Glass Ionomers: A Therapeutic Alterative to Direct Composite Restorations

Daniel H. Ward, DDS

Years ago, the restorative material options for the dental practitioner were limited. Direct placement materials available were either amalgam or silicate. Amalgam has long been recognized as a forgiving restorative material that works well in a variety of circumstances. Advantages of amalgam include cariostatic properties, the ability to work in varied moisture conditions, and quick bulk placement.[1] Through the years tooth-colored materials have been developed with improved physical properties, enhanced optical qualities, and quicker use, eliminating the use of silicate restorations.

The public has increasingly demanded non-metallic esthetic alternatives resulting in a decrease in the placement of amalgam restorations. In ideal situations, composite often may be the non-metallic direct placement material of choice. With ample time, moisture control, appropriate size, ideal enamel margins, and a cooperative patient, excellent results can be achieved with composite restorations. The color, translucency, polishability, and smoothness of the material make it ideal in areas that are clearly viewed. However, limitations of composite material exist which were not present with amalgam. These include polymerization shrinkage and the resulting stress, susceptibility to moisture contamination, post-operative sensitivity, increased placement time, and technique sensitivity subject to operator variability.[2-6] Composite materials are not cariostatic and rely on sealed margins to prevent recurrent decay. Dentin bonding can be unpredictable with significant variability of bond effectiveness.

The number of medications taken by our patients has increased significantly. In a published study of 131 different prescribed medications the most common side effect cited was xerostomia.[7] A significant result of xerostomia can be root caries.[8] Patients often take so many medications that they may be confused as to their proper regimen. This was recently demonstrated when a patient brought in a chart with actual pills taped to the paper and the timing of the dosages displayed. (Figure 1) Dietary changes have occurred as well with the increased consumption of refined carbohydrates. Many adolescents consume beverages with high levels of sucrose, especially the popular "energy drinks." Also the use of illicit drugs can cause rampant caries to develop. (Figure 2) The result has been an increase in high caries risk patients and the need for a therapeutic esthetic restor-

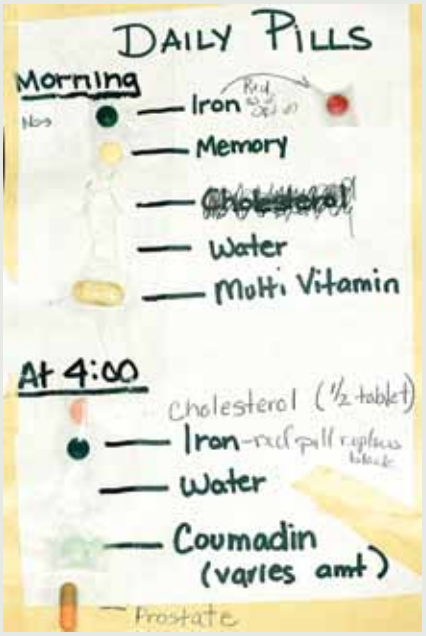

FIGURE 1—Chart with actual pills attached.

FIGURE 2—Patient taking illicit drugs.

FIGURE 3—Pre-treatment multiple cervical lesions.

FIGURE 4—Post-treatment multiple cervical GI restorations.

FIGURE 5—Fractured tooth.

ative material that can help to reduce potential recurrent decay. Often the practitioner is placing restorations in areas with limited access, non-ideal preparations, and in areas susceptible to recurrent decay. These areas may not be clearly visible and longevity may be more important than appearance. A material is needed that does not contain objectionable materials, is not technique sensitive, reduces post operative sensitivity, helps reduce recurrent decay, and can be predictably and rapidly placed in less than ideal conditions.

Glass ionomer direct restorative materials are an excellent alternative which solves many of the challenges associated with composite materials. (Table 1)

They set with an acid/base reaction resulting in a long term stable ionic bond.[9] An ionic exchange continues through the lifetime of the restoration resulting in a dynamic bioactive interaction between the material and the tooth. Their fluoride release has been well documented and anti-microbial properties recognized.[10-11] A significant decrease in post-operative sensitivity following placement in deep restorations has been reported compared to traditional composite bonding techniques.[12] Long-term stable bonding to tooth structure results in extremely low adhesive failures. Glass Ionomers exhibit increased wear rate conpared to composites on occlusal surfaces of teeth which can be reduced by placing a filled surface sealant on the outer surface of the exposed restoration.[13]

USE IN CERVICAL DECAY PATIENTS

The increased incidence of patients taking multiple medications (often 10-20 different each day) has created difficult restorative situations. Alterations to salivary flow and composition have increased the incidence of cervical root caries among our elderly patients. Often multiple carious lesions exist requiring extensive restorations.

Polymerization shrinkage stress may create microgaps along the dentin margins if restored with traditional composite restorative materials.[14] Restorations

TABLE 1.

