Bioactive materials support proactive dental care

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By John C. Comisi, DDS, MAGD

Resin bonding of the human denti-
tion has become a “standard” in the United States and Canada. There are more than 80 different bonding sys-
tems on the market today. We have seen them evolve through multiple generations in an attempt to “simpl-
ify” 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” effec-
tiveness of contemporary adhesives is quite favorable, regardless of the approach used [however] in the long term, the bonding effective-
ness of some adhesives drops dra-
tically.1,2 The hydrophillicity that both etch-and-rinse and self-etch bonding agents offer initially in the dentin-bonding process becomes a significant disadvantage in terms of longterm durability.3

It is this hydrophillicity of simplified adhesive systems combined with other operator-induced challenges that contribute to these failures.4

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dipal and anterior Class V restorations, especially in high caries prone pa-
tients (Figs. 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 pro-
vide satisfactory results. It is with this in mind that the “sandwich tech-
nique” 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 intractability of GICs to the set GIC often creates many failures. The materials by themselves are incom-
patible over the long term. The modified sandwich technique evolved as a means to overcome this problem. Placing RMGIC over set GIC — and then adding a RBC to that — provided a better solution, but was as laborious and time consuming to do, as is the sandwich technique.

The ‘Co-Cure Technique’

In 2006, an article was published4 that, in my opinion, has revolution-
ized the way I approach direct posterior restorations and direct restorations as a whole. The article presented a radical approach to di-
rect posterior restorations, called the Co-Cure Technique. This technique is the polymerization of two different light active materials that involves “the sequential luting of CIC, RMGIC and composite resin prior to photo polymerization and be-
cause of the GIC’s [which] enables an efficient single-visit place-
ment of a [direct] restoration.” In the Co-Cure Technique, the com-
posite restoration does not require a

GP Extra (GC America) in posterior Class I and V restorations (Figs. 1–7). Polishing and shaping of the restora-
tials must be done with water spray finishing burrs and polishers so as not to destroy the surface of the material as it is applied.11

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bonding agent because the bonding agent is essentially the RMGIC. The RMGIC acts as the interface between the different restorative materials. It combines the GIC, RMGIC, and composite in a way to form what can best be described as a "monolithic biomimetic restoration." This restoration is an "open sandwich" type of sandwich technique. That is, the GIC component is exposed to the environment (Fig. 15) at the gingival portion of the restoration. It is quickly and efficiently accomplished with the use of a reduced postoperative sensitiv- ity protocol and typical direct RBC techniques. I have been placing these types of direct posterior restorations since 2007 and have become the cornerstone of my practice.

Technique procedure (Fig. 14)
After placement of an appropriate dental matrix, the technician incor- porates the use of 37 percent phosphoric acid to prepare the tooth for the restorations. The acid is essentially “flooded” into the preparation in a similar manner to doing a "total etch" RBC technique. The tooth is then dried and desiccated for five to ten minutes. The matrix is then finely contoured with a diamond bur before being pretreated with an etchant. Fill the preparation with the triturated GIC material up to the level of the matrix and cure. With a large round burnisher dipped in water, the excess GIC and composite are removed. The occlusal surface is flat cut away and polished (Fig 16).

It is also envisioned that the incor- poration and utilization of these na- noparticles in the form of nanorods, nanospheres, and nanocubes orormers (organoically modified ceramics) into dental restorative and bonding materials could enhance the bio- mimetic (life-like) restorations. This will not only enable these materials to mimic the natural anatomy of the tooth structure, but will also be able to facilitate the remineralization of that structure. As Saunders states in his conclusion, "such nano-reconstituent biomaterials could very credibly be the next trans- formative clinical leap" in restorative dentistry.

Gioner
In 2015, an exciting advance- ment in bioactive materials is the development of gioner products (Shofu Dental, Beauflull II, and Beau- troll Flow Plus). These products are resin-based com- posites that contain pre-reacted glass ionomer particles (IPG). 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 gioners have prop- erties in a manner similar to GICs. They release ions and react with the tooth structure to mimic plaque formation and neutralize and buffer the acids of the mouth. No other composite material has this property to date. I use these gioners instead of traditional nano-hybrid composite restorations in my restorations because of these properties. They complete the entire biomimetic and bioactive nature of all the co-cure protocols that I create. The Beauflull Flow Plus product line has also expanded the way that I cre- ate restorations due to their unique viscosities. These materials can be stacked (Fig. 17) and used in a restora- tive process I call the “modified resin com- posite technique” (Fig. 18). 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 position and shape, plus their 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 (3M, North America; Rio Bond LC). This product is a specially formulated liquid RMGIC that can be used to bond composite restorations 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 a wood margin- al seal when used as a bonding agent on cut dentin surfaces.1-7 It is also thought that these RMGICs are additional se- cretory phosphoprotein8 and when doing anterior res- torations. Using this technique I am able to get a completely biomimetic, bioactive restoration in both situa- tions because of the bioactive nature of the materials used. The technique for use of this RMGIC bonding agent with composite is as follows:

1. Etch with 37 percent phosphoric acid for 30 to 40 seconds with an LED curing light is needed for complete cure of any direct restorative material. The restoration is evaluated for com- plete cure and then a layer of un- filled resin is placed on the exposed GIC/RMGIC/composite complex and cured for an additional 10 sec- onds. The matrix band is removed and the restoration is trimmed and polished as any typical RBC restora- tion would be.

2. Wash and dry but do not desiccate. 3. Triturate and apply the RMGIC bonding agent with a micro-brush and cure for 20 seconds.

4. Place composite to fill the prepara- tion and cure as appropriate.

When I use this material in the Co- Cure Technique, I just substitute it for the traditional RMGIC material that I would have used otherwise.

References

The full list of references is available from the publisher.