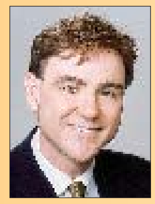
Clinical Success Using A Low-Shrinkage Composite



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The integrity of the bond and the marginal adaptation to tooth structure are critical for clinical success in posterior composite restorations.[1] In a restorative procedure using composite resins, the polymerization reaction of the resin matrix phase could compromise dimensional stability. Shrinkage stress, caused by polymerization, may be the origin of many clinical challenges encountered with adhesive restorations in clinical dentistry. Such challenges include microleakage, marginal breakdown, fractures, secondary caries, postoperative sensitivity, inadequate marginal adaptation, staining, and pulpal irritation.[2] Acknowledgment of these obstacles, together with the development of an optimal protocol for placing posterior composite restorations, enhances serviceability of posterior composite resins in the oral cavity. A successful restorative procedure for posterior composite resins relies on the interrelation of the clinician's skills, cavity design isolation, occlusion, material selected, and compliance of the patient. The fundamental principles of this process require maintaining sound tooth structure, achieving a sterile, gap-free hybrid layer, and eliminating microleakage by securing a stress-free, tooth-restoration interface.

The key to stress relief lies within the complex interplay between polymerization and adhesion. Cross-linking resin monomers into polymers accounts for an unconstrained volumetric shrinkage of 2% to 5%.[3] The bond strength of the latest generation of dentin bonding agents is often superior to the cohesive strength of the substrate. Uncompensated forces may exceed the bond strength of the tooth-restoration interface, generating gap formation from a loss of adhesion.[4] Bacterial and fluid penetration through the marginal gaps may occur causing colonization of microorganisms, recurrent caries, and postoperative sensitivity with possible subsequent irritation of the pulp, all which effectuate clinical failures. To prevent destructive shrinkage stress and manage these undesirable effects, the following stress-reduction techniques should be considered when selecting restorative materials that are subject to shrinkage:

- Selective bonding in appropriate cavity configurations
- The application of liners and bases that acts as shock absorbers
- The reduction of light intensity from curing units
- Using combination of selective bonding and incremental layering of small increments composite resin.[5,6]

The use of low-shrinkage formulations of posterior hybrid composite may offer an additional clinical solution for stress-reduction for Class 1 and Class 2 restorations. Following is a clinical scenario describing the use of a low-shrinkage hybrid nanocomposite resin with an incremental layering technique for the replacement of a Class 2 amalgam restoration with defective margins and recurrent decay.

In a restorative procedure using composite resins, the polymerization reaction of the resin matrix phase could compromise dimensional stability.

Clinical Procedure

A 41-year-old woman presented with a defective amalgam restoration and recurrent decay on the mandibular right second bicuspid (Figure 1). The preparation was cleaned with a 2% chlorhexidine digluconate solution (Cavity Cleanser, Bisco Dental Products), rinsed, and lightly air-dried (Figure 2). The "total-etch" technique was used to minimize the potential of microleakage and enhance bond strength to dentin and enamel (Figure 3). The preparation was etched for 15 seconds with a 32% phosphoric acid semigel (Uni-Etch, Bisco Dental Products), rinsed for 5 seconds, and gently air-dried for 3 seconds. A single component adhesive (One-Step Plus, Bisco Dental Products) was applied with a disposable applicator for 10 seconds with continuous motion (Figure 4). Any excess adhesive was removed with an applicator, air-thinned for 10 seconds to evaporate excess solvent, and then light-cured for 10 seconds per surface. Although a small amount of excess adhesive can be applied over the margins to improve sealing, this excess should be removed during finishing procedures.

As a cavity liner, a radiopaque self-curing flowable composite resin (Bisfil 2B, Bisco Dental Products) was injected into the proximal box of the mandibular right second bicuspid with a Centrix needle tube (Centrix, Inc), and the syringe tip was slowly removed (Figure 5). The gingival increment was uniformly distributed with a ball-tipped instrument (M-1 TN) [**QA: Is this a generic product or does this have a specific manufacturer?**] after the needle tip was removed. It should remain apical to the contact area. If the gingival margins of the proximal box are apical to the cemento-enamel junction, a self-curing flowable composite resin placed in this region will ensure a more complete cure.

The cavity preparation was filled incrementally using an A 2-LS shaded hybrid composite (Aelite LS, Bisco Dental Products) and a ball-tipped instrument (M-1 TN) (Figures 6A and 6B). An oblique layering of the hybrid in increments of 1 mm and feathering the material up the cavity wall "V" shape with a curved instrument may reduce cuspal flexure [**QA: Edit okay?**].

