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DENTAL CEMENTS – NEED OF EVERY DENTIST

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ABSTRACT

The number of choices for indirect restorations has evolved significantly over the previous decade. The appropriate choice of the dental cements is an key feature to reach a successful restoration and raise the standard of the restoration. The assortment of appropriate dental cement for a precise clinical application has become ever more complicated for the most experienced dentists. The rationale of this article is to review the presently existing dental cements and to help the dentists to decide the most suitable materials for clinical applications.

KEYWORDS: Restoration, Cement, Dentist, Decade, Application.

INTRODUCTION

The chief function of dental cement is to seal the space between restorative material and tooth preparation, as well as to enhance the resistance to restoration dislodgement during function.[1,2] The long-term success of a restoration is heavily dependent on the proper selection and manipulation of dental cements. Loss of retention has been found to be one of the most common causes of restoration failure.[3] In dentistry we should be aware of the three terms cement, luting and bonding. Luting refers to a mechanism in which micromechanical locking occurs between the objects to be joining. Bonding is chemical or physical interaction occurs to both surfaces that to be attracted. Cement is defined as a joining medium provided adhesion and/or micromechanical locking between the two surfaces to be connected.[4]

According to the durability of the restoration, dental cements are classified into 2 groups:

1) Provisional (Temporary)
2) Definitive cements.

All definitive cements can be further divided into 2 subgroups

a) Luting cements
b) Bonding cements.

The most commonly used luting cements are zinc phosphate cement, zinc polycarboxylate cement, conventional glass-ionomer cement and resin-modified glass-ionomer cement. There is only one bonding cement which is resin cement.

Ideal requirement[5-7]

1) Good biocompatibility
2) Low solubility
3) Short setting time
4) Low viscosity,
5) Radiopaque;
6) High shear/tensile/compressive strength
7) High bonding strength
8) Easy to mix/clean-up.

Provisional (Temporary) cement

Provisional (temporary) cements are of further two a category first is calcium hydroxide and second one is zinc oxide cements with eugenol. The most primitive provisional dental cement was zinc oxide eugenol cement, which was made-up in 1850. ZOE cement is created by mixing zinc oxide powder and eugenol liquid. Since many years ZOE cement has been often used for provisional cementation.[8] The main disadvantages is inhibition on the polymerization of resin cement and high film thickness.[9,10] Many researchers found a reduced bonding strength of resin cement when eugenol containing provisional cement were used.[11,12]

It is important to point out that the application of the provisional cements with or without eugenol, contaminates the tooth structure, which might eventually affect the bonding strength of definitive cement.[13] According to recent studies it has been found that the bonding strength of self-adhesive resin cement remained unchanged when provisional cement was used previously.[14,15]

Definitive cement

In the earlier period permanent cement has been commonly employed for the final restorations. As a matter of fact it was called as a cement until which is removed.[2] Various cements in this category includes: zinc phosphate cement, zinc polycarboxylate cement, conventional glass ionomer cement, resin-modified glass ionomer cement and resin cement.

1. Zinc phosphate cement

It is the dental cements having a long-term successful track record of more than a century since its introduction in 1880.[16] Zinc phosphate cement is mixed using phosphoric acid liquid, and powder that is composed of ZnO and magnesium oxide. There are good clinical results of for zinc phosphate cement.[17]

Zinc phosphate cements lack chemical bond to tooth structure and exhibit a moderate compressive strength, a low tensile strength, a high degree of solubility Brannstrom and Nyborg[18] reported that zinc phosphate cement has no irritating effect on the dental pulp and the probable irritant effect of zinc phosphate cement might be due to the bacteria left on the prepared tooth surface. Though, in clinical practice, the tooth preparation with low Residual Dentin Thickness (RDT) to be cemented with zinc phosphate cement may bear from sensitivity during and after cementation. So zinc phosphate cement is well thought-out as the gold standard against other ultimate dental cements compared.[19]

2. Zinc polycarboxylate cement

Zinc polycaboxylate cement is a acid-base reaction cement. It is prepared by mixture of polyacrylic acid and a powder containing zinc oxide and magnesium oxide.[1] Zinc polycarboxylate cement in 1968 was the foremost cement which exhibit chemical bond to tooth structure.[17] Its adhesive properties produce a weak bond to enamel and an even weaker bond to dentin through the interaction of free carboxylic acid groups with calcium from tooth structure.[20] Zinc polycaboxylate cements exhibit a low compressive strength , and a low tensile strength. It has been reported that zinc polycarboxylate cement may undergo significant plastic deformation under dynamic loading after set.[21] This property limits the use of zinc polycarboxylate cement for single unit restoration or short span fixed partial denture cementation.

The foremost advantage of this cement is its good biocompatibility with the dental pulp, which could be partially due to a rapid rise in pH after mixing and lack of tubular penetration from the large and poorly dissociated polyacrylic acid molecule.[22] This property reduces the possibility of post-cementation sensitivity for tooth preparations with low RDT. Although zinc polycarboxylate cement has the merit of producing a chemical bonding with tooth, its use has decreased over the recent syears.[8]

3. Glass-ionomer cement Conventional glass-ionomer cement

Glass-ionomer cements were introduced as hybrids of silicate cements and they adhere to enamel and to some extent to dentin.[23] It consists of a powder containing aluminosilicates with more fluoride content, and a liquid composed of polyacrylic acid and tartaric acid. When conventional glass-ionomer cements are mixed, the polyacrylic acid reacts with the outer layer of the particles which releases calcium, aluminum and fluoride ions. When a adequate amount of metal ions are present, gelation occurs. Hardening of the material continues for 24 hours. Conventional glass-ionomer cements reveal a low bonding strength to tooth structure, a moderate compressive strength, and a low tensile strength.

