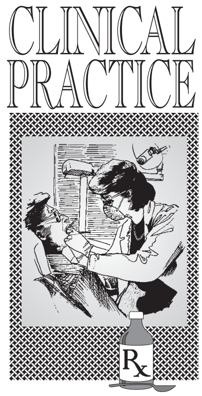

Dental Cements: A Further Update

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PRACTITIONER'S QUESTION

Further to the article on cements that appeared in the September edition of the *Journal* (64:569-70), I have some additional questions. 1) I recently came across the term phenolate cement. Is this a new type of dental cement? 2) Why are zinc oxide-eugenol cements recommended for temporary restorations? 3) I am very confused about the difference between the so-called traditional glass ionomer cements and the newer hybrid or resin ionomer cements and their potential use. 4) Which of the cement materials have the best resistance to solubility in the mouth?

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Dr. Jones's Answer:

The Phenolate Cement

Zinc oxide-eugenol cements have always been regarded as the blandest in terms of their effect on the dental pulp. For this reason, these materials were commonly used as the control in biocompatibility pulp research studies on cements and restorative materials. Zinc oxide-eugenol cements have traditionally been used as temporary restoratives because of the sedative effect on the pulp, which may be enhanced by the excellent seal they produce. As a young child, I always associated the characteristic lingering smell of the eugenol (oil of cloves) with a visit to the dentist. Replacing part of the eugenol liquid with ethoxy benzoic acid can produce cements that have greater strength. Zinc oxide-eugenol cements are in fact classified as "phenolate" cements based on the chemistry of the mixing liquid and the matrix of the set cement. Phenolate cements have been around for a long time.

Selection of Cements

Particular clinical applications require some knowledge of the chemistry and physical properties of the different cement types. It should be noted that not all cements may be suitable for their specific intended application due to incompatibility with adjacent materials or the particular clinical requirements involved. Zinc polycarboxylate cements were the first to be developed (by Dr. Dennis Smith) that had the capacity to chemically bond to natural tooth. Aquacem, Durelon and Tylok Plus are zinc polycarboxylate cements.

Hybrid or Resin Ionomer Cements

Conventional glass ionomer cements can be supplied as an ion leachable glass powder to be mixed with an aqueous mixture of polyacrylic acid or as a blend of freeze-dried polyacrylic acid and an ion leachable glass powder for mixing with distilled water. The manufacturer can also add a small amount of tartaric acid to the water that will provide a sharper, better defined setting reaction. Early release of calcium ions is responsible for the setting reaction of glass ionomer cements. The slower release of the aluminium ions is responsible for increased cross-linking, which significantly improves the strength over a period of several days. This clinical factor is important when using glass ionomer cements. Examples of traditional glass ionomer cements include Ketac-Cem, Fuji I, and Shofu I.

The so-called hybrid ionomer cements (Advance, Fuji Plus and Vitremer Luting) combine an acid-base reaction of the traditional glass ionomer with a self-cure amine-peroxide polymerization reaction.

In recent years, the so-called light-curing resin-modified glass ionomer (dual cure) systems have been developed by adding some polymerizable functional methacrylate groups with a photo-initiator to the formulation. Such materials undergo both an acid-base ionomer reaction as well as curing by photo-initiation of methacrylate carbon double bonds. Some systems have also incorporated a chemical curing tertiary amine-peroxide reaction to polymerize the methacrylate double bonds along with the photo-initiation and acid-base ionic reaction. These materials are known as tri-cure glass ionomer cements. The chemical cure component of tri-cure cements has been shown to have a significant effect on their overall strength. Photo-initiated cements cannot be used in cases involving opaque structures such as metal substrates. The resin-modified glass ionomer cements generally have a much lower release of fluoride than the conventional glass ionomer materials.

Expanding Cements

After the setting, expansion due to water uptake has been observed for some of the newer resin-modified glass ionomer cements (Fuji Duet, Vitremer and Advance) compared to a regular resin (BIS-GMA or urethane acrylate) cement such as Panavia 21, which is a self-cure resin cement. Conventional glass ionomer luting cements, the old standby zinc phosphate cement and resin cements all undergo contraction during setting. The BIS-GMA or urethane acrylate resin cements all undergo polymerization shrinkage during setting. However, the presence of glass filler in some resin cement materials reduces the shrinkage and can impart radiopacity. Many of the resin cements are now supplied in the form of dual cure systems (photo-initiated as well as tertiary amine-peroxide reaction). Such materials include Adherence, Choice, Duolink, Enforce, Lute-it, Nexus, Opal, Resinomer, Scotchbond Resin Cement and Variolink.

Marginal Gap

It is important to note that the main function of a luting cement is to provide a non-permeable seal at the margins around the restoration. The marginal cement-filled gaps around inlays, crowns and bridge abutments can range from 25 to 150 μm. Research has shown that the wider the cement gap at the margin, the greater the cement loss (ditching). A rough cement surface is an ideal site for plaque accumulation. In such a situation, slow release of fluoride can be a very distinct advantage.

Erosion and Solubility

In general, glass ionomer cements tend to have the least erosion, and polycarboxylate cements the most. However, solubility, erosion and strength are significantly affected by the powder/liquid ratio used. Cement erosion and solubility during static immersion in distilled water have been found to give very different results to a jet erosion test using lactic acid. Polycarboxylate cement is the most soluble by a jet erosion test and is much less soluble during immersion in distilled water. In contrast, resin-modified glass ionomer cements can be soluble, releasing constituents during immersion in distilled water, but prove to be the least soluble using a jet erosion test. In contrast, the resin cements are basically insoluble, but may release small amounts of unpolymerized monomer constituents.

Conclusion

It is very important for all dentists to recognize that conventional dental cements are in fact generally manufactured at the chair side in the dental office. The dentist or chair-side assistant mixes a powder and liquid, which results in an acid-base chemical reaction. Manipulation of the cement is very important; variations in the powder/liquid ratio can influence the working and setting time, the consistency and flow, as well as the degree of solubility, erosion, strength and film thickness. However, as stated in the previous article on cements, several cements are now being supplied in capsules containing the pre-proportioned powder and liquid.

We should never select any material on the basis of one property alone. In the case of cements, we have to consider the following: solubility, erosion, tensile strength, shear strength, toughness, elastic modulus, creep, working and setting time, sensitivity to moisture during and after setting, thermal conductivity and diffusivity, pH during setting, biocompatibility, compatibility with other restorative materials, potential for fluoride release, adhesion to enamel and dentine, sensitivity of setting reaction to temperature, rate of change in viscosity, film thickness, and dimensional change in the presence of moisture. Thus the selection of a cement, like all other dental materials, must always be a compromise. ■

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The author has no declared financial interest in any company manufacturing the types of products mentioned in this article.

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