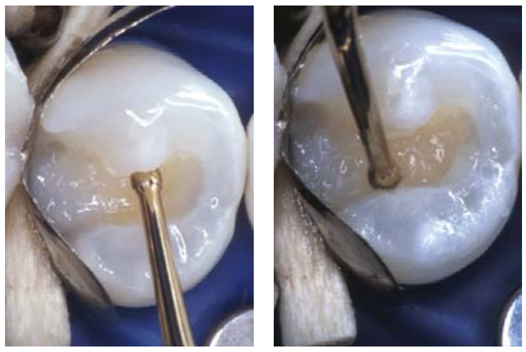
Figure 1—The patient presented with a defective amalgam restoration and recurrent decay on the mandibular right second bicuspid.

Figure 2—The preparation was cleaned with a 2% chlorhexidine-digluconate solution, rinsed, and lightly air-dried.

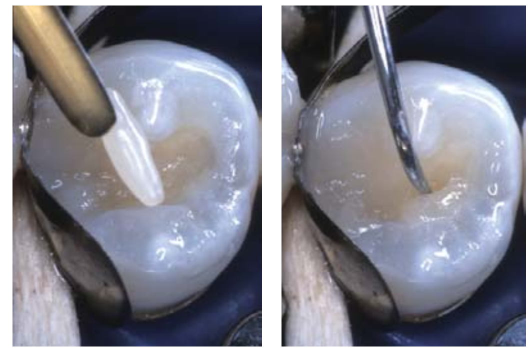
Figure 3—The "total-etch" technique was used to minimize the potential of microleakage and enhance bond strength to dentin and enamel.

Figure 4—A single component adhesive was applied with disposable applicator for 10 seconds with continuous motion.

Figure 5—A radiopaque self-curing flowable composite resin was injected into the proximal box of the mandibular right second bicuspid with a Centrix needle tube.



Figures 6A and 6B—The cavity preparation was filled incrementally, using an A 2-PLS shaded hybrid composite and a ball-tipped instrument.



Figures 7A and 7B—An initial enamel layer of A1-E shaded hybrid composite was applied with an interproximal instrument and invaginated with an explorer creating developmental groove while the material was still soft.

The composite increments were applied in an oblique layer and light-cured for 15 seconds through the cusp, and the original cavity floor became part of the cavity walls. Increments should be light-cured for the amount of time specified in the curing chart.

An initial enamel layer of A1-E shaded hybrid composite was applied with an interproximal instrument and invaginated with an explorer (ODU 11/12 Hu-Friedy Manufacturing Company, Inc) creating a developmental groove while the material was still soft (Figures 7A and 7B).

To create the illusion of occlusal fissure staining, an ochre tint was placed into the developmental groove with a 0.08 endodontic file.

To create the illusion of occlusal fissure staining, an ochre tint was placed into the developmental groove with a 0.08 endodontic file (Figure 8). The serrations of a clean endodontic file were used to enfold the layers, compressing the layers together, which caused a narrowing of the invagination and allowed the stain to migrate to the occlusal. This created a fine line of stain from the base of the invagination to the occlusal surface. This allows intraoral adjustment without the loss of internal characterization.

The final enamel layer, a clear translucent shaded nanofilled hybrid composite (incisal clear [Aelite LS]) was applied with a long bladed interproximal instrument and smoothed with a No. 4 sable brush to the functional and anatomical occlusal morphology (Figure 9). The completed restoration demonstrates the harmonious integration of composite resin with natural tooth structure in the interproximal zone (Figure 10).

The completed restoration demonstrates the harmonious integration of composite resin with natural tooth structure in the interproximal zone

Figure 8—An ochre tint was placed into the developmental groove with a 0.08 endodontic file.

Figure 9—The final enamel layer was applied with a long bladed interproximal instrument and smoothed with a No. 4 sable brush to the functional and anatomical occlusal morphology.

Figure 10—The completed restoration.

Conclusion

The complex interrelation between polymerization shrinkage and adhesion requires the clinician to use appropriate application techniques in combination with newer formulations of restorative materials. Although the long-term benefits of these low-shrinkage composites remain to be determined through clinical studies, the clinical results described demonstrated enhanced sculptability, the strength of a hybrid, and the polishability of a microfill combined with the ability to simulate the optical properties of the natural dentition. ■

References

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