COMPOSITE PLACEMENT CHALLENGES	GLASS IONOMER SOLUTION
Poor cariostatic properties	Fluoride release
Require dry field	Prefer slight moisture
Larger restorations require layered placement	Bulk placement
Technique sensitivity	Simple technique
Higher incidence of post-operative sensitivity	Low incidence of post-operative sensitivity
Unstable long term bond to dentin	Predictable long term bond to dentin

FIGURE 6—Equia System.

FIGURE 7—Long-term interim GI restoration.

FIGURE 8—Old restoration removed for GI core buildup with multiple cracks.

FIGURE 9—Completed glass ionomer core buildup.

FIGURE 10—Broken restorations.

FIGURE 11—Glass Ionomer restoration and core buildup.

relying totally on the bonds strengths of micro-mechanical retention associated with resin bonding are known to decrease over time and may become dislodged.[15] The presence of fluoride in glass ionomer helps to reduce recurrent decay and staining along dentin margins.

The patient was taking multiple medications and was evaluated every three months for caries. He routinely required numerous restorations at each visit. Cervical lesions were noted on multiple anterior teeth. The patient was anesthetized and the lesions evaluated. (Figure 3). The coronal portion of the tooth was prepared first and then the shaping extended towards the gingiva. A slow speed handpiece with a round bur was used to remove the carious dentin. A pre-contoured matrix strip was inserted along the gingival margins and held. The primer (GC Cavity Conditioner) was applied for 10 seconds, washed and excess moisture removed. The glass ionomer restorative material (GC Fuji IX Extra) was mixed and syringed into the preparation. The material was allowed to cure for 2½ minutes. The excess material was shaped, the restorations polished and a sealant (GC G Coat Plus) applied. (Figure 4)

LONG-TERM PROVISIONAL RESTORATIONS

During this difficult economy, patients may not be able afford a crown yet are looking for a restoration that will allow them to keep a fractured tooth. (Figure 5) Glass Ionomer restorative materials can serve as excellent long term interim restorations. With no polymerization shrinkage stress and an expansion/contraction ration similar to tooth structure, the remaining tooth structure is not strained by the restoration.

A new system of fast-setting glass ionomer restorative material along with filled resin surface sealant has been introduced. The Equia system (GC) (Figure 6) packages a highly filled glass ionomer (GC Fuji IX Extra) with a filled resin surface sealant (GC G Coat Plus). The filled resin helps to seal the margins, reduce wear and increase fracture toughness. The material can be used for Class I, II and V restorations.

The patient was anesthetized and the decay and old restoration removed. The conditioner was applied for ten seconds, washed and lightly dried to remove excess moisture. The glass ionomer material capsule was activated, mechanically mixed for ten seconds and the material inserted into the tooth. After 2½ minutes the excess was removed and the restorations smoothed, polished, and sealed. (Figure 7) Teeth restored in this manner will easily enjoy a 3-8 year lifetime.

CROWN BUILDUPS

The removal of decay and old restorative material prior to the shaping of a tooth for a crown often results in significant exposure of tooth structure. Postoperative sensitivity becomes a greater concern the deeper the restoration. Amalgam core buildups require time for the amalgam to set and result in an additional office visit which may be undesir-

able for dentist and patient alike. Non-bonded amalgam cores can frequently become dislodged during treatment. Composite core buildups require bonding techniques that may increase sensitivity. When using conventional resin bonding, the deeper the restoration, the lower the bond strengths to dentin.[16] Long term bond strengths of composite to dentin can be quite variable.[17] Stained and affected dentin gives unpredictable bond strengths as well.[18] The difference in bond strengths of glass ionomer to tooth structure compared to traditional composite resin to tooth structure has not been observed by the author to be clinically relevant in deep crown buildups. The majority of loosened crowns with the core material inside the crown have been observed to contain amalgam or composite, not glass ionomer.

The preliminary crown preparation was performed and the old composite restoration removed. Significant cracks within the dentin were discovered under the excavated composite. (Figure 8). The carious area was excavated thoroughly using a round bur in a slow speed handpiece. A glass ionomer core was used to eliminate the negative effects of polymerization shrinkage stress associated with composite cores. The primer was applied for ten seconds, washed and excess moisture removed. The glass ionomer was mixed, placed, and allowed to set for 2½ minutes. The crown preparation was completed. (Figure 9)

USE IN DEEP POSTERIOR CLASS II RESTORATIONS

Deep or wide Class II restorations are often a source of significant post-operative sensitivity. As the tooth is shaped further sub-gingivally, the convex shape of the interproximal surface results in the preparation becoming closer in proximity to the pulp. As the preparation becomes wider buccal/lingually, polymerization shrinkage can pull inward on the cusps creating internal stresses. Restoring the tooth with a glass ionomer decreases the likelihood of patient complaints to air, water, temperature sensitivity and biting pressure.

