Glass Ionomer Cement

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Glass ionomer cement contains a powder similar to that of silicate cement and a polyacrylic liquid similar to that of polycarboxylate cement. It was first described in 1972,[1] but it was not marketed in the United States until 1977. It has found increasing popularity among restorative dentists.

Orthodontists have not been as eager to use glass ionomer cement, perhaps because of their experience with polycarboxylate cements, which showed great promise in the early 1970s, but were found to wash out after a few months. Despite the similarity between the liquid portions of glass ionomer cements and polycarboxylate cements, glass ionomer cements have several special properties that make them ideal for orthodontic use:

1. While the composite bonding systems now in vogue rely on acid etching to create a mechanical bond, glass ionomer cement bonds chemically to enamel, cementum, dentin, nonprecious metals, and plastics.[2] Glass ionomer cement requires no more tooth preparation than cleansing with pumice and moderate drying with a cotton roll. This makes it an ideal luting agent for bands and brackets.

2. Glass ionomer cements have shown significantly higher tensile and compressive strengths than zinc phosphate cements in laboratory tests.[3] A recent study showed one type of glass ionomer cement to have no significant retentive strength advantage over zinc phosphate cement,[4] but this investigation was performed on extracted human molars and used one of the weaker glass ionomer cements. Only one study has compared the bond strengths of glass ionomer cements and composite resins, and in this case the resins showed more shear strength.[5] But this test was done on extracted bovine teeth, and there is good evidence that dessication of teeth significantly reduces the bond strength of glass ionomers. The absolute dryness necessary for composite bonding appears to be unnecessary and even harmful for glass ionomer bonding.[6]

3. Although the slightest moisture contamination prevents composites from mechanically locking to etched enamel, glass ionomer cements need only be isolated from moisture during gelation, when calcium polyacrylate is being formed.[14] This gel stage ordinarily takes about four minutes, but it can be speeded up by mixing a thicker cement. If a tooth does become wet just before cementation, it can be adequately dried with a cotton roll before proceeding. Several clinicians have suggested covering the freshly set cement with a water-resistant varnish to prevent water contamination during the first hour after placement, but this doesn't seem to enhance the strength of the cement.

4. Glass ionomer cement acts as a reservoir for fluoride ions.[7-9] The silicate cements of the past also had this property, and that is why recurrent caries was almost never seen around silicate cement restorations. Fluoride ions are homogeneously distributed throughout the glass ionomer matrix; studies have shown that fluoride ions are released in the immediate vicinity of the cement soon after it has been placed, and that the fluoride influence extends some distance from the cement site.[10]

This feature alone should make glass ionomer cements attractive to orthodontists, because decalcification around bands and brackets is still a serious problem despite the introduction of fluoride rinses and dentifrices. Combined with low solubility, superior adhesiveness, and ease of application, this also makes glass ionomer cement an ideal pit and fissure sealant.[11] The clinician can easily seal occlusal surfaces by simply spreading out the excess cement while cementing

bands. There is no published evidence of dermal toxic reactions like those that have occurred with some composites.
5. Glass ionomer cements offer longer working time than composites, and the time can be prolonged further by mixing on a frozen glass slab.[15] However, the liquid should be kept at room temperature, because chilling it increases the viscosity and makes mixing more difficult. Mixing on a frozen slab allows brackets to be manipulated for several minutes without jeopardizing the bond strength, and permits a single mixture to be used for an entire arch.
6. Glass ionomer cement is easier to remove from enamel than composites are. Because no enamel has been leached from the tooth surface to insure its adhesion, glass ionomer cement can be dessicated by a stream of air from an air syringe or a hair drier, and the cement will easily flake off. The enamel surface can then be polished with a fluted bur in an air turbine handpiece.

Types of Cements

The currently available brands of glass ionomer cements fall into two categories. Fuji II* is a conventional type, made from a glass powder and a concentrated solution of a polyacrylic acid, that lends itself well to orthodontic use (Fig. 1).

