Clinical Update

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Dental luting cements

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Introduction

The clinical success of fixed prosthodontic restorations can be complex and involve multifaceted procedures. Preparation design, oral hygiene/microflora, mechanical forces, and restorative materials are only a few of the factors which contribute to overall success. One key factor to success is choosing the proper luting cement. This clinical update will review several luting cements, their physical properties, clinical implications, and recommendations for usage.

An ideal luting cement would have: easy manipulation, low film thickness, long working time with rapid set, low solubility, high compressive and tensile strengths, high proportional limit, adhesion to tooth/restoration, anticariogenicity, biocompatibility, and translucency or radiopacity. Physical properties should be taken into consideration *along with* handling characteristics, technique sensitivity, and results from long term clinical trials (1).

Most cements are formed by an acid-base reaction. Liquids may be phosphoric acid, polyacrylic acid, or eugenol. Powders are either zinc oxide or aluminosilicate glass. Resin cements, however, are not acid-base formed but utilize BIS-GMA or urethane dimethacrylate resins. Cements can be classified into five groups: phosphate bonded, polycarboxylate bonded, phenolate bonded, resin cements, and glass ionomer/hybrid cements.

Phosphate bonded

Zinc Phosphate is a combination of zinc oxide powder and phosphoric acid. It is one of the oldest (1877) and most widely used cements. It is considered the standard by which all other cements are measured. Zinc phosphate cement has the advantages of high compressive strength and a thin film thickness of less than 25 microns. It is good for general/routine use and recommended for long span fixed partial dentures due to its rigidity. Fleck's (Mizzy) is an example of zinc phosphate cement.

Zinc Phosphate's disadvantages include: low initial pH, which can cause post cementation sensitivity, lacks chemical bond to tooth structure, and no anticariogenic effect. Several techniques can be employed to improve the characteristics of zinc phosphate cement. Mixing the cement on a cool glass slab will increase working time and allow incorporation of more powder to liquid. An increased powder to liquid ratio will increase compressive strength and decrease solubility. The technique of "slaking" can increase working time by mixing small increments of powder to liquid and waiting ~60 seconds between mixed increments. Water contamination of zinc phosphate should be avoided while it is setting, as this increases the solubility of the cement. Avoid using zinc phosphate on teeth that are already sensitive.

Polycarboxylate bonded

Zinc Polycarboxylate was developed by Dennis Smith in 1968 and was one of the first chemically adhesive formulas (adheres primarily to enamel) (2). This cement is formed when zinc oxide powder is mixed with polyacrylic acid. The advantages of zinc polycarboxylate are its kindness to pulp tissue and ability to bond to tooth structure. This cement has a short working time and the tooth surface requires conditioning (acid etch) prior to cementation. Although there is approximately 4% stannous fluoride in the powder, this cement is not considered anticariogenic. The amount of fluoride released by this cement is only 10-15% compared to glass ionomer cements. Zinc polycarboxylate may also plastically deform resulting in failure after a few years (2). This cement is recommended for single units and short span fixed partial dentures. It is also recommended for hypersensitive teeth and when preparations come close to the pulp. Durelon (3M ESPE AG) and Tylok Plus (Dentsply/Caulk) are examples of polycarboxylate cements.

Phenolate bonded

Zinc Oxide Eugenol (ZOE) was developed by Dr. J. Foster Flagg in 1875 (3). Zinc oxide powder reacts with water, forming zinc hydroxide. Zinc hydroxide then reacts with the eugenol to make zinc eugenolate. Zinc eugenolate is a very soluble cement because it can hyrolyze back into zinc hydroxide and eugenol (i.e. a reversible reaction). ZOE cement is relatively weak in strength when compared to other cements. Orthoxybenzoic acid can be added to the eugenol and alumina or poly (methyl methacrylate) can be added to the powder to increase the cement's strength. This cement is known to have an obtunding effect on the pulp. Because of its weak strength and high solubility, zinc oxide eugenol cement may be questionable as a permanent luting agent. This cement may be used on very sensitive teeth that have excellent retention/resistance form. Fynal (Dentsply/Caulk) is a reinforced zinc oxide eugenol cement

Resin cements

Resin cements were first developed in the 1950s. The first resin cements had high polymerization shrinkage and increased microleakeage because of low filler content. They also had high residual amine levels, which contributed to significant color shift after polymerization. Today's resin cements have improved properties because of increased filler content and decreased residual amine levels. Resin cements are composed of urethane dimethacrylate (UDMA) resin that can contain from 30 to 80% filler particles. The advantages of resin cement are its high compressive strength and low solubility. The disadvantages of resin cements include: high film thickness and potential irritating effects to the pulp. Problems with film thickness have been reduced by using smaller filler particles and diluent monomers (4).