It is significant that the physical properties of conventional glass-ionomer cement can be extremely variable based upon different powder/liquid ratio.[24] One of the main reward of convention glass-ionomer cement is the constant long-term fluoride release which is helpful to caries prevention. The bonding strength between conventional glass-ionomer cement and dentin drastically reduces when dentin is excessively dried, which also contributes to post-cementation sensitivity.[25] So before cementation the wet dentin surface should be dry with cotton wool. The main drawback of this cement is vulnerability to moisture contamination and desiccation during the critical initial setting period.[26] Early on exposure to water and saliva contamination has been shown to considerably increase the solubility and lessen the ultimate hardness of conventional glass-ionomer cements.[27] When working with conventional glass ionomer cement, the material at the restoration margins should be sheltered with petroleum jelly.[28] Moreover, conventional glass-ionomer cement has rather low resistance to acid attack and bleaching so it not recommended in gastric reflux problems.[29,30]

4. Resin-modified glass-ionomer cement

Resin-modified glass-ionomer cements merge the technology and chemistry of resin and conventional glass-ionomer cement. This class of dental cement was produced to conquer the two important weakness of conventional glass-ionomer cement, which are sensitivity to early moisture contamination & high solubility.[31] Resin-modified glass-ionomers were formed by replacing part of the polyacrylic acid in conventional glass-ionomer cements with polymerizable functional methacrylate monomers.

As a comparassion to conventional glassionomer cement, resin-modified glass ionomer cement showed improved adhesion to tooth structure, higher compressive tensile strength, and low solubility to ensure the long-term integrity of the margins and low option of post-cementation sensitivity while maintaining high levels of fluoride release which is similar to conventional glass-ionomer cement.[32]

Resin-modified glass-ionomer cements show moderate bonding strength to tooth structure, good compressive strength and tensile strength.An *in vivo* study pointed out that the patients with restorations cemented with resin modified glass-ionomer cement confirmed the least post-cementation sensitivity compared to the ones cemented with conventional glass-ionomer cement and zinc phosphate cement at all different intervals of time tested.[33] Setting reaction of this cement is a dual mechanism, which includes acid-base reaction and polymerization. When the powder and the liquid are mixed, acid base reaction occurs with the formation of polyacrylate salt. Beginning of polymerization can be triggered by either light or sufficient free radicals.[34]

5. Resin cement

An substitute to acid-base reaction cements, resin cements were introduced in the mid-1970s.[35] Resin cements are based on bisphenol-a-glycidyl methacrylate (Bis-GMA) resin and other methacrylates, which are modified from the composite resin (restorative material). This class of cements has a setting reaction based on polymerization. Resin cements have the benefit of high compressive/tensile/ bonding strength, low solubility, and esthetics.[36] These properties allow them to be employed in cases where there are concerns about retention or with weak and esthetic restorations.

While earlier studies considered high film thickness as one of the major disadvantages of resin cements, Kious et al.[37] showed all the recently introduced dental cements meet the ISO standard of film thickness (25 microns) for up to 2 minutes after mixing. Also, some resin cements contain ytterbium trifluoride or barium aluminium fluorosilicate filler and are capable of releasing fluoride after setting stage. This may mean that these types of resin cements offer cariostatic potential.[38]

Resin cements vary in curing mechanism (light-cured, self-cured, and dual-cured).[39] Self-cured and dual-cured resin cements can be used for all cementation.

Applications. However, conflicting results have been reported in the literature.[40,41] It has been reported that dual-cured resin cement showed a reduced bonding strength and microhardness without curing light.[42-44] Therefore, it is important to light cure all dual-cured resin cements at all accessible restorative margins for enough time periods. As mentioned previously, resin cements can be divided into 3 subtypes based on bonding mechanism (total-etch, self-etch, selfadhesive).[39]

The total-etch (etch-andrinse) systems have 3 main steps

1) Acid etching, rinse, gently dried
2) Bonding agents applied, cured
3) Resin cement applied, cured

For the self-etch systems, the acid etching and bonding steps are replaced with the self-etch bonding agent application, which combines the conditioner, primer, and adhesive.[7] The total-etch and self-etch resin cements could be considered as conventional resin cement. In order to improve the ease of use, the self-adhesive resin cements were developed and introduced in 2002. Although this subtype of resin cements does not have long-term clinical track record, it is already the most popular subtype of resin cements.[45] The first product, RelyX Unicem from 3M ESPE, has been well studied and widely used around the world. These cements do not require surface pretreatment and bonding agents to maximize their performance.[46]

The technique sensitivity of self-adhesive resin cement has been really condensed compared to the conventional resin cements.[47] All resin cements are fairly insoluble when compared to the dental cements mentioned before. They have the highest mechanical and physical properties as well as they are cheaper.[2,48] This cement has a more tooth-like translucency. Prominently, for resin-containing dental cements (resin cement and resinmodified glass-ionomer cement), polymer degradation over time is still an issue. Mineralized dentin contains matrix metalloproteinases (MMPs) and MMPs are fossilized and activated during bonding procedure. The collagen fibers to be bonded might be slowly degraded by the activated MMPs, resulting in reduced bonding stability over time.[49] As a matter of fact, this action is far beyond the control of dentists. Pre-treat dentin with chlorhexidine or combination of chlorhexidine and bonding agents might prevent this action of the endogenous enzymes.[50,51]

CONCLUSION

The clinician should give special consideration to the advantages and disadvantages of any dental cement and select them scientifically, and of utmost importance, adhere strictly to manufacturers instructions. So the appropriate choice of the dental cements is an key feature to reach a successful restoration and raise the standard of the restoration.

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