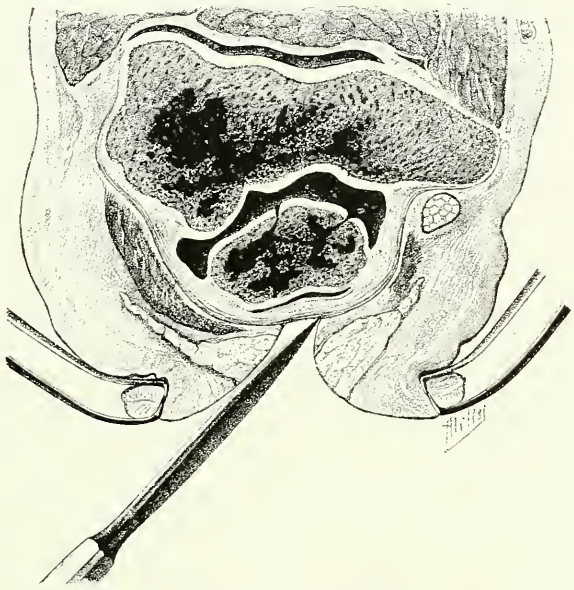


Fig. 797.—The Same.

Second stage: Dissection of the tendon with the bistoury, leaving the tuberculous tissues which have to be resected still adherent to the bone.

that apophysis. The internal lateral ligament and ulnar nerve are then divided, and with them all the other soft tissues in the vicinity of the inner side of the band of the olecranon.

The direction of this manœuvre is reversed in case of the left elbow.

The tendon of the triceps now alone remains. The olecranon is then luxated by a brusque movement of traction; the full edge of the blade is then employed above that apophysis, where it is made to divide the triceps tendon with a to-and-fro movement. The forearm is now completely detached.

Fifth Stage.—Hæmostasis and toilet of wound. The brachial artery and vein are tied; in exceptional cases, two or three arterioles or superficial veins.

Sixth Stage.—Reunion and drainage.

By Elliptical Incision. — This method is specially suited to the cases in which the integuments of the posterior aspect of the limb have been destroyed as far as the olecranon process, while the skin and muscles of the front have escaped.

First Stage.—Cutaneous elliptical incision, with the culminating point of its convexity opposite the tip of the elbow, and its inferior extremity towards the middle of the anterior aspect of the forearm. This incision is carried out with a single stroke, while the limb is held at the wrist like a taper. In case of a right limb, it is placed in the position of forced internal rotation, and the blade is made to enter the skin at the tip of the olecranon, and pass around the limb by its internal border and anterior surface, to reach the point at which it originally penetrated. Care must be taken not to limit the median portion of the flap unduly; it must include all the fleshy structures on the anterior aspect of the forearm.

Second Stage.—Liberation of the skin, especially at the level of the olecranon, by passing the point of the knife into the incision and cutting the anterior flap by transfixion, while the skin is retracted with the left hand. The knife is made to penetrate the muscles as high up as possible, and emerge at the point of the circumference of the elbow, which is diametrically opposite; the muscles are then divided while directing the edge of the blade along the margins of the retracted cutaneous flap.

Third Stage.—The musculo-cutaneous flap is raised; the articulation is attacked with the full edge of the knife, as in the circular procedure, and the joint is then penetrated along the articular interval with the point of the blade, which is made to trace a _∧ incision in case of a right elbow, and a ∧_ incision in the case of a left—the horizontal limb corresponding to the plane of the epicondyle of the humerus, and the circumflex accent to the coracoid process of the ulna and the opposed trochlea.

Fourth and Fifth Stages.—See above.

OPERATION ON THE FOREARM.

Traumatic Lesions.

The wounds should be carefully disinfected, and then tamponed or sutured, according as there is or is not any danger in the attempt to promote immediate reunion. In a case of complicated fracture, a simple aseptic dressing is applied, or it may be tamponned, with or without liberating incisions, according to the state of the bones and surrounding soft tissues. For the first eight or ten days the application of a simple roller bandage should be made to suffice, as it will secure sufficient immobilization of the fragments. There is nothing special to be noted regarding the hæmostasis or repair of divided tendons and nerves.

In a case of grave contused wound, tamponing should be carried out after liberating incision, and continuous irrigation is then maintained.

Treatment of Fractures of the Forearm.

1. *Fracture of Both Bones in the Middle Third.*

The fragments should be carefully adjusted in parallel position, so as to prevent approximation of the adjacent fragments, which become crossed when placed in a position of either extreme pronation or supination. Accordingly, the forearm should be semiflexed, and adjusted in the position of semisupination, the radio-cubital plane being thus placed at an angle of 45 degrees with the horizontal, while the palm of the hand is directed upwards and inwards. In a case of simple fracture, without any considerable laceration of the surrounding soft parts, a plaster apparatus should be applied as early as possible.

This apparatus, which is composed of sixteen layers of prepared book-muslin, should be outlined with a coloured pencil on the folded tissue; it is then partially bent along the dotted lines (Fig. 798), and divided with strong scissors. It is then soaked in hot water, to which an equal proportion of plaster has been added, after which it is spread out flat on a table covered with a used cloth. It is then suitably adjusted and adapted to the external aspect of the forearm. The lower portion of the apparatus is arranged on the forearm, along which it reaches as far down as the wrist, and the roller bandage is applied from above downwards. The three terminal branches are now curved towards the palm of the hand, No. 1 slip being adjusted on the ulnar side, while the other two are made to embrace the thumb. The two brachial segments of the apparatus are so adjusted as to provide for counter-exclusion.

The apparatus should be removed after some days, so as to enable the surgeon to verify the coaptation of the fragments by cutting through the palmar junction of the three terminal heads of the apparatus, which are folded towards that region. It is then immediately replaced, and massage can be commenced after the third week.

2. *Fracture of the Inferior Extremity of the Radius.*

The deformity which usually follows this injury is that of "the back of a dinner-fork." In a single instance I have seen the dinner-fork curvature on the palmar aspect; the fracture in that case had been produced by a fall on the back of the hand. If the fracture is seated in the lower third, we may see the apparatus in the following figure. If in the middle third, brachial counter-extension should be secured. This can be effected by tracing a rectangular segment of 15 centimetres at the upper portion of the apparatus, and making two lateral incisions opposite the bend of the elbow. The apparatus is adjusted to the dorsal aspect of the limb; in exceptional cases it may be desirable to place it on the palmar.

The apparatus employed in the treatment is the same as that above described, with omission of the brachial segments. It is applied on the dorsal aspect of the forearm, and the three inferior slips are made to meet

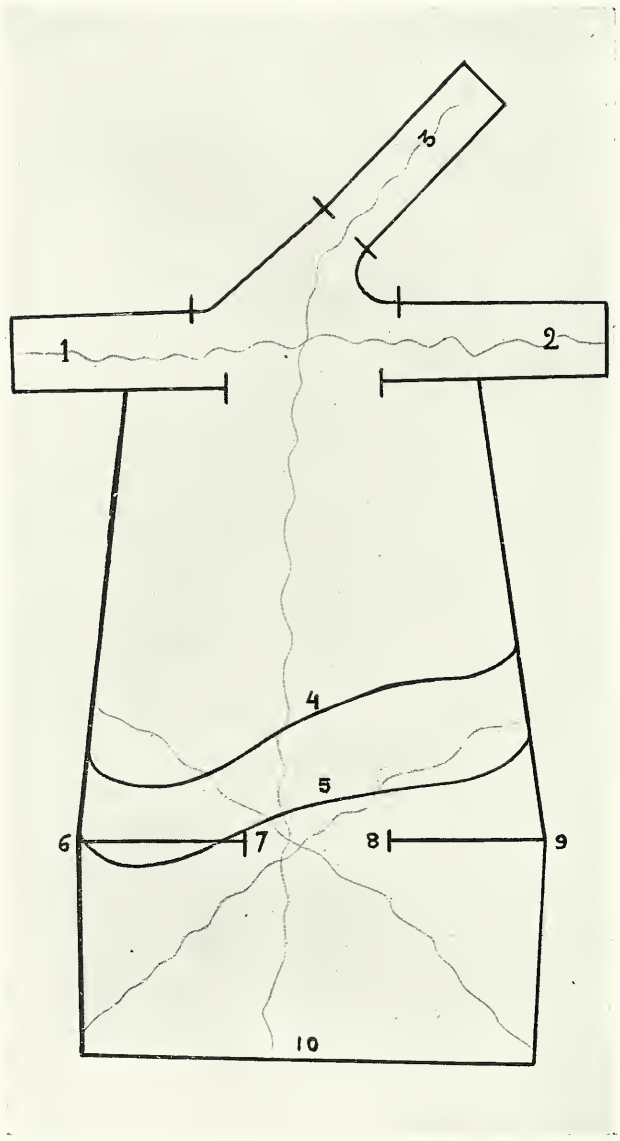


Fig. 798.

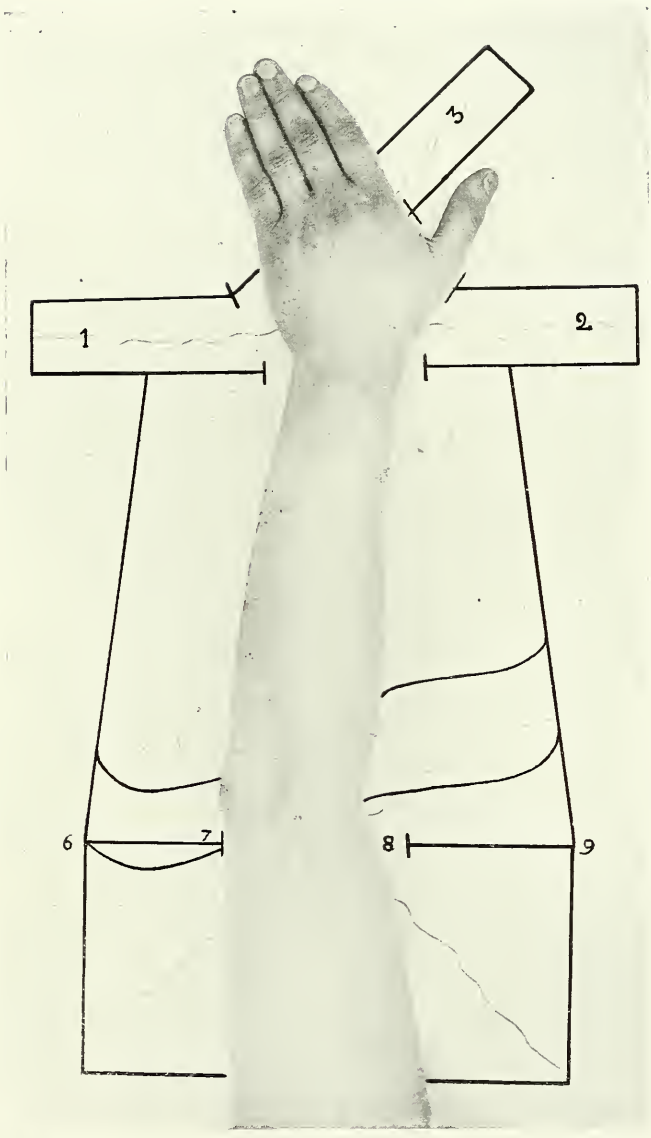


Fig 799

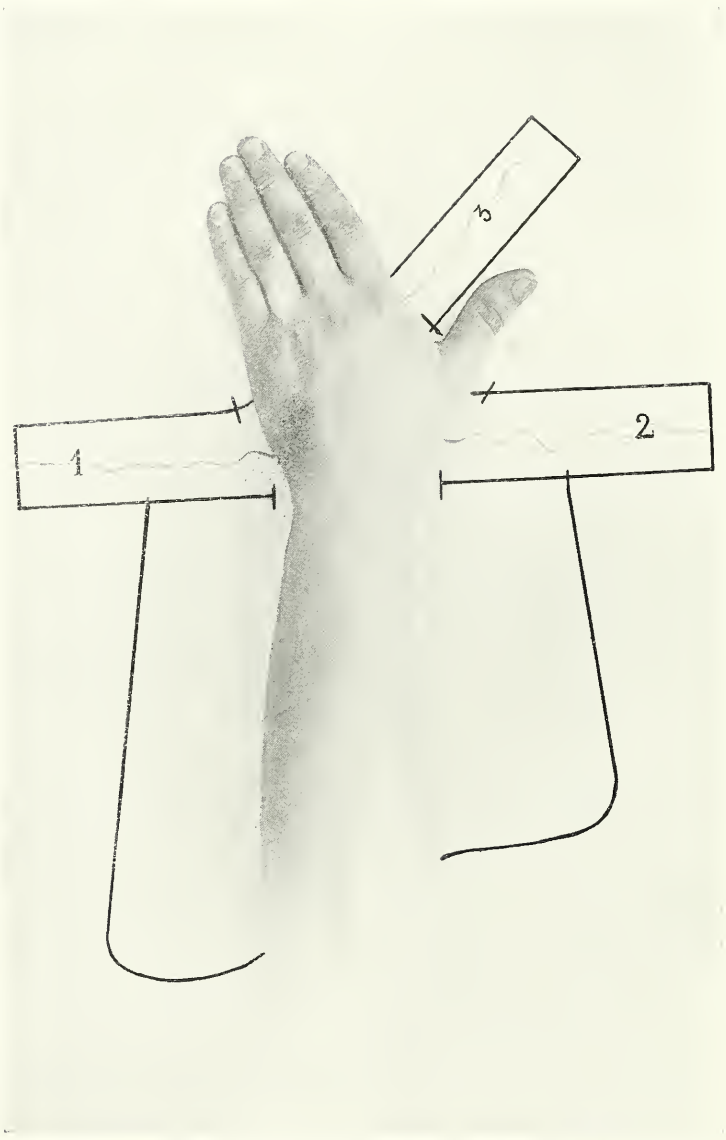


FIG. 800.—TREATMENT OF FRACTURE OF LOWER EXTREMITY OF RADIUS.

Six lines are traced with a pencil—two at the level of the wrist, two at the root of the thumb, and two opposite the limits of the metacarpus. Lines are also drawn corresponding to the circumference of the affected limb above the wrist and below the elbow respectively, for the purpose of indicating the necessary width of the apparatus opposite these respective levels. The cubital, radial, and outer metacarpal portions are then outlined as indicated in the figure; and the upper limit of the apparatus is traced by a curved line which is located in a position that permits the movement of flexion at the elbow.

FIG. 801.—FRACTURE OF LOWER EXTREMITY OF RADIUS.

Plaster apparatus used for fracture of the left side, shown directly after removal. Division with the scissors had been made at the junction of the cubital slip with the external ones, 2 and 3. The apparatus is usually removed on the fourth day in order to verify the completeness of the reduction. If the adjustment of the fragments is not found perfect, it is then completed under general anæsthesia. The apparatus is then replaced, and movement of the fingers is commenced.

FIG. 802.—FRACTURE OF LOWER EXTREMITY OF RADIUS.

Application of author's apparatus. The plaster apparatus has been adjusted, and the surgeon has arranged the turns of the bandage. Reduction has not yet been carried out.

FIG. 803.—FRACTURE OF LOWER EXTREMITY OF RADIUS.

First stage: Reduction of the fracture. The surgeon disengages the lower fragment by drawing the hand towards the ulnar side. During this process the wrist is firmly held on his knee by the operator's right hand.

FIG. 804.

The reduction of the dinner-fork displacement can also be effected while resting the injured limb on the back of a chair. First stage: The hand is forcibly drawn towards the ulnar side while utilizing the extremity of the bone as the point of support.

FIG. 805.

The reduction of the dinner-fork displacement can also be effected while resting the injured limb on the back of a chair. Second stage: The hand is placed in the position of forced flexion. The superior fragment of the radius is then disentangled and the inferior one is adjusted in its normal relations.

in the palmar of the hand. After the adjustment of the apparatus, the reduction is carried out as follows:

The surgeon stands opposite the patient, grasps the patient's wrist with his right hand and the hand with his left; he then, while resting the injured limb on his own left knee, flexed at a right angle, or on the back of

FIG. 806.

This apparatus can be temporarily removed for the purpose of massage after division of the lines of union of the three palmar slips.

a chair, disentangles the lower fragment by drawing the hand towards the ulnar side, while taking the head of the bone as point of resistance. With a second movement he completes the reduction by bringing the injured hand in the position of forced flexion. The process of consolidation is obtained in the composite position of abduction, semiflexion and semisupination. I devised the apparatus in 1884.

Inflammatory Lesions.

Phlegmonous affections of the forearm are in most cases the results of upward prolongation of those of the tendinous sheaths in the palm of the hand. When the case is one of diffuse streptococcal phlegmon, which was of frequent occurrence in the pre-antiseptic era, early multiple incisions on the antero-internal aspect of the forearm were indicated, sometimes on the inner border and on the dorsal surface. In carrying out this procedure, the skin and aponeurosis are incised longitudinally; the closed blades of blunt-pointed scissors are then forcibly made to penetrate the deep struc-

tures. The opening thus made is then enlarged by divulsion—that is to say, by brusque withdrawal of the divaricated blades.

Infective osteomyelitis of the radius or ulna is of rare occurrence, although not very exceptional, and always requires early intervention, if we wish to avoid the development of consecutive necrosis.

I have just recently had an opportunity of observing the complete resolution of a diffuse phlegmon of the hand, wrist, and forearm without operation, produced by treatment with hypodermic injections of mycolysine.

Deformities: Congenital and Acquired.

Congenital Deformities.

Rachitic Curvature.

These curvatures are rather rare in the forearm. When met with, they should be adjusted to the normal before complete calcification of the softened bone has taken place, otherwise they must be treated by osteotomy.

Acquired Deformities.

Vicious Callus—Pseudarthrosis.

Consolidation of diaphysary fractures of the bones of the forearm with vicious callus produces an immense variety of deformities. The most frequent of these is the formation of a curvature with postero-external convexity. Synostosis of the radius and ulna is also met with.

Pseudarthroses are of frequent occurrence, and may be the result of interposition of shreds of fibrous or muscular tissue between the fragments.

All these lesions should be treated by osteotomy and osseous suture.

Complications of Fracture of the Inferior Extremity of the Radius.

Vicious consolidation of this fracture in its dinner-fork deformity is not rare; it necessarily occurs in those cases in which such deformity had not been reduced. Early operation should be carried out. But if the case is met with before the end of five or six weeks, disentanglement of the fragments can be effected fairly easily.

Operation—First Stage.—External longitudinal incision of 15 millimetres, opposite the projecting angle formed by the lower fragment.

Second Stage.—Exposure of the seat of fracture with the raspatory.

Third Stage.—Introduction of MacEwen's largest osteotome between the lips of the incision and down to the radius. This instrument is then rotated on its longitudinal axis through an angle of 90 degrees, and the cutting edge is introduced into the interval between the fragments, where it is arrested by the projection of the inferior one.

Fourth Stage.—The osteotome is now made to penetrate the osseous tissue of the radius through two-thirds of its thickness by well-directed strokes of the mallet, as the ulnar border of the wrist lies supported on a sand cushion.

Fifth Stage.—The inferior fragment is now mobilized by using the osteotome as a lever: it is then removed and the wound is sutured. A provisional aseptic dressing is applied.

Sixth Stage.—The wrist is now placed on its dorsal surface at the edge of the table, over which it leans in the position of a door ajar, and the fracture is reproduced by a brusque effort. The reduction is then carried out as in a case of recent fracture produced by ordinary violence.

A compressive dressing of cotton wadding is now applied. The plaster apparatus is adjusted after an interval of eight or ten days. The immediate result and the subsequent course of the case should be carefully subjected to radioscopic supervision.

The plaster apparatus used is that employed in the treatment of the classic fracture of the inferior extremity of the radius.

Tumours.

Benign Tumours.

Lipoma.

Of the subcutaneous tumours, lipoma is not of exceptional occurrence. Operation is carried out with the ordinary technique.

Cysts of the Osseous Tissues.

I have met with two cases of polycystic osseous tumours in the bones of the forearm; they were similar in general formation to a multilocular ovarian cyst, of which the walls had become calcified. The dimensions of such a neoplasm may become very considerable, surpassing even those of the adult human head. The only available treatment is amputation of the limb.

Malignant Tumours.

Sarcoma.

Primary sarcoma of the muscular tissue is met with both in the child and adult, and demands early intervention

Enchondroma.

Enchondroma of the ulna or radius is sometimes met with. Benign enchondroma, when treated by early extirpation, may yield a permanent cure.

Osteosarcoma.

Osteosarcoma and myeloid sarcoma can be readily recognized with the help of the X rays. In the initial stage of the growth a partial extirpation of the affected bone may afford a successful result.

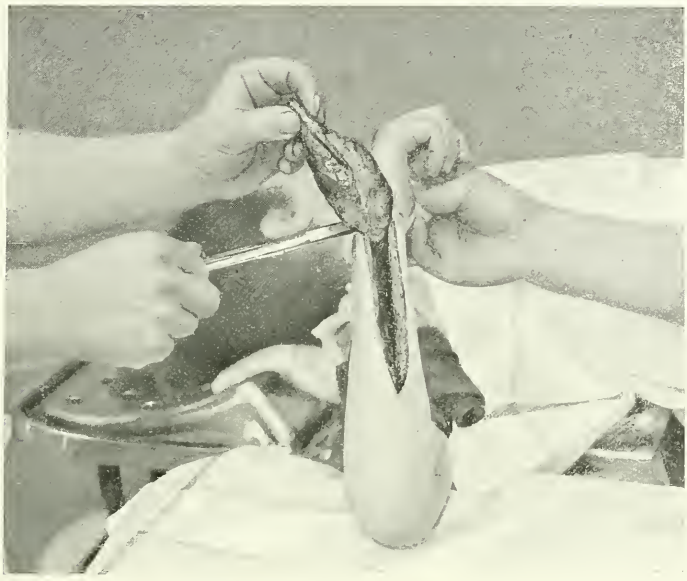


Fig. 807.—Retrograde Extirpation of Inferior Half of Ulna for a Myeloid Sarcoma.

In the case represented in the adjoining illustration (Fig. 807), the function of the forearm has hardly been modified in any way by the extirpation of the lower half of the ulna. No recurrence has followed the operation in that case.

Operations on the Bloodvessels of the Upper Limb.

Ligature of the Brachial Artery.

1. *In the Middle Third of the Arm.*

Operation—First Stage.—Incision of 5 centimetres along the inner border of the biceps muscle.

Second Stage.—Division of the aponeurosis and exposure of the artery by divulsion.

Third Stage.—Denudation of the artery, which is then raised on a curved forceps.

2. Opposite the Bend of the Elbow.

Operation—First Stage.—Incision of 5 centimetres along the inner border of the biceps tendon, and with its median point opposite the fold of the elbow.

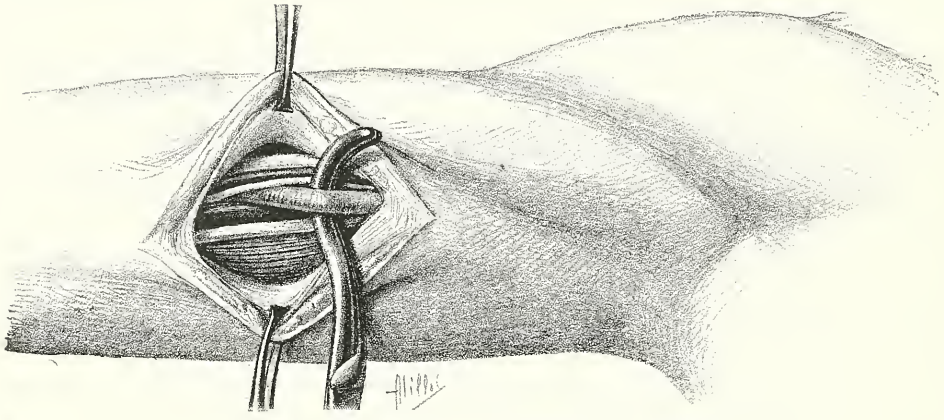


Fig. 808.—Ligature of Brachial Artery.

In front of the artery are found the internal cutaneous and median nerves, and one of the brachial veins; behind it are the ulnar nerve and triceps muscle.

Second Stage.—Incision of the aponeurosis.

Third Stage.—Exposure of the artery, which is then raised on a curved forceps, that is also utilized in passing the ligature.

Fourth and Fifth Stages.—Ligature. Reunion of the wound.

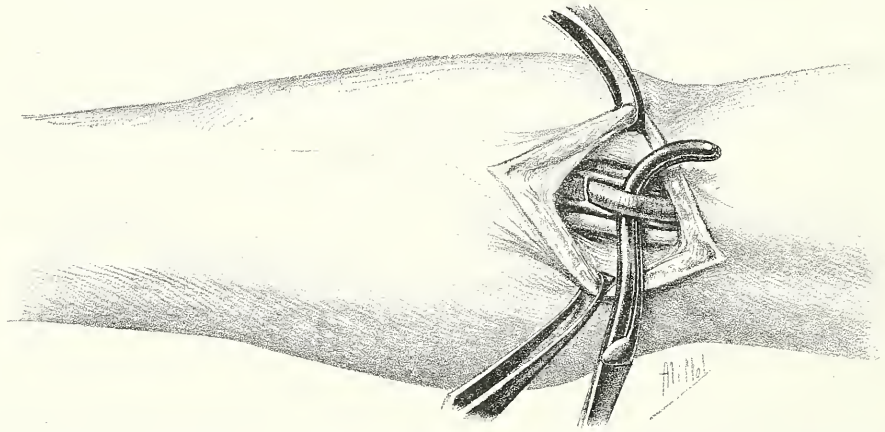


Fig. 809.—Ligature of the Brachial Artery at the Bend of the Elbow.

Ligature of the Ulnar Artery in its Inferior Third.

Operation—First Stage.—Incision of 5 centimetres along the outer border of the flexor carpi ulnaris.

Second Stage.—Division of both antibrachial aponeuroses.

Third Stage.—Exposure of the artery beneath the tendon of the flexor carpi ulnaris.

Fourth and Fifth Stages.—Ligature. Reunion of wound.

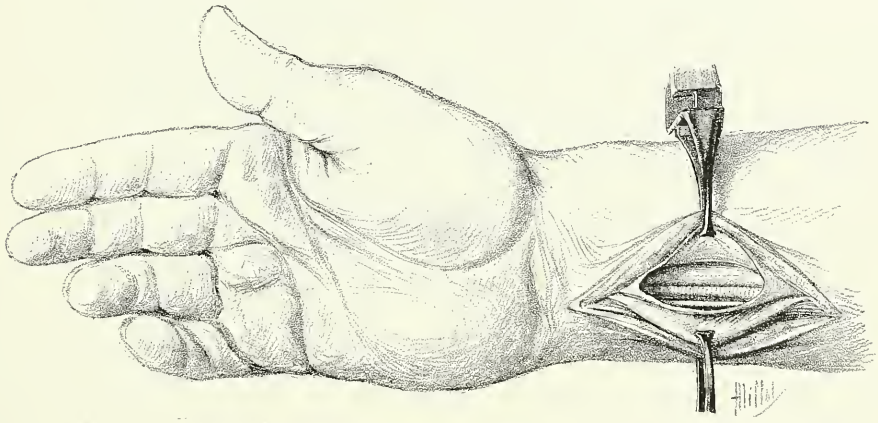


Fig. 810.—Ligature of Ulnar Artery.

Exposure of the sheath of the vessels.

Ligature of the Radial Artery in its Inferior Third.

Operation—First Stage.—Longitudinal incision of 5 centimetres along the radial groove, between the tendons of the supinator longus and the flexor carpi radialis.

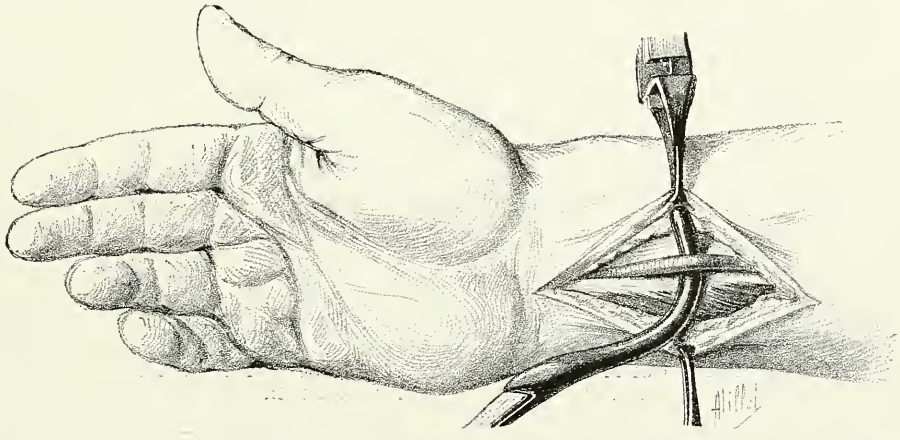


Fig. 811.—Ligature of Ulnar Artery.

The ulnar artery is raised on a curved forceps.

Second Stage.—Incision of the aponeurosis, immediately under which the artery is found.

Third Stage.—The radial artery is raised on a small forceps.
Fourth and Fifth Stages.—Ligature. Reunion of wound.

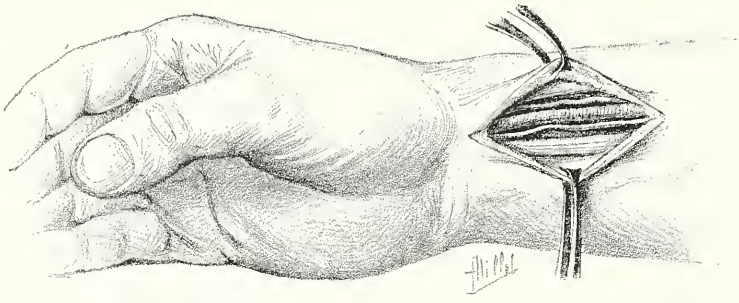


Fig. 812.—Ligature of Radial Artery above the Wrist.

Amputation of the Forearm.

Preventive Hæmostasis.—During the past few years I have employed for the preventive hæmostasis of the brachial and femoral arteries a compressive forceps somewhat similar to that which I designed for tonsillar

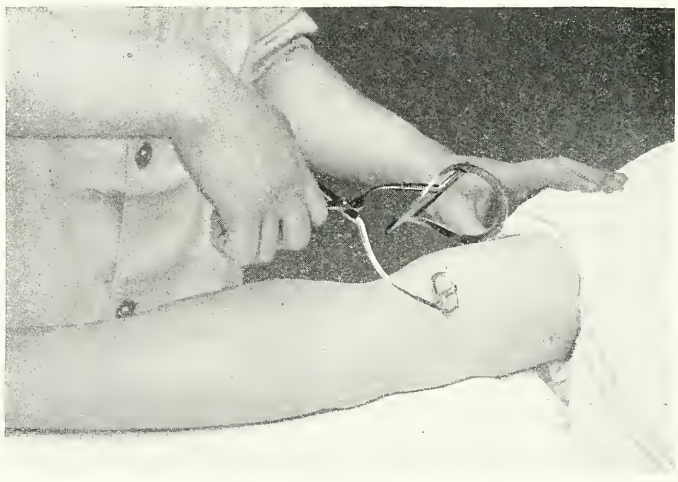


Fig. 813.—Author's Compressive Forceps for Prevention of Hæmorrhage from the Arteries of the Limb.

Application to brachial artery in lower third of arm.

hæmorrhage, but of a different curvature. This instrument is represented in the adjoining figures.

The amputation of the forearm in this position is preferably carried out with formation of anterior and posterior flaps of equal dimensions. In

rarer instances the circular method is resorted to, with a liberating vertical incision, which facilitates the dissection of the cuff. It should be remem-

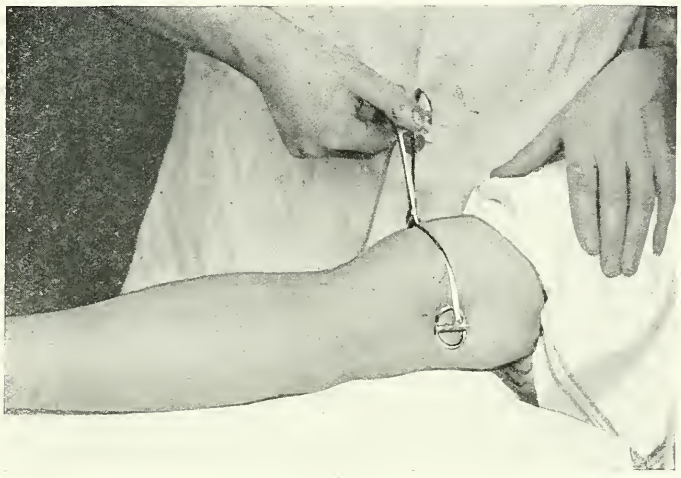


FIG. 814.—AUTHOR'S COMPRESSIVE FORCEPS FOR PREVENTION OF HÆMORRHAGE FROM THE ARTERIES OF THE LIMB.

The compressive forceps has been closed. An external point of counter-pressure is utilized, and the artery is compressed with a metallic ring which is furnished with a slight convexity.

FIG. 815.—EPITHELIOMA OF PALM OF HAND AND WRIST, WHICH HAS ALSO INVADED THE SUBJACENT BONES.

bered that this procedure of circular incision and formation of a cutaneous cuff does not produce a very satisfactory stump, as the tendons always

undergo retraction, with the inevitable result that the cicatrix is brought to rest on the divided extremities of the bones.

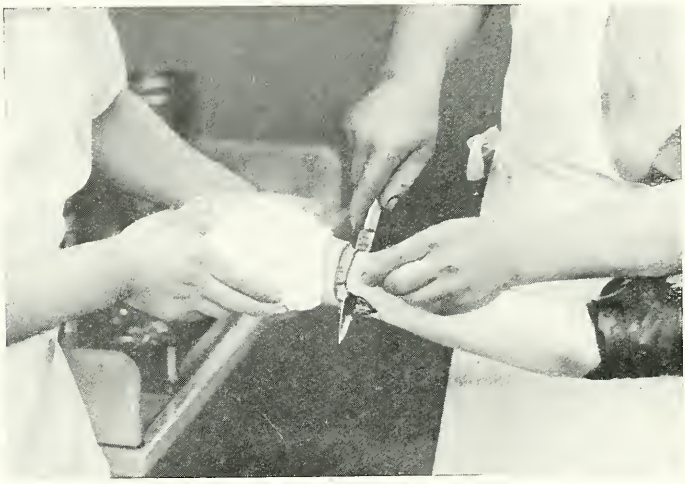


FIG. 816.—AMPUTATION OF FOREARM IN ITS LOWER THIRD, WITH FORMATION OF TWO EQUAL FLAPS.

First stage: Formation of dorsal flap in the position of pronation.

FIG. 817.—AMPUTATION OF FOREARM IN ITS LOWER THIRD, WITH FORMATION OF TWO EQUAL FLAPS.

The forearm has been supinated. Formation of palmar flap, outline of cutaneous incisions, and transfixion of muscles.

Operation.—In case of a left arm, the surgeon stands on its inner side; in that of a right arm, on the outer side. In this position he can grasp the

upper segment of the forearm with his left hand, and thus secure its fixation when dividing the bones. When the limb which has to be operated on is already infected, it should be wrapped in an aseptic dressing.

FIG. 818.—AMPUTATION OF FOREARM IN ITS LOWER THIRD, WITH FORMATION OF TWO EQUAL FLAPS.

Second stage: Commencing figure-of-eight movement on the outer aspect of the radius

FIG. 819.—AMPUTATION OF FOREARM IN ITS LOWER THIRD, WITH FORMATION OF TWO EQUAL FLAPS.

Second stage (*continued*): The knife, which has just cleared the radius, is plunged through the interosseous space, and is made to execute the figure-of-eight manœuvre.

FIRST STAGE.—Formation of the posterior flap in the position of pronation. either by total transfixion of the soft parts or by muscular

transfixion after preliminary incision of the skin. The arm is then supinated, and the operator proceeds to the formation of the anterior flap. Both flaps are then retracted.

FIG. 820.—AMPUTATION OF FOREARM IN ITS LOWER THIRD, WITH FORMATION OF TWO EQUAL FLAPS.

Second stage (*continued*): The knife has been passed beneath, and is now completing the circular division of the muscles.

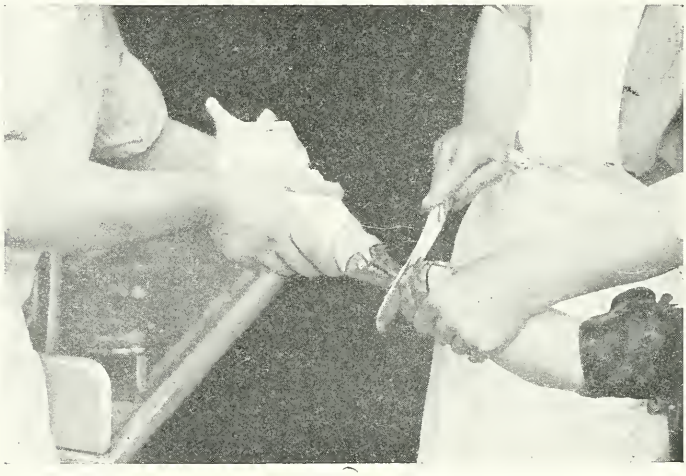


FIG. 821.—AMPUTATION OF FOREARM IN ITS LOWER THIRD, WITH FORMATION OF TWO EQUAL FLAPS.

Third stage: Division of both bones of forearm with saw with movable back.

SECOND STAGE.—Circular division of the muscles around the bones of the forearm with the double-edged interosseous knife, and division of the interosseous soft parts by the figure-of-eight manœuvre.

Third Stage.—Division of radius and ulna with the saw.

Fourth Stage.—Resection of median and ulnar nerves; forcipressure and ligature of the principal arteries.

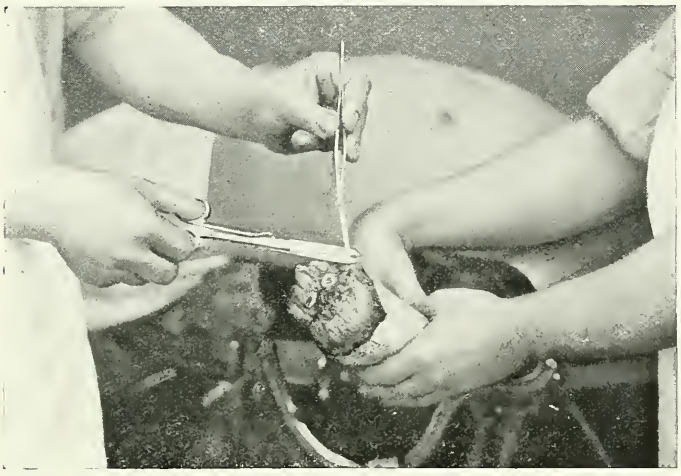


Fig. 822.—Amputation of Forearm in its Lower Third, with Formation of Two Equal Flaps.

Fourth stage: Resection of median and ulnar nerves.

