CLINICAL ROUNDTABLE

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Question:
Should RMGI liners be used in the placement of direct composites?

DR. ALEX

The short answer to this question is yes. It certainly appears to makes sense that either a flowable composite or a resin-modified glass ionomer (RMGI) liner be placed in a thin layer under direct composite restorations. For one thing, both of these relatively low-viscosity materials have the potential to act as good "wetting" agents before placement of more heavily filled and viscous composite restoratives. Said another way, flowable composites and RMGI liners adapt more easily to the topography of the cavity preparation, essentially getting into all the "nooks and crannies" of the preparation more easily than higher-modulus composite restoratives can on their own. Another potential, albeit controversial, benefit of both flowable composites and RMGI liners is they both have a relatively low elastic modulus (are flexible) that may help attenuate shrinkage stress from subsequently placed heavily filled composite restoratives.

While both flowable composites and RMGI liners are being used successfully under composite restorations, my opinion is that RMGIs potentially offer distinct advantages over flowables, and my preference is the routine use of an RMGI liner under composites. For one thing, numerous in vivo and in vitro studies demonstrate the superiority of RMGIs over dentin bonding agent (DBA)/flowable composite combinations in terms of controlling dentin microleakage. For another thing, a RMGI liner is placed on the dentin before placement of a DBA, while a flowable composite is placed after placement of a DBA. As a consequence, the success of a flowable composite is highly contingent of the abilities of the practitioner to first correctly place a DBA. Placing an RMGI liner (before placing a DBA) may be more forgiving in this regard because RMGI liners are designed to interact directly with dentin. Also, a potential benefit not often mentioned in regard to the use of RMGI liners, is that because a significant amount (often all) of the dentin is covered by the RMGI liner before placing a DBA, the whole issue of "wet" bonding for those choosing to use a total-etch bonding technique (after the RMGI is placed) is not much of an issue at all. The dentin already is covered/protected by the RMGI liner. RMGI liners are also simple to mix and place, release high, sustained levels of fluoride, have significant antimicrobial properties, evidence very low solubility, and exhibit a favorable modulus of elasticity and coefficient of thermal expansion and contraction (similar to that of dentin).

While more research is needed to clearly show the benefits of either an RMGI liner over a flowable material, or vice versa,at this time my personal belief is that RMGI liners should be used under direct composite restorations.

DR. KUTSCH

This is a good question, and there are several issues to consider. The short answer is yes, and routinely. And maybe even auto-cure glass ionomer cements (GICs) should be considered as well. Scientific studies indicate there are several challenging issues with direct resin bonding of composite restorations.

1. Achieving a successful dentin–resin bond is technique sensitive, although I think the self-etching systems have improved this issue.
2. The dentinal tubules are parallel to the preparation surface in the base of a box- or slot-type preparation, which leads to poor adaptation of the materials and leakage at the gingival margin of box or slot preparations. While this has been demonstrated in research, there is no conclusion to its effect on the long-term success of the restorations clinically.
3. Composite shrinks volumetrically and, the greater the bulk of filling material, the greater the stress and shrinkage at the gingival margin. C-factors also play a significant role and must be addressed.
4. As a result of these issues, many clinicians have a problem with post-insertion sensitivity.

On the other side, scientific studies also show that the use of resin-modified GIC (RMGIC) improves these same issues.

1. The use of RMGIC as a liner is much less technique-sensitive to achieve a successful dentin bond. The material actually creates a true hybrid layer that acts as a biologic and chemical seal. Interestingly, use of a dentin bonding system with an RMGIC improves the shear strength of the bond as well.
2. By the nature of the acidic RMGIC creating a true hybrid layer when it interacts with dentin, it does not matter what direction the dentinal tubules are in relationship to the restoration interface, and there is better marginal adaptation with less microleakage on these materials at the gingival margin on box and slot preparations.
3. By replacing the dentin with RMGIC, the bulk of composite needed is much smaller, reducing the overall volumetric shrinkage of the restoration and stress applied to the bond. It is also so easy to reduce the C-factors when placing the composite.
4. It is clear that there is less dentin sensitivity when using RMGIC as a liner.