The recently introduced "water-hardening" types, such as Ketac**, blend the glass powder with a dry polyacrylic powder; the cement is formed by mixing this powder with water or diluted tartaric acid.[16] These cements set faster than the conventional brands and reduce the possibility of moisture contamination. However, there is also evidence that water-hardened cements are not as strong as the conventional types.[17]

Most of the manufacturers of glass

*Distributed by GC International, 7830 E. Redfield Road, Suite 12, Scottsdale, AZ 85260.

**Premier Dental Products, 1710 Romano Drive, Norristown, PA 19401.

Fig. 1 Fuji II powder and liquid.

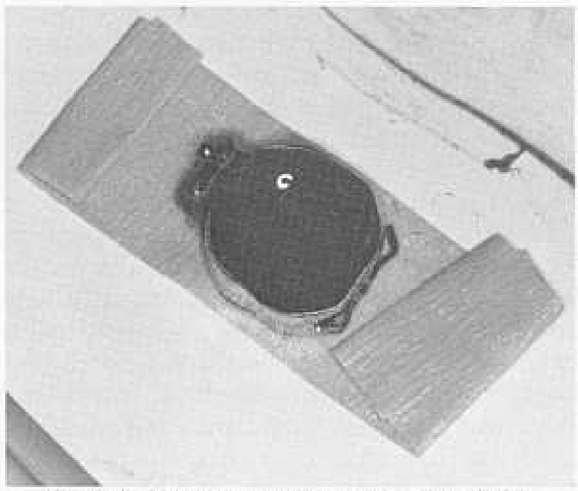

Fig. 2 Cement-filled band on masking tape.

Fig. 3 Spreading excess cement onto occlusal surfaces.

ionomer cements also make glass ionomer luting materials that differ only in the particle size in the powder. These materials are more efficient for cementing castings and for sealing pits and fissures.

Adding silver amalgam filings to Fuji II in a ratio of 7 parts cement powder (by volume) to 1 part amalgam filings produces a cement that is 30 percent stronger than Fuji II alone.[18] It is not known whether the amalgamated version has enhanced adhesive properties, but it has not been shown to stain the teeth.

Band Cementation Technique

First polish the teeth thoroughly with a nonflavored water and pumice mixture to remove pellicle and plaque. Dispense the cement powder and liquid onto a frozen glass slab. Following the manufacturer's instructions may produce a thinner mixture than desired, so you may want to find your own best powder-liquid ratio.

Set the occlusal surface of each band on a piece of masking tape (Fig. 2). The tape prevents the cement from running out of the band and makes it easier to push the band over the tooth with a finger. After mixing, place the cement on the inside of the bands.

Teeth may be isolated with cotton rolls, Dri-Angles, or saliva ejector, but each tooth should be dried with a cotton roll before the band is placed. This prevents dessication of the tooth, which will result in a weaker bond. After seating the band, use a finger to spread excess cement into the pits and fissures of the banded tooth's occlusal surfaces for additional caries protection (Fig. 3).

Because the lower teeth are more susceptible to moisture contamination, a specially designed saliva ejector may be helpful in keeping lower teeth dry. This can be combined with a covering of tinfoil, coated with denture adhesive, which adapts closely to the tooth and is easily removed once the cement hardens (Fig. 4).

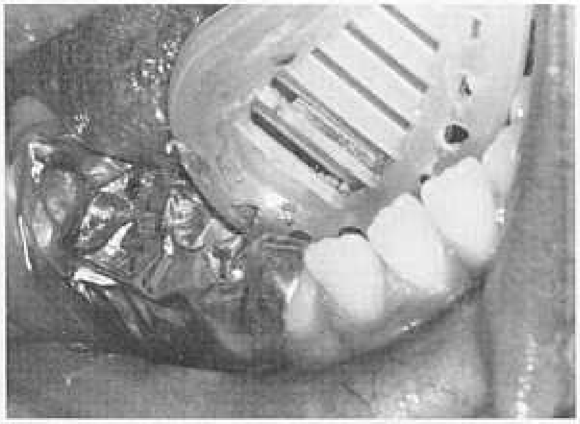

Fig. 4 Special saliva ejector for cementation of lower arch, with tinfoil covering to keep teeth dry.

