Bioactive materials support proactive dental care

Resin bonding of the human dental hard tissues has become a "standard" in the United States and Canada. There are more than 80 different bonding systems on the market today. We have seen them evolve through multiple generations in an attempt to "simplify" the bonding process. Yet, as these agents have simplified, many in our profession have seen many challenges arise.

A significant number of reports in the literature have been showing that the "immediate bonding" effectiveness of conventional adhesives are quite favorable, regardless of the approach used in these studies in long term. The bonding effectiveness of some adhesives drops dramatically. The hydrophilicity that both etch-and-rinse and self-etch bonding agents offer initially in the dentin-bonding process becomes a significant disadvantage in terms of long-term durability.

It is this hydrophilicity of simplified adhesive systems combined with other operator-induced challenges that contribute to these failures. Tay, Carvalho, Pashley, et al have reported repeatedly in the literature that GICs are moisture-sensible materials, which makes them very sensible in use in the intraoral cavity. The transfer of dental fluids from the tooth to the GIC essentially creates a "self-trauma" mechanism of glass ionomer that serves to defluorify or blunt any cracks that attempt to propagate through the matrix and... plays an adjunctive role by obliterating porosities which delay the growth of inherent cracks in the GIC under loading.

The intermediate layer of the GIC provides flexibility during functional loading and acts as a stress absorber at the interface of the restoration and the tooth. The "sandwich technique" was developed.

It was thought that using the properties of GIC to bond to the tooth and then applying resin-bonding agents and composite to the set GIC could help reduce sensitivity and bond failure, typically seen in resin-bonded composite (RBC) techniques. Typically, the GIC is placed in the preparation allowed to set, cut back to ideal form and then bonded to with an RBC. However, the lack of ability of RBCs to adhere to the set GIC often creates many failures. The materials by themselves are incompatible over the long term. The modified sandwich technique evolved as a means to overcome this problem. Placing RBC over set GIC... and then adding a RBC to that... provided a better solution, but was laborious and time-consuming to do, as in the sandwich technique.

The 'Co-Cure Technique'

In 2006, an article was published that, in my opinion, has revolutionized the way I approach direct posterior restorations and direct restorations as a whole. The article presented a radical approach to direct posterior restorations, called the Co-Cure Technique. This technique involves the use of two self-activated composites that polymerize with the use of RMGIC products, such as Riva LC or Fuji II LC, which is a big breakthrough in the field of dentistry, especially in high caries prone patients (Figs. p. 9-12).

Class II restorations, however, have always presented a challenge to the clinician. If the operator wanted to use GIC or RMGIC, there was no easy way to do this that appeared to provide satisfactory results. It is with this in mind that the "sandwich technique" was developed.

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boding agent because the bonding agent is essentially the RMGIC. The RMGIC acts as the interface between the resin material and the dentin material. It combines the GIC, RMGIC, and comonomer in a way to form what can best be described as a “monolithic biomimetic restoration.” This is an “open sandwich” type of sandwich technique. That is, the GIC component is exposed to the oral cavity on the labial or gingival aspect (Fig 13) at the gingival portion of the restoration. It is quickly and efficiently accomplished by coalescing the resin on the reduced postoperative sensitiv- ity and with typical direct RBC techniques. I have been placing these types of direct posterior restorations since 2008. They have become the cornerstone of my practice.

Technique procedure (Fig 14)

After placement of an appropriate dentin matrix, the bonding agent incorporating the use of 57 percent phosphoric acid to prepare the tooth for the restoration. The acid is essentially “flooded” into the preparation in a similar manner to doing a “total etch” RBC technique. The tooth is then dried but not dis- tributed with an air-water spray. A plastic occlusal matrix by either can then be compressed gently with margins and prevent ditching and in an unfilled resin material (i.e., Riva to slightly overfill the preparation. Fill the preparation with the triple-agitation and utilization of these new materials used to form the restoration by creating a func- tionally occlusal plane. The restoration is then cured for 20 to 40 seconds with an LED curing light that generates at least 1,500 mw/cm². Appropriate light output is critical for all direct cured restora- tions, and assurance that appropriate light output is provided by the curing light is needed for complete cure of any direct restorative technique. The restoration is evaluated for com- plete cure and then a layer of an un- filled resin is placed on the exposed GIC/RMGIC/composite complex and cured for an additional 30 sec- onds. The matrix band is removed and the restoration is trimmed and polished as if any typical RBC restora- tion would be.

I have found that an entire three- surface posterior restoration can be accomplished in less than three minutes once the matrix has been placed. Typically, finishing the restora- tion can also be done in less than three minutes. This makes the direct posterior restoration quite efficient and beneficial to the clinician and the patient. The bonding agent is easy to use and will not require the addition of any accelerators or light. It is also envisioned that the incor- poration and utilization of these na- noparticles in the form of nanorods, nanospheres, nanotubes and oromoers (organically modified ceramics) into dental restorative and bonding agents could conceivably be life-like or bio- mimetic (life-like) restorations. This will not only enable these materials to mimic the structure and anatomy of the tooth structure, but will also be able to facilitate the remineralization of that structure. As Saunders states in his conclusion, “such nanocomposites could very credibly be the next trans- formative clinical leap” in restorative dentistry.

Giovanetti.

In addition, an exciting advance- ment in bioactive materials is the development of gionomer products (Shofu Dental, Beaur1l II, and Beau- turn Fill Plus). These gionomers are resin-based com- posites that contain pre-reacted glass ionomer particles (SGP). These particles are made of fluoro- silicate glass reacted with polyacrylic acid (just like a GIC), just before being incorporated into the resin. This cre- ates a new type of bioactive material. These gionomers appear to benefit the patients in a manner similiar to the traditional approach of using RMGICs. The nanoparticles in the bioactive nature of all the co-cure bonding agent. The Shofu Dental Bioturn Plus product line has also expanded the way that we cre- ate restorations due to their unique properties. These materials can be stacked (Fig 15) and used in a restora- tive process I call the “modified resin composite technique” (Fig 16). They can also be applied to create direct composite veneers that can be easily placed, sculpted and highly polished (Fig 17). Easy placement, the ability to maintain the position and shape, plus the bioac- tive nature, make these materials a “game changer.”

Resin-modified, light-cured bonding agents

Another advancement that I have been working with is a product that is a resin-modified, light-cured bonding agent (SDI, North America: Rinov Bond LC). This product is a specially formulated liquid RMGIC that can be used to bond composite restora- tions in the traditional sense; used in traditional sandwich and modified sandwich techniques and, of course, used in the Co-Cure Technique. This concept is especially appealing in light of the research that indicates RMGICs provide superior seal and margin- al seal when used as a bonding agent on cut dentin surfaces.1-4 It is, however, required to use it with a conventional tech- nique and when doing anterior restor- ations. Using this technique I am able to complete a biocomposite-bioactive restoration in both situations because of the biocompatibility of the materials used. The technique for use of this RMGIC follows as composite with the following steps:

1) Etch with 37 percent phosphoric acid for 15 seconds. 2) Wash and dry but do not desiccate. 3) Triitate and apply the RMGIC bonding agent with a micro-brush and cure for 20 seconds. 4) Face composite to fill the prepara- tion and cure as appropriate. When I use this material in the Co-Cure Technique, I substitute it for the traditional RMGIC material that I would have used otherwise.

References

5. R. A. Forton, J. A. Tsimplis, & R. J. Yew. Adhesive—Bonded dentin composite repair systems and that learning and incor- porating these into the day-to-day provision of care to continue to help our patients with our practices and our profession.

The full list of references is available from the publisher.