Resin cements are polymerized in three different ways: light-activated, chemically-activated, and dual-activated (light and chemical activation). Light-activated cements are best suited for restorations that transmit light, like porcelain veneers or restorations <1.5mm thick. Chemically-activated resins can be used for cementation of non light transmitting restorations. Examples are all-ceramic restorations, resin-bonded fixed partial dentures, ceramic inlay/onlay (>2.5mm) or full metal restorations. Light transmitting restorations of moderate thickness (1.5-2.5mm) can be cemented with a dual-activated cement when light penetration is limited. Adhesive resin cements are claimed by their manufacturers to chemically bond to tooth structure and metals. This is due to adhesive monomers in these cements containing MDP, HEMA, and 4-META (5-8).

It is important to adequately light cure dual-activated cements because only a portion of the total cure comes from the chemical curing (9). Chemically activated resins need a period of approximately 24 hours before they are fully cured. In general, it is safe to function on restorations cemented with these cements after one hour. Provisional restorations cemented with eugenol-based cements may detrimentally affect bonding of resin cements because of eugenol acting as a free-radical scavenger (10). However, several researchers have found no effect on resin-dentin bond strengths because of eugenol contamination (11,12). Resin cements are suitable for luting porcelain, cast ceramic, and composite restorations and recommended for teeth that have inadequate retention/resistance after preparation. Examples of resin cements include PANAVIA (Kuraray Co., Ltd.) Calibra (Dentsply/Caulk), and Variolink (Ivoclar Vivadent, Inc.).

Glass ionomer/hybrid cements

Glass Ionomers were first introduced as luting cements in 1972 by Wilson and Kent. They can be considered as a hybrid of silicate and carboxylate cements (aluminofluorosilicate glass powder combines with polyacrylic acid liquid). The fluoride content of the powder ranges from 10-23%. Examples include Fuji I (GC Corp.) and Ketac-Cem (3M ESPE AG).

The advantages of glass ionomer cement include its ability to chemically bond to tooth structure, anticariogenic effect, high compressive strength, low solubility, and a coefficient of thermal expansion similar to that of tooth structure. This cement's disadvantages include: potential post-cementation sensitivity because of low initial setting pH and the setting reaction sensitivity to moisture contamination/dessication. These cements are excellent for general prosthodontic use. Fluoride release may be beneficial for some patients. Avoid using glass ionomer with hypersensitive teeth.

The self-cured hybrid cements (also known as resin-modified cements) are a new form of glass ionomer cement that incorporate resin filler particles with the glass ionomer cement. These hybrid cements have increased tensile strength and are not as brittle as glass ionomer cements. Examples of these cements include Principle (Caulk) and FujiCEM (GC Corp.) Hybrid cements release the same amount of fluoride as glass ionomer cements and are less soluble and less sensitive to moisture contamination when setting (4, 13). It is not recommended to cement certain all-ceramic restorations, like veneers and pressed ceramics, with hybrid cements because of the potential for post-cementation fractures. It is believed that these cements undergo hydrolytic expansion after water sorption, which leads to crack propagation in the overlying restoration.

Post cementation sensitivity

A resin-based desensitizer can be placed on the prepared tooth prior to cementation to decrease the potential for post cementation sensitivity when using zinc phosphate or glass ionomer cements. These desensitizers should not adversely effect crown retention (14).

Summary

The table below lists the indications and contraindications for luting agent types.

Indications and contraindications for luting agent types

Restoration	Indicated	Contraindicated	Key:
Cast crown, PFM crown, fixed partial denture	1,2,3,4,5,6	-	1=Resin cement
Pressed ceramic crown, ceramic inlay, ceramic veneer, resin bonded FPD	1	2,3,4,5,6	2=Glass ionomer
Patient with history of post-treatment sensitivity	3,6	1	3=Reinforced ZOE
Crown or FPD with poor retention	1	2,3,4,5,6	4=Resin reinforced glass ionomer
Cast post and core	1,2,4,5	3,6	5=Zinc phosphate 6=Zinc polycarboxylate

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