The State of Luting Materials for Fixed Prosthodontics and Dentistry

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ABSTRACT

The use of adhesives that can create an impenetrable barrier between the restoration and the tooth is a factor in the long-term clinical success of fixed prosthodontic treatment. There are various different kinds of luting agents that are readily available, each with its own special qualities and methods of use. There is no one product that works best for all repair types. This article reviews the dental luting agents that are now on the market, discusses the benefits and limitations of recently developed adhesives, and lists the applications for each. Each form of cement is distinct chemically and physically. In today's clinical setting, one adhesive will not do.

Keywords: Luting agents; Prosthodontics;

INTRODUCTION

The cementation process is crucial to the clinical success of permanent prostheses. Traditional crowns and fixed partial dentures were found to fail for the second most common reason, which was loss of crown retention (FPDs). [1] According to a different study, uncemented restorations are the third most common reason for prosthetic replacement, failing after just 5.8 years of usage. [2] Although establishing the best resistance and retention forms in the tooth preparation is crucial, it is also necessary to use dental cement to act as a barrier against microbial leakage by sealing the area where the tooth meets the restoration and holding them together through some kind of surface attachment. [3] This attachment could be chemical, mechanical, or a hybrid of the two.

An ideal dental adhesive should be able to wet the tooth and the restoration, have sufficient fracture toughness to prevent dislodgement due to interfacial or cohesive failures, exhibit adequate film thickness and viscosity to ensure complete seating, be resistant to dis- integration in the oral cavity, be tissue compatible, and exhibit adequate working and working anatomical properties. [4-6] For the long-term cementation of permanent prostheses, there are currently 5 different types of commercially available luting agents. These include zinc phosphate, polycarboxylate, glass ionomer, resin composite, and resin-modified or "hybrid" glass ionomer cements. No luting agent is perfect in all circumstances since each type is physically and chemically distinct. This article's goal is to review the make-up and properties of these luting agents.

ZINC PHOSPHATE CEMENT

A zinc oxide and magnesium oxide powder and a phosphoric acid and aluminum and zinc buffered liquid are combined to form zinc phosphate cement, which hardens through an acid-base reaction. Because it regulates the ionization of the acid, which in turn affects the rate of the setting process, the water concentration (33%) is important. [7] For more than 90 years, zinc phosphate cement has been in use. [8] The cement should have sufficient film thickness to meet American Dental Association (ADA) criterion No. 8 if it has been correctly mixed. [9,10] The mixing process is essential to creating the best cement and should be carried out on a cool slab over a large area for around 1 minute and 30 seconds to incorporate small amounts of powder into the liquid. Because most cements are known to rapidly increase in viscosity over time, the crown should be installed as soon as the cement is ready.

Zinc phosphate only offers a retentive seal through mechanical methods; it does not chemically attach to any substrate. Therefore, the tooth preparation's taper, length, and surface area are crucial to its success. After crown cementation, numerous studies have shown a sizable linear penetration of silver nitrate from the external edge along the restoration-tooth interface. [12,13] The long-term luting of precisely fitting, prefabricated and cast posts, metal inlays, onlays, crowns, FPDs, and aluminous all-ceramic crowns to tooth structure, amalgam, composite, or glass ionomer core buildups is made possible by the cement's demonstrated dependability.

POLYCARBOXYLATE CEMENTS

A quick acid-base reaction occurs when zinc oxide and magnesium oxide powders are swiftly absorbed into a viscous solution of high molecular weight polyacrylic acid, causing polycarboxylate cements, first developed in the 1960s, to set. Fortunately, these cements display pseudoplastic or thixotropic behavior, which causes an initially viscous mixture to flow easily under pressure. [14-16] They do, however, show an early, abrupt increase in film thickness that would prevent a casting from seating properly. [17] The cement goes through a rubbery stage while curing, and it should be left alone during this period to avoid being pulled out from under the margins.

Additionally, because polycarboxylates show interfacial adhsive failures at the cement-metal interface, their adhesion to tooth structure is said to be of limited consequence for the retention of well-fitting cast restorations. [18] Only with films thicker than 250 m were cohesive failures within the cement seen. Polycarboxylate cements show much more plastic deformation after hardening than zinc phosphate cement [19], making them unsuitable for application in areas with severe masticatory stress or in the cementing of long span prosthesis. [20] This cement is guaranteed for use in cementing single metal units on sensitive teeth in low-stress locations.

