When it comes to bases, bondings, and build-ups, glass ionomer cements are the restorative material of choice to replace dentin.

One of the best "well-kept secrets" in this day of dentin adhesive dentistry is the use of glass ionomer cements (GICs) in both the direct and indirect restorative processes. Since their discovery, GICs have been one of the most widely researched of all dental materials. In many countries of the world, GIC presents the restorative material of choice, because of its low cost and anticariogenic properties. According to Dr. Hien Ngo, glass ionomer cement forms a "chemically fused seal to dentin" that many regard as superior to dentin adhesive technology.

Universal dentin replacement
There is some truth behind the high regard. Some argue that the dentin bond hydrolyzes with time, allowing microleakage to occur. Others even say that the dentin bond doesn't work, or that bonded restorative material to enamel has to be cut off, while material bonded to dentin can be "popped off." This is partly true. However, an important clinical distinction should be made: There is "good" dentin for bonding, as well as "bad" dentin. Good dentin is dentin close to the dentinoenamel junction that has fewer dentinal tubules per square millimeter, therefore leaving more peritubular dentin to demineralize through the acid-etch process. In turn, this creates a very good micromechanical surface for the bonding of adhesive resins. On the other hand, bad dentin includes deeper excavated areas close to the dental pulp, Class V cervical areas, sclerotic dentin, and deep Class II proximal boxes without an "enamel rim." These all are areas where the dentin bond does not perform as well, leading to the possibility of recurrent decay and marginal failure of the restorative material.

As a clinician, it is important to differentiate between good and bad dentin when choosing a material to seal a restorative interface. It is well accepted that glass ionomer cements seal bad dentin better than dentin bonding systems, and in areas of good dentin, dentin adhesives perform very well. Therefore, the key is to use the appropriate material where it performs best. Because of the challenges associated with the placement and finishing of glass ionomer materials and the resulting esthetics, it may be easy to overlook GIC as a direct restorative. However, as a liner or base (dentin replacement), GIC is hard to beat. Its coefficient of thermal expansion is the same as dentin, so GIC expands and contracts at the same rate as dentin.

The following presents some of the uses of glass ionomer cement in the fabrication of direct and indirect dental restorations.

Base/liner under restorations
Glass ionomer cements have been widely used as bases under restorative materials for some time. Some evidence suggests that glass ionomers, when placed over decalcified dentin substrate, can promote remineralization—even in carious areas. For this reason alone, many practitioners may desire to place glass ionomer in areas of deep carious excavation prior to placing restorative material. Also, GICs will bond to dentin without etching or removal of the smear layer. Some practitioners believe this may limit postoperative sensitivity in deep posterior carious lesions. It makes sense, then, that GIC would make an optimal liner or base under restorative materials; in fact, this so-called "sandwich technique" has been employed for many years. Nonetheless, the use of glass ionomer cements as bases always has been a bit techniquely sensitive. Finding that precise consistency

BASE/LINER UNDER RESTORATIONS
(1) This facial view of a maxillary central incisor with a Class V lesion shows an example of "bad" (sclerotic) dentin. (2) Fuji II LC is placed on the affected area and light cured. (3) A facial view of the completed restoration. After placement of the GIC, the remaining enamel was acid-etched, rinsed and air-dried.
of the cement base for packing traditionally has proven a challenge, because of the very short window of opportunity for handling the material prior to setting. Through the use of automix technology and the optimal handling characteristics of materials including Fuji II LC and Fuji IX (GC America), placement of glass ionomer bases has been greatly simplified. As a liner, a light cured GIC such as Fuji II LC can be placed over all dentin surfaces in a thin layer, then cured, as in Figs. 1-3.

For more bulk replacements of dentin, a material such as Fuji IX will present increased compressive strength at greater thicknesses (note Figs. 4-6).

Sandwich technique

The patient presented with an amalgam restoration that required replacement on tooth No. 14 due to recurrent decay on the occlusal and mesial proximal surfaces. It will be restored using composite resin with glass ionomer cement underneath as a “dentin substitute.”

Procedure

1. Remove the existing amalgam restoration along with any recurrent decay.
2. Condition the preparation using Fuji conditioner and rinse thoroughly with water.
3. Activate and mix the automix capsule per manufacturer’s instructions, and syringe the Fuji IX directly into the cavity preparation (Fig. 4).
4. Pack GIC material into the floor of the preparation with a non-serrated amalgam plugger (Fig. 5). Allow it to set.
5. Remove excess material using a bur and handpiece, and recreate the optimal internal form to the cavity preparation (Fig. 6). The material stays in the deep excavated areas of the preparation.
6. Etch the preparation with 37% phosphoric acid for 10-15 seconds, then rinse with water.
7. Evacuate excess moisture using high volume suction, taking care not to desiccate any remaining dentin not covered by the GIC base.
8. Place the 7th generation bonding resin (G-Bond, GC America) into the cavity preparation and agitate it using the microbrush. This ensures penetration into the demineralized tooth structure.
9. Evaporate the solvent (carrier) by directing air spray across the cavity preparation, then light cure the adhesive for 20 seconds.
10. Incrementally place the composite restorative material (Gradia Direct, GC America). Next, using a plastic filling instrument, sculpt the material to proper occlusal form.

Note: Use an artist’s brush dipped in resin to further smooth and pull the composite material toward the cavosurface margins. This step reduces the amount of marginal finishing with carbide burs because of the ready adaptation of the resin-tooth interface.
11. Light cure the facial increment per manufacturer’s instructions. Afterward, sculpt both facial and lingual
12. Remove the rubber dam and check the occlusion with articulation paper. In this case, a minor adjustment is made using an interproximal composite finishing diamond.