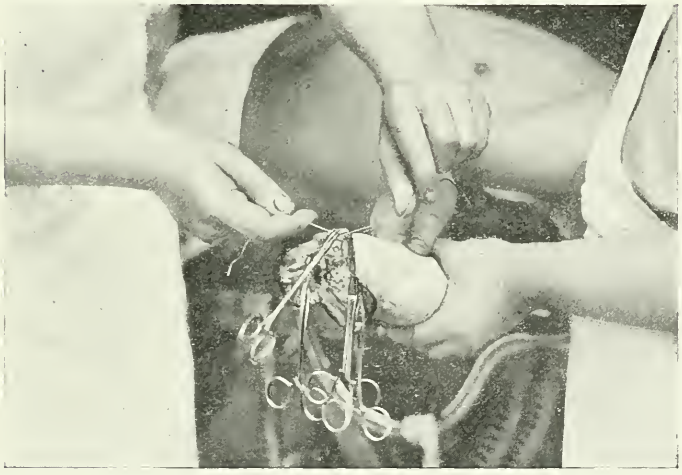


Fig. 823.—Amputation of Forearm in its Lower Third, with Formation of Two Equal Flaps.

Fourth stage: Forcipressure and ligature of radial and ulnar arteries.

Fifth Stage.—Reunion, drainage.

When this operation has been carried out on aseptic tissues, complete

reunion will be obtained in five or six days. The drainage can be suppressed on the second or third day. If the case which calls for amputation is one of

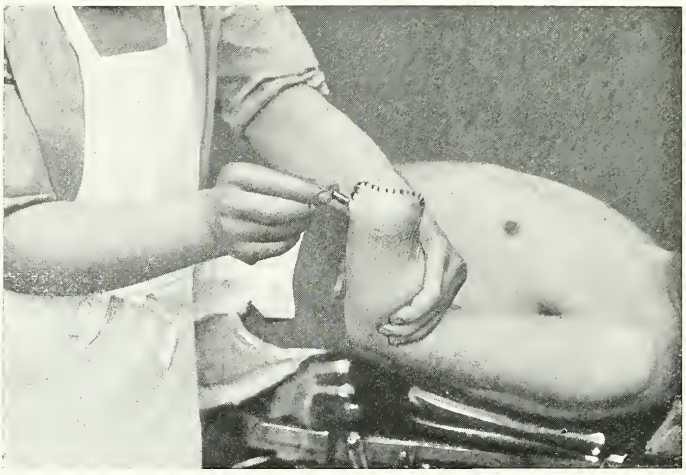


FIG. 824.—AMPUTATION OF FOREARM IN ITS LOWER THIRD, WITH FORMATION OF TWO EQUAL FLAPS.

Fifth stage: Reunion of skin with points of interrupted suture or clips, and adjustment of glass drainage-tube.

an acute inflammatory affection, I always have immediate recourse to tamponing, without insertion of any points of suture.

AFFECTIONS OF THE WRIST.

Traumatic Lesions.

Wounds of the wrist are often accompanied with divisions of nerves or tendons which necessitate the use of suture. Immediate suture should be resorted to only in case of a perfectly aseptic wound, in which immediate reunion can be carried out. When the wound is infected, tamponing must be resorted to, and continuous irrigation applied. In such cases the nerves and tendons are sutured in an ulterior operation, which is carried out after complete cicatrization of the original wound. Cicatricial adhesions of the dorsal or palmar tendons are treated by extirpation of the abnormal fibrous bands.

Application of the elastic bandage is necessary, as the least oozing of blood obscures the field of operation. But it should be applied by beginning on the arm and then passing down to the forearm, and not in the opposite direction as is usually done; this artifice has the effect of pressing the divided ends of the tendon downwards. The tendon should then be carefully

dissected out, without removal of any portion of their own tissues. When retracted, elongation can readily be obtained by adopting a very oblique section of the affected tendon, followed by suture with fine silk (Vol. I., p. 348).

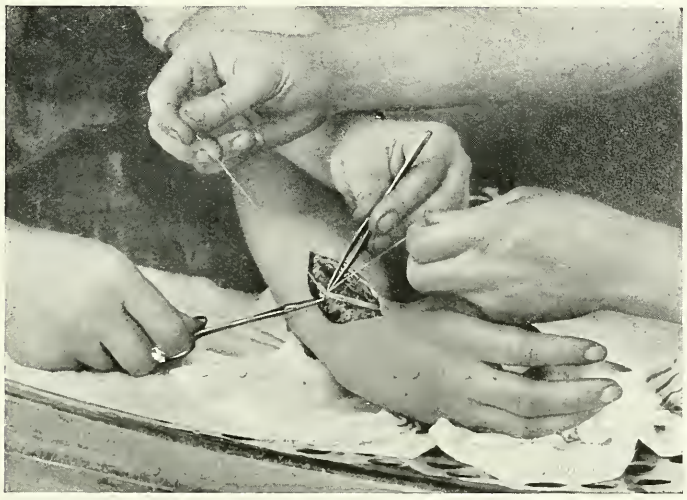


Fig. 825.—Reparation of the Tendon of the Extensor Indicis Muscle.

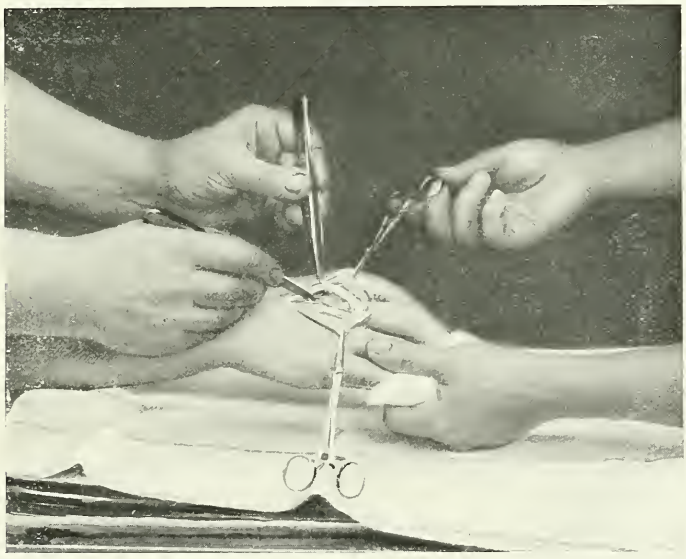


Fig. 826.—Dissection and Elongation of Tendons of the Hand, which had become Adherent to a Vicious Cicatrix.

The same procedure can be successfully adopted for the shortening of a tendon which had remained elongated after injury in consequence of vicious cicatricial adhesion to the wall of its sheath.

Inflammatory Lesions.

Acute Inflammatory Lesions.

Phlegmons of the wrist are due to extension of those of the tendinous sheaths of the hand (see below). The skin and aponeurosis are divided by a longitudinal incision, and the extremity of a blunt-pointed scissors is introduced through the wound into the deep parts and made to enlarge the orifice by divulsion during withdrawal.

Chronic Inflammatory Lesions.

Synovial Cyst (Ganglion).

Ganglion or synovial cyst of the neighbourhood of the wrist-joint is found on the dorsal aspect in the majority of cases. They are of very fre-

Fig. 827.—Extirpation with the Bistoury of a Fungous Synovitis, occurring in the Hand of a Child.

quent occurrence in the female. We usually try to crush them with the thumb. When too resistant, or when there is recurrence, we have recourse to extirpation.

Operation.—General anæsthesia with ethyl chloride is preferable to local anæsthesia with cocaine, inasmuch as the latter tends to produce bad cutaneous reunion. The elastic bandage should be applied.

First Stage.—Longitudinal incision of skin—which should be as small as possible—and exposure of the cyst; this should be completely isolated all around its periphery, and without perforation.

Second Stage.—Resection of all the accessible part of the cyst wall, after evacuation of its colloid contents. We then proceed to extirpate what has been left of the deeply adherent portion of the sac, and complete the destruction of the same with the curette.

Third Stage.—Suture, compressive dressing.

Fig. 828.—Extirpation with the Bistoury of a Fungous Synovitis, occurring in the Hand of a Child.

The resection of the tuberculous tissues has been completed. Appearance of the tendon after dissection.

Tuberculous Synovitis.

Tuberculous synovitis at the wrist may be limited to a few tendons. The variety of fungous synovitis usually affects the dorsal tendons. It is more rarely met with than is the synovitis accompanied by formation of rice-grain bodies, which involves one or both of the two great palmar synovial sacs.

The general treatment consists of combined administration of mycolysine and phymalose.

Localized Fungating Synovitis.

Operation.—Preventive hæmostasis by application of elastic bandage.

First Stage.—Longitudinal incision and exposure of seat of disease.

Second Stage.—Resection with clawed forceps, bistoury, and scissors of the whole of the affected synovial membrane, inclusive of all its deep-seated prolongations. The tendons themselves should be thoroughly divested of every particle of their fungating sheaths, and have their smooth and pearly surfaces exposed throughout the whole extent of the field of operation.

Third Stage.—Reunion without dressing; compressive dressing.

Tuberculous Arthritis.

Tuberculous arthritis of the wrist-joint frequently coexists with tuberculous synovitis. When fistulæ are present, and both general and orthopædic modes of treatment have failed, we must have recourse to resection.

Partial Resection of the Wrist-Joint.

Some cases of cold abscess on the dorsal aspect require only a longitudinal incision, and curettage of the focus of disease followed, when necessary, by ablation of the affected carpal bones.

2. *Total Resection.*

This operation is nearly always performed for tuberculosis, and we rarely find that any of the carpal bones wholly escape—always excepting the

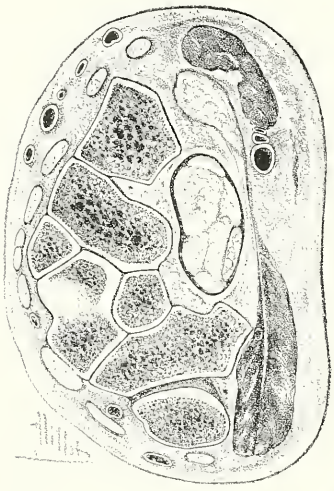


FIG. 829. — TRANSVERSE ANATOMICAL SECTION OF WRIST OF RIGHT SIDE THROUGH THE HEALTHY CARPAL BONES.

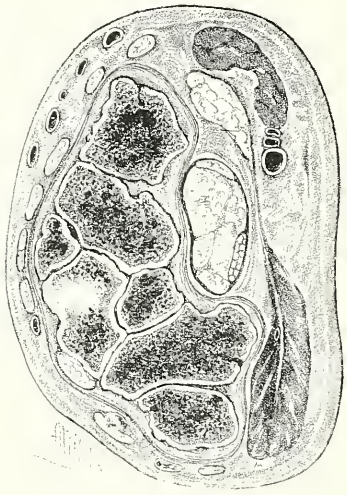


FIG. 830. — TRANSVERSE ANATOMICAL SECTION OF WRIST OF RIGHT SIDE THROUGH BONES AFFECTED WITH TUBERCULOUS CARIES.

pisiform. White swellings of the wrist are nearly always accompanied by considerable deformity. This is, in some instances, bilaterally symmetrical, while in others it is more pronounced on either the radial or ulnar side. Whatever be the extent of the lesion, it should be attacked laterally, along the axis of either radius or ulna, according to the preponderance of the local signs. Anatomy teaches us that it is easy to extirpate all the carpal bones either through a unilateral longitudinal incision, or similar bilateral ones, without wounding any of the structures of functional importance which lie in their vicinity.

1. **External Lateral Incision**—Operation.—Preventive hæmostasis by application of an elastic bandage, or of the authors' compressive forceps.

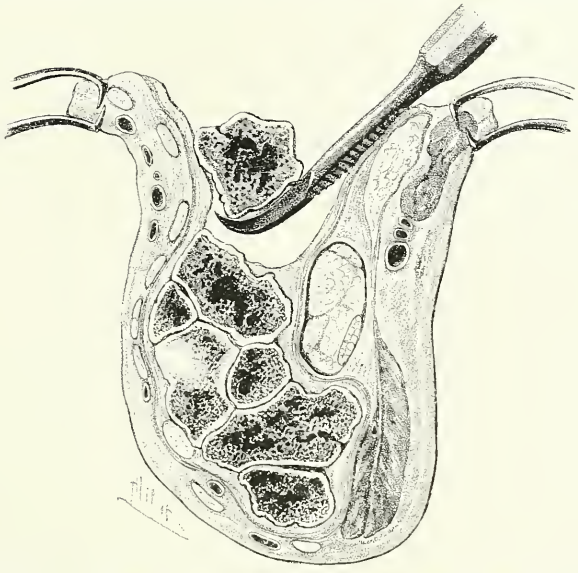


Fig. 831.—Resection of Wrist from the Outer Side.

Third stage: Luxation of scaphoid bone.

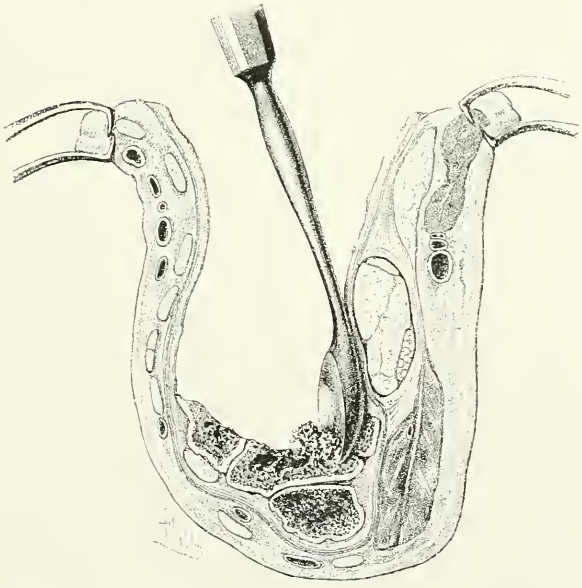


Fig. 832.—Resection of Wrist from the Outer Side.

Third stage: Evacuation and extirpation of the carious bones with a curette.

First Stage.—External longitudinal incision of 5 centimetres, in front of tendon of the extensor ossis metacarpi pollicis. This incision is made from

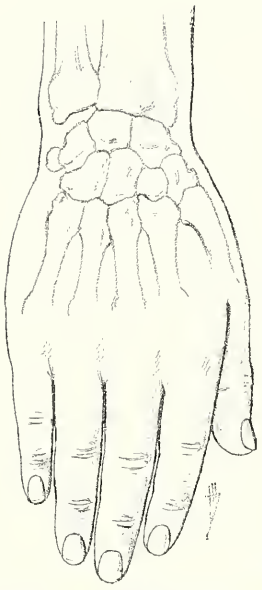


FIG. 833.—DIAGRAMMATIC SKETCH OF THE CARPAL ARTICULATIONS OF THE RIGHT SIDE.

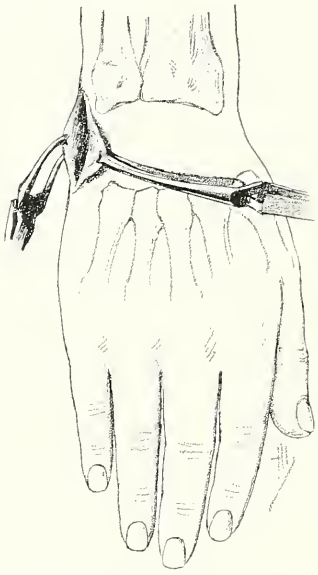


FIG. 834.—RESECTION OF WRIST BY INTERNAL LATERAL INCISION.

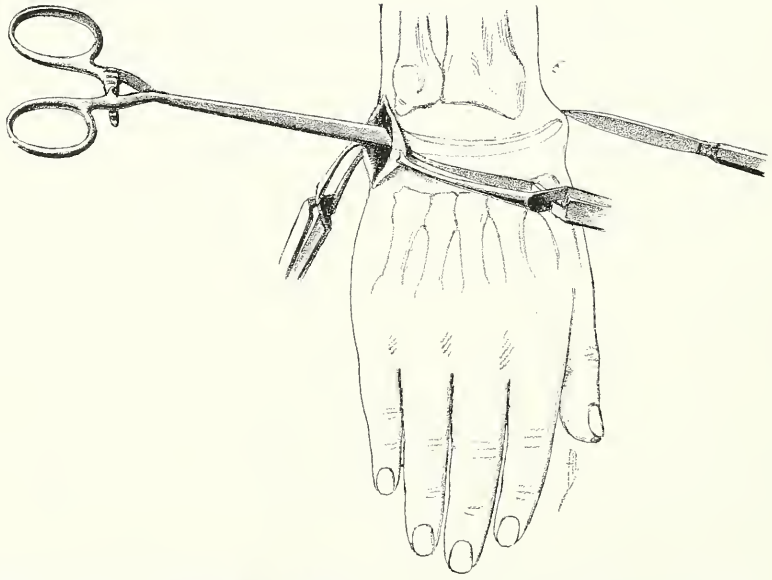


FIG. 835.—RESECTION OF WRIST BY INTERNAL LATERAL INCISION.

Fifth stage: A counter-opening is made on the outer side, by cutting down on the extremity of a curved forceps

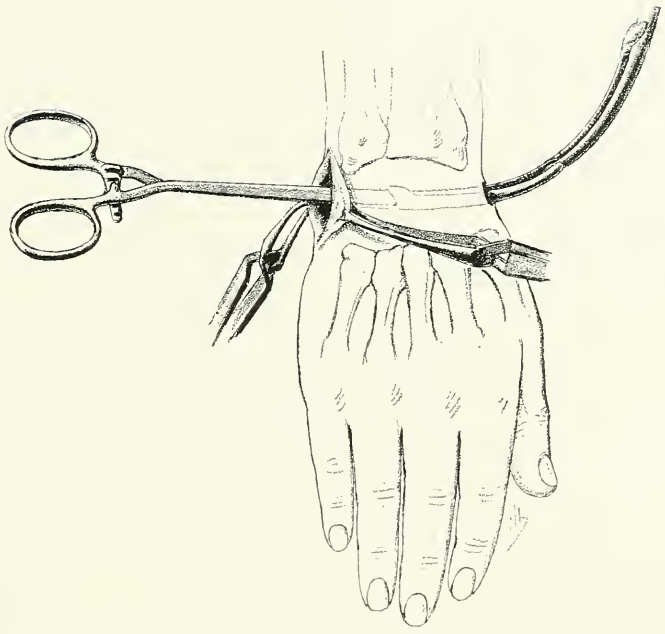


Fig. 836.—Resection of Wrist by Internal Lateral Incision.

Fifth stage: The blades of the curved forceps have been made to project through the counter-opening, and the closed blades of a similar one are made to follow them into the wound as they are withdrawn.

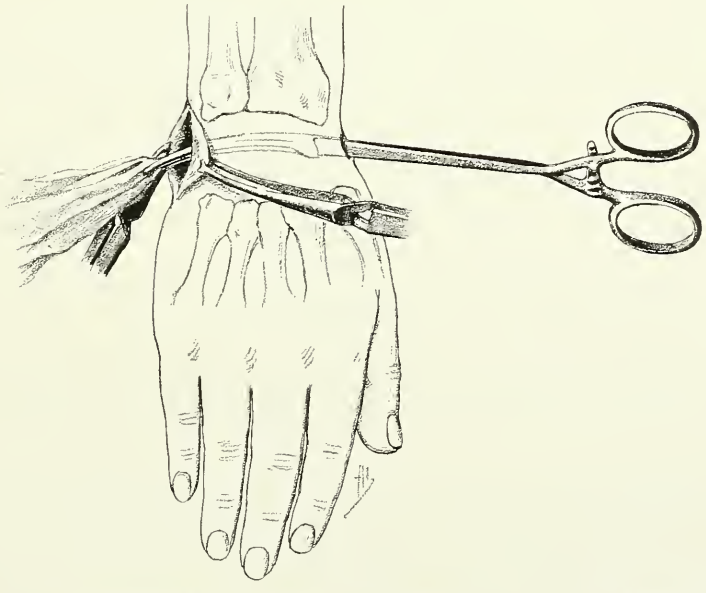


Fig. 837.—Resection of Wrist by Internal Lateral Incision.

Fifth stage: The second forceps has now passed through the field of operation, and is made to grasp the extremity of a compress, which will be drawn through the counter-opening and utilized as a tampon.

above downwards, and should be prolonged to a distance of about 2 centimetres below the styloid process of the radius.

Second Stage.—The field of operation is exposed by division with scissors or bistoury of all the external fibrous adhesions of the scaphoid and trapezium. The anterior and posterior lips of the wound are each grasped with curved forceps, and drawn aside so as to expose the field of operation. The radial artery can be readily preserved, and the incision is now carried down to the bone. When the articular internal has been reached, we can readily use the raspatory as a lever of divulsion—after passing it beneath the radius, with its convexity directed towards the carpus.

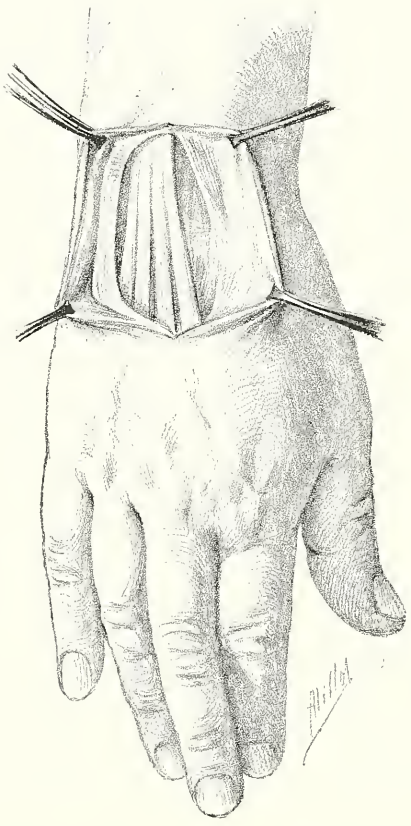


FIG. 838.—INVASION FROM THE DORSAL ASPECT OF AN OSTEO-ARTHRITIS OF THE WRIST, COMPLICATED WITH TUBERCULOUS SYNOVITIS OF THE EXTENSOR TENDONS.

Third Stage.—The scaphoid bone is the first to be luxated with the curved raspatory; the next in order, the trapezium, semilunar, trapezoid, and so on. All the carpal bones can readily be luxated through the external lateral incision. They can be lifted out in a single mass when the osseous tissues are still resistant, and more especially when we are dealing with a fungating arthritis. On the other hand, when they are extensively affected with caries, they must be removed in pieces with the help of a curette.

Fourth Stage.—Verification of the field of operation, curettage of fungosities, and aero-cauterization of the whole field of operation.

Fifth Stage.—Aseptic tamponing. A counter-opening is made on the ulnar side, and a compress is drawn through by the manœuvre represented in detail in Figs. 836, 837

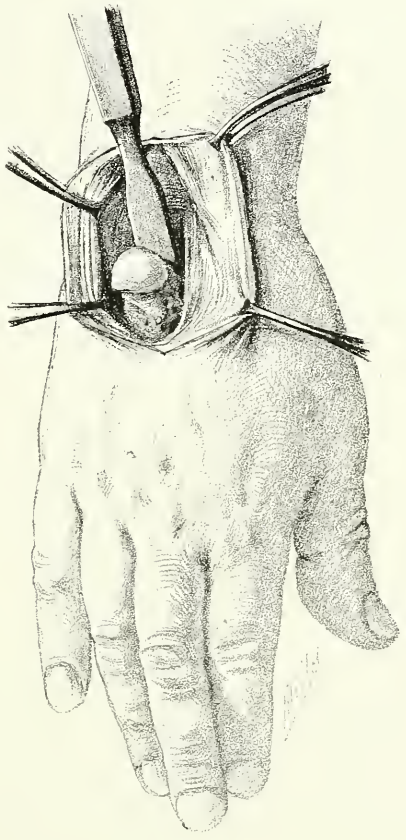


Fig. 839.—Invasion from the Dorsal Aspect of an Osteo-Arthritis of the Wrist, complicated with Tuberculous Synovitis of the Extensor Tendons.

The extensor tendons have here been drawn aside with hooked forceps, and the os magnum is being luxated with a raspatory.

2. **Internal Lateral Incision.**—In cases in which the wrist is more suitably invaded from the inner side, the operation should be carried out according to a similar technique, after making an internal lateral incision commencing at the level of the lower extremity of the ulna.

3. **Bilateral Incision.**—When the lesions are very extensive, it is better to start with two lateral incisions, as a better view of the affected structures is thus provided.

4. **Dorsal Incision.**—This incision should be reserved for cases in which dorsal tuberculous synovitis coexists with the carpal arthritis.

Operative Results.—This technique has given me perfect functional results. The tamponing of the wound should be continued for a considerable time, and cicatrization of the skin should not be allowed to take place till we have made sure that the deep-seated process of repair has been perfected. The permanent cicatrization has appeared to be considerably

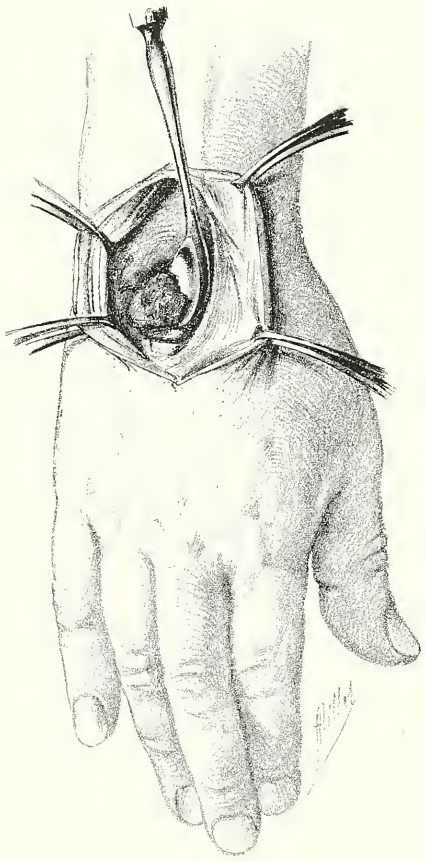


FIG. 840.

Curettage of the diseased carpal bones can be readily commenced in the cavity left by ablation of the os magnum.

accelerated in those cases of articular tuberculosis by associating with the operation the procedure of antituberculous vaccination, carried out according to the author's phagogenic method. The treatment of tuberculous arthritis by this method should always be commenced as soon as possible. Then, if operation be subsequently found necessary, it will be carried out under the conditions most favourable to success.

Fig. 841.—Bacillary Osteo-Arthritis cured after Resection of the Carpal Bones by the Author's Method.

Deformities: Congenital and Acquired.

Congenital Deformities.

Congenital Club-Hand.

Congenital clubb-hand is a rare affection, and is often accompanied with other congenital deformities of the upper limb. In some of the cases the skeleton is complete and well formed; in others it is imperfect, and presents various deformities. Some examples can be dealt with only by orthopædic methods of procedure, and demand the temporary or permanent application of appropriate orthopædic apparatus. Other cases are capable of permanent improvement by suitable orthopædic operations; these may involve the skeleton only, or also include the ligaments and tendons, the technique necessarily varying with the individual case.

Acquired Deformities.

Acquired Club-Hand.

1. **Vicious Cicatrices.**—Vicious and retractile cicatrices, when involving no structures deeper than the subcutaneous cellulo-adipose tissue, should be treated by complete extirpation, followed by the grafting of a cutaneous bridge raised from the fold of the groin.

The photographic reproductions here shown represent an autoplasty of the right upper limb carried out at the expense of the skin of the lower part of the abdomen on the same side.

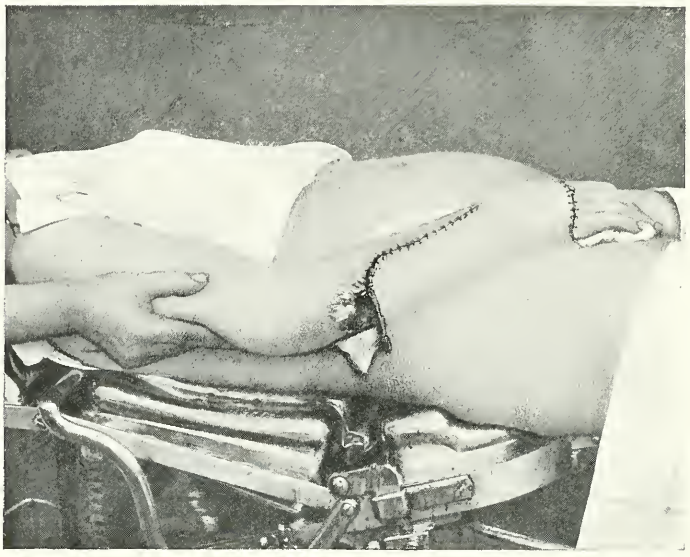


FIG. 842.—REPARATION OF CUTANEOUS LOSS OF SUBSTANCE INVOLVING THE WHOLE DORSUM OF HAND AND DORSAL AND EXTERNAL ASPECT OF FOREARM.

The cicatrix has just been extirpated. The affected limb has been passed under a cutaneous bridge raised in the inguinal region.

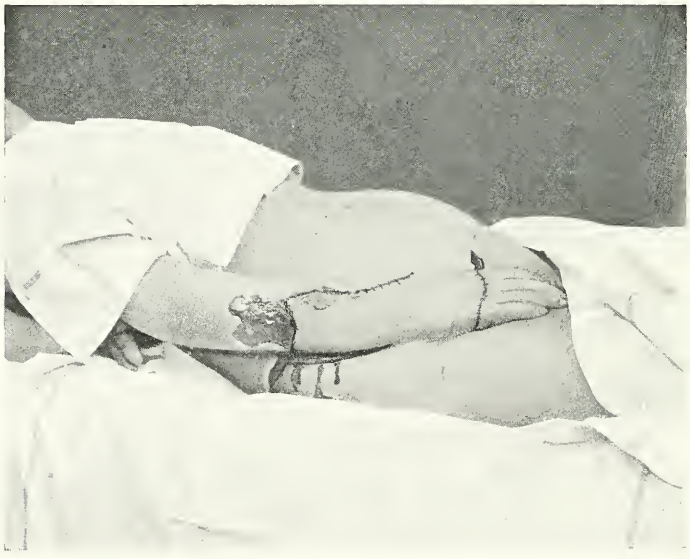


FIG. 843.—REPARATION OF CUTANEOUS LOSS OF SUBSTANCE INVOLVING THE WHOLE DORSUM OF HAND AND DORSAL AND EXTERNAL ASPECTS OF FOREARM.

Reunion has been carried out on the hand and along the radial border of the forearm. Partial division of the inguinal pedicle of the cutaneous flap has been carried out.

First Operation—*First Stage.*—Extirpation of the whole cicatrix and envelopment of the resulting wound in sterilized compresses.

Second Stage.—Formation of a cutaneous bridge, of dimensions sufficient to cover the loss of substance, from the neighbourhood of the groin, at the locality on which the hand naturally comes to rest when the body is in the horizontal position. A thin layer of cellulo-adipose tissue is left adhering to the deep surface of the skin flap.

Third Stage.—The hand and wrist are passed beneath the abdominal cutaneous bridge, which is then partially detached in order to permit the suture of a certain portion of the periphery to the adjoining skin of the hand, wrist, and forearm, while leaving a broad vascular pedicle still attached on each side.

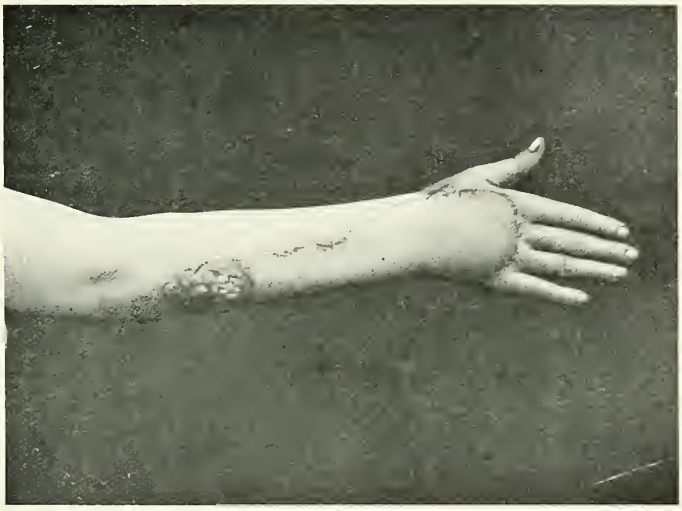


Fig. 844.—Reparation of Cutaneous Loss of Substance involving the Whole Dorsum of Hand and Dorsal and External Aspects of Forearm.

Appearance of the region one month after the operation. Some dermo-epidermis grafts are seen above.

Second Operation.—After an interval of twelve or fourteen days the cutaneous bridge is partially detached on either side, and sutured to the adjacent skin of the upper limb after verification of the opposed margins.

Third Operation.—At the close of another interval of eight days the remaining attachments of the abdominal cutaneous bridges are severed, and the autoplastic suture is completed. In the case represented in the photographs here reproduced, this method of autoplasty has given a perfect functional result: it is impossible to suspect from the general appearance of the region that we are in presence of a transplanted cutaneous flap, and the sensibility of the skin has returned to an approximately normal degree. The patient was a midwife who had suffered from a burn, the effects of which had obliged her to give up for a time the practice of her profession. She now

uses the hand, which had thus been rendered temporarily useless, just as well as before the accident. And the sensiblity of the skin has also been re-established.

2. **Muscular Paralyses**—Operation.—This consists of tenotomy or, better still, tendinous elongation—which must often be combined, in case of complete paralysis, with tendinous transplantation.

3. **Articular Lesions.**—In those cases we have recourse to either orthopædic or surgical treatment—the latter in case of complete ankylosis. In the latter condition orthopædic resection must be carried out; this procedure is, in the majority of instance, limited to partial or complete ablation of the carpal bones.

Tumours.

Tumours of the skin, benign or malignant, do not demand special discussion here. Localized tumours are destroyed by electro-coagulation. Amputation should be resorted to only in those cases in which the functions of the affected limb have been otherwise hopelessly compromised, as happens in cases of polycystic osteomata, which sometimes present a volume greater than that of the adult human head.

AFFECTIONS OF THE HAND.

Traumatic Lesions.

Wounds of the Palmar Region.

Wounds of the hand by pricking or cutting instruments are accompanied by hæmorrhage and division of tendons or nerves. In case of hæmorrhage, compression may be resorted to, or a mediate ligature may be passed under the injured vessel with a curved needle and moderately tightened. In other cases the wound must be enlarged, and both divided ends of the vessel tied. Reunion of divided tendons and nerves can be carried out at once when the wound is aseptic. When the wound is infected, we must have recourse to tamponing and continuous irrigation.

Contused Wounds.

Contused wounds accompanied by osseous splintering are usually infected. No part of the hand should be sacrificed till it has become gangrenous. When the hand has been extensively crushed by the violence which produced the contused wound, continuous irrigation must be resorted to (see Vol. I.). Sphacelated structure should be resected after the lapse of one or two weeks, and cicatrization by granulation must be allowed to take place. An autoplastic operation is performed ultimately. Preventive injections of 10 c.c.

of antitetanic serum should be administered during the first three or four days; in each case the injection is repeated after an interval of eight days.

Contused gunshot wounds are similarly treated. So also are those produced by explosion of cartridges carried by hunters, and of those used in fireworks. Radioscopic examination should be carried out at once, whenever possible.

Wounds of the Fingers.

Cases of incomplete section of one or more fingers by a cutting instrument are often met with, especially in the last phalanx. We also frequently meet with injuries inflicted by a heavy blunt structure, as in cases of incomplete amputation of a finger by a falling piece of timber, or the sudden closing of a door which had been left ajar.

The wound should at once be washed and an endeavour should be made, to obtain immediate reunion. The edges of the wound should be brought together with points of interrupted suture, made with silk or Florentine hair. The parts can then be retained in position by rolling a stip of Vigier's sparadrap around the sutured finger.

Transverse section of the heads of metacarpal bones or phalanges sometimes occurs in workshops furnished with planing and mortising machines. The detached osseous fragments should be extirpated, and the divided tendon sutured.

Longitudinal Section of the Fingers.

I have met with a case of complete median longitudinal section of the middle finger in a workman who had been engaged in pushing forward the planks for division with the circular saw. Cutaneous suture was immediately applied, and was followed by a completely successful result, with restoration of the normal movements.

Strangulation of Fingers.

We sometimes meet with strangulation of a finger in a child, produced by a tight string or introduction into a narrow orifice. A string can always be divided, although we may have to sacrifice some epidermis in carrying out the process. Metallic rings must be divided with strong cutting forceps, or a file, or even a saw.

Ordinary rings can be removed readily enough by rolling a very thick waxed thread in closely juxtaposed spirals around the finger involved; beginning at the ungual extremity, and ending by passing the end of the thread under the ring with the aid of a blunt-pointed needle. When the thread is then slowly unrolled, the ring can be readily made to follow it gradually to the tip of the finger.

Foreign Bodies in the Hand.

Foreign bodies are frequently met with in the hand: fragments of glass, grains of shot, bullets from small pistols, etc. Sometimes these foreign bodies are found to have been encysted for a long period. The diagnosis

must be assumed by the X rays. When necessary, the foreign body can be more definitely located by introduction of two acupuncture needles from different directions towards its position, which can be seen on the photographic *plates*, and made to serve as guides in the procedure of removal. When the body cannot be found in operation, the process of extraction must be completed in the radioscopic cabinet, which should be close to the operation-theatre; the passage of the forceps and prehension of the foreign body can then be followed out on the screen.

Inflammatory Lesions.

Acute Inflammatory Lesions.

Panaris.

1. **Superficial Panaris—Whitlow.**—Superficial or phlyctenoid panaris sometimes occurs, in the shirt-button or dumb-bell form, being complicated by the simultaneous existence of a deep panaris. We should always endeavour to obtain resolution by the administration of hypodermic injections of mycolysine.

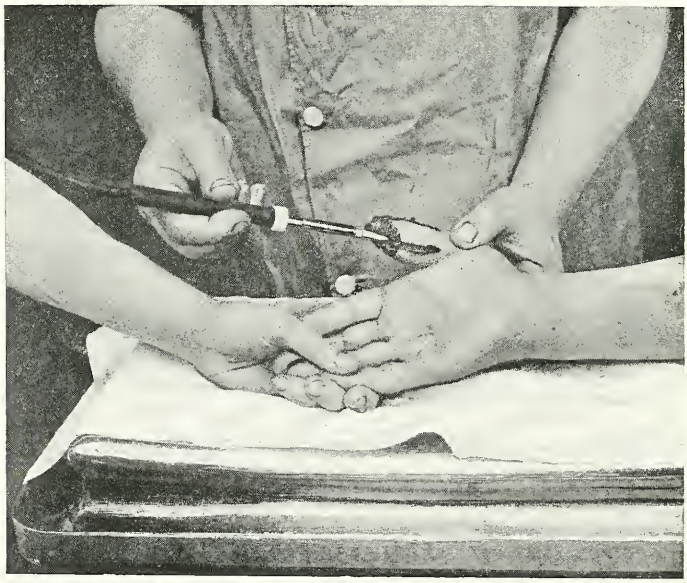


Fig. 845.—Opening of a Diabetic Whitlow of the Thumb with the Thermo-Cautery.

Operation.—Local anæsthesia. Removal of detached epidermis, and incision, when indicated. Bacteriological examination of the pus is then carried out.

2. **Palmar Panaris of the Phalangette.**—This must be incised immediately, when pus has commenced to form.