GLASS IONOMER CEMENTS

The silicate and polycarboxylate cements are the ancestors of this cement type, which was first used in dentistry as a luting agent in the early 1970s. [21] Aluminum fluorosilicate glass particles and a liquid made of copolymers of relatively weak polyalkenoic acids, such as itaconic, maleic, and tricarboxylic, fix the cement in place by an acid-base reaction. These acids can also be freeze-dried and added to the component's powder form, which is then reconstituted by adding water. In order to increase the working time and provide flow, tartaric acid is also added [22]. [23]

The carboxyl groups in the acid are thought to chelate with the calcium and/or phosphate ions in the apatite of enamel and dentin, forming ionic bonds at the tooth-cement interface, which is thought to be how these cements cling to tooth structure. [24]

This cement's well-known vulnerability to moisture attack and subsequent solubility when exposed to water during the first setting period are its principal downsides. [25] It has been demonstrated that early exposure to saliva and water contamination greatly reduces the final hardness of zinc phosphate and glass ionomer cements. [26] Water sorption and dissolution may cause the restoration to become dislodged if the marginal adaptation of the repair is poor. The modest amount of cement near the periphery, even though fluoride is released, might not have much clinical therapeutic effect as a cariostatic agent. [27] In the same way that zinc phosphate cement is advised, glass ionomer cements can be used to cement cast restorations.

RESIN COMPOSITE CEMENTS

Resin cements are modifications of filled BIS-GMA resin and other methacrylates. They can polymerize chemically, via photopolymerization, or through a mix of the two. They can cling to several dental substrates thanks to their chemistry and range of hues and opacities.

Dentin "adhesion" is produced by resin infiltrating etched dentin, resulting in a micromechanical interlock with partially demineralized dentin that sits beneath the hybrid layer or resin interdiffusion zone. [28] An acid or dentin conditioner must first be applied to remove the smear layer, smear plugs, open and widen tubules, and demineralize the top 2 to 5 mm of dentin in order to prepare the surface for resin adhesion.

Demineralization, the primer, is followed by the application of a wetting agent like HEMA. The agent is dual-functional in that it can bond to dentin when it is hydrophilic and to the adhesive when it is hydrophobic. A wet dental surface is coated with the primer several times. [29] The polymerization shrinkage that is present in all resin composites has been somewhat offset by the application of dentin bonding agents.

To resin composite restorative materials and silanated porcelain, resin composite cements form a chemical link. Ceramic materials that can be etched and silanated have more fracture resistance thanks to resin adhesives. [30] The bond strength of resin composite adhesives to metal has been found to increase, up to a point, with a concurrent increase in cement film thickness, similar to polycarboxylate cements. Some resin composite cements can leak some fluoride because they include ytterbium trifluoride. Other formulations promise to release greater fluoride and contain the filler barium fluorosilicate. [31]

Resin composite cements have become the preferred adhesive for esthetic type restorations, such as resin composite inlays and on lays, all-ceramic inlays and on lays, veneers, crowns, FPDs, and the recently developed fiber-reinforced composite restorations, due to their versatility in adhering to a variety of substrates, high strength, insolubility in the oral environment, and potential for shade matching. A number of technique-specific procedures are needed for proper utilization.

RESIN-MODIFIED GLASS IONOMER CEMENTS

The creation of a metal polyacrylate salt and a polymer is how this fifth family of luting agents harden. These cements harden through a reaction between fluoroaluminosilicate glass powder and an aqueous solution of polyalkenoic acids modified with pendant methacrylate groups. They also harden through the photo-initiated or chemically initiated polymerization of free radicals containing methacrylate units. [32]

Dehydration shrinkage has been noticed as late as three months after maturity, and the addition of resin has not considerably lessened dehydration of the glass ionomer component of these cements. [33] The hydrophilic character of polyHEMA, which leads to enhanced water sorption and consequent flexibility and hygroscopic expansion, is a key drawback of the resin ionomers. This behavior is comparable to that of a man-made hydrogel. Although initial water sorption may reduce the strains caused by polymerization shrinkage, ongoing water sorption is harmful. [44-37] Their usage with all-ceramic feldspathic-type restorations is contraindicated due to the possibility of significant dimensional change. Desensitizing chemicals help seal dentinal tubules and reduce microleakage when used after tooth preparation.

CONCLUSION

Luting agents have a variety of, complicated chemistries that impact their durability, clinical suitability, and physical characteristics. It seems that in current practice, one adhesive will not be sufficient. No adhesive, as of yet, is able to entirely make up for the drawbacks of inadequately fitted, weak restorations as well as preparation retention and resistance forms. Practitioners must choose cement types wisely by being aware of the benefits and drawbacks of each.

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