13. Polish the restoration using rubber abrasive polishing points. In this case, the final polishing step is accomplished using an Occlibrush (Kerr Hawe).

14. Re-etch, rinse and dry the restoration, and brush on composite surface sealant. Light cure the sealant to complete the restorative process. Figure 7 shows the completed restoration of tooth No. 14, based with Fuji IX and restored with composite resin Gradia Direct.

**GICs as a build-up or foundation**

Before placement of a new restoration, such as a full crown, applying a foundation-type material often is required after the removing defective restorations and associated recurrent decay. The clinical success of these build-ups depends on the amount of healthy tooth structure remaining after preparation. One or two missing cusps usually can be replaced without a problem using a dentin substitute material. However, when more than two cusps are missing, solid dentin should remain at least 2 mm to 3 mm apical to the prepared area for a ferrule effect; otherwise, intentional endodontics and the use of more durable or traditional core materials would be indicated. “Flat-top” type preparations are contraindicated for this technique, because their lack of retention and resistance create too much lateral stress on the tooth, thereby causing a potential adhesive failure.

Note that foundation materials are not designed to withstand the forces of occlusion and therefore, require placement of a more durable restorative material atop them. For many years, dental amalgam was used for this purpose, but its use required a minimum of 24 hours before the preparation for the crown could be done. This meant an extra visit for the patient to complete a crown replacement.

With the development of GICs, dentists could both build-up and prepare the tooth during the same visit. The physical properties of GIC as a dentin replacement quickly led to its widespread use as crown build-up material. More recently, many other kinds of bis-GMA-based composite resins have been developed for use as core build-up materials. However, these require the extra steps associated with adhesive dentistry, including rubber dam isolation...
Glass ionomer cements remain a simple, cost-effective way to build up lost tooth structure before indirect restorative placement. GICs bond to dentin and demonstrate compressive and tensile strengths sufficient for use as a foundation restorative material, when indicated. Figure 8 shows a quadrant after cavity preparation and prior to dentin replacement with GIC. Figure 9 shows glass ionomer buildups in tooth Nos. 3-6. Note that tooth No. 4 had endodontic treatment with a fiber resin post before the glass ionomer placement, and a core form is used to place aid in shaping the GIC that is replacing coronal tooth structure.

The following case describes the use of Fuji IX GP as a core build-up material when preparing a tooth for full coverage. Note: Fuji IX GP and Fuji IX GP Extra are part of a newer class of glass ionomer restorative materials formulated to be more user-friendly than prior generations. Traditionally, when using GIC as a build-up material, mixing the powder and liquid to the consistency necessary for packing the material to place has left an extremely short working time for manipulation before setting. Often, this would adversely affect the build-up, resulting in inadequate bonding and adaptation to the dentin surface.

The improved packability of Fuji IX GP has helped eliminate this problem. The precapsulated mixture is triturated and can be easily manipulated and packed into the cavity while ensuring ample working time. The non-sticky, non-slumping, packable mixture adapts readily to the internal aspects of the preparation.
Use of a rubber dam is optional, as the restorative material allows bonding to a moist, conditioned enamel and dentin. The following is a technique for placing a core build-up using Fuji IX GP in a mandibular molar that required replacement of an existing Class II amalgam restoration.

**Proximal amalgam as matrix**

*Figure 10* shows an occlusal view of tooth No. 19. The patient’s existing Class II distoocclusal amalgam exhibited recurrent decay in the interproximal areas adjacent to the gingival margin. Recurrent decay appeared to be undermining the distobuccal, distal, and distolingual cusps. Also,
vertical fractures extended from the restoration toward the buccal and lingual surfaces. A Class I buccal pit amalgam also was present, with a fracture extending between it and the occlusal portion of the Class II restoration.

The amount of healthy tooth structure remaining after removal of the restorative material resulted in the need for a full-coverage restoration, and Fuji IX GP was chosen for a core build-up. Ordinarily, removal of a Class II amalgam requires the use of a matrix to confine the build-up material during condensation. However, an effective technique that saves time and eliminates an extra step involves using the proximal amalgam as its own matrix.

Procedure
1. Remove the Class II amalgam from the occlusal portion of the preparation, leaving a thin portion of the marginal material in place.

2. Complete the excavation and remove the caries. Note: The thickness of this “amalgam matrix” should be less than the proposed interproximal margin (Fig. 11). As a result, after completing the proximal preparation, the amalgam matrix should be gone, leaving only build-up material on the axial wall.

3. Next, apply the cavity conditioner (supplied with the Fuji IX GP) to the enamel and dentin surfaces for 10 seconds, and rinse with water. Blot away any excess moisture with a cotton pellet or sponge.

4. Mix the GIC and dispense it into the cavity preparation. Note how well the amalgam matrix contains the material.

5. Use a nonserrated amalgam plugger to pack the glass ionomer build-up material into place (Fig. 12). Note: The Class I buccal pit is filled at this time as well. Clinicians should wait approximately 6 minutes for the material to completely set before initiating crown preparation. (If Fuji IX GP Fast material is used, preparation can begin in approximately 2½ minutes).

6. The amalgam matrix has disappeared, leaving a 1-mm rounded shoulder and glass ionomer material only on the dis- toxial surface. After completing the preparation’s lingual and mesial surfaces, the crown preparation using glass ionomer build-up material is complete...and ready for a final impression (Fig. 13).

Well-versed and versatile
In this article, we have discussed some of the many uses for GICs in the restorative process as it relates to dentin replacement prior to coverage with another restorative material. But keep in mind that glass ionomer material can serve as a definitive restoration in some cases, as in primary teeth. In addition, GICs can prove useful for long-term provisionalization in cases of caries management, while the disease process is brought under control. Glass ionomer cements are among the indispensable materials...true “secret weapons” in the restorative armamentarium.

References
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