Operation.—Elastic ligature of root of finger and congelation with ethyl chloride. The finger is placed with its dorsal surface on a table and the

Fig. 846.—Opening of a Panaris of the Tendinous Sheath of the Index-Finger

Fig. 847.—Opening of a Panaris of the Tendinous Sheath of the Index-Finger: Opening of a Dorsal Purulent Focus.

surgeon plunges the bistoury down to the bone, at a distance of 5 or 6 millimetres above the fold of flexion of the phalangette, and cuts down to the bone till the bistoury has reached the extremity of the nail, rasping the surface of the bone all the way.

3. **Panaris of Second and of the First Phalanges.**—Panaris of those phalanges is always one of the tendinous sheath of the palm, which may extend to the whole area of the palm and there become the point of departure of diffuse phlegmon of the forearm.

We should endeavour to procure resolution by the administration of mycolysine. When pus collects, an incision should at once be made.

Operation.—General anæsthesia is necessary in case of sensitive patients.

First Stage.—First incision along the length of the second phalanx, and carried down to the tendons.

Second Stage.—Second deep incision, opposite the first phalanx; the middle point of which is situated on the digito-palmar fold, which is directly opposite the middle of the first phalanx.

Phlegmon of the Hand.

Advanced phlegmon of the hand frequently necessitates, in addition to those incision above described, many others in both the palmar and dorsal regions. It will be prudent to incise the skin only, and then penetrate the deep structures with a blunt-pointed scissors, or even a hæmostatic forceps with long blades, which are introduced closed, and then made to open the orifice by divulsion during withdrawal. A series of drainage-tubes must be applied, and local baths and antiseptic lavages are frequently repeated, with 2 per cent. solution of phenol, 5 per cent. dilution of Labarraque's fluid, oxygenated water of 12 to 20 per cent.

Chronic Inflammatory Lesions.

Necrosis of Phalanges and of Metacarpal Bones—Tendinous Necrosis.

Extirpation of a necrosed phalangette produces no other inconvenience than the resulting deformity of the finger.

Necrosis of a second or first phalanx, when complicated with necrosis of the flexor tendons, is productive of ankylosis of the finger in a vicious position. Accordingly, this complication of panaris demands, where it is found that the use of the finger has been irretrievably lost, amputation through the head of the metacarpal bone.

Spina Ventosa.

Tuberculous osteitis of the phalanges and metacarpals should be treated at the outset by incision, followed by curettage of the diseased osseous foci. When the lesions have advanced too far, extirpation of the tuberculous bones must be carried out. This procedure should be subperiosteal.

Tuberculous Arthritis of the Fingers.

When orthopædic treatment has failed, articular resection should be carried out through a lateral incision.

In both those affections the general treatment should be conducted by combined administration of mycolysine and phymalose.

Rice-Grain Cysts.

The diagnosis is readily made in these cases from the characteristic sensation of friction conveyed to the hand by the movement of the riziform bodies under digital palpation beneath the annular ligament of the wrist.

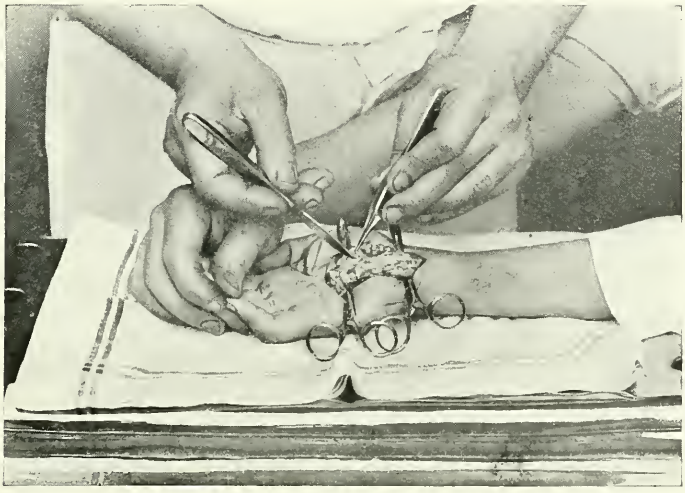


FIG. 848.—DISSECTION OF THE LARGE PALMAR SYNOVIAL SAC, CONTAINING THE RIZIFORM GRAINS PRODUCED BY CHRONIC SYNOVITIS.

The anterior annular ligament of the wrist has been divided.

FIG. 849.—DISSECTION OF THE LARGE PALMAR SYNOVIAL SAC, CONTAINING THE RIZIFORM GRAINS PRODUCED BY CHRONIC SYNOVITIS.

The synovial sac has been incised and the riziform grains evacuated. Dissection of the tendons.

The large palmar synovial sac is that most frequently affected. There may also be co existing synovitis of the synovial membrane at the base of the metacarpal bone of the thumb.

I will now proceed to describe the operation for cyst of the great palmar synovial membrane with characteristic riziform grains.

Operation.—Preventive hæmostasis with elastic bandage or with the author's compressive forceps.

First Stage.—Vertical median cutaneous incision, beginning at the wrist and terminating at the digito-palmar fold; ligature of both ends of the superficial palmar arch.

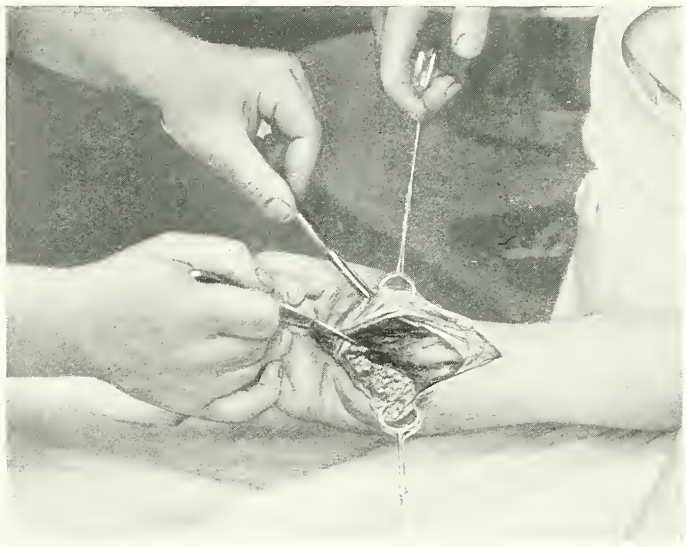


Fig. 850.—Dissection of the Large Palmar Synovial Sac, containing the Riziform Grains produced by Chronic Synovitis.

The tendons are drawn upwards, and a deep prolongation of the synovial sac has been exposed, from which more riziform grains are found to issue.

Second Stage.—Division of anterior annular ligament of wrist and of the palmar aponeurosis; exposure of the synovial sac.

Third Stage.—Incision of the synovial membrane, evacuation of the riziform bodies, and dissection of the synovial sac. The ablation of the whole of the superficial part of the synovial membrane is carried out with scissors and clawed forceps, the tendons are then all drawn up, and the deep-seated folds of the membrane are all completely extracted. Finally, the tendons are all completely divested of the fungosities which partially cover them.

Fourth Stage.—Verification of the field of operation, while taking care not to wound any important vessel. Continuous suture of the anterior annular ligament with fine silk, and interrupted suture of the skin with silk or Florentine hair.

Fifth Stage.—Compressive dressing.

This operation can be very easily carried out by anyone who knows the topographical anatomy of the synovial sheaths. The cutaneous incision should be about 12 centimetres in length. It begins at the interthenar region. After careful division of the radio-carpal ligament, the median nerve must be sought for and carefully retracted. The dissection of the synovial sheaths is then commenced. In dissecting the radial sheath it must be borne in mind there is an intimate relation with the tendon of the extensor ossis metacarpi pollicis, and that the dissection must be carried out with minute care in the thenar region. Then, when dealing with the ulnar sheath, care must be taken to ascertain whether there is any communication between it and the digital sheath of the auricular digit.

Consecutive Care.—The hand is secured in the vertical position and the Esmarch's band is removed. I have always obtained immediate reunion. The operation, when skilfully performed, is followed by complete restoration of the functions of the hand. Complete resection of every particle of the synovial membrane affords permanent security against recurrence, but this operation is one which demands from the surgeon both a perfect knowledge of the anatomy of this region and extreme delicacy of hand and touch. Not one of the deep-seated prolongations of the serous membrane can be neglected. When the case is one of old-standing, some tendons may require to be pared down, or even resected. Tendinous anastomosis should then be carried out.

Deformities: Congenital and Acquired.

Congenital Deformities.

Polydactylism.

The condition of the skeleton in cases such as these can be ascertained by radiography; supernumerary digits are then removed, and an endeavour is made to secure a *restitutio ad integrum*.

Bifid Digits.

When the two divisions are of the same dimensions, a V-shaped amputation of the two inner ones (in regard to the axis of the digit) is carried out, and the outer are then united by suture.

Macrodactylism.

Hypertrophy of the fingers may require surgical intervention, the details of which must vary in each individual case; the same can also, of course, be said of other congenital deformities of the hand, the endless variety of which can never be foreseen.

Brachydactylism.

Brachydactylism frequently coexists with lateral or circular grooves on the skin of abnormally short fingers, which seem to owe their formation to the presence of fibrous bands. At the origin of these grooves are found terminal rounded buttons without any osseous core, the extirpation of which must be resorted to as an orthopædic procedure.

Syndactylism

This deformity presents itself in several types: Membranous, by juxtaposition, and osseous.

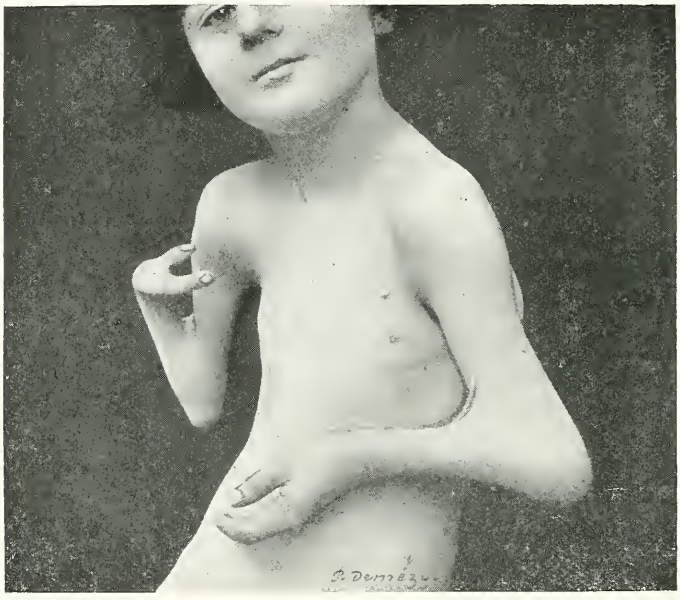


FIG. 851.—EXAMPLE OF MULTIPLE CONGENITAL MALFORMATIONS: LOBSTER-CLAW HANDS.

1. **Membranous Syndactylism**—OPERATION.—Division of the interdigital membrane, and resection of the commissure by formation of a small triangular flap cut from the dorsal aspect of the membrane. The operation is easily carried out when the membrane is of sufficient extent to permit the application of suture.

2. **Syndactylism by Juxtaposition.**—When the skin passes directly from one finger to the other, it is necessarily impossible, even in a case of unilateral syndactylism, to reunite the integuments after separation of the united digits by a simple incision. The proportional deficiency of skin, is of course, still more considerable when several digits are thus enclosed—notably so in the case of digits involved in bilateral syndactylism.

Operation.—One of the best modes of procedure is that which I now proceed to describe. Let us suppose we are dealing with a case of unilateral syndactylism of the index and middle fingers: the skin of the middle finger is incised on the palmar aspect near the middle line, and that of the index-finger near the middle line on the dorsal side. The two flaps thus outlined serve for reconstruction of the tegumentary investment of the index and middle finger respectively. A small dorsal triangular flap can now be provided for the reconstruction of the commissure, and sutured in position on the palmar aspect.

3. **Osseous Syndactylism.**—In a case of this variety of syndactylism, which is more rarely met with, the indications for the necessary sections of the affected bones must be supplied by radiography.

Digitus Varus or Valgus.

This deformity is usually bilateral, and most frequently involves the thumb or auricular digit. It must be remedied either by adjustment of a metallic apparatus, or by orthopædic resection of the upper portion of the distorted finger.

Acquired Deformity.

Tendinous Retractions.

In cases of this kind the suggestion of simple tenotomy should be wholly rejected; we must, in every case, have recourse to the procedure of simple tenotomy such as I have described it. When tendinous adhesions exist, they should be completely detached, and extirpation of all cicatricial tissues should be thoroughly carried out. The gravest form of the condition that can present itself is that in which all eight common flexor tendons are involved, the thumb alone being free.

In such a case, I have incised the skin of the palm and divided the anterior annular ligament, as in the operation for rice-grain cysts of the palmar synovial membrane, and then elongated every one of the eight tendons, in succession, to the extent of 15 millimetres, by a process of dovetailing, and then reunited each with fine silk suture. The orthopædic and functional result was perfect.

Clasp-Knife Digit.

The clasp-knife digit is usually met with as a result of the mechanical influence of hydrarthrosis of the sheath of the flexor tendons, complicated by the formation of nodosities on the tendons themselves.

Operation.—Incision of the sheath of the tendons, followed by a minutely careful dissection of the enclosed tendons and extirpation of every trace of exuberant tissue.

Retraction of the Palmar Aponeurosis.

Retraction of the palmar aponeurosis is an inflammatory affection, characterized by tardy progress and sclerous evolution; it is frequently bilateral and symmetrical.

Operation.—Extirpation of the sclerotic tissues throughout their whole extent, and complete liberation of all adherent tendons.

Vicious Cicatrices.

Complete extirpation of the cicatrix should be carefully carried out, and followed by autoplastic adaptation of a flap grafted from a distance, as above described in cases of the wrist and forearm.

Tumours.

Benign tumours—lipomata, fibromata, cysts, etc.—can be extirpated without difficulty. Warts, which are usually multiple, should be thoroughly extirpated with the help of the curette. The seat of growth should then be cauterized with silver nitrate, or even with the thermo-cautery. It is familiarly known that warts are readily inoculated by the mere contact of the lymph and blood which escape therefrom after incomplete removal.

Angiomata should be treated by extirpation whenever this procedure is possible: in other cases by the use of thermic electro-coagulation. Chondromata, fibromata, and sarcomata may behave as benign growths in the early stage of their development, and not recur after extirpation.

Malignant tumours, especially epitheliomata and melanotic sarcomata, should be destroyed by thermic electro-coagulation.

Cirsoid Aneurismal Tumours.

Tumours of this type sometimes originate at the seat of a wound—for instance, that produced by the bite of a dog (Krause). The arterial dilatation may even attain a considerable volume.

Operation.—Longitudinal incision, exposure of the flexuous arteries, and extirpation of all dilated ones, after ligature of both ends of each, and of their anastomosing branches, as in operations for the radical cure of varicose veins.

Aneurisms.

Aneurisms which are met with in the hand are usually of purely arterial formation, of traumatic origin, and of small volume; they are situated on one of the palmar arches or of the collateral digital branches.

Operation.—Extirpation of the aneurismal sac and ligature of both ends of the artery.

Amputation and Disarticulation of the Metacarpal Bones and Phalanges.

Disarticulation of the Metacarpal Bones.

The procedure of disarticulation of one or more digits, with the corresponding metacarpal bones, is usually—when the selection is an open one—carried out with a racket-shaped incision. The outline of the racket incision should be asymmetrical in case of the terminal digits of the row, so as to direct the resulting cicatrix towards the axis of the hand, and to the dorsal aspect of the same. This operation has been well defined by Farabœuf.

Fig. 852.—Resection of Base of Metacarpal Bone with Bone Forceps with Curved Jaws.

Operation—First Stage: Tracing of the Incision.—The finger, or fingers, which are about to be amputated are grasped with the left hand, with their dorsal surface looking upwards. The handle and right half of the racket are then traced by plunging the bistoury through the skin opposite the carpo-metacarpal articulation, and passing around the head of the metacarpal bone into the palmar surface. The finger is then drawn back, and the left segment of the incision is completed by passing the bistoury beneath the left hand. The operator then retraces the whole outline of the racket, dividing all the tissues down to the bone, and detaching the lateral flaps.

Second Stage.—The hand is hyperextended, with its dorsal aspect towards the surgeon. The edge of the knife is now made to circumscribe the

head of the metacarpal bone, first on the right side and then on the left, and scrape its surface as far as the articular extremity; it detaches the tissues from its palmar aspect, and is finally made to penetrate the carpo-metacarpal interstice first on the right side and then on the left.

Third Stage.—When about to complete the disarticulation, we must bear in mind that the third metacarpal bone ends above in a tubercle which can be readily felt at a distance of about 3 centimetres from the styloid process of the ulna. The articulation of the base of the first metacarpal is found in the same horizontal plane, at a distance of about 25 or 30 millimetres from the styloid process of the radius, when the limb is in the vertical position, the internal and external carpo-metacarpal articular

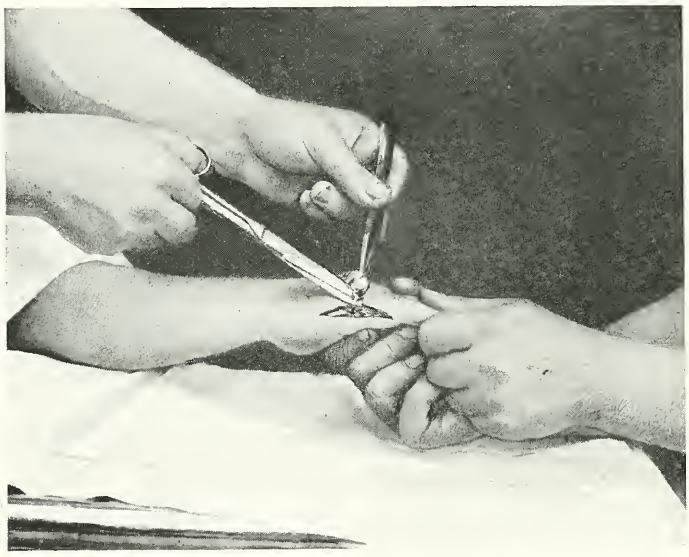


Fig. 853.—Resection of Base of Metacarpal Bone with Bone Forceps with Curved Jaws.

Luxation of the condyle; division of last tendinous attachments.

planes thus directed obliquely from above downwards, and with an inclination towards the axis of the hand. The third and fourth carpo-metacarpal interlines are rectilinear and directed transversely. On the other hand, the second interline presents a re-entrant angle on the metacarpal side, which caps a triangular projection on the adjacent surface of the os trapezium. According as we proceed to deal with the individual metacarpal bones of one or the other hand, the bistoury is made to penetrate the intermetacarpal interval or intervals, the ligamentous connections of which it is made to divide down to the palmar surface of the bones. The point of the blade penetrates the carpo-metacarpal interval easily, on account of the force acting on the base of the metacarpal bone, which tends to dislocate it backwards, and is then made to free it from its last attachments.

Variation of Second Stage.—The second stage of the operation—that of denudation and disarticulation of the metacarpal bone, or bones—may be modified in the following way: When the racket incision has been made, and the cutaneous margin freed, the surgeon keeping the finger drawn towards himself and slightly hyper-extended, makes the blade to penetrate on the flat on the right side of the bone, and there pass around the latter, taking care that it grazes the surface all the time close to its upper extremity. When the blade has completely passed round the deep surface of the bone, the cutting edge is turned upwards and the point is made to project on the left side of the same, and next the whole of the edge, which thus completes the division of the tissues on that side. The surgeon now requires but to advance the right leg in order to place himself on the right side of the hand, and then proceed to the disarticulation, properly so called, which is then carried out in the way above described.

Partial Resection of the Metacarpal Bones.

Partial resection of the metacarpal bones is usually concerned with the phalangeal extremity. I have represented the procedure of resection of the fifth metacarpal bone of the left hand.

First Stage.—Longitudinal incision of 3 centimetres along the inner border of the extensor tendon.

Second Stage.—Opening of the articulation and denudation of the extremity of the bone.

Third Stage.—Section of the neck of the metacarpal bone with the bone-forceps, and extirpation of the osseous fragment.

Fourth Stage.—Toilet of wound. Reunion and drainage.

Disarticulation of the Fingers.

Operation—First Stage.—The finger is held in the vertical position. The bistoury divides the skin transversely along the digito-palmar groove, and severs the soft tissues down to the bone. We then recognize the tendon sheath above the blade, and below it the two phalangeal condyles. The circular incision is now completed on the dorsal aspect of the articulation.

Second Stage.—Two hooked forceps are applied on the lips of the wound, palmar and dorsal respectively. The articular interval is at once recognizable. The bistoury, held transversely, with its cutting edge looking towards the ulnar border of the surgeon's hand, now rapidly penetrates the articular interval; the movement being facilitated by vigorous traction on the finger, which is maintained simultaneously with retraction of the margin of the wound on the palmar side.

Third Stage.—The disarticulation is completed as above described.

Fourth Stage.—Hæmostasis and suture.

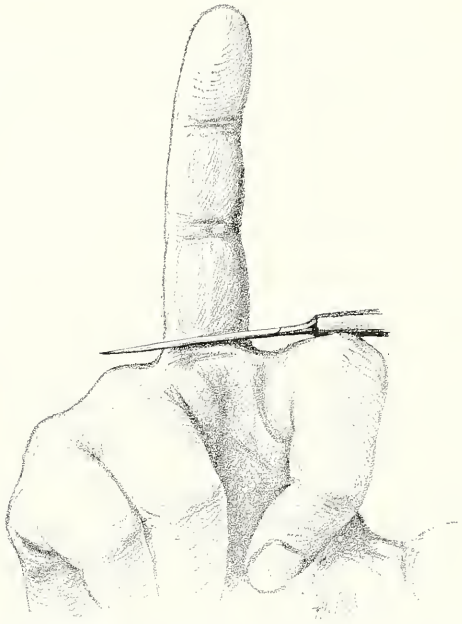


FIG. 854.—METACARPO-PHALANGEAL AMPUTATION BY CIRCULAR INCISION.
First stage: Circular division of skin in the digito-palmar groove.

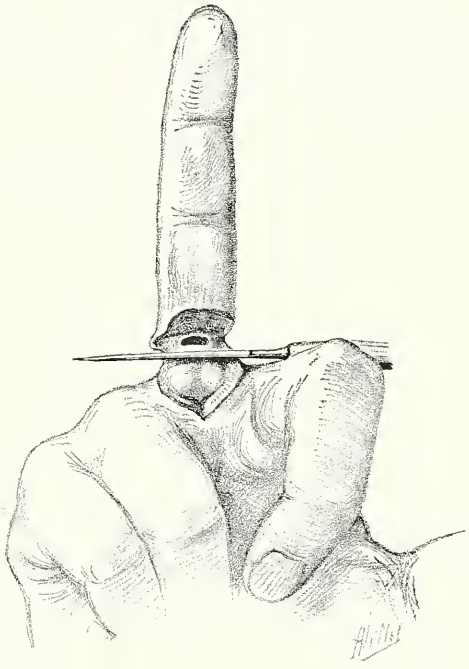


FIG. 855.—METACARPO-PHALANGEAL AMPUTATION BY CIRCULAR INCISION.
Close of first stage: The bistoury has divided all the strata of soft tissues down to the bone. The two phalangeal condyles are seen.

Amputation by Racket Incision.

The amputation by racket-shaped incision has hitherto been regarded as the classic procedure.

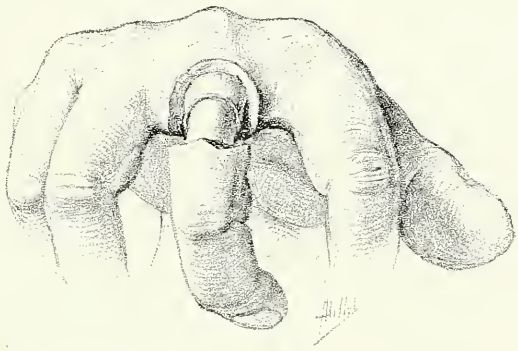


FIG. 856.—METACARPO-PHALANGEAL AMPUTATION BY CIRCULAR INCISION.

Circular amputation of middle finger. Spontaneous retraction of lips of wound.

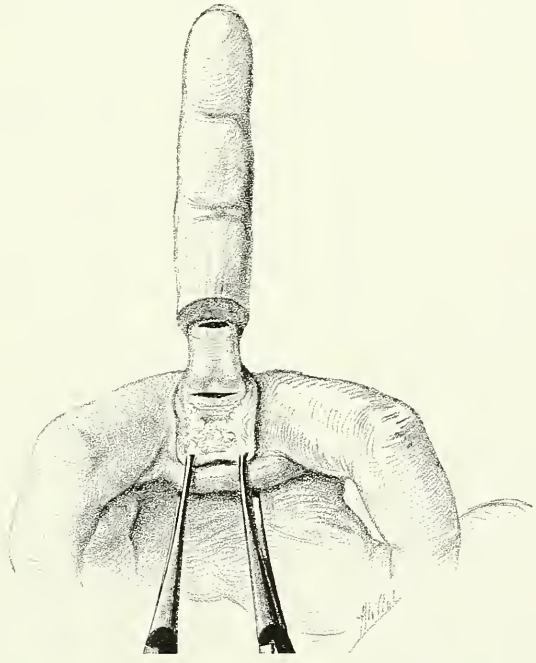


FIG. 857.—METACARPO-PHALANGEAL AMPUTATION BY CIRCULAR INCISION.

Vigorous traction is maintained on the palmar margin of the wound. The articular interval can be entered with ease.

The form of the cutaneous incision, when the presence of fistulæ or loss of substance produces no unavoidable modification of its outline, is symmetrical

in case of the middle finger, ring-finger, or thumb; but asymmetrical in case of the index and auricular digits. This latter arrangement is adopted for the purpose of preserving a small flap which is formed with the object of turning the cicatrix towards the axis and dorsum of the hand—that is to say, externally and away from the palm in case of each of the two former digits;

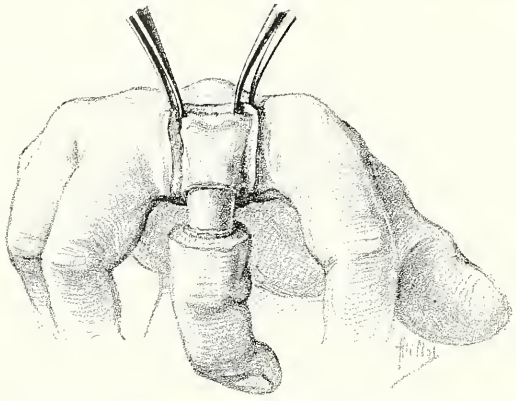


Fig. 858.—Metacarpo-Phalangeal Amputation by Circular Incision.

The articular interval is exposed on the dorsal aspect by the traction maintained with the hooked forceps.

internally, and away from the palm in case of the auricular. When the formation of two lateral flaps is necessary, care should be taken to make them large enough to cover the head of the metacarpal bone without any dragging. When we can form but a single flap, it should be made rather too long than too short. When of exuberant dimensions, it can be readily trimmed down with scissors just before suturing.

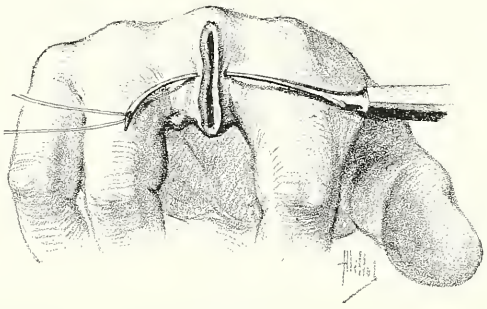


Fig. 859.—Metacarpo-Phalangeal Amputation by Circular Incision.

Suture of the wound.

When the loss of cutaneous substance prevents the covering of the head of the metacarpal bone, this must be resected with bone forceps.

Operation—First Stage.—The finger which is about to be amputated is grasped between the thumb and index-finger, with dorsal surface looking

upwards. The tracing of the racket-incision is commenced on the operator's right side, and is carried from the dorsum towards the palm, and then towards his left side while passing under his left hand. The edge of the bistoury

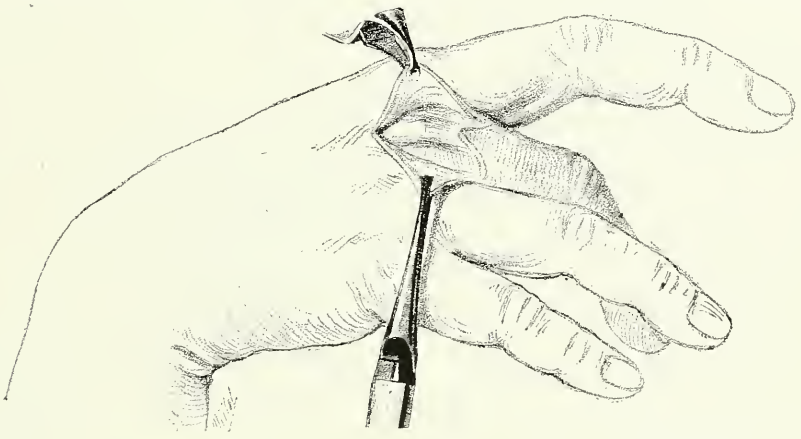


Fig. 860.—Metacarpo-Phalangeal Amputation with Racket-shaped Incision.

Second stage. After the incision of the skin, the lips of the dorsal wound must be grasped with two hooked forceps.

should be made to reach the bone at the moment of reaching the palmar aspect, and divide the tendons and their sheaths as it passes to meet the extremity of the primary incision.

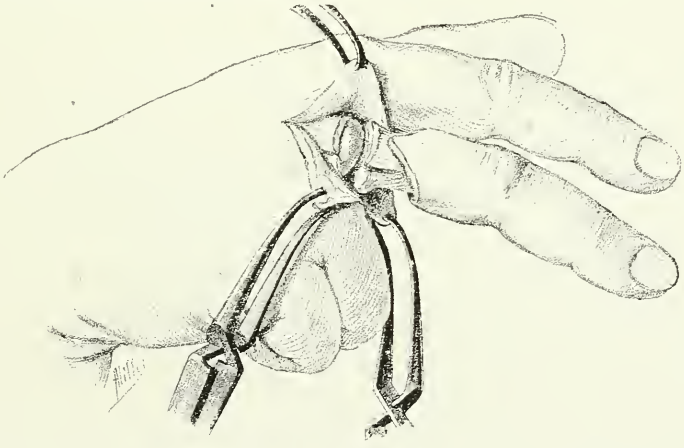


Fig. 861.—Metacarpo-Phalangeal Amputation with Racket-shaped Incision.

Third stage: The palmar flap has been grasped with a third hooked forceps. The articular interline is exposed by the tractions, and the bistoury is made to penetrate the joint from the radial side, in relation to the operator.

The knife is again passed along the course of the incision and made to complete the division of all the soft parts.

Second Stage.—The point of the blade is introduced between the left flap and the phalanx, while the edge, turned towards the patient's wrist, is

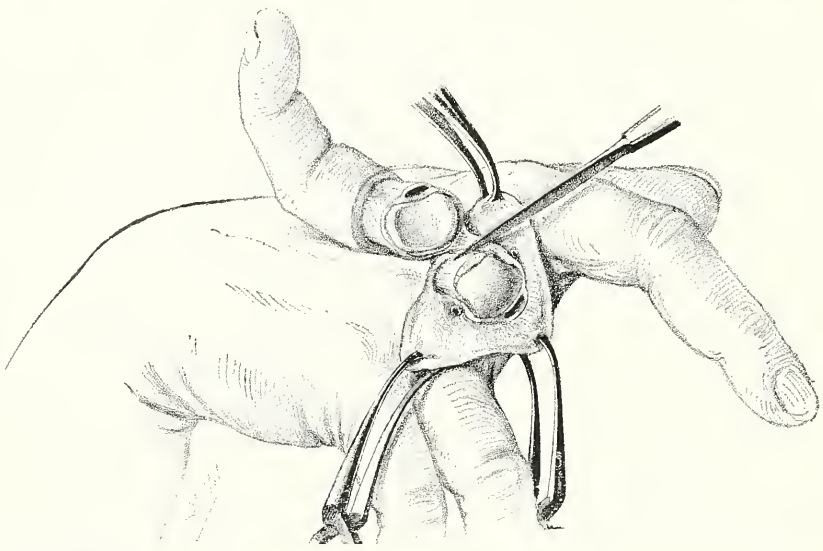


Fig. 862.—Metacarpo-Phalangeal Amputation with Racket-shaped Incision.

The finger, which is almost completely detached, has been turned back on the dorsum of the hand. Conclusion of the division of the capsular investment of the joint from the ulnar side, in relation to the operator.

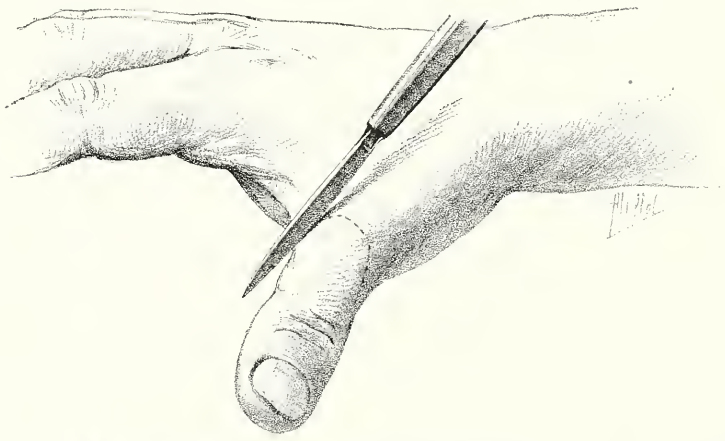


Fig. 863.—Intermetacarpo-Phalangeal Disarticulation of the Thumb, with Formation of External Flap.

First stage: The thumb has been forcibly abducted, and the bistoury is made to penetrate the articular interline, after having divided the skin a little above it.

made to penetrate the articulation, after having passed around the phalangeal tubercle. The edge, which is turned towards the operator's right side,

is held in the vertical position, and thus made to divide the first lateral ligament; the point, which must pass below the articular interline, completes the division of the capsule on this side; then the blade, passing towards the

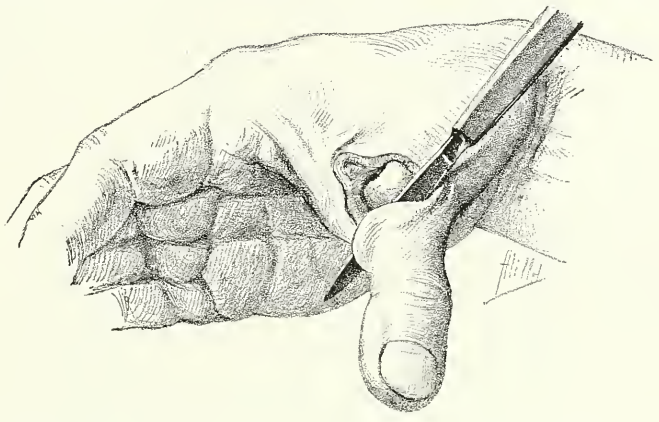


FIG. 864.—INTERMETACARPO-PHALANGEAL DISARTICULATION OF THE THUMB, WITH FORMATION OF EXTERNAL FLAP.

Second stage: The thumb is held in the position of forced abduction, and the bistoury, having penetrated the articulation, is now severing the external lateral ligament.

right, divides the second lateral ligament which is presented to its edge by a forcible rotation of the finger upwards and to the left side; after which it is immediately turned forwards towards the operator, so as to avoid wounding the internal flap.

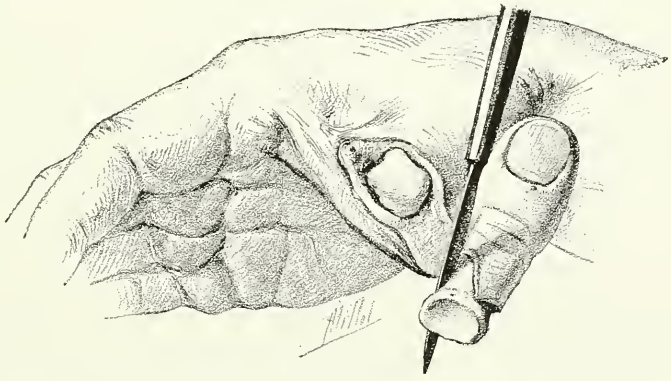


FIG. 865.—INTERMETACARPO-PHALANGEAL DISARTICULATION OF THE THUMB, WITH FORMATION OF EXTERNAL FLAP.

Third stage: The thumb has been reversed and turned inwards, to permit the formation of the broad external flap with the bistoury.

THIRD STAGE.—It now suffices to twist the finger towards the left with the left hand, while supinating and bending backwards the hand which is being operated on, in order to present whatever is left of the glenoid liga-

ment and the tendinous sheath to the cutting edge, after which the finger remains in the surgeon's hand.

Fourth Stage.—Hæmostasis, suture.

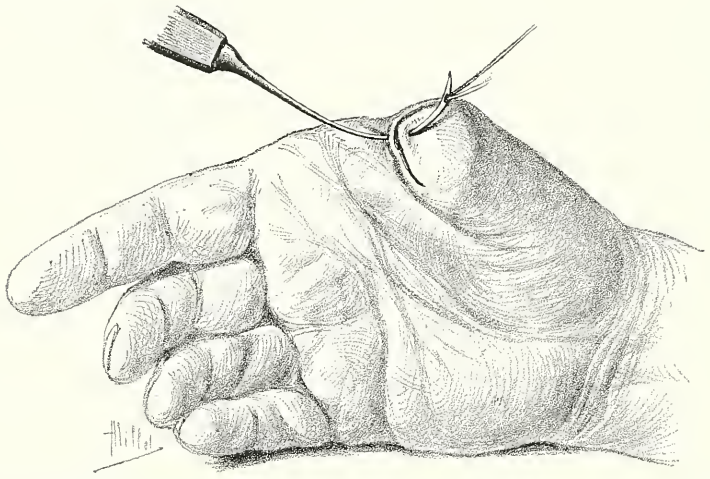


Fig. 866.—Intermetacarpo-Phalangeal Disarticulation of the Thumb, with Formation of External Flap.

Fourth stage: Suture of wound, which has been covered over with the external flap.

Amputation with External Flap.

This operation is usually reserved for the case of the thumb.

Operation—First Stage.—The thumb is abducted, and the bistoury is made to divide the skin obliquely from below upwards, and then plunged in the direction of the articular interline.

Second Stage.—The internal lateral ligament is divided, and the blade is passed into the articulation.

Third Stage.—Division of the external lateral ligament and formation of an external cutaneous flap.

Fourth and Fifth Stages.—Hæmostasis and suture.

Amputation of the Phalanges in their Continuity.

In most cases this operation consists of the resection of the extremity of a phalanx which has been laid bare by a traumatism, without sufficient skin to recover it.

Operation—First Stage.—Dorsal incision of 10 millimetres in length, reaching down to the bone.

Second Stage.—Circumferential denudation of the extremity of the phalanx with a small raspatory.

Third Stage.—Resection of the phalanx with a Liston's forceps.

Fourth Stage.—Suture. When the field of operation is aseptic, the reunion is carried out by the insertion of two or three parts of interrupted suture. Otherwise, it is treated by tamponing.

Disarticulation of the Second Phalanx.

An assistant holds the hand in the horizontal position, with the dorsal surface looking upwards. The second phalanx is grasped between the index-finger and thumb of the surgeon's supinated left hand, the nails indicating the position of the distal extremities of the lateral tubercles, which are placed on either side of the head of the phalanx.

