Bioactive materials support proactive dental care

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 several 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 are quite favorable, regardless of the approach used [however] in the long term, the bonding effective-
ness of some adhesives drops dra-
matically.1 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.2

It is this hydrophilicity of simplified adhesive systems combined with other operator-induced challenges that contribute to these failures.3 Tay, Carvalho, Pashley, et al. have3 that contribute to these failures.3 Tay, Carvalho, Pashley, et al. have3 that contribute to these failures.3 Tay, Carvalho, Pashley, et al. have3 that contribute to these failures.3 Tay, Carvalho, Pashley, et al. have3 that contribute to these failures.3 Tay, Carvalho, Pashley, et al. have3 that contribute to these failures.3 Tay, Carvalho, Pashley, et al. have3 that contribute to these failures.3 Tay, Carvalho, Pashley, et al. have3 that contribute to these failures.3 Tay, Carvalho, Pashley, et al. have3 that contribute to these failures.3 Tay, Carvalho, Pashley, et al. have

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terial. Their early formulations made the material difficult to handle, and the etch-and-rinse approach is at an unacceptable level in dental restoration. However, these materi-
als, because of their chemical formula-
tions and pre-encapsulated presen-
tations, have many properties that make them useful in the restorative process.

The work at companies such as SDI North America (Riva product line), GC America (Fuji product line) and VOCO (Iono product line) have con-

resin cements for luting of indirect restora-
tions. The term “water-tree” formation has been coined to describe this process, which originated from the tree-like deterioration patterns that were found within polyethylene in-

The fluid blisters act as stress raisers and form initial flaws that cause subsequent catastrophic failure along the adhe-
sion interface.5

The previously mentioned plasma proteins are released by the dentin when subjected to acids and cause hydrolytic and enzymatic break-
down of the dentin and resin bond-
ing agent interface.6 These enzymes are called matrix metalloproteinases (MMPs).7

Currently, there are only three methods of reducing these MMPs: 2 percent chlorhexidine solutions that are used prior to application of bonding agents; etchants containing benzalkonium chloride, otherwise known as BAC (e.g., Risco’s Uni-etch products); and polylactic/polyphos-
phonic acid-producing products (glass ionomer and resin-modified glass ionomers).8

Due to the short efficacy of these chlorhexidine solutions being used before bonding, this methodology has come into question as of late.9 Etchants with BAC have been shown to be valuable in the reduction of MMPs and should be considered in all bonding pro-

areas of the restoration.15 However, the most intrig-
ning methodology of reducing MMPs and remineraliz-
ing tooth structure is with the use of glass ionomer ce-

ments (GIC) and resin-modified glass ionomers (RMGIC).

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The combination of the polyacrylic acid and the calcium fluoroalumino-
silicate glass typically found in GICs reacts with the tooth surface, which releases calcium and phosphorus ions that combine into the surface layer of the GIC and forms an inter-

molar expansion of “the interfused-

No resin bonding agents are re-

quired during this chemical fusion to the tooth structure. This ion release helps inhibit plaque formation and provides an acid buffering capability that helps to create a neutralization effect intrinsically. In addition, these GICs have very good marginal integ-

Fig. 1

Fig. 2

Fig. 3

Fig. 4

Fig. 5

Fig. 6

Fig. 7

Fig. 8

Fig. 9

Fig. 10

Fig. 11

Fig. 12
bonding agent because the bonding agent is essentially the RMGIc. The RMGIc acts as the interface between the restoration material and the tooth substance. It combines the GIC, RMGIc, and composite in a way to form a material that 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 on the outer surface (Fig. 15) at the gingival portion of the restoration. It is quickly and efficiently accomplished by simply “flooded” into the preparation. The remainder of the technique includes polymerized RMGIc in a thin layer to cover the GIC and walls of the preparation, followed by application of a composite over the previous materials to slightly overfill the preparation. With a large round burr, material is then trimmed away, and the excess GIC and composite are removed with a scaler. The occlusal table of the restoration can then be contoured with a finishing burr with a plastic occlusal matrix by either having the patient gently close the occlusal matrix by the operator passing gently with his or her thumb or forefinger to improve the contour of the composite material. This can help the tooth reduce the time in- placed, polished, and beneficial to the clinician and the patient because it will reduce the restoration material to create your restoration. It is quickly and efficiently accomplished by simply “flooded” into the preparation. The remainder of the technique includes polymerized RMGIc in a thin layer to cover the GIC and walls of the preparation, followed by application of a composite over the previous materials to slightly overfill the preparation. With a large round burr, material is then trimmed away, and the excess GIC and composite are removed with a scaler. The occlusal table of the restoration can then be contoured with a finishing burr with a plastic occlusal matrix by either having the patient gently close the occlusal matrix by the operator passing gently with his or her thumb or forefinger to improve the contour of the composite material. This can help the tooth reduce the time in- placed, polished, and beneficial to the clinician and the patient because it will reduce the

Technique procedure (Fig. 14)
After placement of an appropriate direct matrix, the technique incorporates the use of 37% 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” technique. It is then rinsed off after five seconds of placement. The tooth is then dried but not desiccated. The restorative material is then placed into the preparation. Fill the preparation with the triturated GIC material up to the level of the preparation. The restoration is then polymerized (RMGIc is a very thin layer to cover the GIC and walls of the preparation, followed by application of a composite over the previous materials to slightly overfill the preparation. With a large round burr, material is then trimmed away, and the excess GIC and composite are removed with a scaler. The occlusal table of the restoration can then be contoured with a finishing burr with a plastic occlusal matrix by either having the patient gently close the occlusal matrix by the operator passing gently with his or her thumb or forefinger to improve the contour of the composite material. This can help the tooth reduce the time in- placed, polished, and beneficial to the clinician and the patient because it will reduce the

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