Return to the Resin-Modified Glass–Ionomer Cement Sandwich Technique

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"Clinical Showcase" is a series of pictorial essays that focus on the technical art of clinical dentistry. The section features step-by-step case demonstrations of clinical problems encountered in dental practice. If you would like to propose a case or recommend a clinician who could contribute to this section, contact editor-in-chief Dr. John O'Keefe at jokeefe@cda-adc.ca.

One of the critical goals of adhesive dentistry is to restore the peripheral seal of dentin that is interrupted when enamel is lost as a result of developmental sequelae, trauma, caries or operative intervention such as preparatory excision. For coronal lesions the exposed strata may be bounded by dentin, enamel or both. Manufacturers continue to work vigorously on resin formulations that will restore this peripheral seal with operative ease and absolute durability.

Enamel Bond

The bond between resin and enamel is generally satisfactory. Most clinicians report that it is possible to achieve seemingly impeccable margins at the visible cavosurfaces when restoring posterior teeth with a direct composite-resin technique. Clinical experience, however, reveals that these resin–tooth interfaces deteriorate as they age. More pertinently, in vitro studies have revealed the formidable challenge of achieving a predictable seal at the proximal margins when tooth-coloured restorations are used.[1]

Dentin Bond

The bond between resin and dentin has been more of a challenge, and numerous generations of resin-bonding agents have been energetically touted as the ultimate dentin bonding agent. Regrettably, predictability of outcome has been trumped by simplicity of application; as a result, the newer bonding agents are certainly simple to use (one bottle; separate etching, priming and rinsing not required) but are no better (in fact, they are far worse) than the 3-bottle systems of the 1990s. For dentin bonding, it appears far easier to achieve a seal than to maintain it, and in vivo studies have confirmed that resin–dentin bonds degrade in the oral cavity.[2]

Figure 1: Preoperative view shows lesions approximal to teeth 15 and 16. The patient requested a direct tooth-coloured restoration.

Figure 2: When restoring 2 approximal lesions containing sound marginal ridges, it is prudent to gain access through the tooth that displays the largest lesion radiographically. Accordingly, a pear-shaped diamond FG 830 drill (Axis Dental, Irving, Texas) was used to penetrate through the enamel of the second premolar.

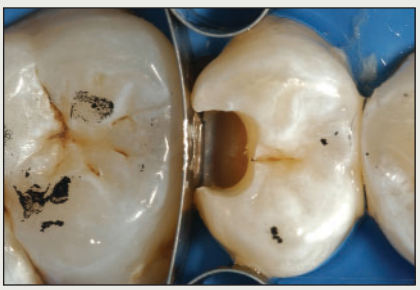

Figure 3: A stainless steel protective matrix (InterGuard, Ultradent, South Jordan, Utah) was used during removal of the caries to preserve those portions of the adjacent tooth that were sound. A round #6 carbide bur was used for the bulk of the excision.

Figure 4: Intraoperative view of caries removal. The depth of the premolar lesion has approached the cementoenamel junction, and the molar has a substantial rim of enamel along the gingival margin.

Figure 5: A wooden wedge is inserted in such a way that it depresses the interproximal tissue, revealing the extent of the decay. Round burs are then used to remove the decay; the wooden wedge serves as a buttress to limit the action of the bur during refinement of the margin.

Figure 6: A curved AutoMatrix retainerless band (Dentsply, Woodbridge, Ont.) is placed in a circumferential position, and a wedge is put into place before the separating ring is applied. The separating ring will provide interproximal separation, and the wedge will affect matrix adaptation as it is pressed into the proximal space along the gingival margin.

Figure 7: When a G-Ring (Garrison Dental Solutions, Spring Lake, Mich.) is applied, the curve of the matrix becomes distorted. Because the position and form of the matrix will determine the outline of the definitive restoration, it is important to refine the curve of the matrix before placing the restorative material.

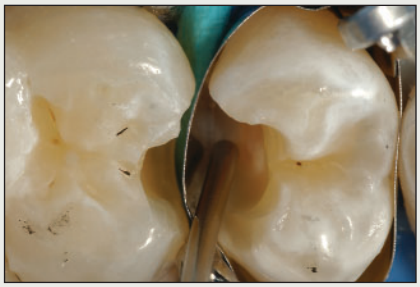

Figure 8: A thin burnishing instrument is inserted between the lingual surface of the premolar and the matrix and is manipulated to pull the matrix out of the proximal convexity. The instrument is then inserted to the proximal depth, and a burnishing action is used to re-form the matrix to an ideal physiological curve.

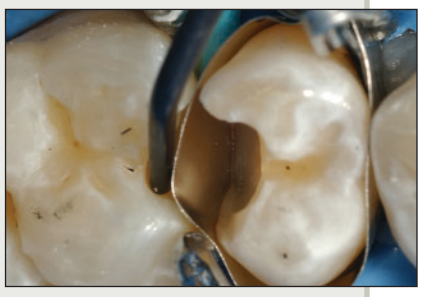

Figure 9: It is time well spent to adjust the matrix by applying burnishing actions on both sides until the ideal curve is attained. It is far more time consuming (and destructive to the restorative interface) to attempt to change the proximal contour once the composite resin has been polymerized.