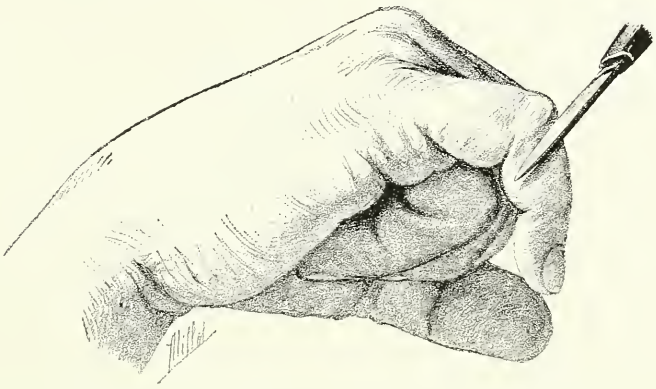


Fig. 867.—Interphalangeal Disarticulation.

First stage: The articular interline is reached with the first stroke of the bistoury.

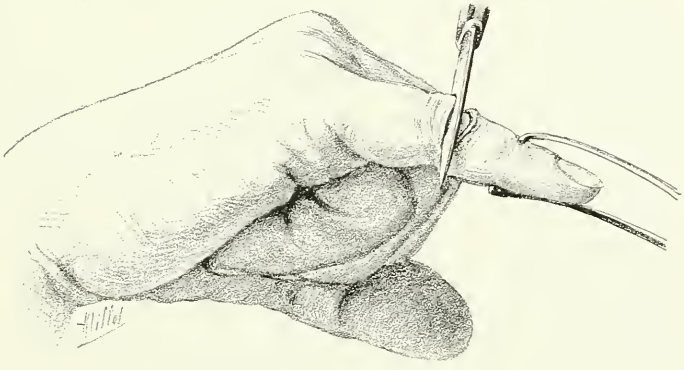


Fig. 868.—Interphalangeal Disarticulation.

Second stage: The bistoury passes into the joint and divides the lateral ligaments, being aided in its course by the traction made on the second phalanx with a hooked forceps.

Operation—First Stage.—The bistoury, which is held like the bow of a violin in the fingers of the right hand, incises the skin on the dorsum of the finger, and penetrates the articular interval.

Second Stage.—After division of the lateral ligaments, the second phalanx is brought down to the vertical position, and the bistoury, after circumscribing the articular extremity, is made to shave its anterior surface in passing completely beneath it.

Third Stage.—The phalanx is then re-elevated to the horizontal position, and the blade, of which the cutting edge is now turned towards the operator, is made to complete the section of the flap, which it terminates in the vicinity of the fold of flexion of the distal interphalangeal articulation, by a vertical section made in a direction perpendicular to the surface of the skin.

Hæmostasis of digital vessels, if necessary, and reunion with suture of Florentine hair.

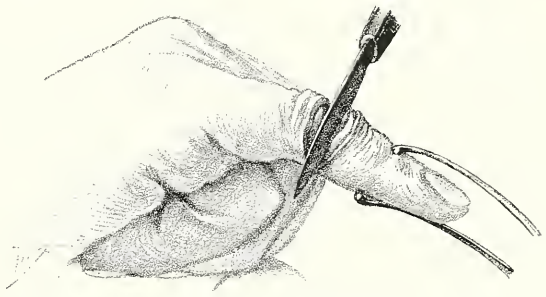


Fig. 869.—Interphalangeal Disarticulation.

Third stage: The edge of the bistoury, having traversed the joint, is directed along the axis of the finger to form the palmar flap.

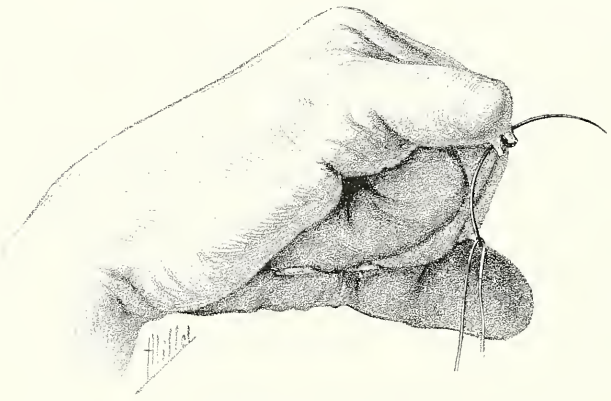


Fig. 870.—Interphalangeal Disarticulation.

Third stage: Reunion of skin with points of interrupted sutures.

Disarticulation of the Phalangette (Ungual Phalanx).

The same technique is adopted for this operation, till we reach the third stage. This must be modified in forming the flap.

Third Stage.—The blade is passed beneath the phalangette with the edge turned horizontally towards the operator, and cuts off a palmar flap which reaches the extremity of the finger.

OPERATIONS ON THE SACRUM, ILIUM, AND THE LOWER LIMB.

OPERATIONS ON THE SACRUM AND ILIUM.

Traumatic Lesions.

Wounds of the ilio-sacral region are rarely penetrating. Radiography is employed in the search for a foreign body, if such should exist. When implanted in a bone, extraction of a foreign body such as a revolver ball may be a very delicate operation.

Inflammatory Lesions.

Acute Inflammatory Lesions.

Sacro-Iliac Osteomyelitis.

Infective osteomyelitis may attack either the ilium, the sacrum, or the sacro-iliac articulation. Diagnosis is difficult if the suppuration courses towards the cavity of the pelvis. Several of these cases are described

Fig. 871.—Sacro-Iliac Resection for Tuberculosis (Electric Instrumentation). First Position of the Circular Saw.

in the chapter relating to pelvic suppuration in the male (Vol. III.). The phlegmon may run a subacute course, and provoke symptoms of rectal stenosis, rendering the diagnosis of this condition very obscure.

The focus is reached by coccy-sacral resection, which operation will be described in connection with tumours of the rectum. If the suppuration is directed backwards and a sinus already exists, it is approached by the direct route. The following out of the course of a deep sinus is often a delicate operation. The sinus must be widely laid open, and the affected tissues must be curetted and resected in a very free manner. Aero-cauterization is then applied and the wound is plugged. When active granulation has set in, cicatrization is hastened by applying mycolysine in powder, which accelerates the repair in an extraordinary manner.

Chronic Inflammatory Lesions.

Sacro-Iliac Tuberculosis.

Tuberculosis of the sacro-iliac articulation is not rare. The lesion is often very extensive, requiring partial resection of the sacrum and ilium.

Operation—*First Stage.*—Vertical incision and opening of the abscess.

Second Stage.—Curetting of the walls and exposure of the diseased bone.

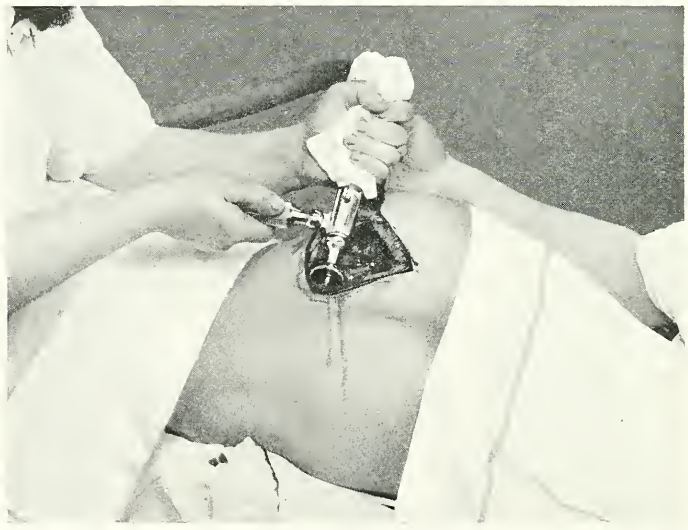


Fig. 872.—The Same. Second Position of the Saw, which is in Action on the Sacrum.

Third Stage.—The carious portions of the bone are circumscribed by several sections, using the circular saw (Fig. 871). They are then removed by the gouge-forceps.

The limit of the loss of osseous tissue is then regularized by means of the electric mortising machine (Fig. 874).

Fourth Stage.—Aero-cauterization. Aseptic plugging. Treatment by phymalose is instituted. Cicatrization of the wound is hastened by using

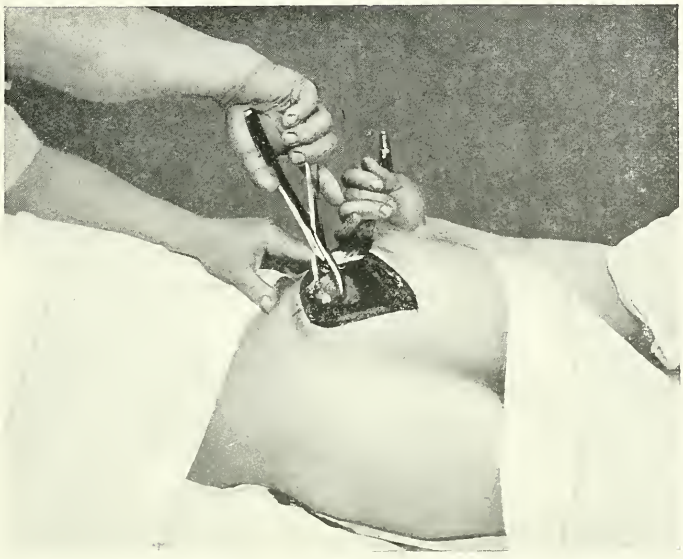


Fig. 873.—The Same. Removal of the Carious Portion.

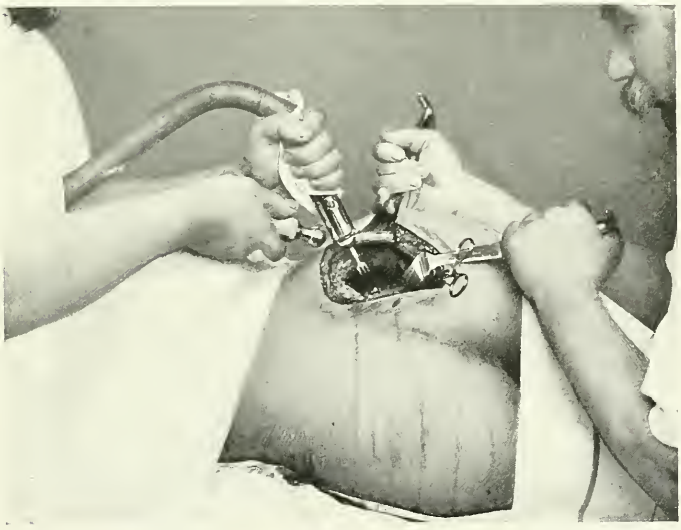


Fig. 874.—The Same. Application of the Electric Mortising Machine.

mycolysine in powder. Tuberculosis of other parts of the ilium may require interventions which do not merit any special description.

Congenital and Acquired Malformations.

Deviation of the Coccyx.

Certain painful and very obstinate symptoms are caused by an ankylosis of the coccyx in a vicious position. An ankylosis of the coccyx at a right angle on the anterior surface of the sacrum may be a cause of dystocia. Extirpation of the coccyx will be described in the operation of posterior trans-coccy-sacral rectotomy (Vol. III.).

Tumours.

Benign Tumours.

These are exceptional. After removal their site should be treated with the thermo-electric bath as a measure of prudence.

Malignant Tumours.

Sarcoma of the Iliac Bone.

Sarcoma of the ilium is fairly frequent. If the diagnosis is made early the tumour is treated by electro-coagulation.

The patient must be kept in observation in order that a fresh intervention may take place if a suspicious point is left. Curetting combined with electro-coagulation is employed with a view to destroying the neoplasm as far as its utmost limits.

In a child of twelve years, where the tumour invaded the coxo-femoral articulation and almost the whole extent of the ilium, I performed an inter-ilio-sacral disarticulation, an operation which was completed in seven minutes.

Inter-Ilio-Sacral Disarticulation.

First Stage.—Shaping of a small femoral anterior cutaneous flap. Ligature of the external iliac artery and vein, and stripping up of the whole of the iliac peritoneum.

Second Stage.—Shaping of a flap from the buttock, which is limited to about one half of the skin of this region. The two incisions unite at the perineo-crural fold.

Third Stage.—Dislocation of the sacro-iliac articulation with a strong osteotomy chisel and mallet. The whole mass of the lower limb is immediately liberated, and all that remain to be severed are the last attachments of the peritoneum, the mass of the psoas iliac muscle, and the symphysis pubis.

Fourth Stage.—Hæmostasis.

Fifth Stage.—Skin suture and drainage.

I have described this technique as a curiosity, for cases where an inter-ilio-sacral disarticulation can be carried out with any chance of a durable cure are extremely rare.

OPERATIONS ON THE HIP-JOINT.

Traumatic Lesions.

Penetrating Wounds.

Penetrating wounds of the coxo-femoral articulation are very grave, and often occasion dangerous infection.

If it be certain that the wound is not infected (which would necessitate immediate opening), it is treated by aseptic plugging, and 10 to 20 c.c. of mycolysine are injected subcutaneously every day until all danger is passed. In gunshot wounds the same technique is followed in every case: incision of the tract, removal of the foreign body, antiseptic plugging, and subcutaneous injections of mycolysine.

Should infectious symptoms arise, the focus is freely incised and all the ramifications of the wound are plugged, rubber drains being used to drain the cavities. Continuous antiseptic irrigation is instituted, using boiled water, to which is added alternatively Labarraque's fluid (1 per cent.) and peroxide of oxygen (20 per cent.). The irrigation is stopped ten to twelve days after the temperature is normal (morning and evening).

[Note by the Translator.—It is well to mention that during the past three years experience in treating wounds during the present war has led to the employment of a mixture of these two fluids for irrigation purposes, with the happiest results. Equal quantities of a 20 per cent. solution of Labarraque's fluid and peroxide of hydrogen are used for the irrigation, in a special apparatus devised by Dr. Raphaeledis, an assistant of the author, the bacteriological control being in the hands of the translator. A description of this method of treating infected cavities now standard at the Institut Doyen was communicated by the author to the Société de Biologie shortly before his death.]

Dislocation.

Dislocation of the head of the femur occurs either into the external iliac fossa, or inwards towards the foramen ovale. Reduction is rendered difficult owing to the strangulation of the neck by the capsular débris; at times the head of the femur dislocates through a fibrous buttonhole opening of the capsule. No attempt should be made at reduction without a general anæsthetic. Muscular relaxation must be complete.

Reduction of Dislocations of the Hip.

Position of Patient.—The patient is placed on the operating table, allowing the sacrum to occupy the depression arranged for it. Two assistants hold the legs, the sound leg in a position of abduction and the other in the position given to it by the accident.

First Stage.—As soon as muscular relaxation is complete, the surgeon moves the femur and tries by successive small movements to bring its axis into a normal direction. This mobilization requires strong tractions above the knee, where a bandage may be applied.

Second Stage.—When the dislocated head is sufficiently mobilized the surgeon, facing the dislocated thigh, flexes the leg and thigh, and stoops, letting the limb rest on his right shoulder. A strong assistant keeps the leg and foot flexed in contact with the surgeon's back. The operating table must be low enough for the surgeon to have his legs slightly bent. Two assistants hold the pelvis of the patient firmly on the operating table.

Third Stage.—The surgeon seizes the upper part of the thigh between his open hands, and slowly adopts the upright position, at the same time oscillating the shoulder, which carries the dislocated limb in such a way as to disengage the femoral head and replace it in its cavity.

By this method I have reduced every case of dislocation of the femur which has been sent to me. In a recent case of dislocation into the foramen ovale, where the great trochanter occupied the acetabulum, and where the difficulty of reduction was enhanced by a compound and comminuted fracture on the other side, I easily reduced the dislocation by this manœuvre. The patient was an aviator. The next day he was able to move the right thigh almost without pain, being obliged to use his right leg in order to change his position in bed.

I may also quote another case of dislocation of the femur into the iliac fossa. This occurred in the case of a man of sixty years, as a result of an automobile accident. The case had escaped diagnosis for three months. The dislocation was reduced in less than five minutes by the above procedure.

Inflammatory Lesions.

Acute Inflammatory Lesions.

Osteitis of the Epiphysis.

Osteitis of the epiphysis may occur at the level of the growing cartilage of the head of the femur. Symptoms are produced of acute abscess with a typhoid state. In a case which had evolved in a few weeks in a child of ten I found the femoral head necrosed and free in the pus. The neck of the femur was in relation with the acetabulum.

Chronic Inflammatory Lesions.

Coxalgia.

Tuberculosis of the coxo-femoral articulation should be treated in its early stage by means of immobilization and the administration of mycolysine and phymalose. I have obtained by this method rapid cures in four, five, or six months by simply keeping the child in bed without apparatus. If the coxalgia be fistulous, and if the femur be dislocated, resection must be performed.

Resection of the Head of the Femur.

Operation—*First Stage.*—Longitudinal incision beginning behind the anterior superior iliac spine and ending below the great trochanter.

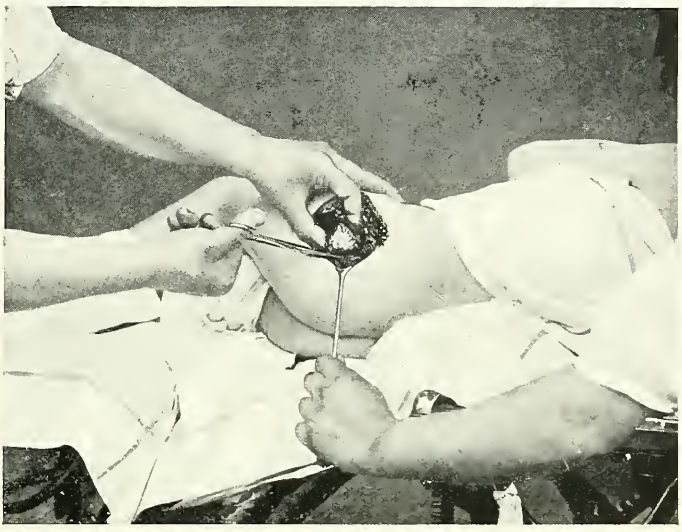


Fig. 875.—Resection of the Hip. Second Stage : Opening of the Capsule.

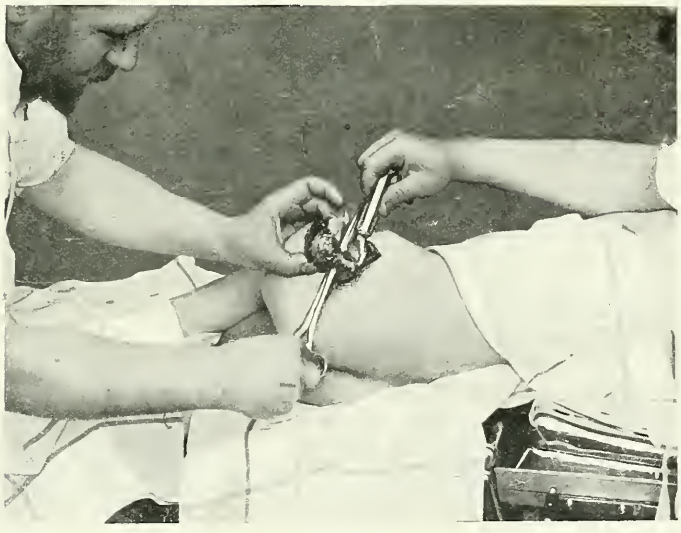


Fig. 876.—The Same. Third Stage : Luxation of the Head out of the Wound.

Second Stage.—Incision of the aponeurosis, exposure of the great trochanter and the capsule of the joint, which is incised. Often some pus

escapes at this moment. The incision in the capsule is prolonged as far as the lip of the acetabulum, and a second incision is made in the capsule perpendicular to the first.

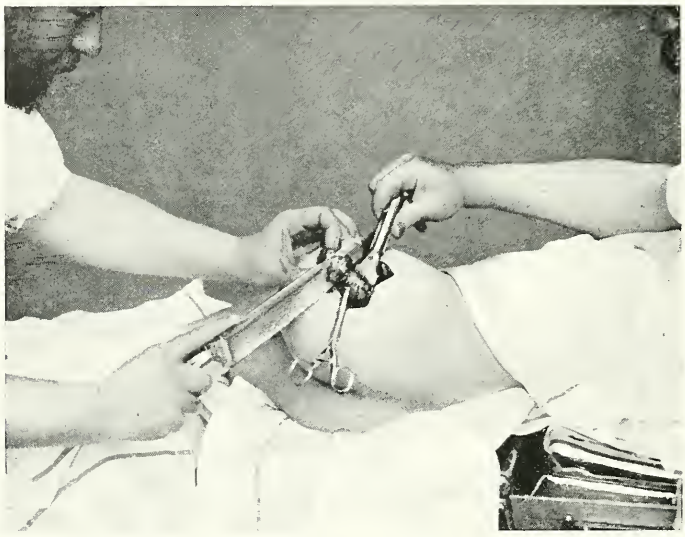


FIG. 877.—THE SAME. FOURTH STAGE: OBLIQUE RESECTION OF THE HEAD AND PART OF THE NECK.

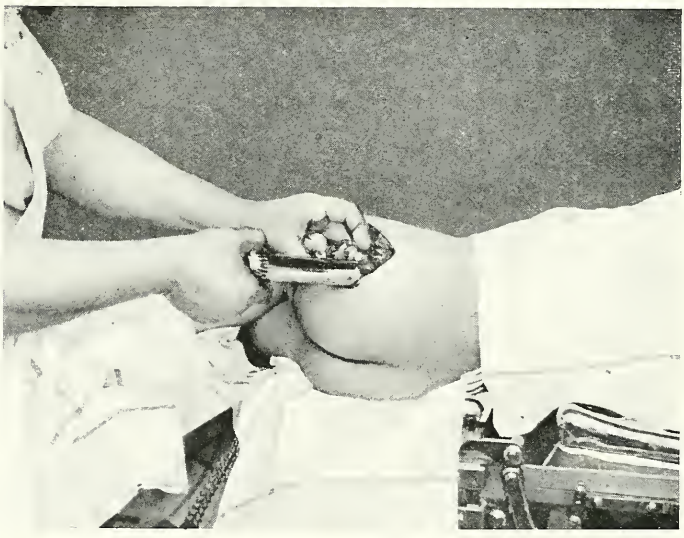


FIG. 878.—THE SAME. ENLARGING A TUBERCULOUS PERFORATION OF THE ACETABULUM TO REACH A PELVIC ABSCESS.

Third Stage.—Dislocation of the head. An assistant flexes and rotates the limb outwards in order to force the head to dislocate from the aceta-

bulum and then out of the wound. When a spontaneous dislocation exists the same manœuvre serves to force the head of the femur out of the wound.

The extremity of the femur is made to extrude freely by severing with the bistoury all aponeurotic and capsular attachments which hold it in the depths, and the osseous lesions are examined.

Fourth Stage.—Resection of the head of the femur. The section of head of the femur is limited as far as is possible, and an attempt is always made to spare a certain length of neck which can enter the acetabulum. This result can be obtained by sawing the neck very obliquely from the great trochanter towards the lower part of its insertion to the head of the femur. The toilet of the acetabulum is now carried out, as this is often carious.

FIG. 879.—THE SAME. PLUGGING THE PELVIC FOCUS THROUGH THE PERFORATED ACETABULUM.

Fig. 879 shows the plugging of a sinus at the bottom of the acetabulum communicating with a pelvic cold abscess. The acetabulum was widely perforated with one of the cutting tubes which I employ for the bloody operation for congenital dislocation of the hip, and the pelvic abscess is drained by this orifice.

AFTER-CARE AND POSITION OF THE PATIENT.—Resection of the hip is a bad operation if a satisfactory joint be not obtained. I have obtained a perfect result in a number of cases by the following method: As soon as the immediate results of the operation are over and the wound is cicatrizing I anæsthetize the patient, and place the femur in a position of forced abduction, so that the upper extremity of the femur—*i.e.*, the remains of the neck—must penetrate the acetabulum. The thigh is fixed in this position by a plaster apparatus with opening. After four weeks, when

cicatrization is almost complete, the apparatus is removed and the thigh is allowed gradually to assume its normal position. This result should be obtained not before the fifth week after the operation. The fixation of

Fig. 880.—Orthopædic Resection of Congenital Dislocation of the Hip. Application of the Plaster Apparatus.

the thigh in forced abduction for several weeks allows all the periarticular ligaments to retract definitely, thus constituting a new capsule which is solid and strong. I often see one of my patients (the case represented in Fig. 877); he is now a vigorous man who hardly limps at all.

Congenital and Acquired Malformations: Congenital Malformations.

Congenital Dislocation of the Hip.

1. *Orthopædic Reduction.*

In young children, especially below the age of five years, reduction of congenital dislocation of the hip can be successfully carried out by forcible manœuvres.

The pelvis is fixed by the hands of an assistant. The right thigh is mobilized until the head of the femur engages the vestige of the acetabulum and becomes lodged therein close to the foramen ovale. The moment when the head of the femur engages in the region of the acetabulum can be easily perceived. The member is now fixed in the plaster apparatus, the thigh being in a position of forcible abduction and the leg semiflexed. The limb is kept in this position for four weeks. The plaster apparatus is then changed, allowing the femur to gradually adopt its normal position. The reduction is verified by radiography and examined in the same way

on each occasion that the plaster is renewed. When the dislocation is bilateral both sides are reduced at the same time.

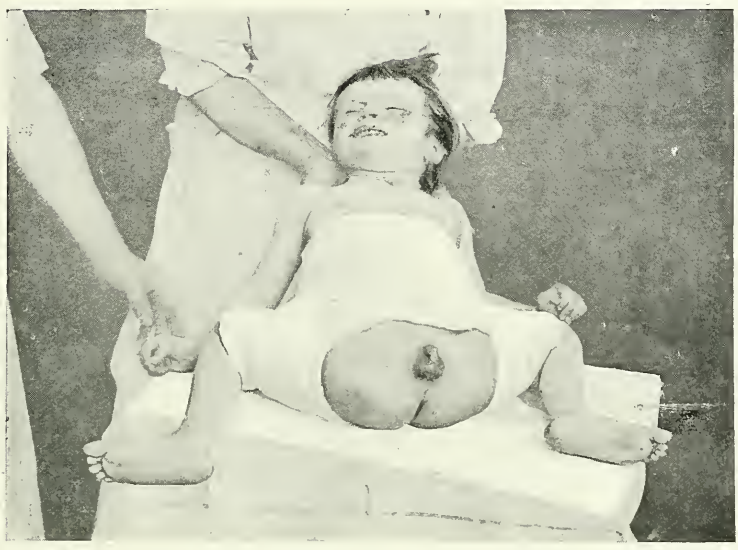


Fig. 881.—The Same. View of the Plaster Apparatus from the Other Side Both Thighs are in Forced Abduction.

2. *The Bloody Operation.*

The orthopædic reduction of congenital dislocation of the hip is impossible after a certain age, which is indeed very variable, since I have been able to reduce the femoral head in some children of six to eight years more easily than in others several years younger. In 1898 I devised a new instrumentation for the two chief stages of this operation—viz., the reconstruction of the acetabulum and the reduction. This comprises—

1. A series of cutting tubes, cylindro-spherical in shape, for shaping out the acetabulum.

2. A screw apparatus with direct action on the upper extremity of the femur for reduction.

3. A dismountable metal stretcher, which is used for the application of the plaster apparatus.

1. *Cylindro-Spherical Tubes to shape the Acetabulum.*—These cutting tubes are of five different diameters, and are constructed to resemble the cutting tubes I devised for the emptying fibromata of the uterus. The tubes, as in the case of those employed for fibromata, have one end shaped into four triangular teeth. Each of these teeth is then bent outwards on its straight edge, and then filed in order to have, as in the teeth of a saw, sufficient "bite" to attack the walls of the acetabulum. When the pole of the perforating tube is in the centre of the obliterated acetabulum the instrument is turned in the direction of the cutting edge

of its teeth, and a hemispheric cavity is shaped out of the osteo-cartilaginous mass, as smooth and as regular as if it had been made with a turning instrument. These tubes also allow the axis of the new acetabulum to be shaped in the most favourable direction to receive the head of the femur. This can be managed by placing the axis of the tube in the direction which will be adopted by the neck of the femur after reduction. The shaping of the acetabulum then continues without changing the direction of the instrument. The antero-external lip of the acetabulum is made as resistant

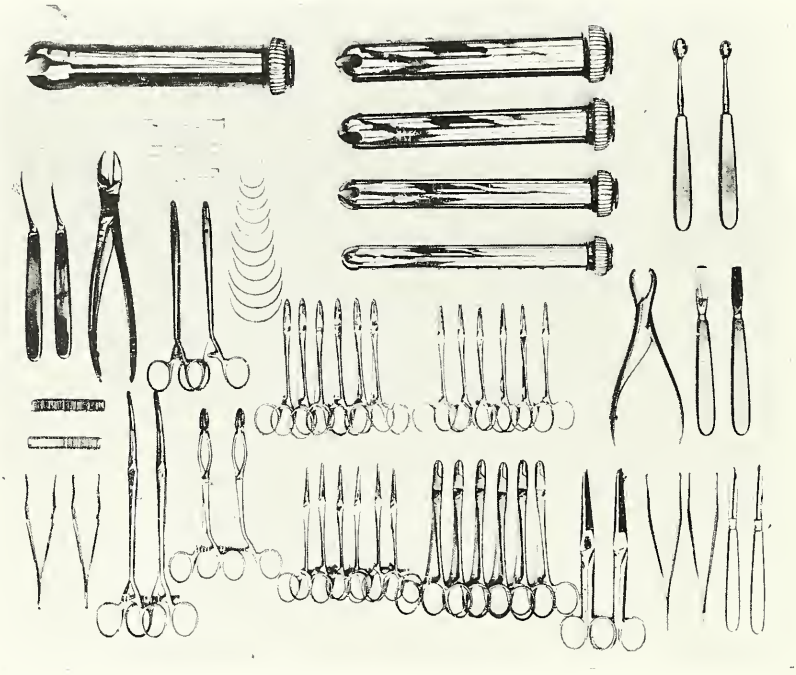


Fig. 882.

Commencing below and to the left: 2 bistouries, 2 dissecting forceps, 2 pairs of scissors, 6 pairs of Doyen's artery forceps, 6 artery forceps, 2 oval forceps, 2 long curved forceps, 2 Michel's clip forceps, 2 raspatories, 1 gouge-forceps, 6 Championnière's forceps, 6 small needle holder forceps (Doyen), 2 Doyen's eccentric needle holders, assorted open-eyed needles, 1 Liston's forceps, 2 needles with handles, 2 curettes, 5 Doyen's cutting tubes, glass drains.

as possible by commencing with a small diameter instrument directed inwards and downwards. The special resistance caused by the inner table of the iliac bone to the instrument warns the surgeon when the excavation is finished. The compact tissue of this table is easily recognizable to the operator in the depths of the wound.

These cutting tubes have a further advantage in that they leave no trace of foreign body in the wound, since the shavings of cartilaginous tissue accumulate in the interior of the instrument as the acetabulum is being shaped. This new instrument has allowed not only the reconstruction of

the acetabulum, with a perfection hitherto unknown, but simplifies the after-treatment and allows of immediate union, a step which till now has always been considered as dangerous.

2. *Apparatus arranged for Direct Action on the Extremity of the Femur.* — This apparatus is designed to reduce the femoral head when it resists manual effort. It consists of a support for the lumbar region, pierced with a series of orifices by which the pelvis can be immobilized between four or six long pegs enframing the iliac crest, and a series of metallic pieces for lowering the head of the femur (see Vol. I., p. 201, Fig. 247).

The principal portion, movable on its axis, serves as a fixed point for the whole apparatus. This portion is in relation with the symphysis pubis. To its upper extremity is fixed a horizontal lever, which during reduction

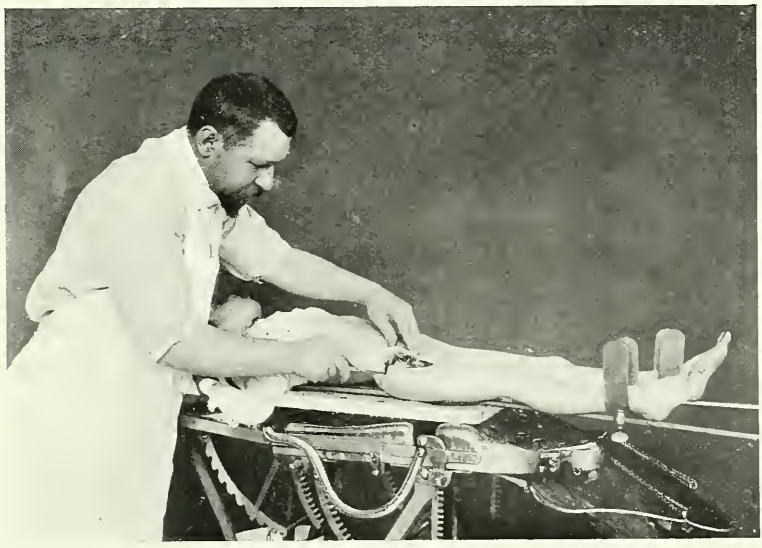


Fig. 883.—Bloody Operation for Reducton of Dislocation of the Hips. Skin Incision.

facilitates the approximation of the head of the femur with the external border of the acetabulum. The whole of the metallic portion of the instrument is sterilized before operation.

The special apparatus is only brought into use when direct pressure on the head of the femur by the thumbs or the end of the boring instrument is unsuccessful.

3. The metal stretcher is composed of seven pieces: two steel stems 1·80 millimetres long; a rectangular frame with four holes through which the stems pass; two screw fittings to allow of fixation at any angle; and two slings for the legs.

Operation—*Preliminary Stage.*—In order to facilitate the necessary manœuvres of reduction and pose of the apparatus, the child should be placed on the stretcher, upon which the perforated plate of the reduction

apparatus has already been placed. These two apparatus are placed on the operating table as shown in Fig. 883.

First Stage.—Incision of the soft parts and exposure of the head of the femur. A straight incision 10 to 12 centimetres in length is made on the anterior border of the tensor muscle of the fascia lata. This incision is prolonged behind the anterior superior iliac spine and parallel to the iliac crest for a length of 5 or 6 centimetres. The femoral aponeurosis is incised in front of the tensor muscle of the fascia lata, and this section is followed above and behind in order to retract with the skin all the tissues covering the head of the femur. The section of the gluteus maximus is made in such a way as to leave adherent to the iliac crest enough muscular tissue to allow of its repair at the end of the operation. The capsule of the false articulation, often 5 to 6 millimetres thick, is crucially incised and the head of the femur is exposed.

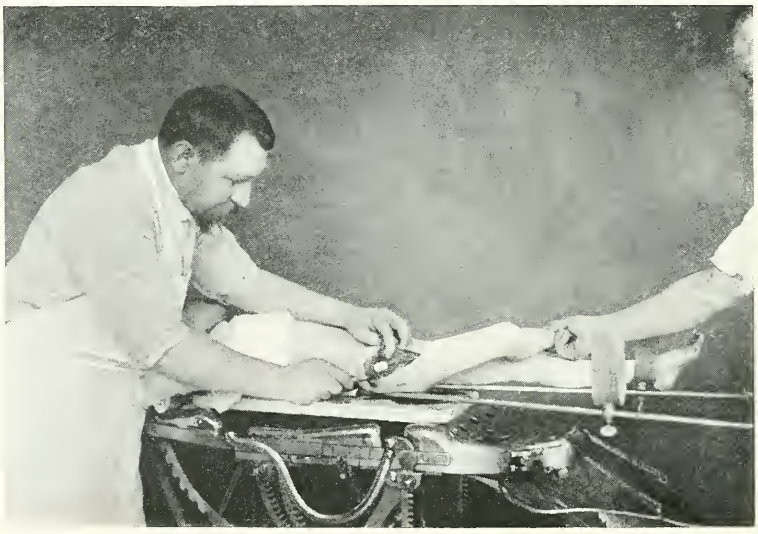


Fig. 884.—The Same. Second Stage: Exposure of the Head of the Femur. The Limb is in Forced Abduction and External Rotation.

Second Stage.—Liberation of the head of the femur. The capsule of the false joint is incised throughout its circumference. It is then detached from the external iliac fossa, to which it is inserted. The upper end of the femur is mobilized by degrees. The index finger is pushed in the direction of the small trochanter, and explores on the inner side and above the neck of the femur the remaining bands, which are destroyed by a straight raspatory. The bleeding arterioles are tied.

Third Stage.—Reconstruction of the cavity of the acetabulum. The region of the acetabulum is recognized by means of the index finger, which passes below the tendon of the psoas; it is laid bare by a raspatory. The cavity of the acetabulum, which will be found to be obliterated by osteo-

cartilaginous stalactites, must now be hollowed out. The dentated end of a cylindro-spherical cutting tube of appropriate diameter is slipped on to the index finger towards the acetabulum. and the hollowing out is commenced, attacking preferably the internal and inferior portion, in order to preserve above a lip of bone which is fairly strong. The axis of the tube is at first very obliquely inwards and backwards on an almost horizontal plane. It is then brought gradually into the direction which will be occupied by the neck of the femur after reduction.

The acetabulum is hollowed out as far as the inner table of the iliac bone. The instrument is removed, carrying with it the whole of the osteo-cartilaginous fragments which gather in the interior of the tube. The new

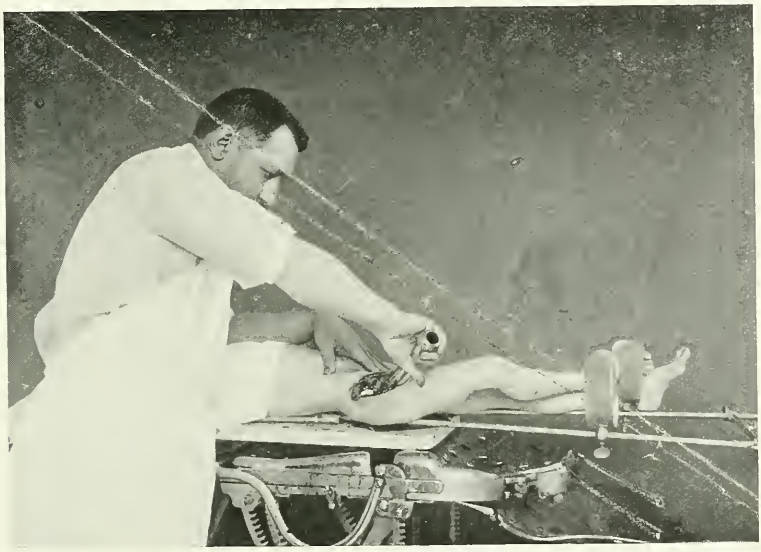


FIG. 885.—THE SAME. THIRD STAGE: HOLLOWING OUT THE ACETABULUM.

The head of the femur will be recognized below and on the outer side of the cutting tube.

acetabulum is exposed by means of retractors. The depth is examined, also the thickness of the bony lip which is to hold the head of the femur in position above.