Fig. 5 Isolating teeth with lip retractors.

Remove excess cement with a scaler before it hardens too much. This cement is quite difficult to remove once it has gelled completely, and it will dissolve the stainless steel tip of an ultrasonic instrument. If hardened cement must be removed, use a carbide steel polishing bur in an air turbine handpiece.

Bracket Cementation Technique

Pumice the teeth as described above and isolate them with lip retractors to minimize saliva contamination (Fig. 5). Arrange the brackets in sequence on the treatment tray. Mix the cement needed for one entire arch on a frozen slab to the desired consistency. Thicker mixtures set faster, provide more bond strength, and prevent brackets from sliding.

Use a flat toothpick to push the cement

Fig. 6 Flat toothpick used to push cement into bracket mesh.

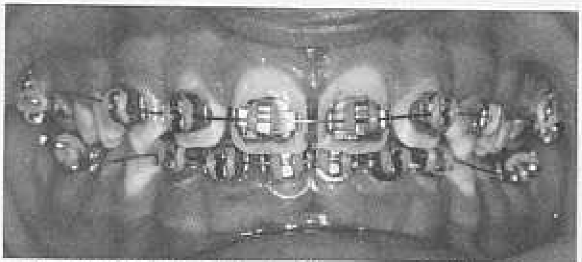

Fig. 7 Light wires ligated to cemented brackets.

into the bracket mesh (Fig. 6). Although the cement bonds chemically with metal, the mechanical locking with the stainless steel mesh is important. Almost every bond failure I have had with glass ionomer cement has occurred at the interface of the cement and the mesh. Because these cements are stronger in bulk, the profession needs to develop a bracket base to maximize their effectiveness.

Dab the teeth dry with a cotton roll before positioning the brackets. Then place each bracket in sequence, using cement from the same chilled mixture. After the bonds have set for 5-10 minutes, light force archwires may be ligated (Fig. 7). It is important to use light forces at first, because gelation continues and full bond strength is not reached for 24 hours.[14] Stronger bonds could be obtained with either a composite or a glass ionomer cement if one waited 24 hours before placing archwires, but this hasn't proven practical or clinically necessary.

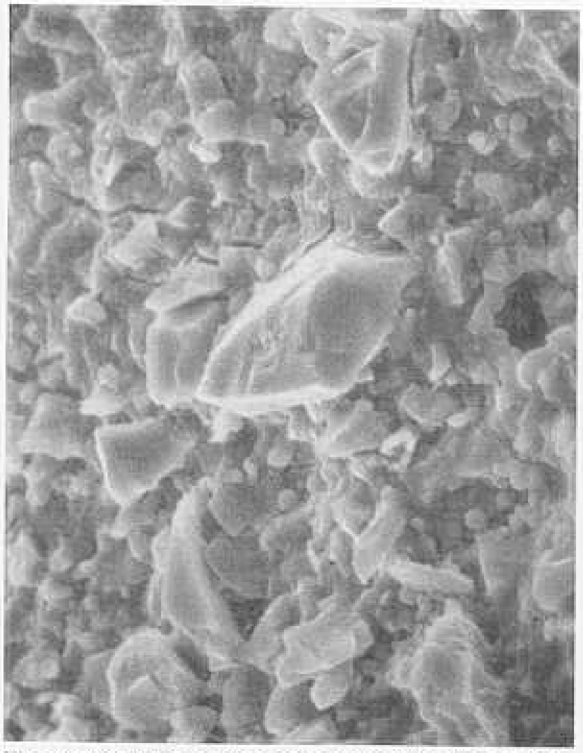

Fig. 8 Etched glass ionomer cement (courtesy of Dr. A.J. Gwinnett, State University of New York).

Conclusion

Glass ionomer cement is cheaper than comparable amounts of composite resins, but more expensive than zinc phosphate cement. For some clinicians, the cement's tendency to wash out before gelation may be a serious obstacle, but this can be overcome by using thicker cement mixtures.