Enamel Protecting Dentin

Several authors have concluded that resin bonded to enamel protects the resin–dentin bond against degradation.[3] It follows from the data on the bond to enamel and dentin that the reliability of adhesion depends on the peripheral seal to the enamel.

The Problem

For a lesion that is entirely bounded by enamel (i.e., an intra-enamel lesion), preserving the dentin seal becomes a matter of establishing a lasting interface between the resin and the enamel. Unfortunately, not all lesions are of this type, and posterior proximal lesions commonly have gingival margins bounded by dentin. The strength and quality of the peripheral seal is therefore compromised and is susceptible to hydrolytic degradation.

The Solution

For a posterior tooth with a proximal margin that extends apical to the cementoenamel junction and for which a direct tooth-coloured restoration is planned, the solution is the open-sandwich technique. This technique is not new,[4] but it deserves to be revisited, given the commercial proclivity

Figure 10: A 10% polyacrylic acid is applied to remove the smear layer in preparation for application of the sandwich layer of the resin-modified glass–ionomer cement (RMGIC).

Figure 11: A Fuji II LC (GC America, Alsip, Ill.) RMGIC is extruded into position. An effort is made to apply the RMGIC as accurately as possible to avoid placing it on the occlusal cavosurface margins.

Figure 12: Once the RMGIC has been polymerized, the entire cavity is etched with phosphoric acid in preparation for the composite resin restoration. The etchant can come into contact with the RMGIC without deleterious affect on the bond to the overlying composite resin.

Figure 13: The author prefers a minimum of 4 consecutive coatings of adhesive resin on dentin when using total-etch adhesives such as Single Bond (3M ESPE, St. Paul, Minn.). This simple change in the bonding technique can improve the strength of the resin–dentin bond and reduce nano-leakage.[8]

Figure 14: The first increment of composite resin shade A1. The separating ring has been removed to accommodate a slight vertical movement of the matrix so that the margin can be slightly overextended.

Figure 15: The final occlusal increment is shaped into the correct occlusal form using fine composite instruments such as the Flexichange line (Dentsply). Note that no attempt was made to round the distal marginal ridge before polymerization.

toward simplification and the inability of many of the newer materials to bond reliably and permanently to the diverse and compromised dentin substrates that clinicians encounter in clinical practice. Traditionally, the filler of the "sandwich" was a glass–ionomer cement, but resin-modified glass–ionomer cements (RMGIC) have superior mechanical properties and bonding strength to dentin.[5] A previous study investigating the durability and cariostatic effect of a modified open-sandwich restoration using an RMGIC concluded that it had acceptable durability for the extensive restorations evaluated.[6] Furthermore, the open-sandwich technique allows the least amount of microleakage of the various direct restorative options currently available.[7]

The Technique

After removal of the caries and placement of the matrix, the tooth is conditioned with polyacrylic acid according to the manufacturer's directions. A single gingival increment of RMGIC is applied by syringe and is allowed to cure or is subjected to light polymerization. The restoration is then completed with composite resin (**Figs. 1** to **21**).

Figure 16: The band is disconnected, and excess composite along the axial margins is removed with finishing disks. The disks are inserted laterally into the proximal space and are used to cut back the excess marginal height.

Figure 17: The tip of an Enhance polishing point (Dentsply Caulk, Milford, Del.) is used to reduce the marginal ridge along the interior to maintain physiological roundness occlusally.

Figure 18: Completed RMGIC sandwich restoration on the premolar. Note the absence of sharp angles and the marginal ridge created by the disk (used on the external surface) and polishing point (used on the internal surface).

Figure 19: A BiTine ring (Dentsply Caulk) and anatomically precontoured Palodent matrix (Dentsply Caulk) were used to restore the proximal border of the first molar. The sandwich technique was not needed here, as there was a rim of enamel circumferential to the lesion.

Figure 20: The matrix is reflected alongside the premolar to allow protective access for finishing the axial surfaces of the molar with the disk. The reflected matrix prevents inadvertent gouging of the proximally restored tooth.

Figure 21: Completed restorations display the appropriate physiological contours. The interfacial (resin–enamel) marginal fidelity is a consequence of the meticulous finishing sequence.

Figure 22: Postoperative view of the restorations 26 months later. In spite of meticulous attention to detail, close examination reveals a slight loss of marginal integrity along the enamel–resin margin. Overall, however, the physiological form has been maintained.

Lessons to be Learned

The case illustrated here was specifically chosen to demonstrate how the immediate marginal integrity (**Fig. 21**) will invariably deteriorate with time (**Fig. 22**). Studies have confirmed that the visible margins have lower leakage scores than those of the proximal gingival margins, which validates the additional effort involved in performing the sandwich technique. Currently available dentin bonding agents can maintain the peripheral seal that is integral to all adhesive procedures only if the seal is bounded by enamel. It is therefore recommended that the sandwich technique be the restoration of choice when proximal gingival margins extend beyond the cementoenamel junction.

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Dr. Liebenberg will be one of the presenters at the Ontario Dental Association Annual Spring Meeting in 2006. His full-day session, titled "Posterior Restorative Excellence: A Potpourri of Procedural Innovations," will take place on Saturday, April 8.