Fourth Stage: Reduction of the Head of the Femur.—Reduction of the head of the femur is brought about in some cases by the simple pressure of the two thumbs, which push it down while an assistant exercises traction on the limb in the position of forcible abduction. If the pressure of the thumbs be insufficient, greater force can be brought to bear upon the head of the femur or upon the great trochanter by transmitting the pressure of both hands by the open extremity of one of the tubes used in shaping the acetabulum. A compress is interposed between the metal tube and the head of the femur, and another between the end of the instrument and the palm of the hand. If these efforts are unsuccessful the special apparatus

with metal spoon and screw must be employed. The apparatus is sterilized in the dry oven. Its principal axis is introduced in a corresponding orifice

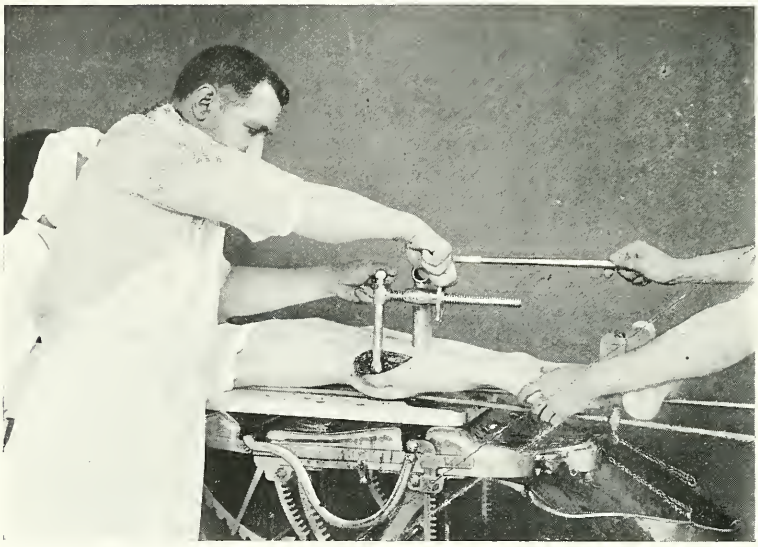


Fig. 886.—The Same. Fourth Stage: Reduction. Final Action on the Lever.

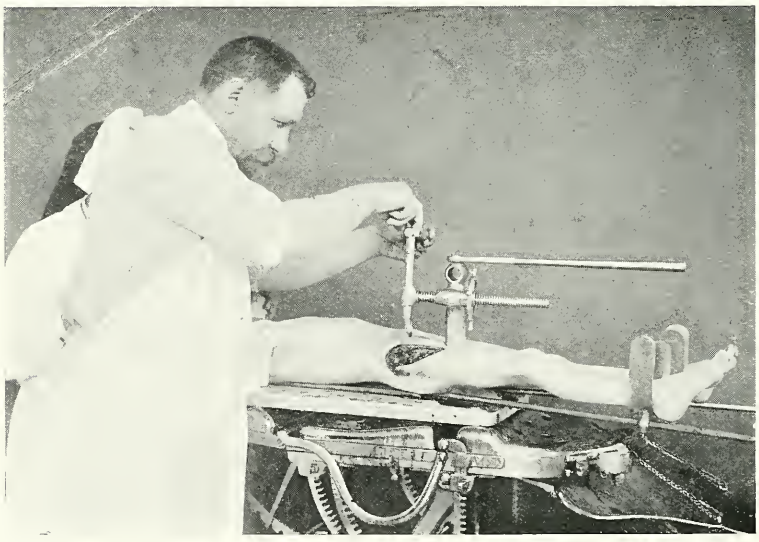


Fig. 887.—The Same. The Reduction is performed and the Metal Spoon is lifted out of the Wound.

in the perforated plate in contact with the pubis, and a double compress is placed between this metallic piece and the soft parts. The transverse

branch on which is mounted the special screw and spoon, which have already been arranged, is placed in the corresponding orifice of the principal axis in such a manner that the spoon corresponds with the head of the femur.

The pelvis and the thighs are fixed laterally by four or six pegs, which are planted in the perforated plate. The threaded wheel is now manœuvred so that the spoon comes into contact with the head of the femur. The axis of the screw is regulated by means of a lever above the central pivot, in such a way that its obliquity conducts the head directly towards the new acetabulum. This lever is held by an assistant. The threaded wheel is now tightened slowly until the head of the femur is lowered to the level of the acetabulum.

The last few millimetres can be obtained, if there is much resistance, by a slight movement of the extremity of the lever, which is displaced towards the opposite side.

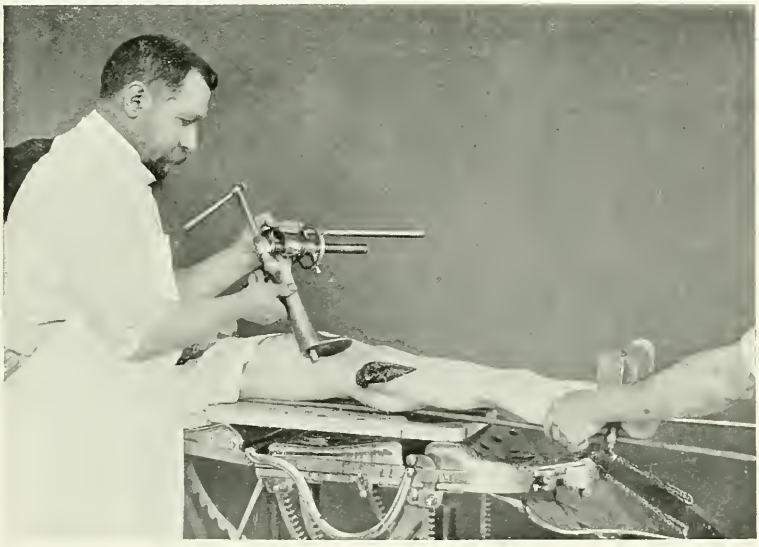


FIG. 888.—THE SAME. THE MECHANICAL APPARATUS IS LIFTED FROM ITS SUPPORT.

As soon as the head of the femur is on a level with the acetabulum it can be placed therein without effort, by a rotation of the spoon on its axis. This rotation is obtained by the action of the handle above the spoon. The head enters directly into the acetabulum. The spoon is slipped into its groove and the whole of the metal apparatus is removed in one piece. If the head of the femur appear to be friable, the spoon can be made to work upon the great trochanter.

Fifth Stage: Union of the Wound.—The gluteus maximus and the femoral and gluteal aponeuroses are sutured with catgut or fine silk, and the skin is united. Two glass drains are inserted, one behind and below, and the other at the lower angle of the incision. The field of operation is covered with sterilized compresses.

Sixth Stage: Complementary Tenotomy of the Abductors.—Before the dressing is applied examination must be made to see if the reduction has

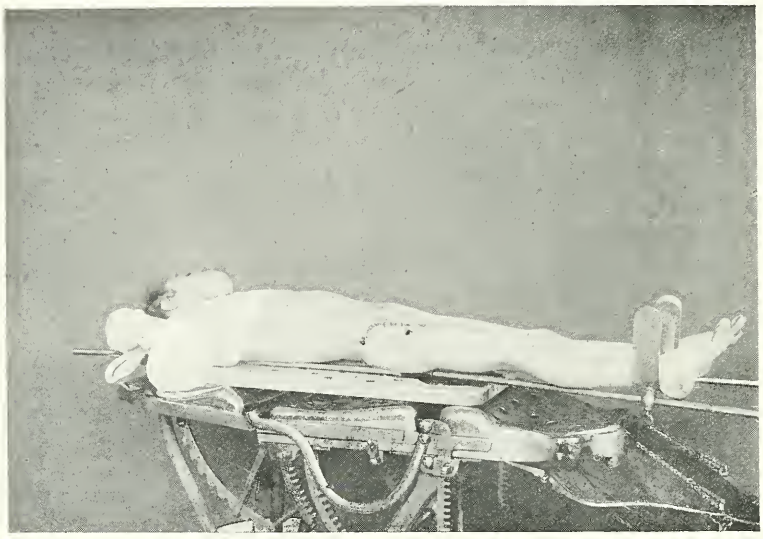


FIG. 889.—THE SAME. THE SUTURE OF THE WOUND IS COMPLETED.

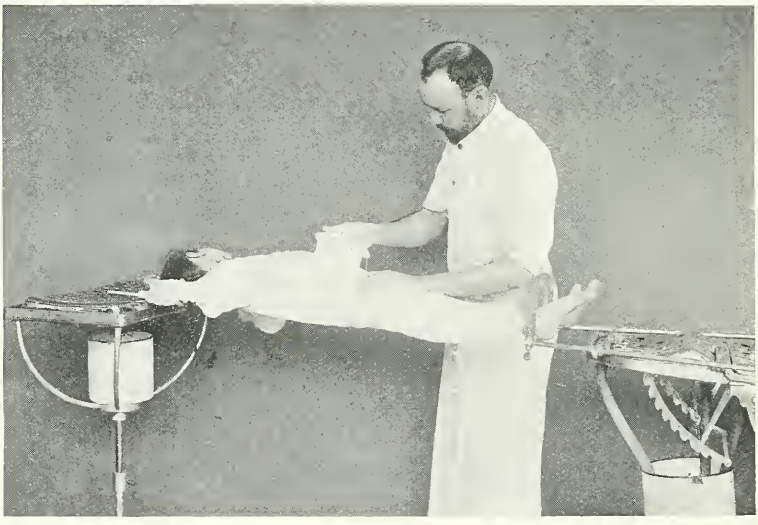


FIG. 890.—THE SAME. THE STRETCHER IS ARRANGED FOR THE APPLICATION OF THE PLASTER APPARATUS.

not caused an excessive tension on the adductors—a tension which is characterized by the production on the upper and inner aspect of the thigh of a hard resistant fibro-muscular cord. If this exist the skin must be

longitudinally incised at this point, and all the resisting tissue must be divided transversally by a bistoury. The wound is united with silk. This section of the adductor band does away with the pain which often follows difficult reduction.

Seventh Stage: Dressing and Arrangement of the Fixed Apparatus.—The leg on the side operated upon, which has been held throughout by an assistant, is placed in the corresponding support, and the child is lifted on to the stretcher. The operating table is then withdrawn so as to receive the cervical end of the metal shafts, whose other extremities are supported on the movable table which serves for arm or leg operations. The child is thus suspended in space without losing the position it occupied during the stage of reduction. The advantages of this stretcher will be readily recognized, since the child is placed before the operation on the support which serves for the application of the fixed apparatus. The surgeon is in no risk of a reproduction of the dislocation, neither during the application of the sutures nor during the application of the fixed apparatus. The limb is placed in the position of forced abduction and inward rotation to receive the plaster apparatus, the leg being in semiflexion. It is in this position that the dressing is finished. Bands of tarlatan soaked in plaster are applied, the legs, thighs, and lower part of the trunk having been protected by cotton or flannelette bandages Semiflexion of the leg upon the thigh prevents dislocation of the reduced head, which might occur if the femur were rotated outwards.

After-Care.—As soon as the plaster apparatus is hard enough the movable portions of the stretcher are removed as already described. After twenty-four hours a large window is cut on the external surface of the thigh opposite the sutures and the drains. In order to renew the dressing, a saw with flexible back, a strong bistoury, and powerful scissors, are employed. The apparatus is further cut away in the region of the anus, and a careful examination is made to see that the child is not chafed or wounded in any way. The creation of the window enfeebles the resistance of the apparatus in the region of the groin, and consolidation is assured by means of three or four thick iron wire rods which are placed in the axis of the thigh and on the front of the apparatus. They extend from the knee to the thorax, and are fixed in position by plaster of Paris. The dressing is changed daily. Skin sutures are removed on the eighth to tenth day. The lower drain is removed at the same time. The posterior and superior drain is left as long as it appears to be useful. Complete union is usually obtained from the twelfth to the fifteenth day, without any rise of temperature. The plaster apparatus is removed after the third week. The patient can walk unaided after five or six weeks. Re-establishment of movement after the operation depends upon the regularity of the movement exercises, which are indispensable the moment that reduction is assured. If the child be left to itself there is danger of the head becoming ankylosed in the acetabulum; the process of ossification of the walls of the latter will lock the femoral head, which is immobilized by the contraction of the pelvi-trochanterian muscles. The early movements cause pain. A great amount

of perseverance is necessary to overcome the resistance of a refractory child, and to assure to the articulation the mobility it should possess.

Children operated upon for congenital dislocation of the hip should, therefore, remain several months in the nursing home or hospital, in order that a systematic and rational after-treatment can be carried out.

Operation in Two Stages.—Is it necessary to reduce the head of the femur at the same time as the arrangement of the acetabulum ? The operation can be performed in two stages when the reduction does not call for the employment of considerable force.

First Operation.—The acetabulum is arranged as described above. The wound is sutured and the dressing is applied without plaster apparatus as soon as cicatrization is complete.

Second Operation.—Reduction of the head of the femur is carried out after three weeks, using the same procedure as for the bloodless reduction. By this plan of action the head of the femur is not placed in contact with the freshened osseous surface during the first weeks which follow the creation of the new acetabulum—that is to say, during the period in which ossification is most active. Reduction in two stages satisfies the desiderata of two opposed methods, the bloodless reduction and the bloody operation.

1. The bloodless method cannot attain a good result in all but the youngest children, owing to the non-existence of the acetabulum.

2. The operation in a single stage exposes the risk of a limitation of movement owing to the fixation of the head by the bony operation in the cavity and circumference of the new acetabulum. Reduction in two stages would thus seem to be the chosen method when a new acetabulum has to be formed. The operation is preceded by all the preliminary manœuvre of the bloodless reduction in order to reduce to a minimum the movements necessary for the mobilization of the head of the femur. The new acetabulum cannot become obliterated in several days, and at the second stage the reduction of the head of the femur is carried out, and the new articulation is immediately mobilized.

3. *Bloody Reduction of Bilateral Congenital Dislocation.*

In cases where the dislocation is bilateral, should the operation be carried out on both sides on the same day ?

In my opinion it is preferable if the operation is performed in one stage to operate upon the other side after a lapse of several months. If the operation is performed in two stages the two acetabular cavities can be formed on the same day. The double reduction can be carried out at the same time when cicatrization is complete.

Coxa Vara.

Coxa vara should be corrected by intertrochanterian osteotomy.

Intertrochanterian Osteotomy.

Operation—*First Stage.*—External vertical incision of 6 centimetres, beginning at the top of the great trochanter.

Second Stage.—Exposure of the femur. An osseous intertrochanterian angle is resected (Fig. 891), whose removal should correct the deviation. The inner table of bone on the inner side is spared.

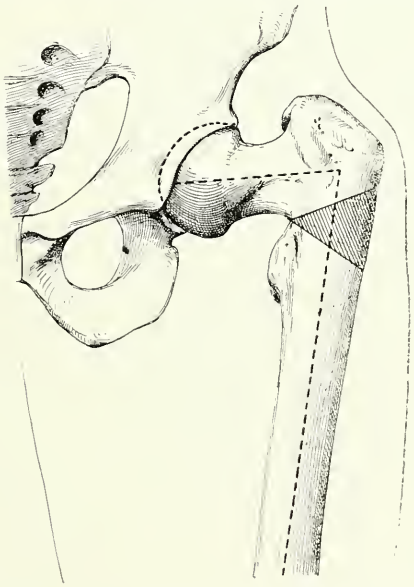


Fig. 891.—Coxa Vara. Axes of the Neck of the Femur and Femur.

The exuberant bony corner is observed between the two trochanters.

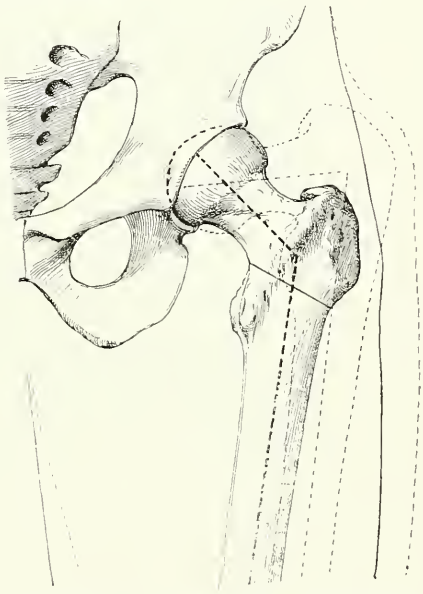


Fig. 892.—The Same. The Cuneiform Osteotomy is Finished. The Bony Surfaces are in Contact. The Axes of the Neck and the Femur have recovered their Normal Relations.

Third Stage.—Toilet of the field of operation, and careful removal of osseous débris. Suture and dressing.

Fourth Stage.—A brisk movement of abduction breaks what is left of the femur, the deformity is reduced, and the patient is put to bed.

After-Care.—The thigh is placed in forced abduction, and kept in this position until the bone is consolidated.

Bone Suture.

First and Second Stage.—As above.

Third Stage.—Toilet of the wound and reduction of the deformity.

Fourth Stage.—Bone suture, using Lane's plates and screw. Suture, dressing.

The operated limb is kept in position by means of sand-bags.

Vicious Ankylosis of the Hip.

Subtrochanterian Osteotomy.

Complete ankylosis of the hip in the position of forced abduction is not rare. It may occur in children spontaneously cured of coxalgia when proper care has not been exercised to keep the lower limb in a satisfactory position.

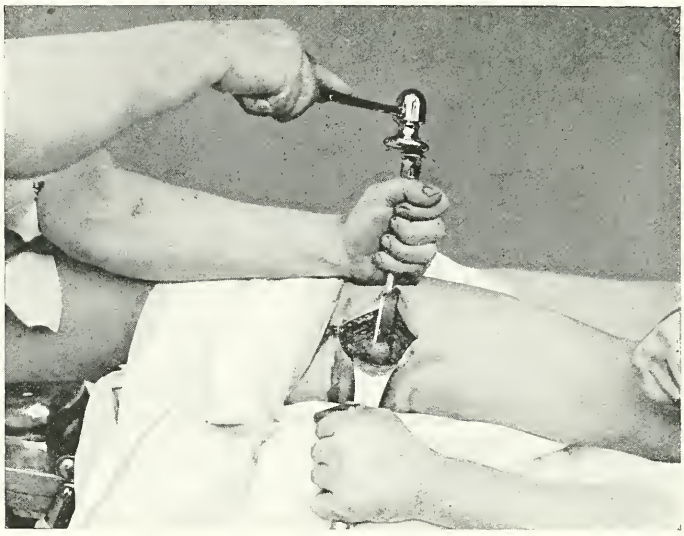


Fig. 893.—Coxo-Femoral Ankylosis in Forced Abduction. Cuneiform Osteotomy (Subtrochanterian).

Ankylosis in forced abduction requires cuneiform subtrochanterian osteotomy. This resection is performed with Macewen's osteotomes. Ankylosis in forced abduction is rare. It is remedied by a simple subtrochanterian osteotomy.

Simple Osteotomy.

Simple osteotomy is applied to cases where the ankylosis is produced in the position of forced abduction. This operation is performed subcutaneously like a tenotomy.

Operation.—*First Stage.*—Vertical incision 12 millimetres in length as far as the bone at the precise point at which the femur is to be sectioned.

Second Stage.—Introduction of No. 1 osteotome, which under the action of the mallet penetrates the bone to mid depth, at first in the middle, then in front, and then behind. The blade is graduated in centimetres. Section of the bone is continued with osteotome No. 2, and then with No. 3, whose blade is thinner in order to allow of deeper penetration.

Third Stage.—Suture of the cutaneous wound. Dressing.

Fourth Stage.—The femur is broken by a brisk movement of adduction;

the deformity is reduced, and the patient is put on a bed, which must be strictly horizontal.

After-Care.—The lower limb on the operated side is maintained in position by sand-bags. Continuous extension is applied to the limb. The position must be examined morning and evening, as the least inadvertence may cause a vicious coaptation.

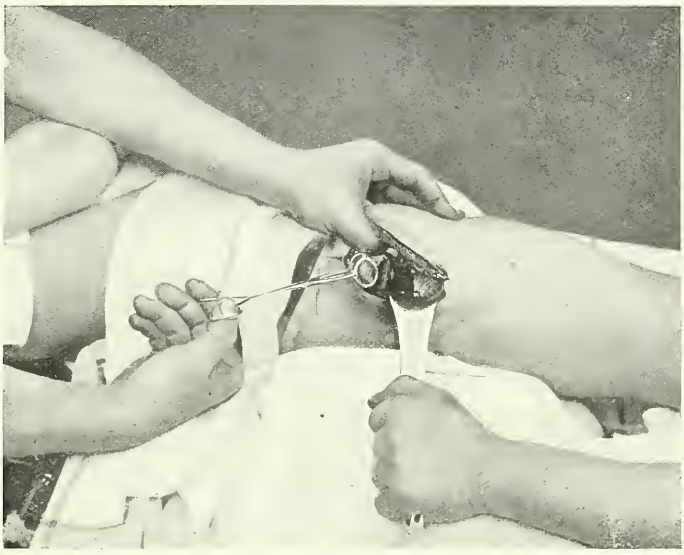


Fig. 894.—The Same. The Bony Triangle detached by the Osteotome is removed by Ring Forceps.

Cuneiform Osteotomy.

When the femur is ankylosed in the position of forced adduction a vertical incision of sufficient length must be made in order to excise a wedge of bone sufficiently large to allow of the reduction of the deformity. The two extremities of the severed femur may be united with Lane's plates and screws.

Operation—*First Stage.*—Vertical external incision 6 centimetres long, commencing at the tip of the great trochanter.

Second Stage.—Exposure of the femur, which is attacked transversely by the osteotome.

An osseous wedge is resected corresponding to the angle of the deviation. The outer table of bone on the opposite side is preserved.

Third Stage.—Toilet of the field of operation. Removal of osseous débris. Suture of the skin and dressing.

Fourth Stage.—The femur is broken by a violent movement of abduction; the deformity is reduced and the patient placed in bed. The patient must be closely watched. When ablation of bone has been performed, which is the most frequent procedure to remedy an ankylosis in forced adduction, the abduction should be exaggerated during the first weeks.

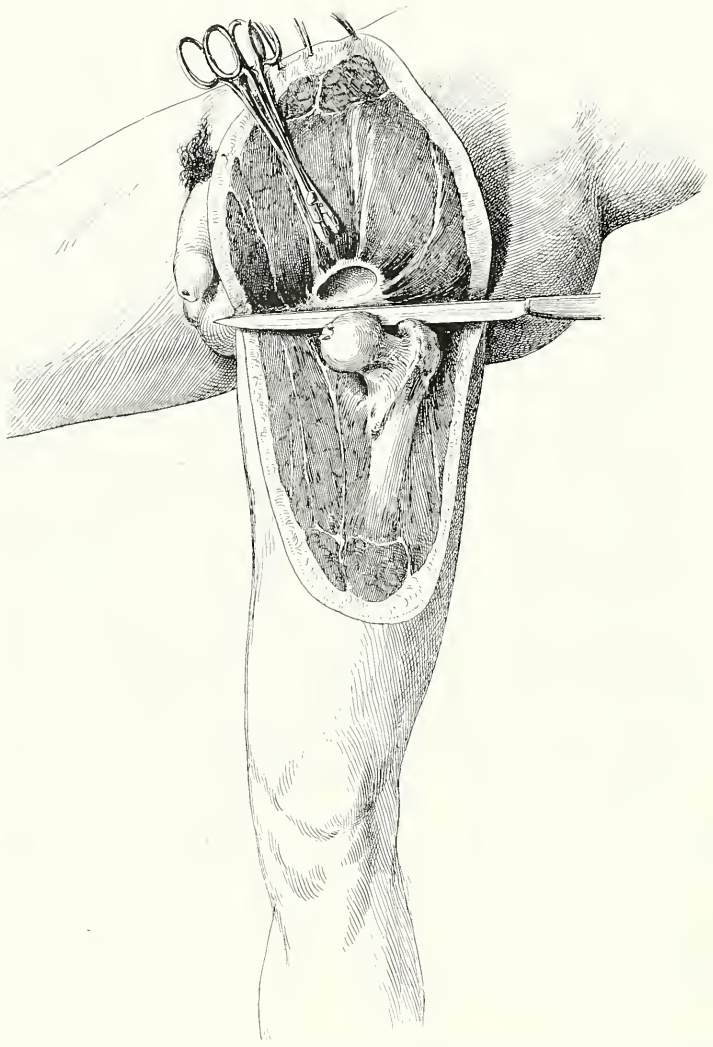


Fig. 895.—Disarticulation of the Hip-Joint. Third Stage: The Knife passes over the Upper End of the Femur and divides the Posterior Muscles.

Old Dislocation of the Hip.

Reduction of old dislocations of the hip is generally very difficult, and requires the application of elastic tractors and pulleys. I have, however, succeeded in reducing one of these cases three months old by the procedure described above for recent dislocations.

Tumours.

Primary tumours of the hip-joint are rare. Osteo-sarcoma is the most frequent.

Special Operative Technique.

Disarticulation of the Hip.

This operation is rare. It is generally practised in cases of osteo-sarcoma of the femur.

Operation—*First Stage.*—The thigh is placed horizontally. Shaping by transfixion of the anterior flap containing the femoral artery, which is compressed by an assistant at the level of the crural arch. The artery is immediately caught in forceps. This flap should extend from the anterior superior spine to the anterior part of the genito-crural fold. The knife should open the articulation. This anterior flap is lifted by ring forceps.

Second Stage.—Cruciform section of the capsule. An assistant lowers the thigh and dislocates the head of the femur by forcible external rotation. The round ligament is severed together with that which remains of the capsule. The thigh and leg are in a vertical position.

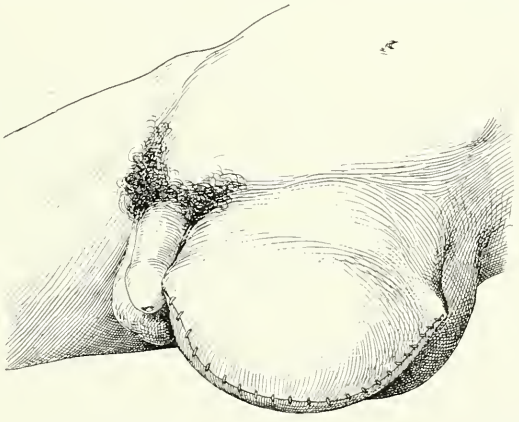


Fig. 896.—The Operation is finished. Aspect of the Wound.

Third Stage.—Rotation of the head of the femur inwards, and section of the peritrochanterian muscles. The knife is placed transversely behind the head of the femur, and in one sweep the posterior tissues are severed (Fig. 895).

Fourth Stage.—Hæmostasis. Section of the sciatic and crural nerves.

Fifth Stage.—Suture and drainage. This operation is quickly performed. There is little hæmorrhage. Slow procedures are much inferior to the operation here described, and which is far the older.

OPERATIONS ON THE THIGH.

Traumatic Lesions.

Penetrating wounds of the thigh may be complicated by wounds of the large vasculo nervous trunks. Nerve suture is carried out according to the technique already described (Vol. I., p. 378). Ligature of veins is performed in the wound, which is enlarged if necessary. The two ends of a wounded artery can also be ligatured in the wound.

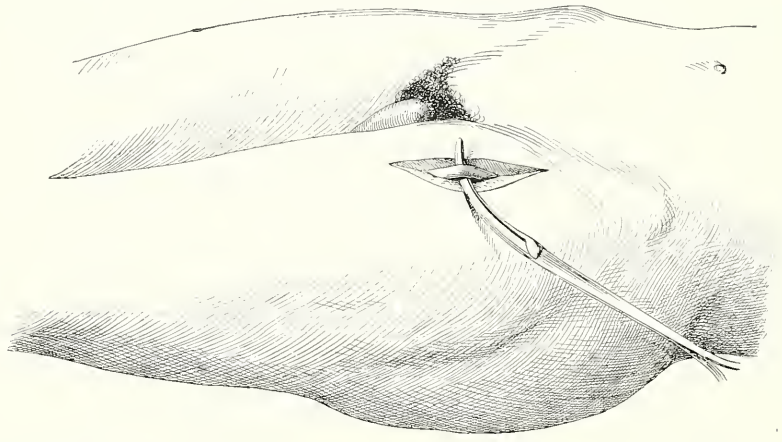


Fig. 897.—Ligature of the Femoral Artery Below the Crural Arch.

The femoral artery is also frequently ligatured above the wound. The following is a description of the classical ligatures:

Ligature of the Femoral Artery.

The femoral artery passes beneath the central part of the crural arch, and follows a line oblique in direction towards the posterior border of the internal condyle of the femur.

1. *Close to the Crural Arch (Origin of Femoral and End of External Iliac).*

Operation—*First Stage.*—Vertical incision 6 centimetres long, beginning exactly at the centre of the crural arch.

Second Stage.—Exposure of the cribriform fascia and incision of the sheath of the vessels.

Third Stage.—The artery is laid bare, using the extremity of a hæmostatic forceps, and is charged upon a curved forceps which is used for passing the ligature.

Fourth Stage.—Ligature of the artery.

Fifth Stage.—Suture of the wound.

The external iliac can be ligatured by prolonging the incision upwards and section of Poupart's ligament. The peritoneum is stripped up as far as may be necessary.

2. *In Scarpa's Triangle.*

First Stage.—Incision along the line of the artery.

Second Stage.—Incision of the aponeurosis and exposure of the inner border of the sartorius.

Third Stage.—Incision of the vascular sheath. The artery is denuded with a forceps.

Fourth and Fifth Stages.—As above.

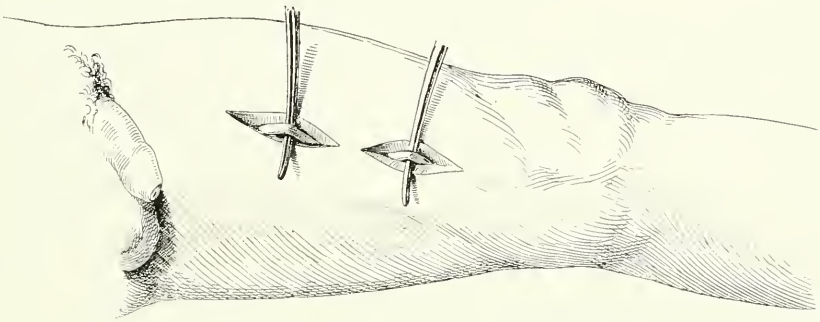


Fig. 898.—Ligature of the Femoral Artery in the Centre of the Thigh and at the Arch of the Adductor Longus.

3. *At the Centre of the Thigh.*

First Stage.—Cutaneous incision over the centre of the sartorius.

Second Stage.—Exposure *above* of the inner border and *below* of the outer border of the sartorius.

Third Stage.—Incision of the vessel sheath.

Fourth and Fifth Stages.—As above.

4. *At the Third Adductor Ring.*

First Stage.—Vertical incision 8 centimetres in length ending three fingers' breadth above the upper part of the internal condyle.

Second Stage.—Exposure of the tendon of the adductor and the fibrous wall of Hunter's canal where the external saphenous nerve and anastomotica magna emerge.

Third Stage.—Incision of the aponeurosis and exposure of the artery.

Fourth and Fifth Stages.—As above.

Simple Fracture of the Femur.

Fracture of the Neck of the Femur.

Fractures of the anatomical neck of the femur are rare, and are only observed in the adult. Consolidation is exceptional. Fractures of the surgical neck occur in the aged, who become exposed to the dangers of hypostatic pneumonia. The patient is placed on a flat bed with the thorax raised, and the lower limb is maintained in a good position by means of sand-bags. The limb is mobilized as soon as the pain is sufficiently diminished.

Fracture of the Diaphysis.

Fractures of the diaphysis of the femur situated in the upper middle or lower third are difficult to manage.

1. *In the Child.*

Excellent results can be obtained by placing the limb in the vertical position. The foot is hung in a stirrup by two pulleys, and furnished with a proper counter-weight.

2. *In the Adult.*

Reduction is obtained either by extension in the axis of the limb in the horizontal position or by extension in the position of abduction with the leg flexed on the thigh (Hennequin's apparatus). Hennequin's apparatus consists of a small femoral gutter and a traction stirrup placed below the knee, on which extension is applied by a counter weight. Counter-extension is made by an inguino-pelvic stirrup.

If the patient has a tendency to move towards the extension weight the legs of the bed are raised at the feet on two supports, in order that the counter-extension may be facilitated by the tendency of the patient to slip backwards.

Compound Fracture.

If the wound be small and *appears* to be uninfected, an aseptic dressing is applied, and each day a preventive injection of 20 c.c. of mycolysine is administered.

In March, 1913, I had occasion to treat an aviator who had an obturator dislocation of the hip and a compound and comminuted fracture of the femur, with large open wound. I observed in this case the disastrous results caused by the tincture of iodine with which the wounded parts had been plentifully sprayed. A large burn had been caused by the motor, a blow from which had broken the femur above the condyle. Gas gangrene set in, complicated by staphylococcic and streptococcic infection. These complications yielded to daily injections of mycolysine, together with continuous irrigation of the wound by liquor labarraque (1 per cent.) and peroxide of hydrogen (20 per cent.).

The *Bacillus perfringens* had completely disappeared after four days and the wound granulated in a normal manner. Up to the above date this is the first time that a thigh with open comminuted fracture complicated by gas gangrene has been successfully preserved.

Clamp with Screw for Retention of the Fragments in the Case of Compound Fracture.

In this patient, when the inflammatory conditions had subsided, the fragments overlapped for an extent of 7 centimetres. When the adhesions had been severed a traction force of 175 kilogrammes with tackle blocks was necessary in order to bring the fragments end to end. In order to retain this reduction I prepared a clamp, which consisted of two pieces of metal with incurved extremities arranged in such a way that each part could be placed in position separately above and below the fragments, just as two blades of a forceps are applied. The tightening apparatus was then placed in position. This consists of a conical tube and a screw-nut, which screws on to the end of the two juxtaposed stems (Fig. 899).

Inflammatory Lesions.

Acute Inflammatory Lesions.

Acute adenitis in Scarpa's triangle and abscess in the thigh are treated by mycolysine (by the mouth and by injection in large doses). When pus collects incision and drainage is the rule. In the case of subacute bubo the inflamed glands may be removed by means of a bistoury and curette.

Chronic Inflammatory Lesions.

Adenopathy in Scarpa's Triangle.

Adenopathy in Scarpa's triangle is frequent, and may attain a considerable volume. Either tuberculous or neoplastic glands are the cause. Primary sarcoma of this region is by no means rare. The following description serves for the treatment of tuberculous glands in this region:

Operation—*First Stage.*—Longitudinal cutaneous incision.

Second Stage.—Exposure and enucleation of the superficial glands which are situated above the cribriform fascia. The deeper glands are exposed by divulsion, and these are removed in their turn. Bleeding vessels are tied.

Third Stage.—Toilet of the wound. Suture of the skin and drainage.

If the glands be tuberculous, antituberculous treatment by means of phymalose is instituted. If a sarcoma be present or epitheliomatous glands, the field of operation is treated by the thermo-electric bath (Vol. I.), and anticancerous vaccination by means of cytolase is commenced.

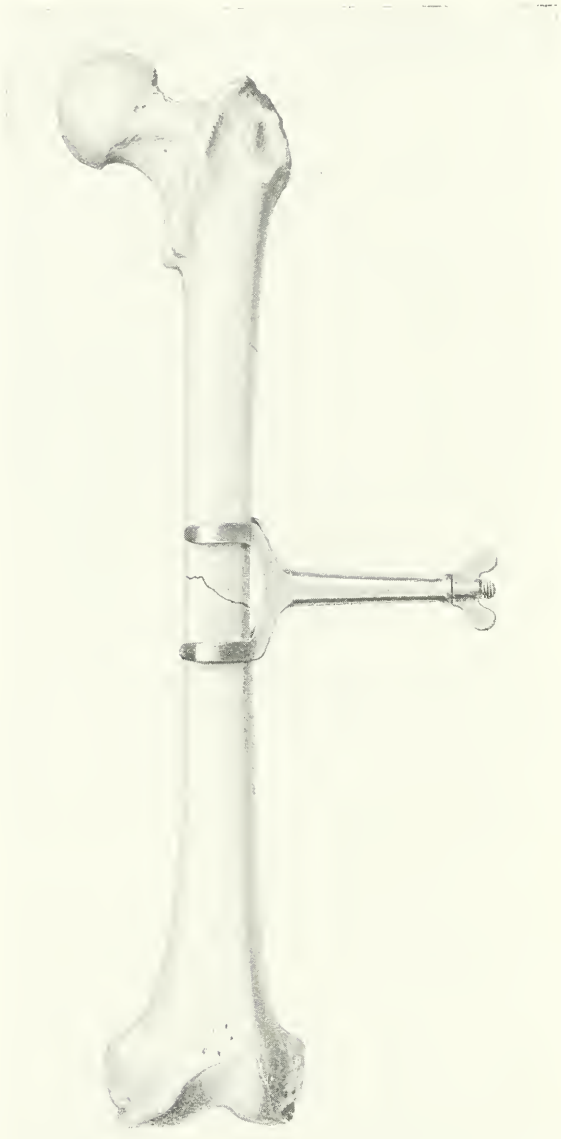


FIG. 899.—CLAMP FOR RETENTION OF THE FRAGMENTS OF THE FEMUR IN OPEN FRACTURE.

The instrument is in position and the screw is tightened.

Diaphysiary Abscess.

I have operated upon several diaphysiary abscesses encysted in the midst of an ovoid tumefaction of the diaphysis whose origin dated from twelve to fifteen years.

Operation—*First Stage.*—Longitudinal antero-external incision.

Second Stage.—Exposure of the bone with the bistoury and raspatory, and application of retractors.

Third Stage.—Perforation of the bone with cylindro-conical burr. Pus appears. Toilet of the cavity. The orifice is enlarged as far as seems necessary with the electric mortice (12 millimetres).

Fourth Stage.—Toilet of the wound. Plugging.

Osteo-Myelitis of the Femur.

Bone sinuses of the femur, whether their origin be tuberculous or an old staphylococcic osteo-myelitis with sequestrum, are treated by hollowing out the bone, using electrical instrumentation.

Tuberculosis of the Femur, Caries, and Sinus.

An analogous technique is employed. The diaphysis is hollowed out with the mortice for the whole length of the lesion.

Congenital and Acquired Malformations.

Acquired Malformations.

Varicose Veins.

Varix attacks most frequently the whole of the lower limb. The sole radical treatment is the removal of the varicose veins. This operation is described later.

Incurvation of the Femoral Diaphysis.

Incurvations of the femur due to rickets are seldom sufficiently accentuated to need osteotomy.

In one case of very accentuated incurvation of the diaphysis I was enabled to re-establish the lower limb in its normal direction by means of a supracondylar cuneiform osteotomy. The case was caused by an osteo-myelitis operated on several times, and there was rotation of the bone on its axis, rendering walking almost impossible.

Genu Valgum.

Supracondylar osteotomy of the femur in the hands of a surgeon possessing a good technique is superior to osteotomy.

Supracondylar Osteotomy of the Femur.