Considering the fluoride-releasing potential of glass ionomers, a promising application may be to use a thin layer of glass ionomer cement on the facial surface as a protective sealant. This layer would then be etched (Fig. 8) and composite applied for bonding brackets. The bond between etched glass ionomer and a composite resin has recently been shown to have more cohesive strength than the glass ionomer cement.[19] This would complicate a simple bonding technique, but it might be indicated where failures are likely.

In any event, glass ionomer cements can be valuable to the orthodontist for both bands and brackets. The release of fluoride ions reduces the likelihood of decalcification and caries, and the increase in strength over zinc phosphate cements reduces the occurrence of loose bands. Using glass ionomer cement over the past nine months, I estimate that I have had about 75 percent fewer band failures than with zinc phosphate cement and about the same number of bracket failures as with the composites.

REFERENCES

1. Wilson, A.D. and Kent, B.E.: A new translucent cement for dentistry, Brit. Dent. J. 132:133-135, 1972.
2. Wilson, A.D.; Crisp, S.; Lewis, B.G.; and McLean, J.W.: Experimental luting agents based on the glass ionomer cements, Brit. Dent. J. 142:117, 1977.
3. McComb, D.; Sirisko, R.; and Brown, J.: Scientific comparison of commercial glass ionomer cements, J. Can. Dent. Assoc. 9:699-670, 1984.
4. Norris, D.S.; McInnes-Ledoux, P.; Schwaninger, B.; and Weinberg, R.: Retention of orthodontic bands with new fluoride-releasing cements, Am. J. Orthod. 89:206-211, 1986.
5. Murray, G.A. and Yates, J.L.: A comparison of the bond strengths of composite resins and glass ionomer cements, J. Pedod. 8:172-177, 1984.
6. Simmons, J.: The miracle mixture, Texas Dent. J., October 1983, pp. 6-12.
7. Forsten, L.: Fluoride release from a glass ionomer cement, Scand. J. Dent. Res. 85:503-504, 1977.
8. Kidd, E.A.M.: Cavity sealing ability of composite glass ionomer cement restorations, Brit. Dent. J. 144: 139-142, 1978.
9. Maldonato, A.; Swartz, M.L.; and Phillips, R.W.: An in vitro study of certain properties of a glass ionomer cement, J. Am. Dent. Assoc. 145:67-71, 1978.
10. Swartz, M.L.; Phillips, R.W.; Clark, H.E.; Norman, R.D.; and Potter, R.: Fluoride distribution in teeth using a silicate model, J. Dent. Res. 59:1596-1603, 1980.
11. McLean, J.W. and Wilson, A.D.: Fissure sealing and filling with an adhesive glass ionomer cement, Brit. Dent. J. 136:269-276, 1974.
12. Tobias, R.S., et al.: Pulpal response to a glass ionomer cement, Brit. Dent. J. 144:345-350, 1978.
13. Parmeijer, G.H.; Segal, E.; and Richardson, J.: Pulpal response to a glass ionomer cement in primates, J. Prosth. Dent. 46:36, 1981.
14. Wilson, A.D.; Paddon, J.M.; and Crisp, S.: The hydration of dental cements, J. Dent. Res. 58:1065, 1979.
15. Mount, G.J.: Restoration with glass ionomer cement: requirements for clinical success, Oper. Dent. 6:59-65, 1981.
16. McLean, J.W.; Wilson, A.D.; and Prosser, H.J.: Development and use of water hardening glass ionomer luting cements, J. Prosth. Dent. 52:175-181, 1984.
17. Prosser, H.J.; Powis, D.R.; Brant, P.; and Wilson, A.D.: Characterization of glass-ionomer cements, J. Dent. 12:231-240, 1984.
18. Simmons, J.: Personal communication.
19. Sneed, W.D. and Looper, S.W.: Shear bond strength of a composite resin to an etched glass ionomer, Dent. Mater. 1:127-128, 1985.

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