RMGIC also has the advantage of releasing fluoride, which is particularly advantageous for high caries-risk patients. The only two clinical challenges I see with using RMGIC as a liner are it adds additional steps in the procedure and it can be tricky to place in smaller preparations. I would conclude by saying the benefits largely outweigh these concerns. So, the long answer is also yes, and routinely, based on the known science and my clinical experience.

DR. TERRY

Use of an RMGI as an intermediate dentin layer has been suggested as a method to improve marginal integrity and enhance internal adaptation of a directly placed high-viscosity composite resin. There may be several benefits for using RMGI liners in the placement of direct composite resins. To begin with, these biomaterials are multifunctional molecules that can adhere to both tooth structure and composite resin, thus providing an improved sealing ability by chemical or micromechanical adhesion to enamel, dentin, cementum, and composite resin.[1] Secondly, RMGIs placed beneath composite resin restorations reduce the interfacial stresses by decreasing the volume of composite necessary to restore the preparation.

Thirdly, the strength of these biomaterials is more cohesive than adhesive and, thus, failure is more likely to occur within the bulk of the glass ionomer than at the dentin interface. This characteristic provides protection to underlying dentin and,

thus, sustains a marginal seal, which helps prevent ingress of bacteria. Also, the glass ionomer intermediate layer provides flexibility during functional loading and acts as a stress absorber at the interface of the restoration and the tooth. Furthermore, while RMGICs may undergo slight internal fracturing from polymerization shrinkage, they have an ability to renew broken bonds and reshape to enforced new forms.[2] This characteristic provides cavity-sealing properties, internal adaptation, and resistance to microleakage over extended periods of time.[3] Finally, although RMGIs have a coefficient of thermal expansion slightly higher than conventional glass ionomers, research has shown no significant clinical difference in microleakage.[4] This characteristic—the materials expand and contract similar to the adjacent tooth structure—is the reason for their excellent marginal adaptation that reduces the potential of gap formation and microleakage between the tooth and restoration.[5]

Although great advancements have occurred in the development of adhesive systems and their effectiveness in bonding composite resin to enamel and dentin, there is still a concern for minimizing clinical challenges related to microleakage and secondary caries. When compared with glass ionomers, composite resins possess superior fracture toughness, wear resistance, and polishability. RMGIs, on the other hand, have lower thermal expansion, setting shrinkage, hydrophilic qualities, and a therapeutic fluoride release effect. The sandwich technique may be a practical method for combining the requisites of these two materials. This technique unites the unique characteristics of both biomaterials to form a monolithic restoration with complete reinforcement of the tooth. This concept, based on the principles of biomimesis, was first introduced and advocated by McLean and Wilson.[6-8] The procedure involves replacement of the dentin with an intermediate layer of GIC while a bonded resin-based composite is used as the enamel substitute;[9] this is called the open-sandwich technique.[10-12] This technique allows placement of the glass ionomer to cover most of the exposed dentin and extend to the external surface of the restoration (ie, the proximal box of a class II restoration). Such a procedure results in causing the glass ionomer to be exposed to the oral environment in the gingival region, thereby forming the cervical seal.[13] The ion exchange on the outer surface of the GIC with the tooth structure at the cavity margin provides remineralization of affected dentin while inhibiting the demineralization of tooth structures adjacent to the restoration.[14] Concerns regarding the potential for eventual dissolution of the exposed glass ionomer have been offered.[15] An alternative procedure, identified as the closed-sandwich technique, allows placement of GIC so that it replaces and covers the dentin while being completely contained by the overlying composite resin. This technique can be used in moderate to large class I, class II tunnel preparations,[16,17] class III, and class V composite restorations.

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