This operation, the instrumentation and technique of which has been regulated by Macewen, is the type of all juxta-epiphysiary osteotomies. This osteotome is the instrument of choice for this operation, because the special consistence of the juxta-epiphysiary osseous tissue allows of section

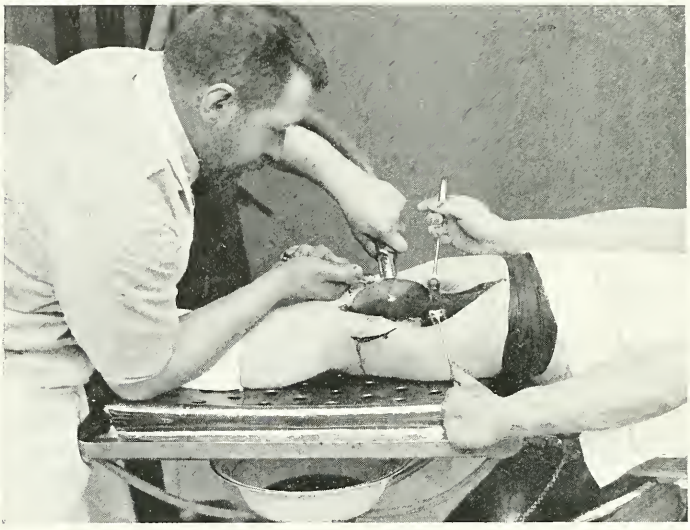


FIG. 900.—OSTEOMYELITIS OF THE FEMUR. HOLLOWING OUT THE BONE.

Double section of the bone with the circular saw, which circumscribes between the two orifices made with the burr, a plate of the external table. A saw of the diameter of 12 centimetres is used in this operation. This saw turns at a speed of 2,500 turns a minute, and requires a powerful and a practised hand.

FIG. 901.—THE SAME. HOLLOWING OUT OF THE DIAPHYSIS WITH THE CYLINDRO-SPHERICAL BURR.

The osseous plate is mobilized with the gouge and mallet, and is entirely removed.

without the formation of splinters. On the other hand, osteotomy, is impracticable on the shaft.

The operation of Macewen is performed with three osteotomes 13 millimetres wide and with rounded cutting surface. No. 1 is the thickest, and No. 3, which is used in the depths, is the thinnest.

Operation.—The thigh rests on its side on a sand-bag.

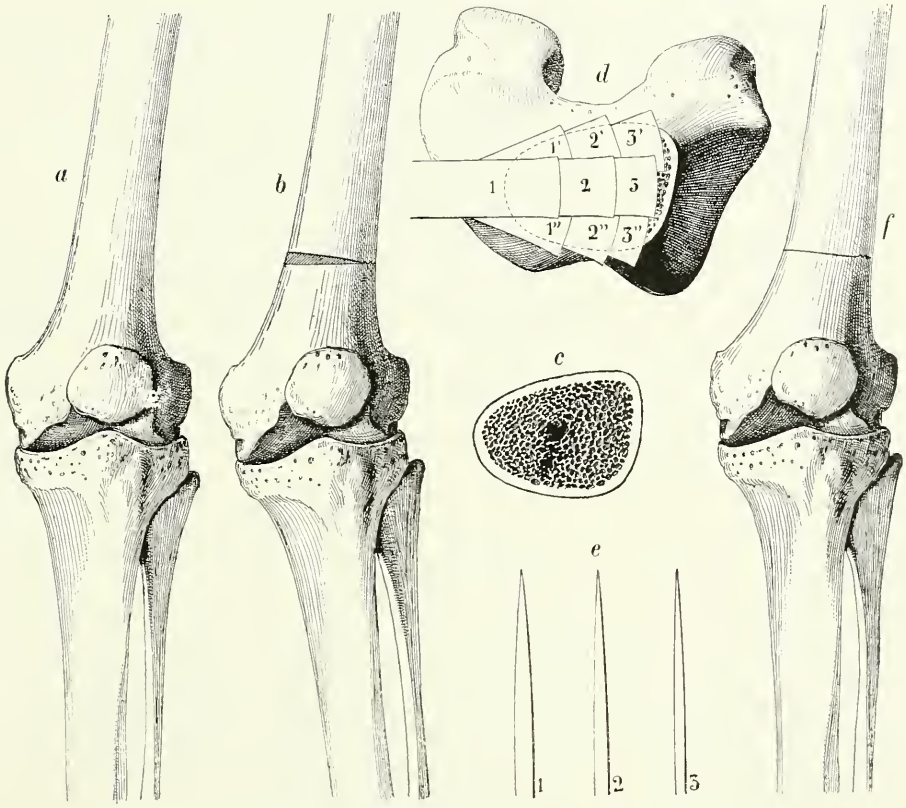


Fig. 902.—Supracondylar Osteotomy for Genu Valgum.

a, Normal relations of femur and tibia; *b*, genu valgum, showing outlined the exuberant portion of the femur; *c*, section of the femur at the point of the osteotomy; *d*, diagram showing the manœuvre of the three osteotomes: 1, 1′, 11″ represents the first or thickest, and 3, 3′, 3″ the thinnest; *e*, the osteotome blades; *f*, reduction of the deformity.

First Stage.—Vertical incision of 10 millimetres two fingers' breadth above the internal condyle of the femur, penetrating as far as the periosteum.

Second Stage.—Introduction of osteotome No. 1 (the thickest) and section of the central part of the bone, then its posterior border, then its anterior border to a depth of 2 centimetres. A soft copper mallet is employed. The osteotome is graduated. The osteotome should be gently moved after the first section, without leaving the groove already made. The posterior and anterior sections are performed in the same way.

Osteotome No. 1 is then removed and replaced by No. 2, which penetrates the central portion of the bone. It is driven to a depth of 15 or 20 millimetres, and it is then removed; keeping it in the same groove, it is made to penetrate backwards and forwards. No. 2 osteotome is then removed and No. 3 is used to complete the section. This instrument penetrates to within 5 or 6 millimetres of the external surface of the femur.

Third Stage.—Suture of the skin.

Fourth Stage.—The femur is broken by a brusque movement of abduction of the leg on the thigh, and the deformity is reduced.

Fifth Stage.—Application of plaster apparatus.

After-Care.—Since the bone section is transverse the patient may be allowed to walk between the thirtieth and fortieth day, according to age. The consolidation and the position are verified from time to time.

Genu Varum.

Simple osteotomy is performed, using the same technique. The limb being placed on its inner aspect, operation is performed from the outer side.

A cuneiform osteotomy also may be performed. This operation, which is performed in an open wound, may cause splintering, and requires a large incision. Cuneiform osteotomy should be reserved for cases where linear osteotomy is likely to be insufficient.

Tumours.

Benign Tumours.

Molluscum fibrosum ; Lipoma.

Molluscum fibrosum may occur in the thigh, when it sometimes attains considerable proportions. Lipoma is not rare. These tumours are removed by the usual methods.

Malignant Tumours.

Myxoma.

Subcutaneous malignant myxoma may attain a considerable volume in the thigh. The tumour invades the muscles and becomes generalized throughout the limb.

Certain of these myxomata are of extreme malignance. Their development can only be arrested by combining extirpation with thermic electrocoagulation and the thermo-electric bath. Subcutaneous injections of cytolase are also employed.

Sarcoma of the Thigh Muscles.

Sarcoma of the thigh muscles is by no means rare; it occurs generally on the external side, which is the side chiefly liable to injury.

These tumours, as in the case of myxoma, are treated by removal combined with electro-coagulation or the thermo-electric bath. These measures

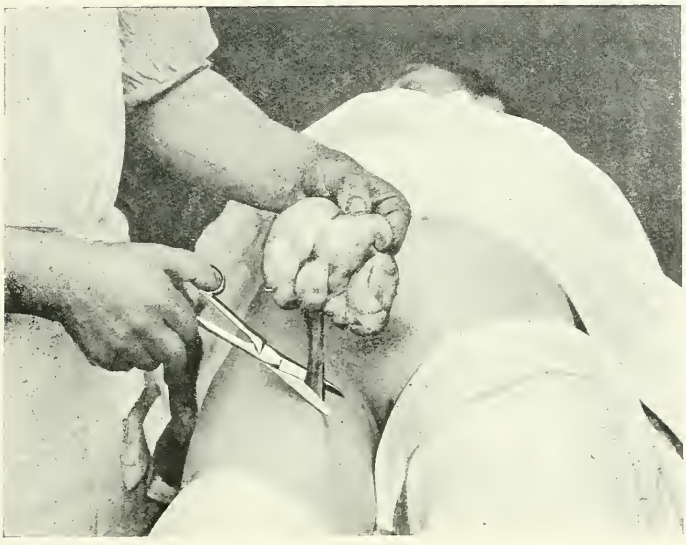


Fig. 903.—Pediculated Molluscum Fibrosum of the Antero-Superior Region of the Thigh.

are indispensable in order to avoid recurrence. Antineoplastic vaccination by means of cytolase is also employed. By using this method I have

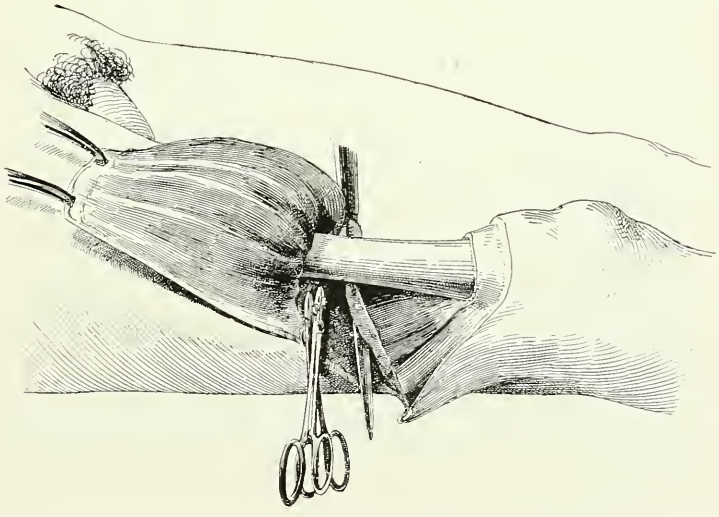


Fig. 904.—Amputation of the Thigh in the Upper Part. Shaping the Small Posterior Flap.

obtained durable cures in seemingly desperate cases and in cases where recurrence had already taken place.

Osteo-Sarcoma.

Osteo-sarcoma of the femur is a very grave infection. If a diagnosis can be made at the onset, an attempt may be made to destroy the tumour by means of curetting and electro-coagulation. If intervention is late

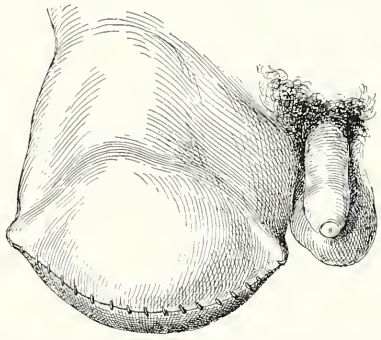


Fig. 905.—The Same. The Stump after Suture.

amputation must be performed at the upper third (in a sarcoma close to the condyle) or disarticulation of the hip.

Amputation of the Thigh.—Amputation is performed as low as possible in order that a useful stump may be obtained.

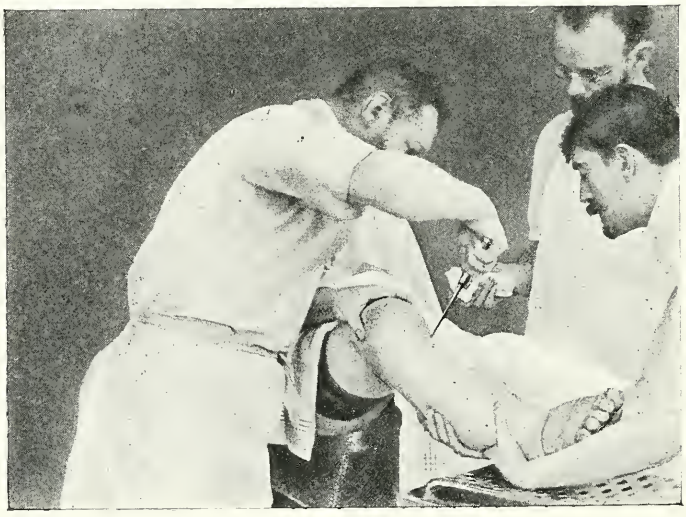


Fig. 906.—Supracondylar Amputation.

Whether the operation be carried out in the middle of the thigh or at the junction of the middle and upper thirds, the technique is the same.

Amputation through the Upper Third—*First Stage.*—A large anterior flap is shaped by transfixion.

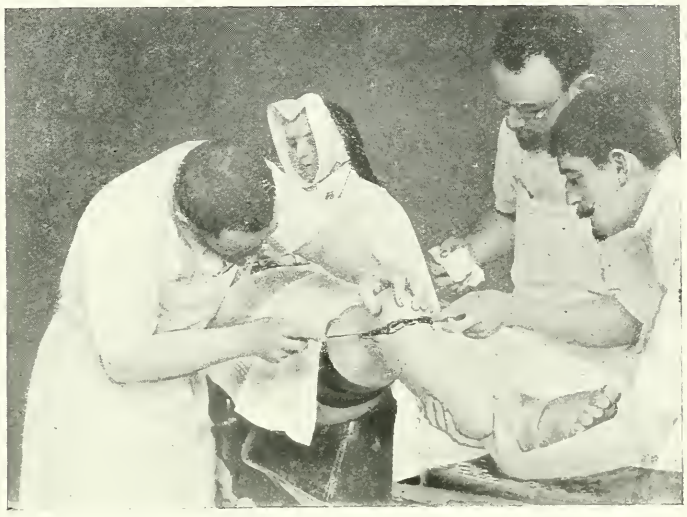


Fig. 907.—The Same. The Flap is completed.

First Stage.—This flap contains the femoral artery, which is compressed by an assistant in Scarpa's triangle. It is found, and a forceps is applied.

Fig. 908.—The Same. Dissection of the Prepatellar Flap.

Second Stage.—Shaping of a small posterior flap by transfixion.

Third Stage.—The two flaps are lifted by hooked forceps, circular section of the muscles, section of the bone with the saw.

Fourth Stage.—Hæmostasis. Resection of the sciatic and anterior crural nerves.

Fifth Stage.—Suture. Drainage.

Fig. 909.—The Same. The Cutaneous Flap is finished.

Amputation through the Middle Third.—This operation is performed with the same technique. Large anterior and small posterior flap. The

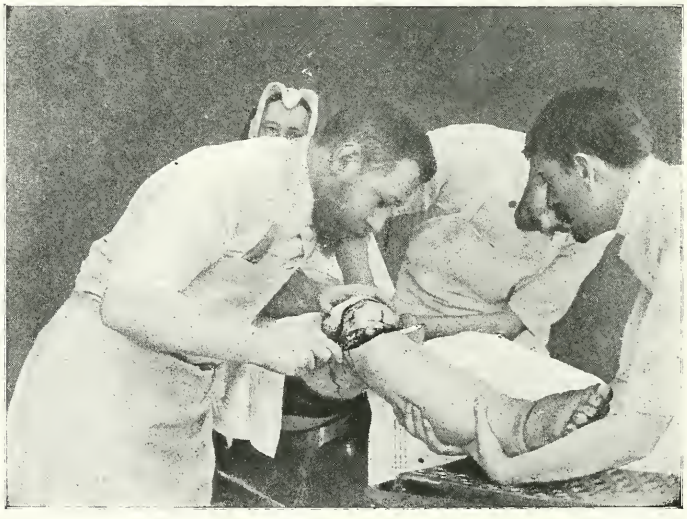


Fig. 910.—The Same. Shaping the Posterior Flap.

artery is contained in the posterior flap, and is compressed by an assistant in Scarpa's triangle.

Supracondylar Amputation.—This operation is indicated when the knee must be sacrificed for a lesion other than an osteo-sarcoma. It is illustrated in Figs. 906-915, which are printed from cinematograph films.

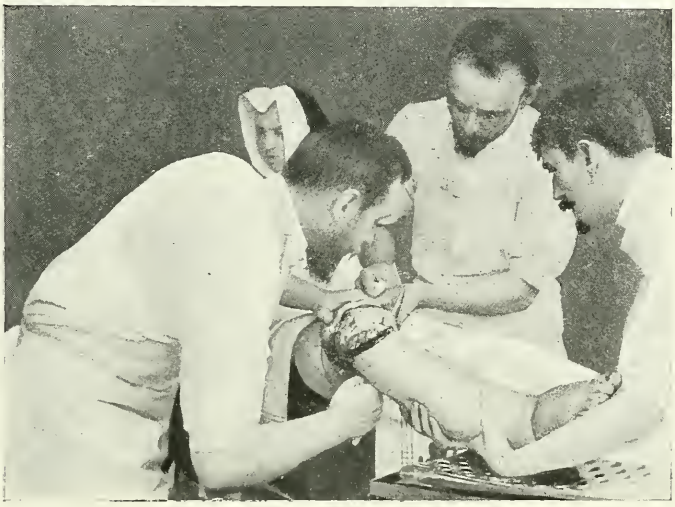


Fig. 911.—The Same. Circular Section of the Soft Parts.

Fig. 912.—The Same. The Knife is held Nearly Vertically to complete the Section.

Operation—*First Stage.*—Formation of a prepatellar flap. A U-shaped incision is employed, extending from condyle to condyle, and passing below the insertion of the patellar tendon into the tibia.

Second Stage.—Dissection of the anterior flap, which is raised by hooked forceps.

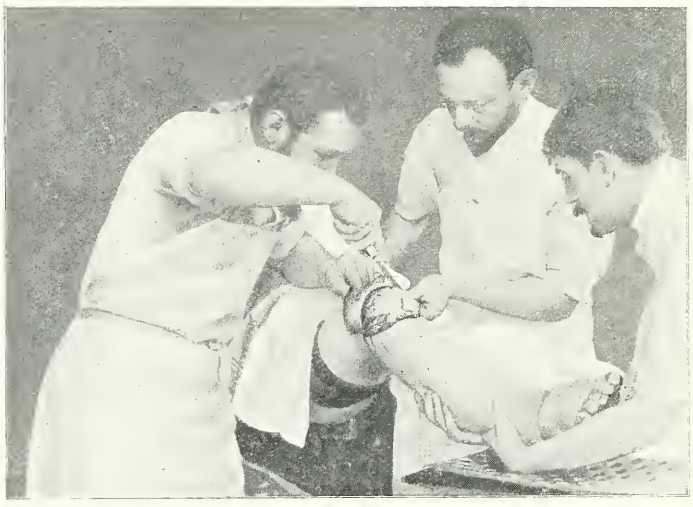


Fig. 913.—The Same.

Third Stage.—An assistant compresses the femoral artery. Formation of a small posterior flap by transfixion.

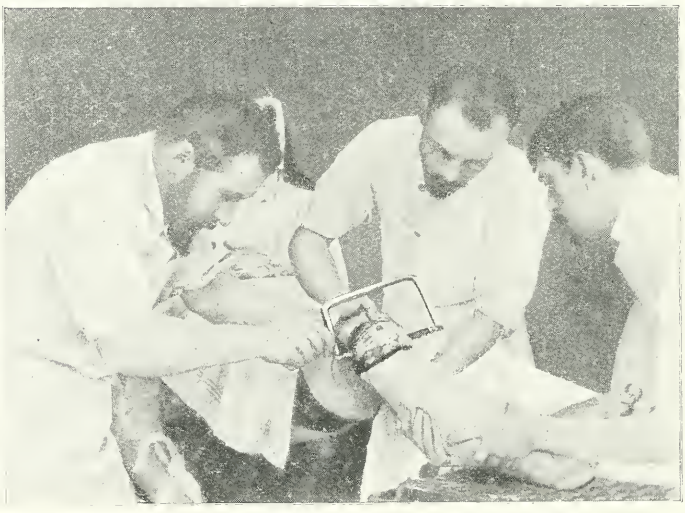


Fig. 914.—The Same. Section of the Femur with Collin's Large Saw.

Fourth Stage.—Circular section of all the soft parts. Section of the bone immediately above the condyles. The artery is immediately seized.

Fifth Stage.—Hæmostasis and resection of nerves.
Sixth Stage.—Suture. Drainage.

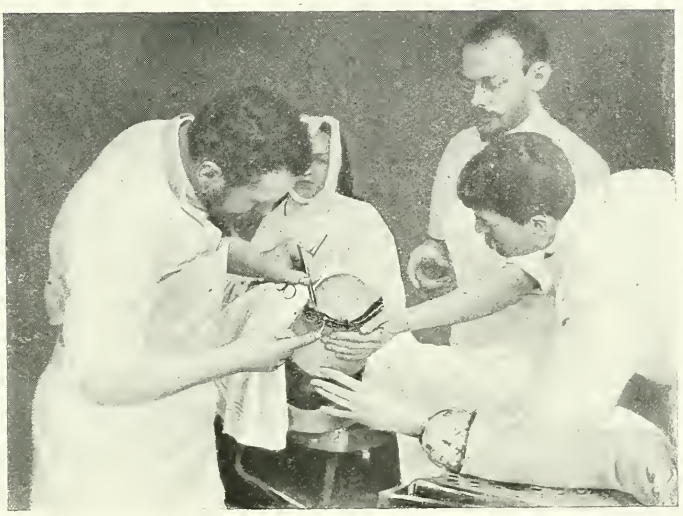


Fig. 915.—The Same. Suture.

OPERATIONS ON THE KNEE AND THE POPLITEAL SPACE.

Traumatic Lesions.

Wounds.

Wounds in the anterior region may attain the prepatellar bursa and the synovial membrane.

Wounds in the posterior may involve the two branches of the sciatic nerve or the vessels. The wound may be complicated by the presence of foreign bodies. Tincture of iodine should never be employed in such cases, since its penetration between the edges of a contused wound is always followed by serious consequences. In the case of a wound of the anterior or the posterior region of the knee the first dressing should be dry and aseptic. The patient is taken at once to the operating room, and the leg and thigh are shaved. The skin is carefully disinfected with formol soap, alcohol, and ether. The wound is then incised to its full depth. All contused tissues are removed, bleeding is arrested, wounded tendons or aponeuroses are repaired, and the wound is sutured and drained. If a nerve is wounded it is sutured (Vol. I., p. 378).

When the synovial membrane is opened the orifice is enlarged; toilet of the synovial membrane is made, using a sterile compress and isotonic saline or Ringer's solution. It is united and drained. As long as it may be necessary, an injection of 20 c.c. of mycolysine is given daily in the femoral region.

Fracture of the Patella.

Fracture of the patella necessitates immediate arthrotomy and the suture of the patella with metallic wire, or the encircling of the bone. Both procedures give good results when the patella is fractured at its centre. Encircling is preferable when the patella is fractured near the point, since longitudinal suture with metallic wire does not give sufficient holding ground in the lower fragment. I have combined the two operations with success in several cases. The patellar ligaments must also be repaired with interrupted silk sutures. The metal wires may be removed after two or three months should they cause irritation.

Tearing of the Patellar Tendon.

Tearing of the patellar tendon at its attachment to the tibia is rare. I have observed this accident. It is necessary to suture the tendon to the torn periosteum and to the bone as soon as possible, by nailing it with nickel looped nails with barbed ends. Lane's method with a transverse bar fastened by two or more screws may also be employed.

Fracture of the Patella and Penetrating Wound of the Knee with Femoral Lesions.

In an aviation accident the petrol pipe had fractured the left patella with loss of the inner third of this bone. It had then dug a deep groove in the inner condyle of the femur, and penetrated the right knee-joint on the inner side of the patella. I resected all the bruised tissues, which were contaminated with black oil. I then sutured and encircled the broken patella. After toilet of the articulation all the fibrous tissues were united. A rapid cure was the result, although daily examination of the liquid from the drainage-tubes gave cultures of both staphylococci and streptococci. Infection was prevented by considerable daily injections of mycolysine.

In another case of penetrating wound of the knee with fractured tibial condyles I obtained a rapid cure by the same method. These cases are worthy of observation, for it seemed at first that amputation was the only course.

Dislocation of the Knee.

Repair of the Articular Ligaments.

I have seen a case of complete dislocation of the knee outwards with rupture of the internal and cruciform ligaments. The leg was turned up upon the external femoral region.

Operation—*First Stage.*—Longitudinal incision 12 centimetres long on the inner side.

Second Stage.—Opening the joint and toilet of the blood-clots.

Third Stage.—Reproduction of the external dislocation to bring into evidence the tearing of the crucial ligaments.

Fourth Stage.—Suture of the crucial ligaments. The femur was doubly perforated in the intercondylar notch at the point of insertion of the crucial ligaments, and the crucial ligaments were sutured one after the other by metal wire. This delicate stage was carried out under satisfactory conditions. The ends of the wires were twisted after the limb had been placed in extension.

Fifth Stage.—Toilet of the wound, suture of the internal ligaments with No. 5 silk. Suture of the skin, compressive dressing without drainage.

The patient wore an orthopædic apparatus for a year as a measure of prudence. The limb functions now in a perfect manner, and there is as much flexion as before the accident.

Inflammatory Lesions.

Acute Inflammatory Lesions.

Furuncle. Superficial Abscess.

Resolution is generally obtained by the administration of mycolysine (injections, and by the mouth). Failing this incision is made.

Suppurating Hygroma.

Mycolysine is immediately administered, and an incision is made should resolution not occur.

Suppurative Arthritis.

From the moment pus has been diagnosed mycolysine is employed in large doses both by hypodermic injections and by the mouth, and an incision is made on one side of the patella. The best treatment following incision is continuous irrigation, employing Labarraque's fluid with peroxide of hydrogen. This irrigation is continued eight days after the temperature falls.

Gonorrhœal Arthritis.

Gonorrhœal arthritis of the knee usually assumes a chronic form, and tends to cause ankylosis. Rapid resolution may be obtained by administering mycolysine in large doses from the start. The treatment is continued until the inflammation disappears.

Chronic Inflammatory Lesions.

Prepatellar Bursa.

Prepatellar bursa may attain a considerable volume (Fig. 916). The whole pouch should be removed. When the cyst is of great volume the

exuberant skin is removed with it, between two transverse curvilinear incisions (Fig. 917).

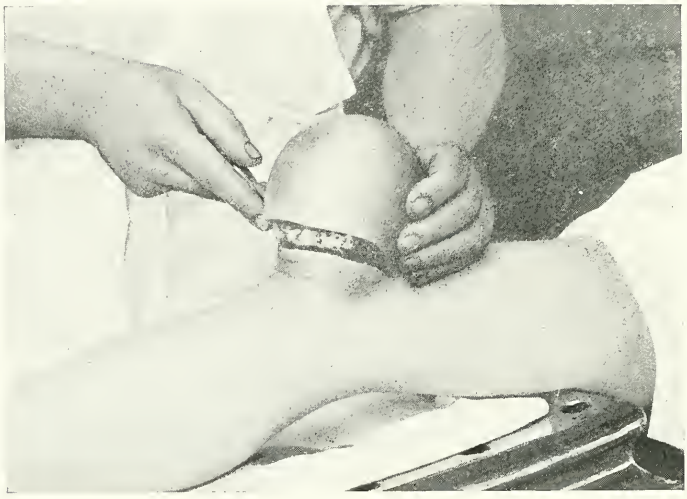


Fig. 916.—Large Prepatellar Bursa.

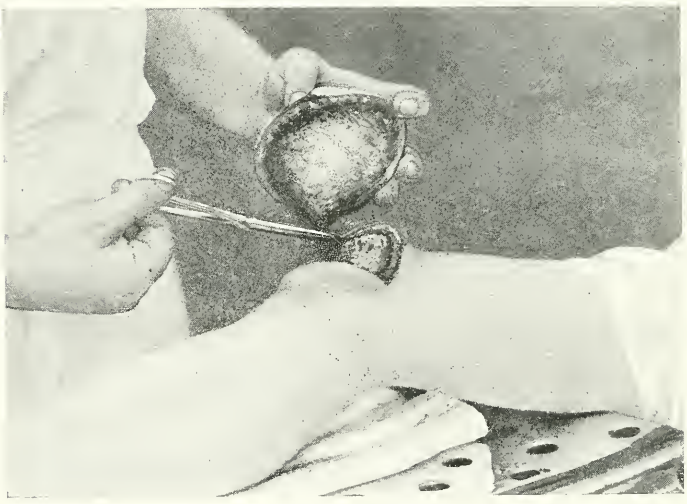


Fig. 917.—The Same. Removal of the Cyst and Redundant Skin.

Tendinous Hygroma.

Cysts of the Popliteal Space.

Cysts in the popliteal space are, usually, hygromata of the bursæ in this region. They are removed by a longitudinal incision. The operation

does not call for any particular description, as the details are very variable. The topography of the hygromata must be borne in mind.

Fig. 918.—Enucleation of a Cyst in the Popliteal Space.

Hydarthrosis. Foreign Body in the Knee.

Obstinate hydarthrosis should be treated by puncture with a large trocar, or by arthrotomy, by which means the condition of the synovial membrane can be examined. Arthrotomy also facilitates the evacuation of articular clots which cannot pass through a cannula.

Arthrotomy of the Knee Joint.

Arthrotomy of the knee should be preferred to puncture in chronic and obstinate hydarthrosis. It is also practised in the case of articular foreign bodies.

Operation—*First Stage.*—Vertical cutaneous incision 5 or 6 centimetres in length, either on the inner or outer side, and corresponding to the anterior border of the condyle. In the case of a foreign body the incision is made on the side on which it has been located. If the foreign bodies are multiple and a certain amount of fluid is present, the incision can be made either on the right or on the left.

Second Stage.—Section of the muscular fibres and opening of the articular serous membrane, the edges of which are caught in hooked forceps. The fluid escapes, carrying with it the foreign bodies if they are numerous.

Third Stage.—If a single foreign body be present it is fixed before the patient is anæsthetized. Should it become lodged, at the moment of

opening the joint, in a remote portion of the synovial membrane, external manœuvres must be patiently employed to discover it. Intra-articular

Fig. 919.—Removal of a Foreign Body from the Knee.

manœuvres must be avoided. I never introduce a finger or even a forceps into the synovial cavity, and I never employ lavage. Under such conditions arthrotomy of the knee is quite inoffensive.

Fourth Stage.—Suture of the synovial membrane and aponeurosis.

Fifth Stage.—Suture of the skin.

Tuberculous Arthritis.

Tuberculous disease of the knee requires resection when it has resisted treatment by phymalose combined with immobilization.

Resection of the Knee.

Resection of the knee joint is performed in cases of obstinate suppurating tuberculous arthritis or in cases of right-angled ankylosis of the joint.

Operation—*First Stage.*—Double anterior oval transverse incision circumscribing the patella, which will be removed with the skin if it is movable or with the bony extremities if it is fixed. The two incisions should meet just behind the femoral condyles.

Second Stage.—The bistoury is carried down as far as the bone and opens the synovial cavity above the patella.

The assistant, by a brusque flexion of the leg on the thigh, dislocates the joint if it is half ankylosed in a rectangular position. If there be

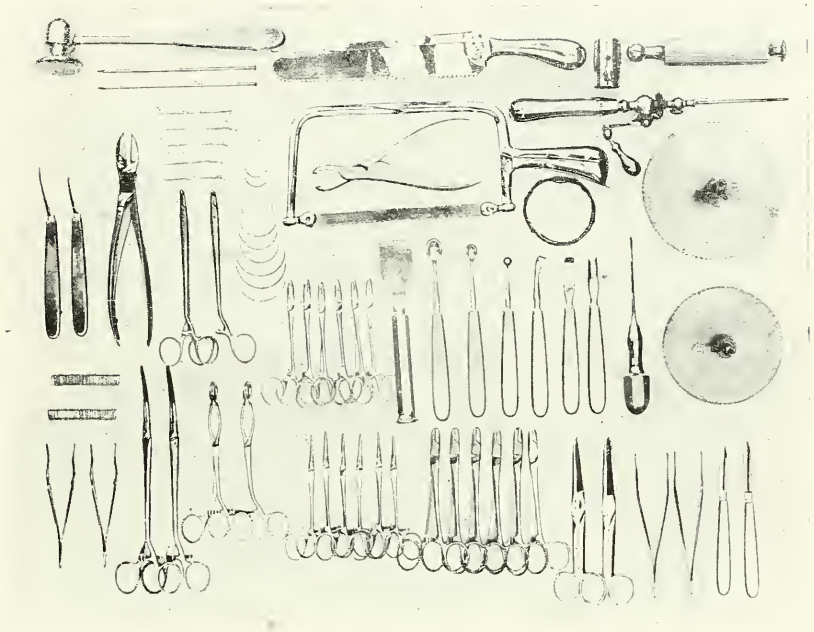


FIG. 920.

From right to left from below upwards: 2 bistouries, 2 dissecting forceps, 2 scissors; 6 toothed Doyen's artery forceps, 6 oblique toothed Doyen's forceps, 2 oval forceps, 2 long curved forceps clip forceps and clips; 2 circular saws, hand perforator curettes; 1 Championnière's large osteotome; and 6 Doyen's needle holders, open-eyed needles, 2 needle holders (eccentric), cutting pliers, 2 Doyen's mounted needles; mechanical perforator, saw with movable back, strand of maillechort gouge-forceps, glass drains; adjustable holder saw, two steel pins mallet.

FIG. 921.—RESECTION OF THE KNEE.

ankylosis of the knee in a straight position it is useless to break the ankylosis.

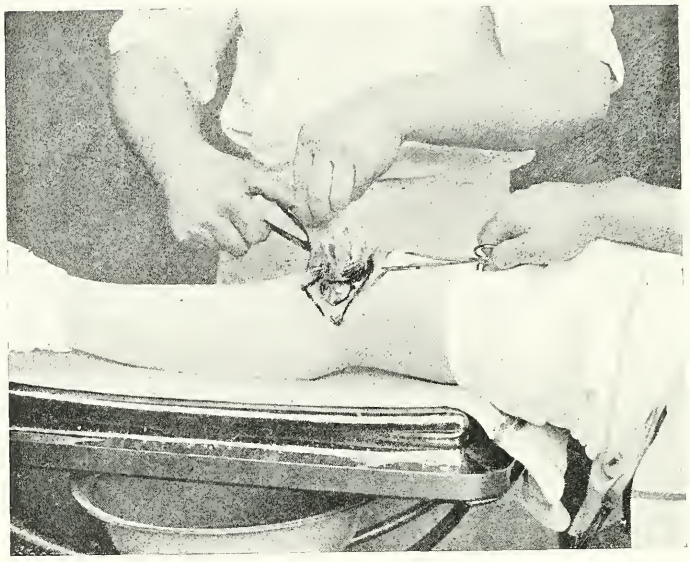


FIG. 922.—THE SAME. EXCISION OF THE PATELLA.

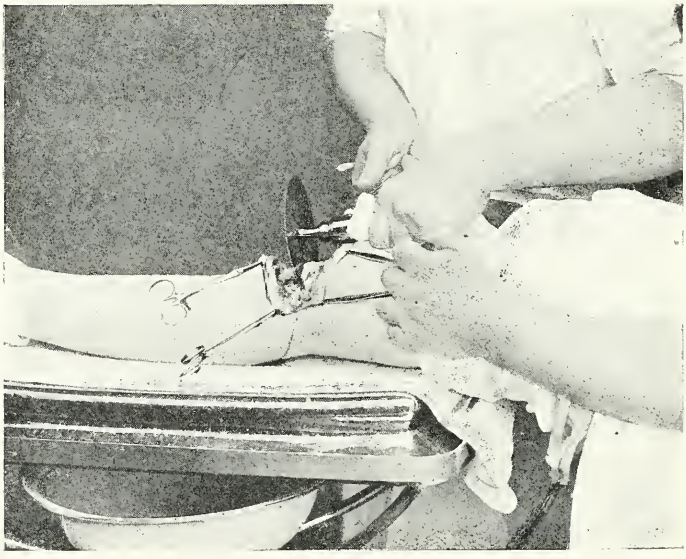


FIG. 923.—THE SAME. SECTION OF THE FEMUR, USING THE CIRCULAR SAW.

Third Stage.—The surgeon determines exactly the axis of the femur, and cuts through this bone above the condyles in a direction parallel to

that which the tibial surface will present. The obliquity of the femoral axis from above downwards and from without inwards must be borne in

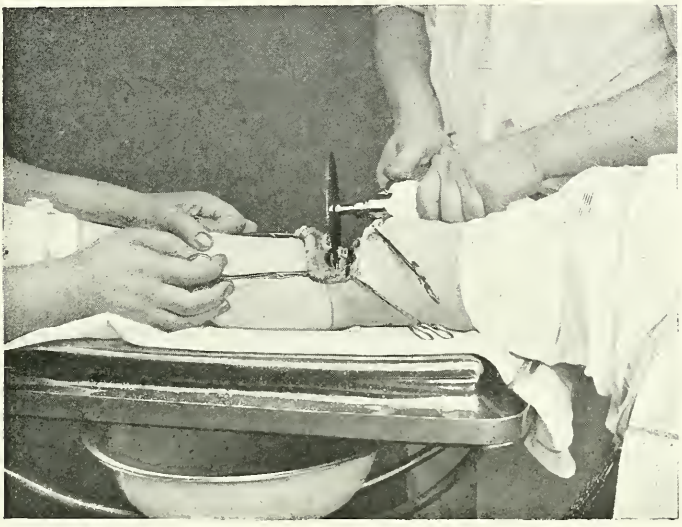


FIG. 924.—THE SAME. SECTION OF THE TIBIA.

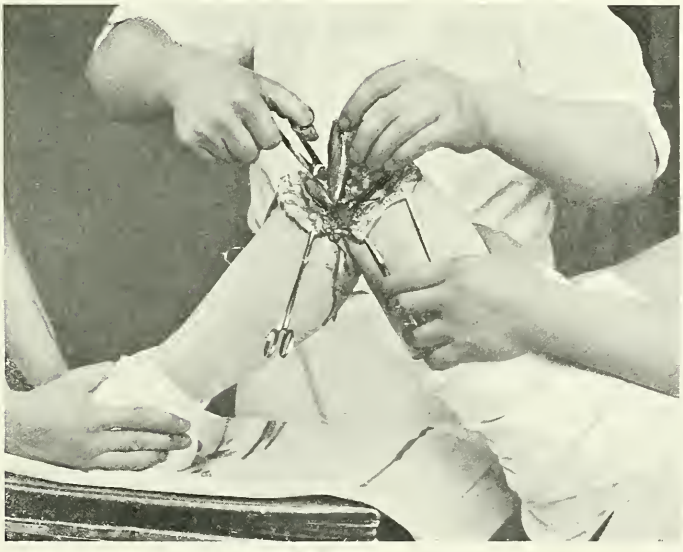


FIG. 925.—THE SAME. REMOVAL OF THE OSSEOUS EXTREMITIES.

mind. The ultimate union of tibia and femur should be obtained with a very slight flexion of the leg on the thigh.

Section of the femur should be perfect with the first cut. I usually

make this section with the 15 centimetres electric saw, very rarely I use the hand-saw with movable back. The amputation saw is defective in

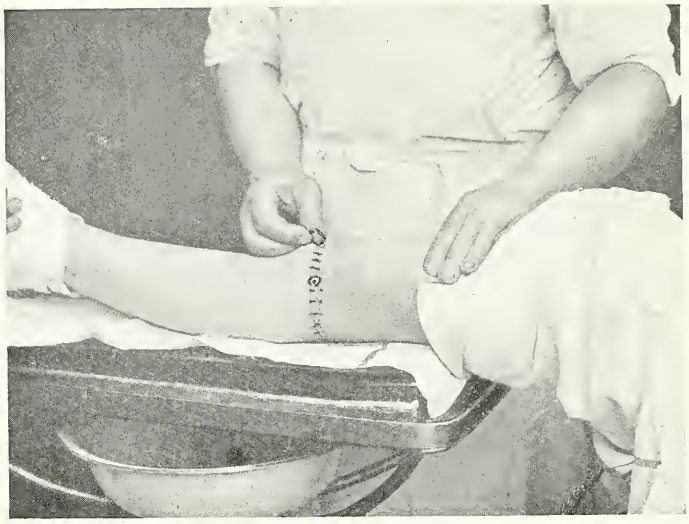


Fig. 926.—The Same. Suture of the Skin and Drains.