The patient was advised that crowns should be placed on the upper premolar and molar. (Figure 10) She stated that she could not afford two crowns at the present time but could afford one. Both teeth were excavated. The premolar was restored with a glass ionomer material and the molar was shaped for a crown and a glass ionomer buildup placed. The premolar was shaped using finishing burs in a method to provide proper occlusal anatomy. The restoration was lightly polished, dried, and a filled surface sealant applied. (Figure 11) Patient complaints are rare. Restorations placed in this manner have a longer lifetime than expected and rarely result in fractured cusps resulting from polymerization shrinkage stress inherent with composite restorations.

CONCLUSION

The glass ionomer restorative material is an invaluable part of the restorative dentistís armamentarium. In the busy practice, the material can be useful in a number of situations on a daily basis. As a non-metallic restorative material with ease of use, good retention, reduced post-operative sensitivity, and anti-cariogenic properties, it is a therapeutic alternative to composite resin materials. **OH**

Dr Ward is an Assistant Clinical Professor in the Department of Restorative and Prosthetic Dentistry at The Ohio State University College of Dentistry and is in private practice in Columbus, Ohio. He is a Diplomate of the American Board of Aesthetic Dentistry, a Fellow of the American Society for Dental Aesthetics, and serves as editor of the ASDA Journal. He has lectured internationally and authored pioneering articles in the field of proportional smile design. Email:dward@columbus.rr.com

Oral Health welcomes this original article.

REFERENCES

1. Leinfelder KF. Dental amalgam alloys. Curr Opin Dent. 1991;2:214-217.
2. Braga RR, Ballester RY, Ferracane JL. Factors involved in the development of polymerization shrinkage stress in resin-composites: a systematic review. Dent Mater. 2005;21:962-970.
3. Gwinnett AJ. Dentin bond strength after air drying and rewetting. Am J Dent. 1994;7:144-148
4. Browning WD. The benefits of glass ionomer self-adhesive materials in restorative dentistry. Compend Contin Educ Dent. 2006;27::308-314.
5. Akpata ES, Sadiq W. Post-operative sensitivity in glass-ionomer versus adhesive resin-line posterior composites. Am J Dent. 2001;14:34-38.
6. Powers JM, OiKeefe KL, Pinzon LM. Factors affecting in vitro bond strength of bonding agents to human dentin. Odontol. 2003;91:1-6.
7. Smith RG, Burtner AP. Oral side-effects of the most frequently prescribed drugs. Spec Care Dent. 1994;14:96-102.
8. Chiappelli F, Bauer J, Spackman, et al. Dental needs of the elderly in the 21st century. Gen Dent. 2002;l50:358-363.
9. Wan Ac, Yap AU, Hastings GW. Acid-base complex reactions in resin-modified and conventional glass ionomer cements. J Biomed Mater Res. 1999;5:700-704.
10. Kawai K, Takaoka T. Fluoride, hydrogen ion, and HEMA release from light cured GIC restoratives. Am J Dent. 2002;15:149-152.
11. Menon T, Kumar CP, Dinesh K. Antibacterial activity of glass-ionomer restorative cements and polyacid modified composite resin against cariogenic bacteria. Indian J Med Microbiol. 2006;24:150-151.
12. Mitra SB. In vitro fluoride release from a light-cured glass ionomer liner/base. J Dent Res. 1991;70:75-78.
13. Ruiz J, Mitra S. Using cavity liners with direct posterior composite restorations. Compend Contin Educ Dent. 2006;27:347-351.
14. Irie M, Suzuki K, Watts DC. Marginal gap formation of light activated restorative materials:effects of immediate setting shrinkage and bond strength. Dent Mater. 2002;18:203-210.
15. Osorio R, Toledano M, Osorio K, Tay FR. Longevity of bonds made by composite and polyacid modified resins to dentin using a dual cure adhesive system. Am J Dent. 2005;18:19-22.
16. Lopes CL, Perdigao J, Lopes MF, Veira LC, Baratieri LN, Monteiro S. Dentin Bond Strengths of Simplified Adhesives: Effect of Dentin Depth. Compend Contin Educ Dent. 2006;27:340-345.
17. Pimenta LA, Amaral CM, Bedran de Castro AK, Ritter AV. Stability of dentin bond strengths using different bonding after 12 months: total-etch, deproteinization, and self-etching. Op Dent. 2004;29:592-598.
18. Haj-Ali R, Walker M, Williams K, et al. Histomorphologic characterization of non-carious and caries-affected dentin/adhesive interfaces. J Prosthodont. 2006;15:82-88.

@ARTICLECATEGORY:587;