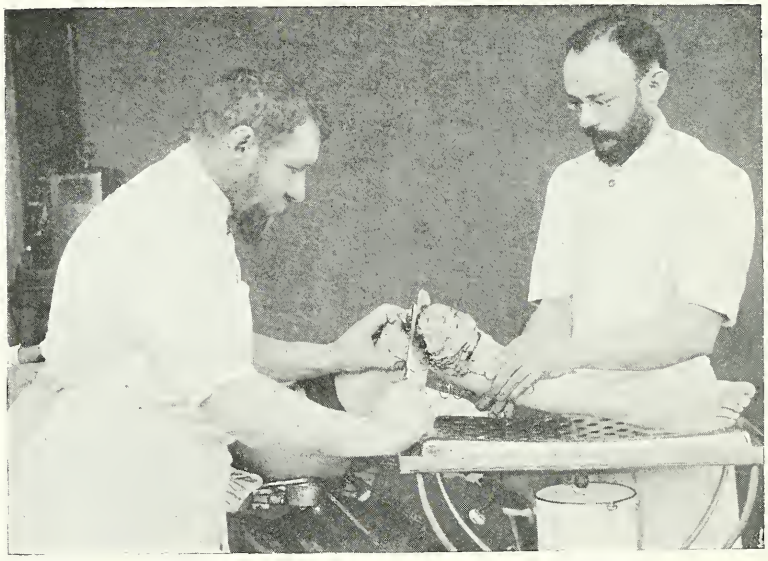


Fig. 927.—Another Case. Section of the Femur, using the Saw with Movable Back.

this operation, as it tends to make a curved surface, and this impedes a satisfactory coaptation.

Immediately afterwards the tibia is sectioned as high as is possible, avoiding the diseased parts.

In cutting through the femur and tibia care must be taken to avoid wounding the popliteal space. If the section is not absolutely complete the bony extremities can be disjointed by means of Champonnière's chisel and mallet. They are detached from their fibrous connections by means of the scissors.

Fourth Stage.—The posterior border of the section is trimmed with a cutting forceps, and a forceps and scissors are used to remove all pathological tissues remaining in the field of operation. Sinuses are curetted and suspicious bony points are excised during the toilet of the wound.

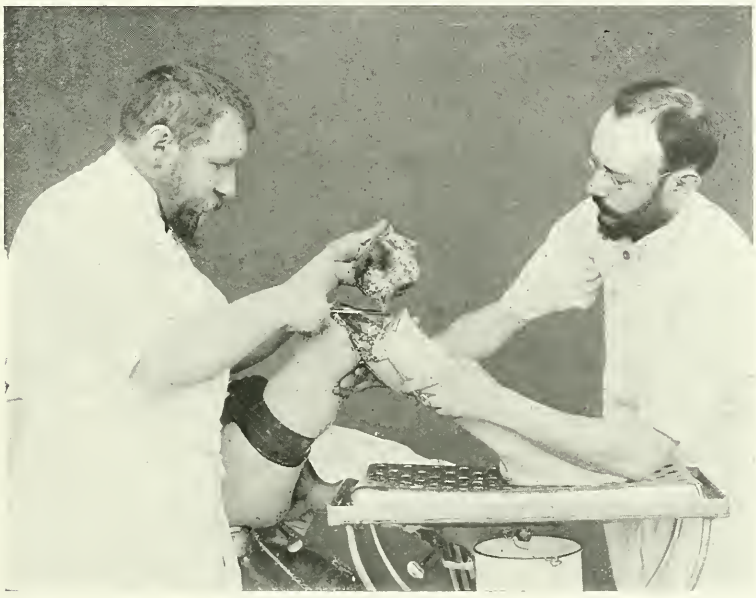


FIG. 928.—THE SAME. REMOVAL OF THE BONY EXTREMITIES OF THE FEMUR AND TIBIA.

Fifth Stage.—The limb is straightened. The perfect coaptation of the surfaces is assured, and the skin is sutured. Osseous suture is useless. Drainage and circular compressive dressing.

AFTER-CARE.—A plaster apparatus or a simple gutter splint is applied over the dressing. If a plaster apparatus is used, a leaf of gutta-percha is interposed between the dressing and the plaster. The plaster gutter can thus be opened in order to change the dressing; it can then be replaced in position.

Immediate union is often obtained without the necessity of changing the first dressing. If the temperature rise, and if the wound oozes, the dressing is removed, and a decision is taken if it is necessary to apply a removable apparatus or a plaster apparatus with a window. Consolida-

tion in the infant occurs after the thirtieth day, and in the adult after the fortieth day. The patient can be allowed to walk before complete consolidation, provided that a suitable orthopædic apparatus be applied.

Congenital and Acquired Malformations.

These malformations, if accentuated, may require simple or cuneiform supracondylar osteotomy of the femur where the articulation is free, or, in the case of ankylosis in bad position, resection of the knee.

OPERATIONS ON THE POPLITEAL VESSELS.

Ligature of the Popliteal Artery.

Operation—*First Stage.*—Median vertical cutaneous incision 8 centimetres long, in the axis of the popliteal space and ending at the fold of the ham. The external saphenous vein is avoided.

Second Stage.—Incision of the popliteal aponeurosis and exposure of the vasculo-nervous bundle. The nerve is on the outer side.

Third Stage.—The artery is denuded; it lies on the inner side of the vein and at a deeper level. Passage of the ligature with a curved forceps and ligature.

Fourth Stage.—Suture of the skin, drainage.

Popliteal Aneurism.

Arteriorrhaphy after Incomplete Ligature above the Sac (Doyen's Operation).—Aneurism of the popliteal artery is one of the most frequent of aneurisms. It can be treated by complete extirpation of the sac, provided that the collateral circulation is assured. Failing this, partial excision of the sac is performed, followed by arteriorrhaphy after incomplete ligature above the sac.

It is easy to determine if the collateral circulation exist. All that is necessary is to apply an Esmarch's bandage before the operation, the limb being held in the vertical position. The aneurismal pouch being isolated, the upper end of the artery is seized in an elastic forceps and the Esmarch bandage is removed. If the foot remain bloodless after four or five minutes the collateral circulation cannot be counted upon, and in such a case arteriorrhaphy is performed. This technique was remarkably successful in a popliteal aneurism, where the tibio-peroneal trunk remained permeable. The arteries of the foot pulsated, but no collateral circulation was established, for after the artery was seized above the sac, and the sac opened, the leg remained totally exsanguine, and no trace of circulation appeared. Extirpation of the sac between two ligatures was impossible, as it would become necessary to amputate the thigh.

The popliteal artery was reconstructed by the procedure I have just indicated, for a length of 11 centimetres, after incomplete ligature above the sac, reducing the ordinary calibre of the vessel by half. The compressor was removed after the arteriorrhaphy, and immediately afterwards the circulation became re-established as far as the ends of the toes, with manifest

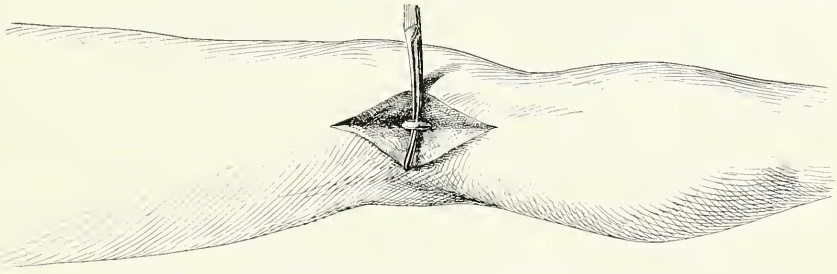


Fig. 929.—Ligature of the Popliteal Artery.

pulsation of the anterior and posterior tibial arteries. This operation was followed by complete success. The only troublesome symptom which remained was a considerable œdema of the leg, due to the obliteration of the popliteal vein, which at the time of the operation was reduced to a fibrous cord, adherent to the sac wall. This operation was performed in 1909.

Reconstruction of the Popliteal Vein by Venous Transplantation.

The persistence of the œdema demonstrated the inadequacy of the deep venous circulation which the superficial circulation was incapable of replacing. I therefore decided to attempt to re-establish the popliteal vein by the transplantation of a venous segment taken from an animal. This operation was performed on the 9th of August, 1909.

The cervical region of a sheep was rendered aseptic and the whole of the external jugular vein was removed between two ligatures. Three small collateral veins had to be ligatured. The venous segment was immersed in Ringer's solution. During this time the patient was anæsthetized. An incision 10 centimetres in length was made to expose the tibio-peroneal veins. This stage of the operation was very tedious, since the walls were arterialized and the veins were the seat of an obliterating endophlebitis. Only one of the veins was permeable; a cannula inserted in the peripheral end allowed the blood to flow.

At the same time I was enabled to verify the pulsations in the tibio-peroneal artery. A femoral incision was then made in order to find the lower end of the femoral vein in Hunter's canal. This exposure was also difficult, owing to the presence of cicatricial tissue. The sheep's vein, which was 25 centimetres long, was now opened at each end and emptied of blood. Three loops of silk were applied to each extremity. The tibio-peroneal vein was incised transversely, and an end-to-end anastomosis was performed, invaginating the tibio-peroneal vein into the sheep's vein, which was sutured to the external tunic of the former. A long curved forceps was introduced

FIG. 930.—FIBROMA OF THE POPLITEAL APONEUROSIS.

The tumour was removed together with a certain extent of thin adherent skin. Two lateral incisions were necessary in order to enable the skin to be united.

FIG. 931.—THE SAME. SUTURE OF THE WOUND, SHOWING THE TWO LIBERATING INCISIONS.

by the femoral wound; this was made to traverse the tissues of the popliteal space. The upper end of the sheep's vein was seized in the tibial wound, and the end of the sheep's vein was brought into contact with the lower end of the femoral vein. This vein was incised longitudinally and sutured to the end of the sheep's vein after the exuberant portion had been cut away. The two wounds were closed, and drained by two glass drains. A light compressive dressing was applied. The result of this operation was highly satisfactory. The deep circulation became re-established immediately, and the leg so diminished in volume as to become smaller in diameter than the other leg. The venous segment transplanted measured 20 centimetres in length.

Tumours.

Benign Tumours.

Fibroma of the Popliteal Space.

I have observed a large fibroma of the popliteal space growing from the aponeurosis. The skin, thin and adherent, had to be partially sacrificed. Two lateral liberating incisions allowed the central wound to be sutured (Figs. 930 and 931).

Malignant Tumours.

Osteosarcoma.

Osteosarcoma of the upper end of the tibia may invade the knee-joint. This disease requires amputation through the thigh. Electro-coagulation can only be employed in this disease when one is fortunate enough to make an early diagnosis and when the tumour is still very strictly limited in extent.

OPERATIONS ON THE LEG.

Traumatic Lesions.

Wounds.

Wounds of the soft parts call for no special mention. If the wound be deep, the bleeding is stopped, and nerve suture is carried out when necessary.

Fractures.

Simple Fractures.

Simple fractures of the two bones occur as a rule on a very oblique plane, from without inwards and from behind forwards. I generally employ a plaster of Paris apparatus. I place a sole in position first, and hold the leg in position by a gutter-shaped plaster, which reaches as far as the upper third of the thigh. The limb is not shaved; it is smeared with vaseline and

covered with an unstarched tarlatan bandage. In order to obtain a good reduction the apparatus should be applied under an anæsthetic. Care should be taken to cover in the heel. This is facilitated by two lateral incisions in the plaster. The foot is placed in a position of forcible flexion and slight adduction. Extension and counter-extension is applied, and the limb is maintained in this position until the plaster is dry (about fifteen minutes). The reduction must be examined after eight or ten days—*i.e.*, before the consolidation is far advanced—in order that a defective reduction may be remedied. The reduction is again examined about the fifteenth day, and the apparatus is left in position until the fortieth day.

Dupuytren's Fracture.

Fracture of the lower extremity of the fibula, or Dupuytren's fracture, generally complicated by the subluxation of the foot outwards, is treated by the same apparatus. The plaster mounts as far as the lower third of the thigh, and the deformity is reduced by placing the foot in the position of flexion and forced adduction.

Consolidation is generally complete in ten days in fracture of the fibula, and in forty days for fracture of both bones, but several weeks elapse in addition before the patient can walk.

Compound Fracture.

If the wound be very small and the extremity of bone which has perforated the skin does not seem to be infected, the wound is plugged with an aseptic tampon after the surrounding skin has been disinfected. Tincture of iodine should not be used, since if it penetrates the wound it hinders union and favours suppuration. Every day an injection of 10 or 20 c.c. of mycolysine is given. If the fracture be comminuted, and the upper fragment infected, the extremity of this fragment must be resected, and the splinters removed through a longitudinal incision. The wound is plugged and drained, and continuous irrigation is installed as indicated for compound fractures of the thigh. Reduction is made when the infection has disappeared. The same treatment is carried out in the case of gunshot wounds.

Inflammatory Lesions.

Acute Inflammatory Lesions.

Phlegmon.

Phlegmon of the leg calls for no special description. General treatment by mycolysine is instituted, and pus is evacuated when it collects.

Infective Osteomyelitis.

Acute osteitis is peculiarly frequent in the tibia. It attacks for preference the lower epiphysiary cartilages, and may extend to involve a

part and even the whole of the diaphysis, and the medullary canal may be infiltrated with pus throughout its entire length. Each day an injection of 10 to 20 c.c. of mycolysine is injected as soon as the first symptoms make their appearance.

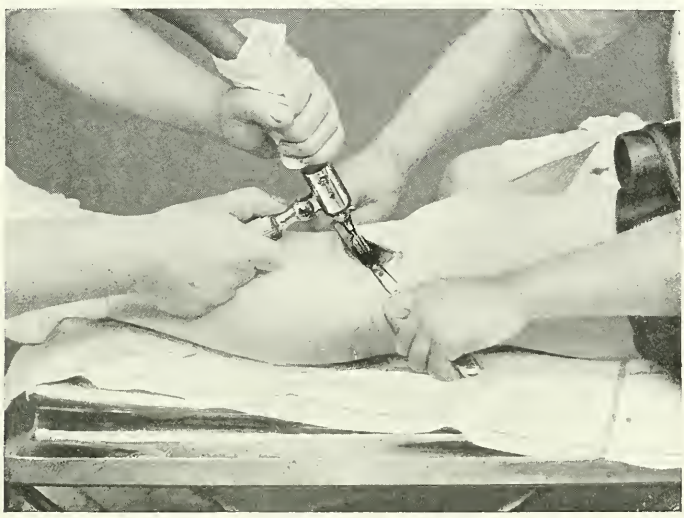


Fig. 932.—Hollowing out the Superior Apophysis of the Tibia to discover a German Bullet from the War of 1870.

If the infection does not yield to this treatment the bone must be hollowed out for the whole length of the infection.

Hollowing out of the Tibia.

Superior Epiphysis.—This operation is indicated in certain cases of inflammation localized to the superior epiphysiary cartilage. I have also performed it for the removal of a foreign body. The first patient on whom I performed the operation close to the epiphysis was a young male of fifteen years who had been treated for two years for white swelling of the knee-joint. He presented no sign of tuberculosis, but had a subacute and relapsing non-suppurating inflammation of the spongy juxta-epiphysiary cells of the diaphysis. The painful crises were characteristic, and the operation was followed by a complete cure.

Operation.—The bone is perforated with the trephine or the conical burr. The epiphysis being formed of spongy tissue, the hollowing out can be carried out by means of the trephine and the large 20 millimetre cylindro-spherical burr. The bone curette is used for enlarging the cavity.

I prefer the electrical instrumentation for this operation. The bone is perforated with the conical burr, and the excavation is continued with the cylindro-spherical mortising instrument 12 millimetres in diameter.

Figs. 932 and 933 show the removal of a German bullet from the war of 1870, which had remained thirty years and eight months in the tibia.

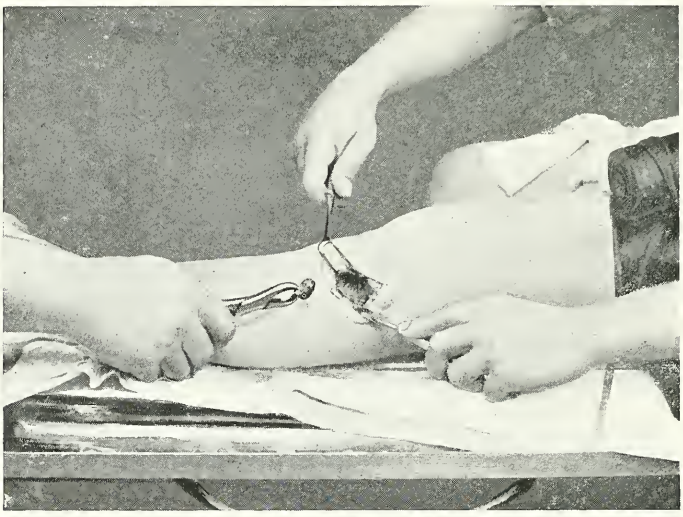


FIG. 933.—THE SAME.

The cavity formed by the electric mortising machine is evident. The projectile is seen in the gouge-forceps.

The bullet was localized by radiography. It was only a few millimetres from the articular cartilage. I removed it after excavation of the bone with the electrical mortising apparatus.

Excavation of the Diaphysis.

Whether the excavation is performed for a distance of 6 or 8 centimetres or throughout the whole length of the diaphysis, the technique is the same. It is performed for acute or subacute osteomyelitis or for an old fistulous case, or one or more sequestra have to be removed.

OPERATION—*Preliminary Stage.*—Application of the elastic bandage to the thigh.

First Stage.—Exposure of the inner surface of the tibia.

Second Stage.—Perforation of the tibia with the conical burr at each end of the wound.

Third Stage.—Double longitudinal section of the diaphysis to the external and internal borders of the two circular orifices, and removal of the fragment thus defined with gouge and mallet.

Fourth Stage.—Mortising of the centre of the bone with the electric mortising machine.

Fifth Stage.—Toilet. Plugging.

[1] *Rev. Crit. de Med. et Chirg.*, No. II., 1901, p. 101.

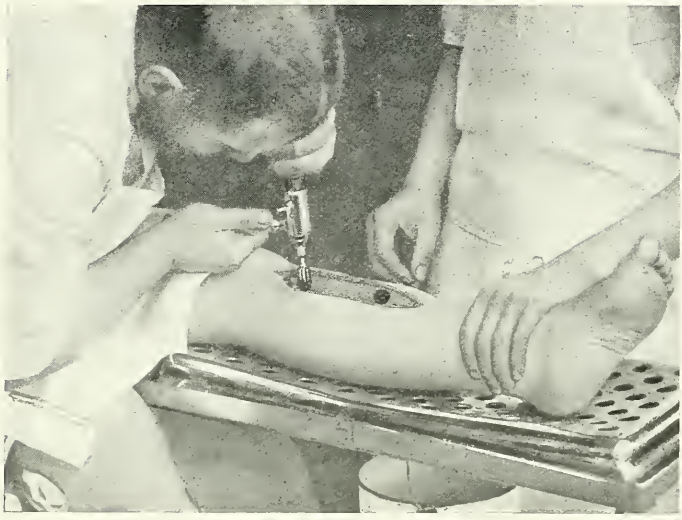


FIG. 934.—EXCAVATION OF THE TIBIA FOR OSTEOMYELITIS. PERFORATION OF THE BONE AT EACH EXTREMITY OF THE DISEASED AREA.

FIG. 935.—THE SAME. DOUBLE LONGITUDINAL SECTION WITH THE CIRCULAR SAW.

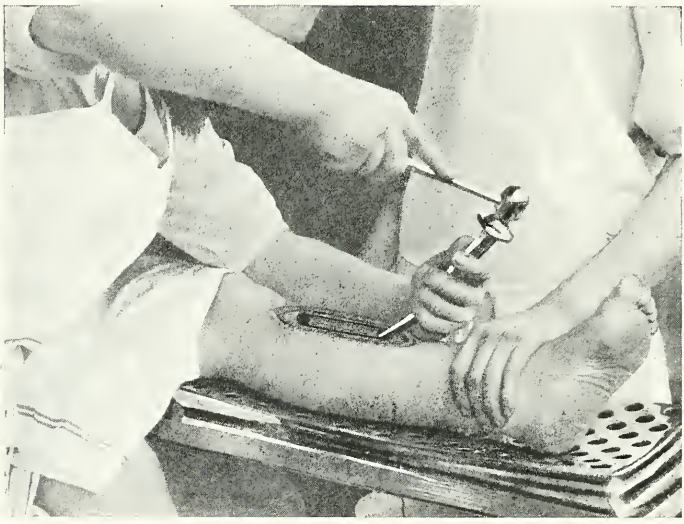


FIG. 936.—THE SAME. REMOVAL OF THE EXTERNAL LAMINA WITH GOUGE AND MALLET.

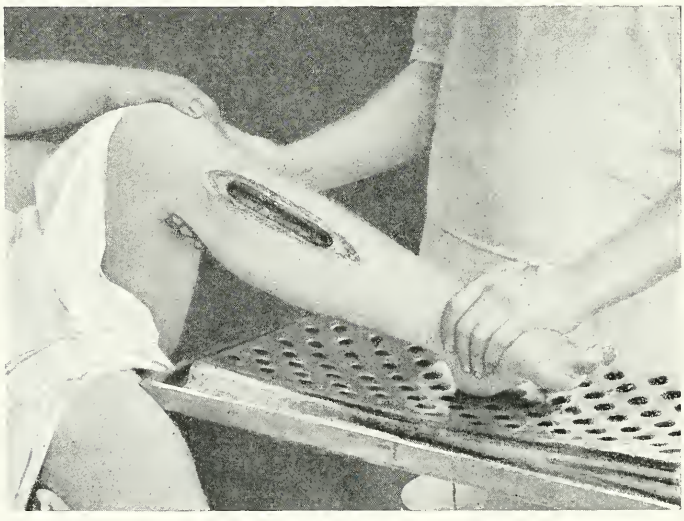


FIG. 937.—THE SAME. THE EXCAVATION IS FINISHED: ASPECT OF CAVITY.

Chronic Inflammatory Lesions.

Tuberculosis.

Tuberculosis of the soft parts is treated by excision or curetting, followed by aero-cauterization. Bony tuberculosis is treated by excavation, using the same technique as in osteomyelitis. The general condition is treated by mycolysine and phymalose combined.

Congenital and Acquired Malformations.

Congenital Malformations.

Congenital Circular Band of the Leg.

I have had the opportunity of operating upon a young child who had a circular cutaneous band of the lower third of the leg. There was a groove more than a centimetre in depth, and it seemed as if the foot was doomed to spontaneous amputation.

I circumscribed this groove by two circular incisions, and removed the band. The stricture did not involve the aponeurosis. Circular reunion of the skin gave an excellent result, and there was no recurrence (Figs. 938-941).

Rachitic Incurvation.

The deformity is remedied by either simple or cuneiform osteotomy.

Fig. 938.—Deep Congenital Band of the Lower Part of the Leg in an Infant of Eight Months.

The strangulation was progressive and advanced with considerable rapidity, so that spontaneous amputation seemed inevitable.

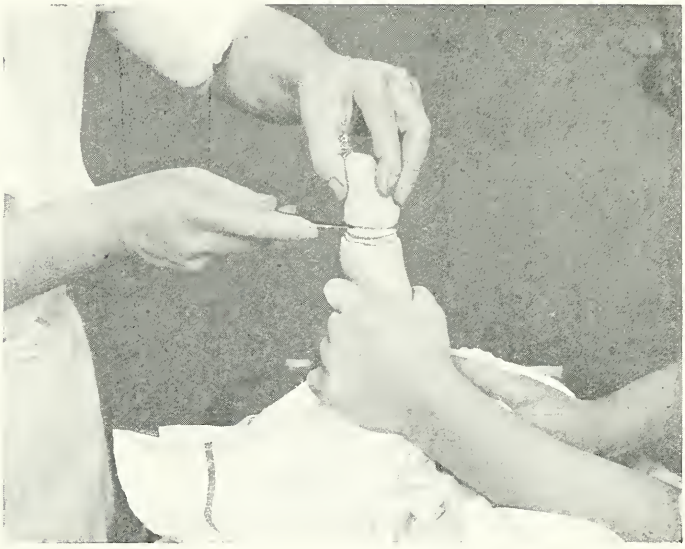


FIG. 939.—THE SAME. CIRCULAR SECTION OF THE SKIN ABOVE AND BELOW THE GROOVE.

FIG. 940.—THE SAME. AFTER CIRCULAR SECTION OF THE SKIN.

I performed resection of the cutaneous band, which had been cut vertically. All the fibrous tissue were then very carefully excised.

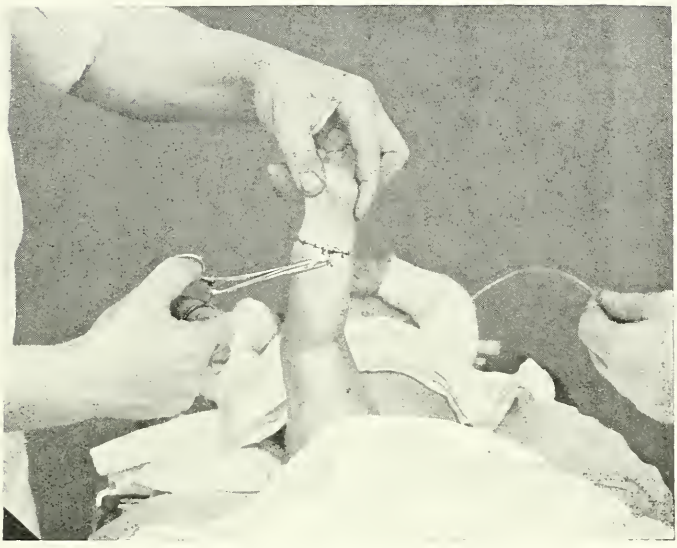


Fig. 941.—The Same. The Fibrous Band has just been removed. Circular suture of the skin. The limb immediately becomes normal in aspect.

Acquired Malformations.

Varicose Veins.

The topography of varicose veins in the lower limb is very variable. Whatever be the seat of the superficial varices, they should be operated on

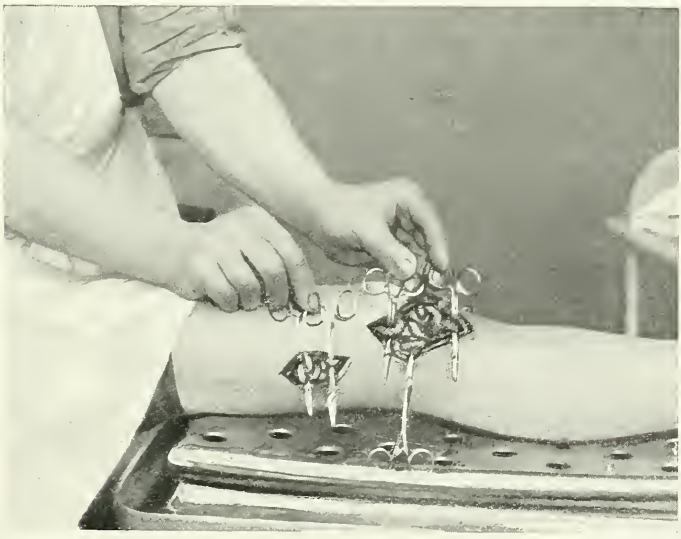


Fig. 942.—Removal of Two Large Groups of Varicose Veins.

when the deep circulation remains normal. The preferable method is the complete removal of the dilated veins. When they are localized the venous bunches are removed by appropriate incisions. If the superficial veins are varicose throughout their length they are removed by small incisions 12 to 20 centimetres apart. This " tunnel " extirpation of varicose veins of the lower limb gives an excellent result.

Removal of Varicose Veins by the Author's Subcutaneous Method.

Operation—*First Stage.*—Successive incisions, each 4 to 5 centimetres in length, along the course of the vein.

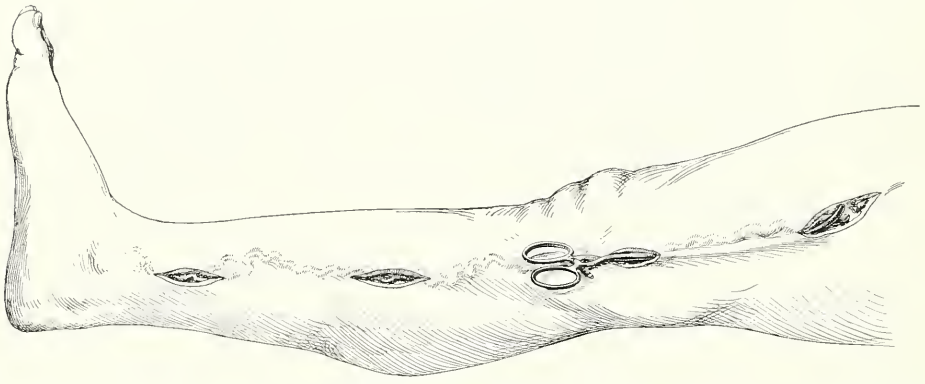


Fig. 943.—" Tunnel " Extirpation of the Varicose External Saphenous Vein

First action of the curved forceps.

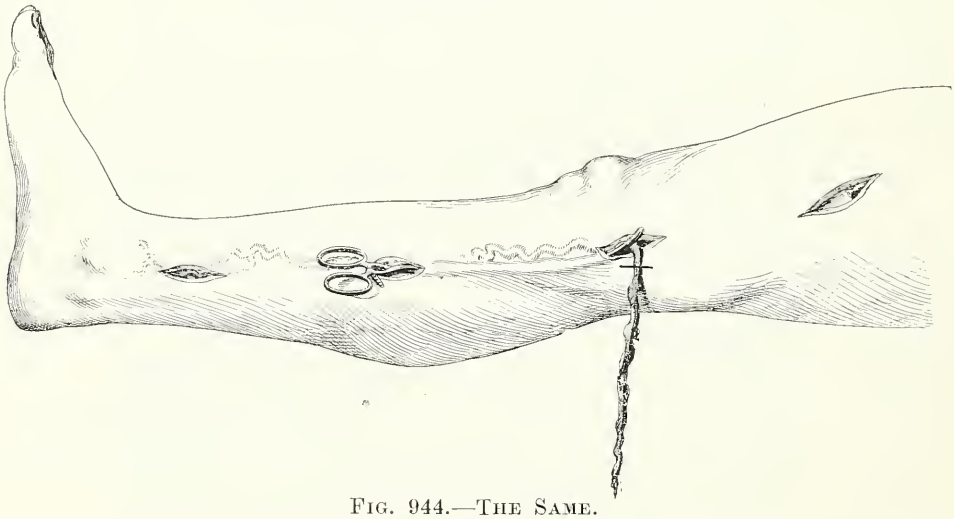


Fig. 944.—The Same.

The first venous segment is torn from its attachments. The forceps by a second tunnel continues the removal of the vein.

Second Stage.—Isolation of the varicose vessel at the level of each incision. The intermediate venous trunk is freed from its cellular attachments by a

long curved forceps, introduced beneath the skin, directed from one incision to the next, and acting by divulsion.

The upper is now tied, and the vein is cut below the forceps. The lower end is caught between the teeth of the curved forceps, which follows the course of the vessel, and tears it from its position as it is removed (Figs. 925 and 926).

Third Stage.—This manœuvre is repeated as often as is necessary to remove the principal varices In this procedure the upper and lower ends of the vein alone have to be ligatured.

Fourth Stage.—Suture of the cutaneous incision. Compressive dressing. By this dressing, and using a very small number of incisions of restricted length, the whole of the subcutaneous varicose veins of the lower limb can be removed from the malleolus as far as the crural arch.

Tendon Transplanting in Infantile Paralysis.

Paralysis of the lateral peroneals, of the anterior tibial, and the extensors of the toes, may be treated successfully by tendon grafting.

For tendon transplantation the posterior tibial and the flexor tendons of the toes are chosen.

Operation—*First Stage.*—Vertical incision 10 centimetres in length behind the external malleolus, and exposure of the external border of the tendo Achillis.

Second Stage.—Opening of the sheath of the deep muscles, and exposure of the tendons which are to serve for the transplantation. The strongest two tendons are chosen of the flexors and the tendon of the posterior tibial.

Third Stage.—The tendon of the tibialis posticus is cut as low as possible. An interior incision is made in the tibio-peroneal space above the articulation, and the interosseous ligament is perforated in a very oblique direction from below upwards, with a curved forceps, which seizes and draws forward the tendon of the tibialis posticus.

This tendon is divided in two parts, which are sutured the one to the terminal tendon of the tibialis anticus, the other to the common exterior tendon of the toes. The edges of these tendons are freshened laterally, and they are anastomosed with the flexor tendons of the toes either by simple juxtaposition or after transfixion at various points.

Fifth Stage.—Toilet of the field of operation. Suture of the cutaneous incision. Compressive dressing.

The tendinous cicatrix is consolidated after twenty days. Passive movements and re-education of the muscles is then commenced.

Pseudarthrosis of the Leg.

Osseous Suture.

First Stage.—Antero-internal longitudinal incision of sufficient length to freely expose the pseudarthrosis.

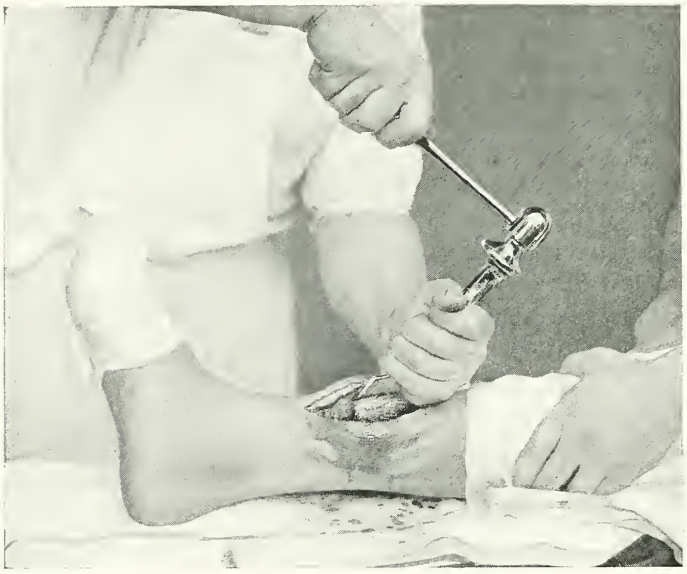


FIG. 945.—PSEUDARTHROSIS OF THE LIMB. DISLOCATION OF THE PSEUDARTHROSIS WITH CHAMPONNIÈRE'S OSTEOTOMY CHISEL.

An elastic bandage is always applied to avoid oozing of blood, which obscures the field of operation.

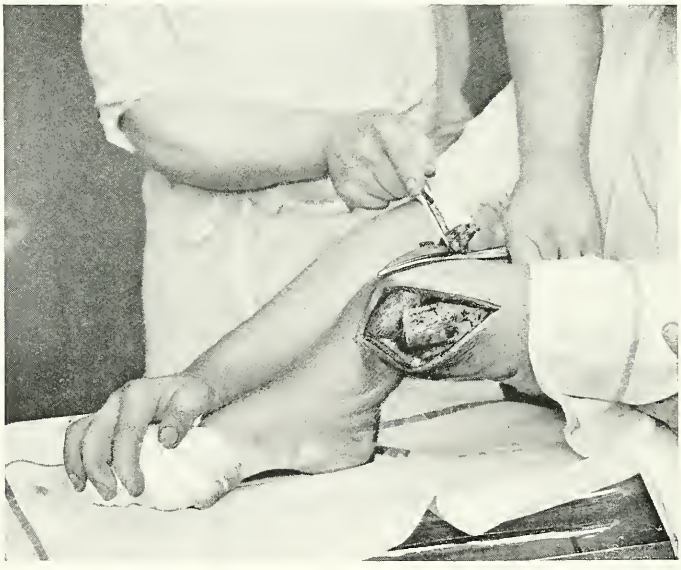


FIG. 946.—THE SAME.

The vicious callus of the fibula is resected, the two ends of the tibia have been freshened with a saw, and are ready for bone suture.

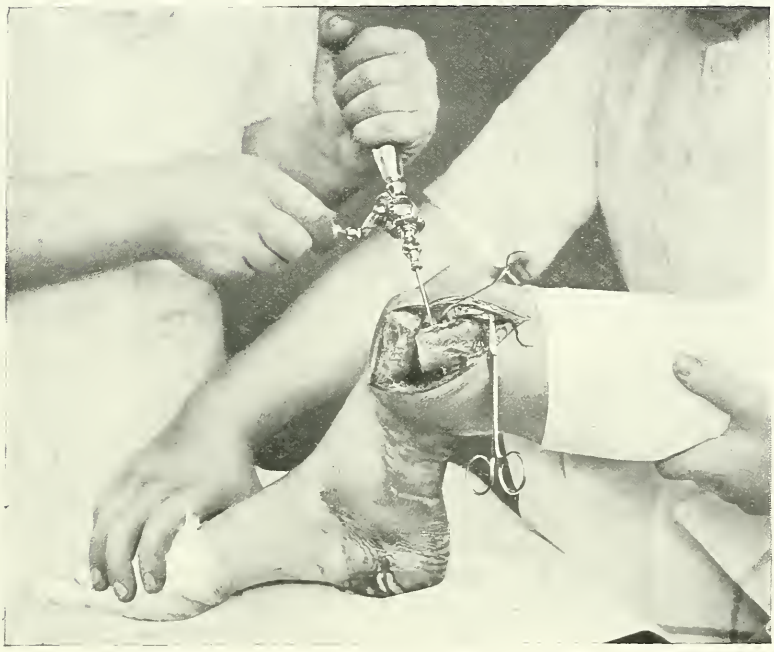


FIG. 947.—THE SAME. PERFORATION OF THE UPPER END OF THE TIBIA AND PASSAGE OF THE FIRST WIRE SUTURE.

The best material for bone suture is a bundle of threads of Mailleshort gilded and twisted into the form of a cord.

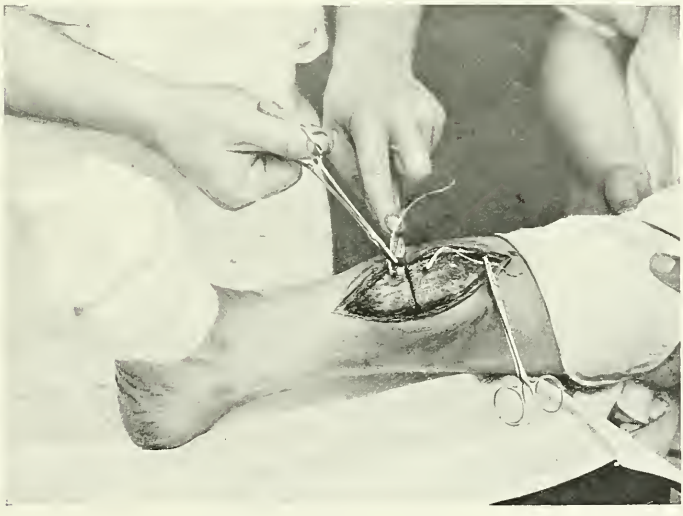


FIG. 948.—THE SAME.

The metal suture has been passed through the inferior end and coaptation is complete.

Second Stage.—Dislocation of the pseudarthrosis with Championnière's chisel and mallet. The fibula is generally left alone. It can be treated in the same way as the tibia, should suture appear necessary.

Third Stage.—Transfer section of the extremities and perforation of the two ends of the tibia to receive metallic suture.

Fourth Stage.—Coaptation of the extremities and twisting of the metallic sutures.

Fifth Stage.—Suture of the skin. Compressive dressing. Gutter splint or plaster apparatus.

Bone suture with metal plates fixed in the diaphysis by special screws have given excellent results in the hands of Arbuthnot Lane.

Tumours.

Benign Tumours.

Lipoma Myxoma.

Simple or myxomatous subcutaneous myxoma may occur in the leg. This tumour must be destroyed at once, since it may undergo malignant transformation. Where the tumour is of sufficient limitation electro-coagulation is employed.

Malignant Tumours.

Malignant myxoma of the leg begins as a rule subcutaneously. The aponeurosis is soon invaded, followed by the tendinous sheath, then the muscles. This species of myxoma is particularly malignant, and requires amputation of the thigh. Electro-coagulation is useless except at the commencement; in fact, when the tumour has become diffused in the muscular layers it has become impossible to follow it in all its ramifications without destroying the limb.

Ligature of Arteries in the Leg.

1. Anterior Tibial.

Operation—*First Stage.*—Vertical cutaneous incision 7 centimetres in length, two fingers' breadth on the outer side of the inner border of the tibia.

Second Stage.—Incision of the aponeurosis. The first muscular outer space from the tibia is penetrated.

Third Stage.—Exposure of the artery, which is deeply placed in contact with the aponeurosis. Passage of the ligature with a curved forceps. Ligature.

Fourth Stage.—Suture of the skin. Drainage.

2. Posterior Tibial.

(*a*) *At the Middle of the Leg.*

Operation—*First Stage.*—Vertical incision 7 centimetres in length, two fingers' breadth behind the inner border of the tibia.

Second Stage.—Incision of the aponeurosis. Exposure of the inner border of the gastrocnemius, and incision of the soleus. Exposure of the deep aponeurosis and the artery.

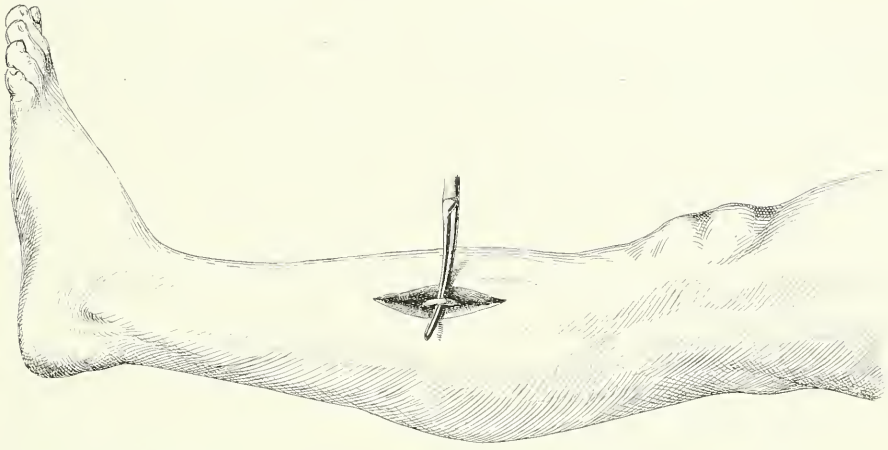


Fig. 949.—Ligature of the Anterior Tibial Artery at the Middle of the Leg

Third Stage.—Denudation of the artery and ligature.
Fourth Stage.—Suture. Drainage.

(*b*) *Behind the Malleolus.*

Operation—*First Stage.*—Vertical incision of 4 centimetres midway between the posterior border of the internal malleolus and the tendo Achillis.

Second Stage.—Incision of the aponeurosis and exposure of the artery, which is found on approaching the malleolus.

Third Stage.—Denudation of the artery and ligature.

Fourth Stage.—Suture.

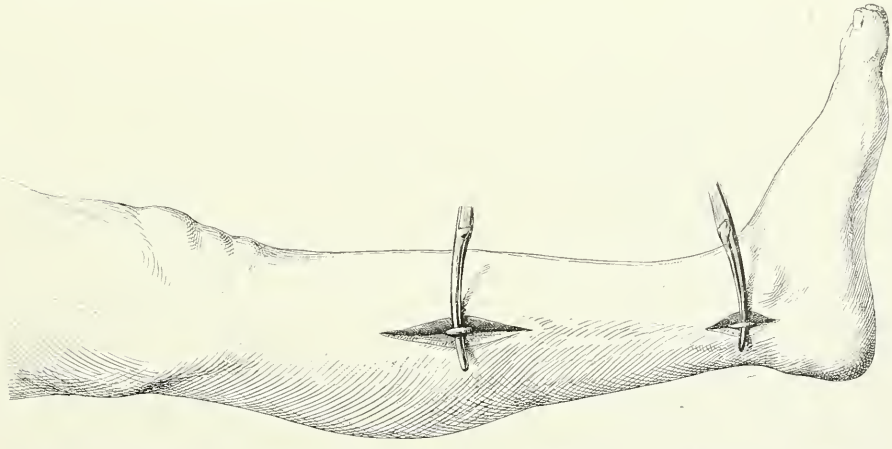


Fig. 950.—Ligature of the Posterior Tibial Artery at the Middle of the Leg and Behind the Internal Malleolus.

Amputation of the Leg.

1. Through the Upper Third.

Amputation of the leg at the seat of election—*i.e.*, at four fingers' breadth below the tuberosity of the tibia—should be made by the circular method.

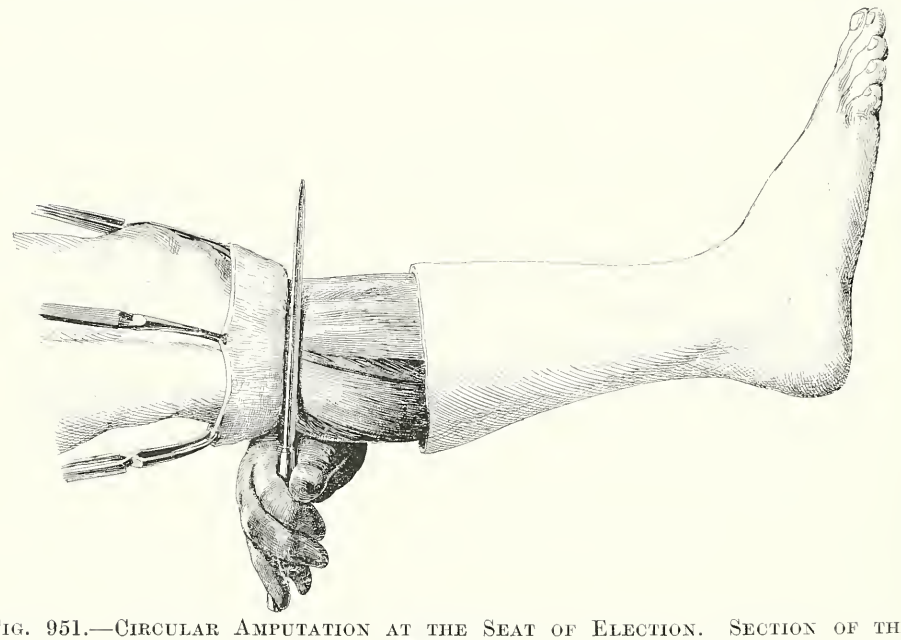


Fig. 951.—Circular Amputation at the Seat of Election. Section of the Muscles.

Operation—*First Stage.*—Circular section of the skin slightly oblique below and in front four or five fingers' breadth from the front section of the tibia.

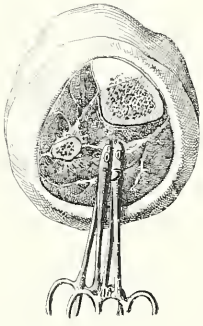


Fig. 952.—The Same. Ligature of Arteries and Veins.

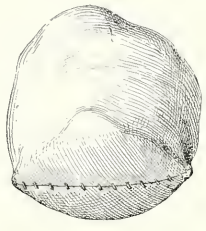


Fig. 953.—Appearance of the Stump after Suture.

Second Stage.—Dissection of the cutaneous sleeve, which should be sufficiently thick, and which is held back with ring forceps (Fig. 951).

Third Stage.—An assistant compresses the femoral artery. Circular section of the muscles at the point where the bone is to be severed. Return and figure of 8, using the double-bladed knife.

Fourth Stage.—Hæmostasis and resection of nerves.

Fifth Stage.—Suture of the skin.

If the amputation is performed for an infectious lesion the stump is plugged with compresses steeped in antiseptic, and only a partial suture is made, leaving room for the compresses.

2. Supramalleolar Amputation.

Guyon's supramalleolar amputation gives a stump which is solid and painless. It is the best procedure where the foot alone has to be sacrificed.

Fig. 954.—Guyon's Supramalleolar Amputation.

The Incision.

The operation can be commenced either by the anterior semicircular section or by shaping the heel flap.

In the case represented in Figs. 957-961 I commenced the operation by section of the anterior soft parts, because the lesion was in the centre of the plantar aspect of the foot and the integrity of the supramalleolar tissues was certain.

On the other hand (Figs. 962-969), the alteration of the perimalleolar tissue led to the supposition that the section of the tibia and fibula would have to be made higher than in the classic Guyon's operation, and the operation was commenced by dissection of the heel flap.

Operation—*First Stage.*—Anterior semicircular section of the soft parts from one malleolus to the other, and from the surgeon's left to right. The line of section is shown in Fig. 954.

Second Stage.—Section of the skin of the heel region, leaving the malleolus on the surgeon's left, passing to the front of the heel, and ending at the

malleolus on the opposite side. The knife is made to repass in the incision as far as the bone, and the posterior flap is detached containing the tendo Achillis.

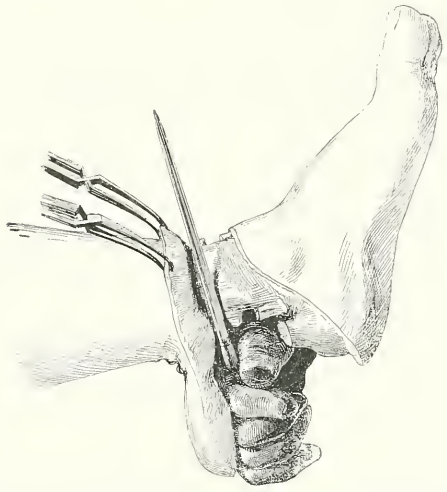


FIG. 955.—THE SAME. SECOND STAGE: CIRCULAR SECTION OF THE SOFT PARTS.

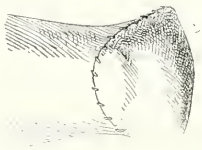


FIG. 956.—THE SAME. SIXTH STAGE: THE SUTURE IS FINISHED.

FIG. 957.—THE SAME. EXPLORING INCISION OF THE CARIOUS REGION.

Second Procedure.—The first and second stages are inversed.

Third Stage.—The heel flap is lifted upwards and backwards by an assistant using ring forceps. Dissection of the small anterior flap and its

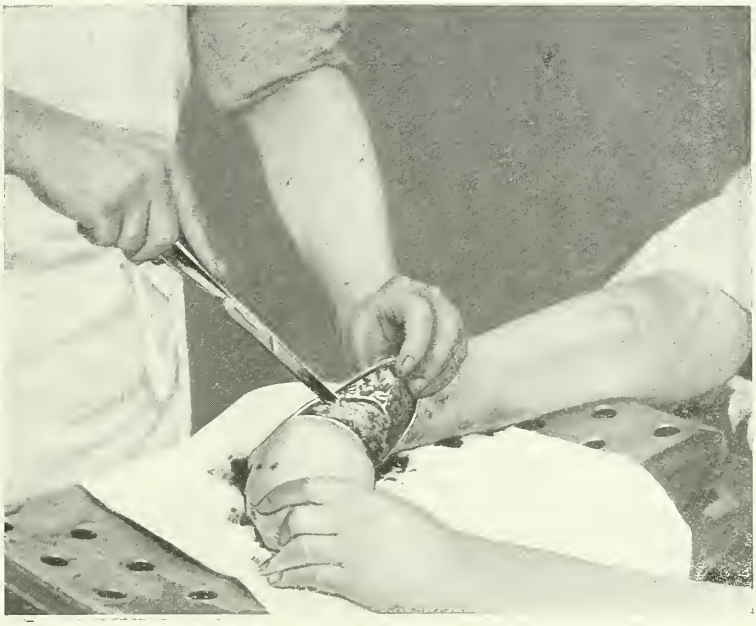


FIG. 958.—THE SAME. ANTERIOR SEMICIRCULAR INCISION.

FIG. 959.—THE SAME. DISSECTION OF HEEL FLAP.

lateral parts to a point above the malleolus, and circular section of the soft parts as far as the periosteum.

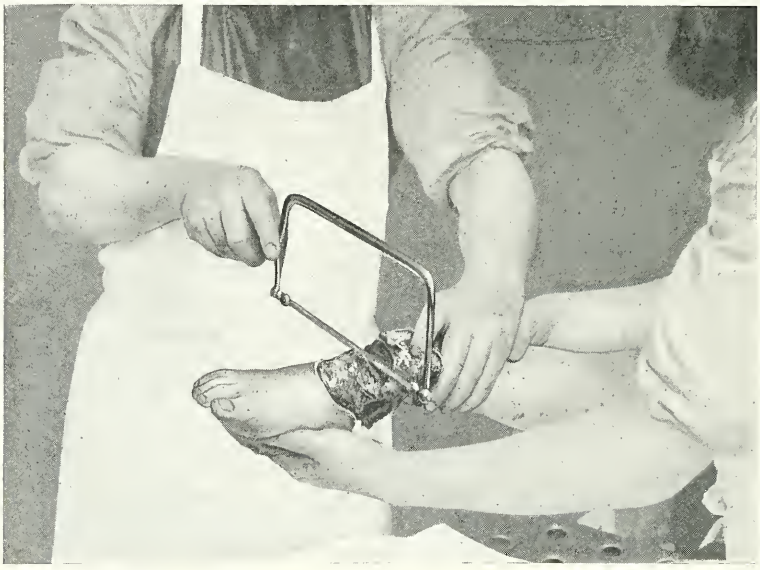


Fig. 960.—The Same. Section of the Bones.

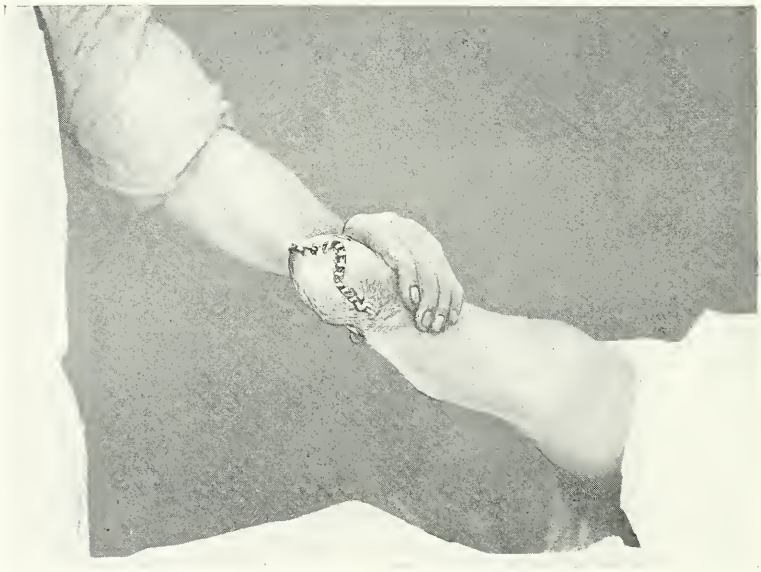


Fig. 961.—The Same. Aspect of the Sutures.

Fourth Stage.—The posterior flap and the anterior external flap are lifted with ring forceps or with the fingers. Supramalleolar section of the tibia and fibula.

Fifth Stage.—Resection of the nerves. Hæmostasis. It is often necessary to resect the tendo Achillis in order to obtain a satisfactory stump.

Sixth Stage.—Suture. Drainage.

Fig. 962.—The Same. First Stage (Cinematograph Film).

Fig. 963.—The Same. The Knife makes the Posterior Incision.

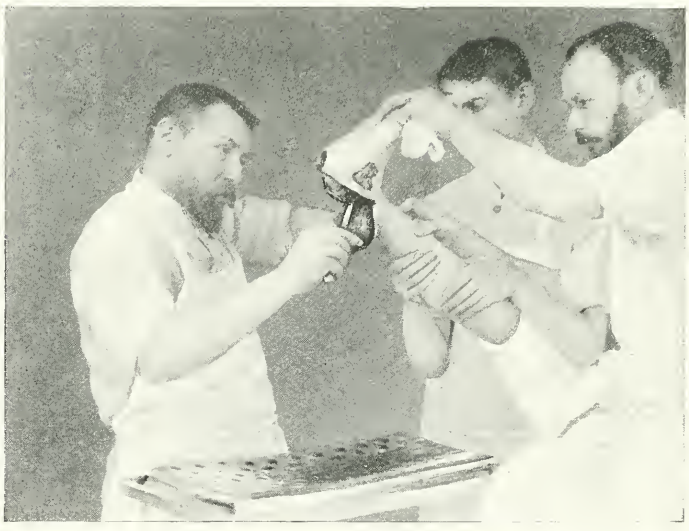


FIG. 964.—THE SAME. SECOND STAGE: THE POSTERIOR FLAP IS DETACHED.

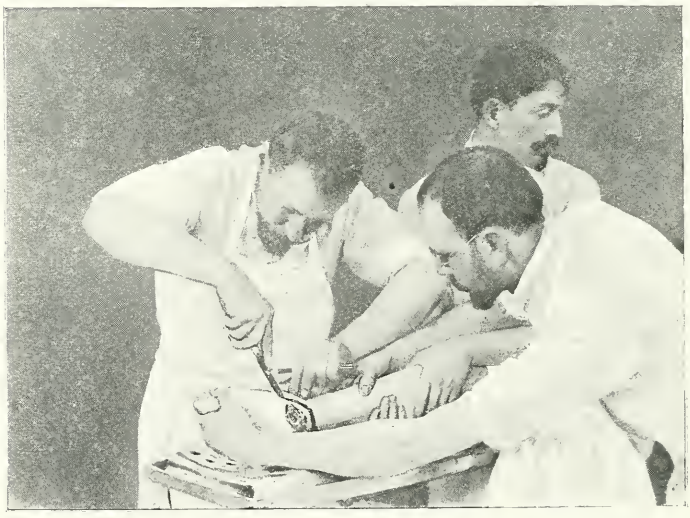


FIG. 965.—THE SAME. THIRD STAGE: ANTERIOR SEMICIRCULAR SECTION.

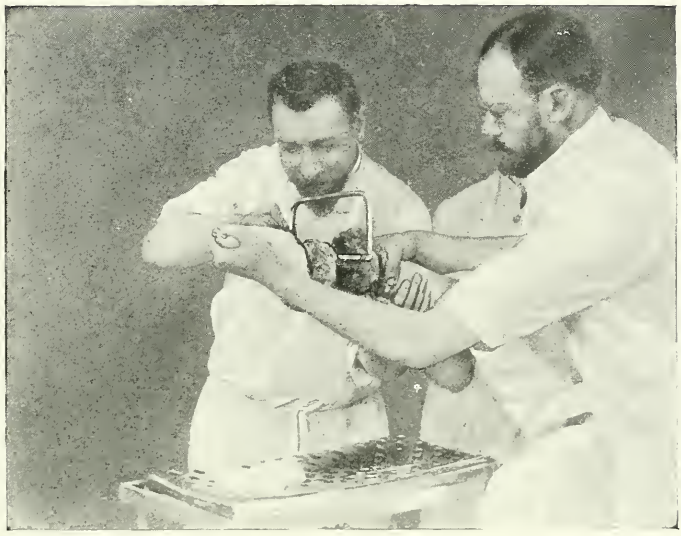


FIG. 966.—THE SAME. FOURTH STAGE: SUPRAMALLEOLAR SECTION OF TIBIA AND FIBULA.

FIG. 967.—THE SAME. FIFTH STAGE: RESECTION OF THE ANTERIOR TIBIAL NERVE.

FIG. 968.—THE SAME. FIFTH STAGE: LIGATURE OF THE ANTERIOR TIBIAL ARTERY.

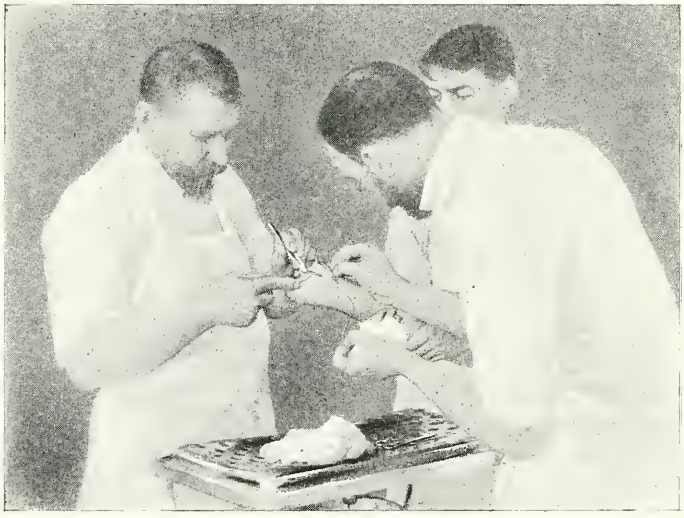


FIG. 969.—THE SAME. SIXTH STAGE: SUTURE OF THE SKIN.

OPERATIONS ON THE TIBIO-TARSAL ARTICULATION AND ON THE FOOT.

Traumatic Lesions.

Rupture of the Tendo Achillis.

Tendon Suture.

I have seen a case of ruptured tendo Achillis in a dancer who accidentally poised the foot on an iron point. A sudden reflex contraction tore the tendon above the calcaneum. Tendon suture was followed by a rapid cure, with complete return of the functions of the foot.

Operation—*First Stage.*—Longitudinal incision.

Second Stage.—Exposure of the two ends of the tendon, which is torn through irregularly.

Third Stage.—Methodical reunion of the tendon from the deeper parts to the surface, using ten or twelve sutures of No. 3 silk. The tendon should be very exactly re-established in its normal length.

Fourth Stage.—Suture of the skin. Dressing with extension of the foot on the leg.

Tibio-tarsal Dislocation.

Fracture of the fibula may be complicated by the luxation outwards of the tibio-tarsal joint, with rupture of the teguments at the internal malleolus, which is itself torn. I have seen several of these cases. I performed toilet of the articulation and suture. If the wound was infected continuous irrigation was installed for ten or fifteen days.

Dislocation of the Astragalus.

Dislocation of the astragalus in the adult requires removal of this bone (see below).

Inflammatory Lesions.

Acute Inflammatory Lesions.

Phlegmons in this region require no special mention.

Chronic Inflammatory Lesions.

Tuberculosis of the Tarsal Bones.

Tuberculous osteitis of the tarsal bones may call for excavation or the removal of one or several bones. The wound is plugged, and general treatment by combined mycolysine and phymalose is instituted.

Congenital and Acquired Malformations.

Congenital Malformations.

Club-Foot.

The most frequent malformation is talipes equino-varus. Tenotomy of the tendo Achillis and replacement by forcible movements are sufficient when this deformity is treated at birth. When the talipes is very accentuated and the infant has passed its first year, the best and most rapid result can be obtained by removing the astragalus by a latero-external incision; and if this does not suffice, the scaphoid. When the operation is well performed the deformity is immediately reduced, and the infant walks after four or five weeks in ordinary shoes. Surgical treatment in skilled hands is superior to orthopædic treatment.

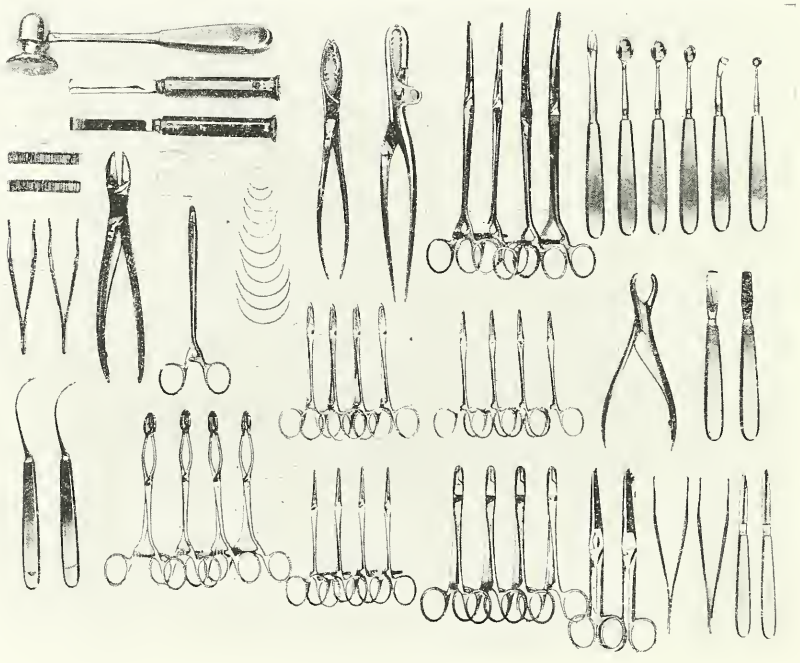


Fig. 970.—Instruments for the Removal of the Tarsal Bones and for Autoplasty of the Tendo Achillis.

From right to left and from below upwards: 2 bistouries; 2 toothed forceps; 2 pairs of scissors; 4 short-nosed and toothed Doyen's forceps; 4 oblique-toothed Doyen's forceps; 4 oval forceps; 2 needles with handles; 2 raspatories, straight and curved; gouge-forceps; 4 Champonnière's forceps; 4 small Doyen's needle holders; open-ended needles; a Doyen's excentric needle holder; glass drains; Liston forceps clips, and 2 clip forceps; 2 fenestrated curettes; 3 Volkmann's curettes; 1 spatula; 4 long curved forceps; 1 Davier's and 1 Farabœuf's forceps; 1 chisel (McEwen); 1 osteotome (McEwen); 1 mallet.

Tenotomy of the Tendo Achillis in the Child.

The foot is maintained in forced flexion.

First Stage.—Puncture of the skin with a pointed tenotome.

Second Stage.—Introduction of a blunt-pointed tenotome and progressive section of the tendon from without inwards. The left hand forcibly flexes

Fig. 971.—Removal of the Astragalus in Club-Foot. Skin Incision.

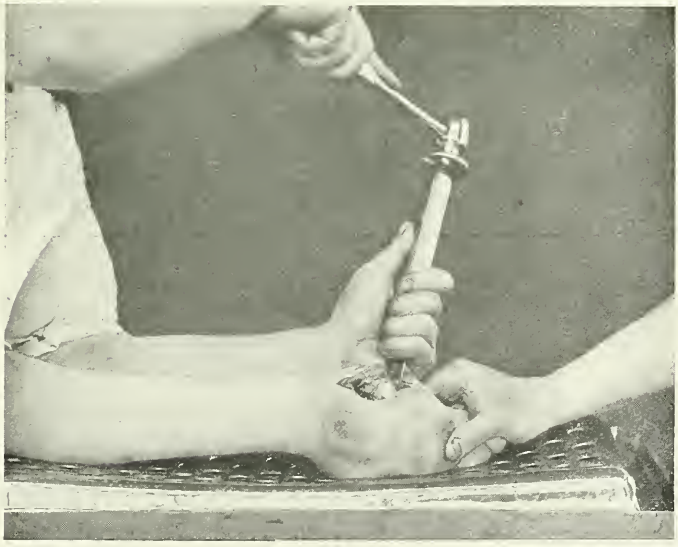


Fig. 972.—The Same. Third Stage: Astragalo-Scaphoid Separation, using the Osteotome.

the foot on the leg, and the moment when the last fibres yield can be appreciated.

Third Stage.—Occlusion of the small wound with a sterile compress. The deformity is reduced and an appropriate bandage is applied. Vigier's plaster or a plaster apparatus is applied.

Elongation of the Tendo Achillis in the Adult.

Tenotomy in the adult in talipes equino-varus leads to an incomplete repair of the tendon.

The preferable operation in the adult is the elongation by a sliding operation of two very oblique lateral sections. The operation is open.

Operation—*First Stage.*—Cutaneous median incision 8 centimetres in length.

Second Stage.—Very oblique section of the tendon.

Third Stage.—Reunion of the tendon after sliding the two ends, which are sutured at the desired length. Numerous sutures are used, employing No. 5 silk.

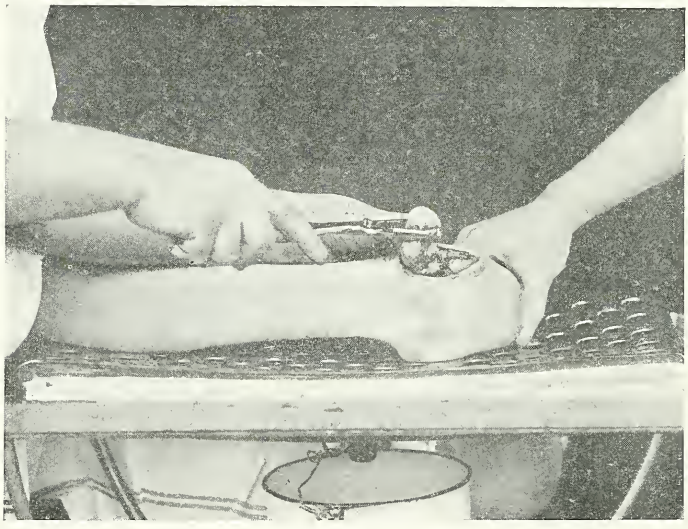


Fig. 973.—The Same. Fourth Stage: Removal of the Astragalus with Farabœuf's Forceps.

Removal of the Astragalus.

Removal of the astragalus is very easy in cases of traumatic dislocation of this bone. All that is required is to seize it after incision of the skin. This operation is more laborious in inveterate club-foot, especially in the adult. In the infant, in very accentuated club-foot, astragalectomy is easy, as the bone is almost cartilaginous. It is nevertheless preferable to remove it entire without crushing it. In cases of very accentuated talipes varus

it is often necessary to remove the scaphoid and the head of the calcaneum after astragalectomy. I will describe the operation in the adult.

Operation—*First Stage.*—Longitudinal antero-external incision 6 or 7 centimetres in length, according to age.

Second Stage.—Exposure and opening of the astragalo-scaphoid articulation, then the tibio-astragaloid articulation. Section of the inter-astragalo-calcanean ligaments. This stage is delicate, as the articulation hardly admits the blade of the bistoury to pass, and the bistoury must penetrate deeply. The section of the ligaments is easily perceived.

Third Stage.—The astragalo-scaphoid separation is completed by using an osteotomy chisel as a lever, and the astragalus is luxated by a brusque exaggeration of the talipes varus.

Fourth Stage.—Removal of the astragalus with a toothed forceps. The field of operation is examined. The scaphoid and the head of the calcaneum are removed, should it be necessary to do so.

Fifth Stage.—Suture of the skin. Reduction of the deformity. Dressing. The foot is fixed in a position of forced flexion by means of a starch bandage or plaster.

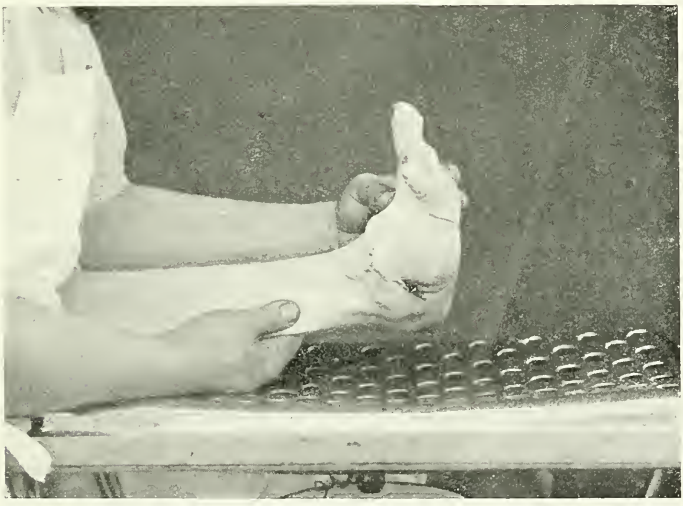


Fig. 974.—The Same. Reduction of the Deformity: Aspect of the Skin Suture.

Acquired Malformations.

Painful Valgus Flat-Foot.

Ablation of the Scaphoid.—Removal of the scaphoid is the preferable treatment for painful valgus flat-foot. This operation allows the plantar arch to be restored.

The scaphoid is removed by the subperiosteal method in order to spare

the fibrous tissues, whose cicatricial retraction produces a radical cure, as it augments the concavity of the plantar arch.

Operation—*First Stage.*—Transverse oblique incision parallel to the axis of the scaphoid, starting from the extensor tendon of the great-toe, and ending above the internal tubercle of the scaphoid.

Second Stage.—Exposure of the bone, care being taken not to wound the tendons, and opening of the articulations.

Third Stage.—The bistoury passes in front of the internal extremity of the scaphoid, and then below and, scraping the bone, detaches all the fibrous tissues inserted into it, whose integrity is necessary for the reconstruction of the plantar arch. The bone is lifted with a strong raspatory and removed with a toothed forceps.

Fourth Stage.—Toilet of the wound. Suture.

The foot is fixed in the position of varus to favourize the retraction of the fibro-tendinous tissues.

SPECIAL OPERATIVE TECHNIQUE.

Inter-Tibio-Calcanean Amputation.

In 1897 I amputated the anterior half of the foot and the astragalus, conserving the whole of the calcaneum.

This operation, which has also been performed by Ricard, gives a very satisfactory stump. Pirogoff's, Chopart's, and Lisfranc's operations exist to-day only as exercises in operative medicine.

Ligature of the Dorsal Artery of the Foot.

Operation—*First Stage.*—Incision 2 centimetres in length, starting from the line between the tibia and astragalus and along the external border of the exterior tendon of the great-toe.

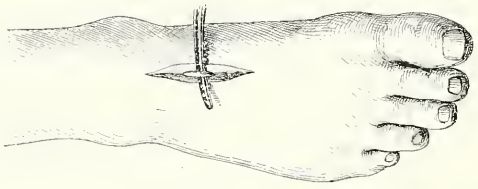


Fig. 975.—Ligature of the Dorsal Artery of the Foot.

Second Stage.—Incision of the aponeurosis and exposure of the artery.

Third Stage.—Denudation and ligature.

Fourth Stage.—Suture of the skin.

Fig 976.—Cuneiform Amputation of Two Metatarsals. First Stage.

Fig. 977.—The Same. Dissection of the Plantar Flap.

FIG. 978.—THE SAME. RETROGRADE EXTIRPATION OF THE METATARSALS.

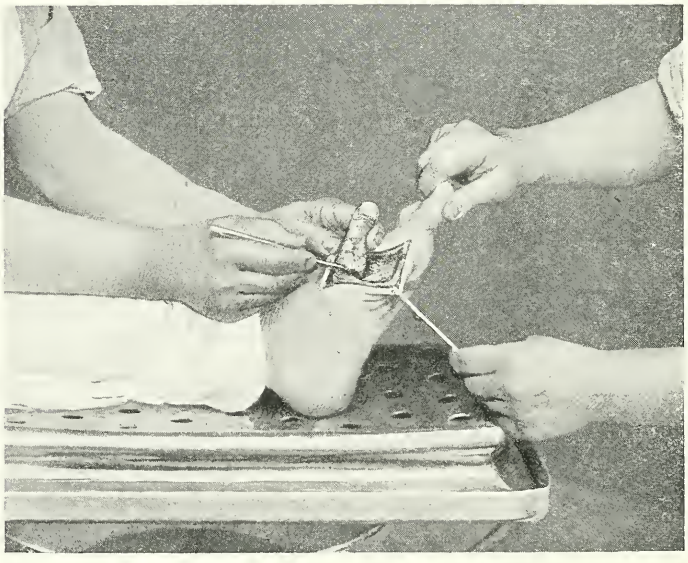


FIG. 979.—RETROGRADE EXTIRPATION OF THE FIRST METATARSAL (TUBERCULOUS), WITH PRESERVATION OF THE GREAT-TOE.

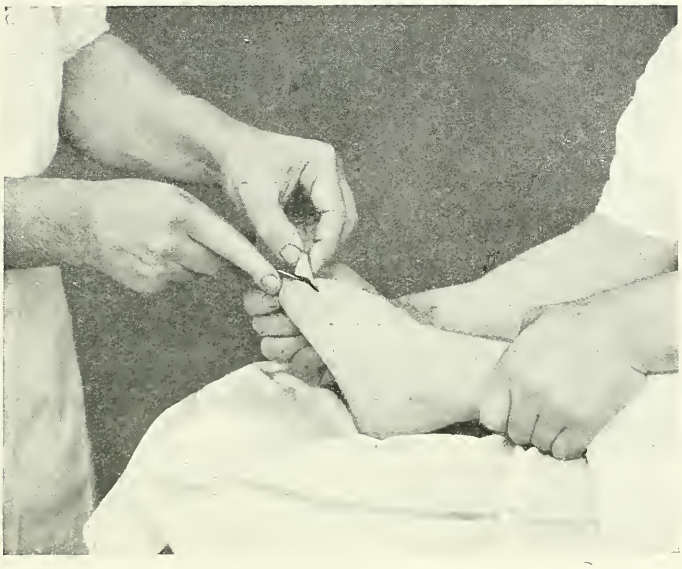


FIG. 980.—RACQUET AMPUTATION OF THE FIFTH TOE. FIRST STAGE.

FIG. 981.—THE SAME. FIRST STAGE. TERMINATION OF THE INCISION.

Perforating Ulcer.

Cuneiform Amputation of Several Metatarsals.

If perforating ulcer calls for surgical intervention an attempt is made to completely extirpate the pathological tissues and the subjacent bone, in order to obtain a coaptation of the edges of the loss of substance. In inveterate cases a cuneiform amputation of toes and metatarsals is performed.

Removal of a Metatarsal.

Removal of a metatarsal without the corresponding toe is an exceptiona procedure. It is performed in the retrograde manner, as shown in Figs. 978 and 979.

Hallux Valgus.

The abnormal protuberance of the head of the first metatarsal is covered with a serous sac and a bunion. Acute attacks of inflammation are often observed

This condition requires the excision of the bunion and serous sac, and osteotomy of the hypertrophied tubercle of the head of the first metatarsal. This resection is performed with mallet and chisel.

Fig. 982.—The Same. Second Stage.

Amputation of the Toes.

Amputation of the toes is performed by the racquet method, and calls for no special description. Amputation is the best treatment for hammer-toe.

END OF VOL. II.

Bailliere, Tindall & Cox, 8, Henrietta Street, London, W.C.