PROFILE



Jeff Brucia, DDS

Current Occupation

Private practice

Education

DDS, School of Dentistry, University of the Pacific, 1988

Academic and Other Affiliations

Assistant Professor, Department of Dental Care, UOP School of Dentistry Co-Director, FACE Occlusion Study Club Visiting faculty, University of Minnesota,

School of Dentistry, Post grad program in restorative dentistry

Professional Memberships

- Associate member of the AAED Fellowship in the American College of Dentists Fellowship in the International College of
- Dentists Fellowship in the Pierre Fachard Academy
- Doctoral degree with Delta Sigma Delta

Positions Held

- Present Chair, CDA Presents, Board of Managers, California Dental Association
- Chair, Council on ADA Sessions and Internation Programs, Local arrangements, 2007–2009
- President, San Francisco Dental Society, 1998 Chair, San Francisco Dental Society Program Committee, 1996–1998; 2003–2005
- Chair, Program Committee, UOP School of Dentistry 100-year Alumni Meeting, 1996

Honors/Awards

- Thomas P. Hinman Medallion, 2001
- SFDS Presidential Meritorious Award for Outstanding Leadership Qualities, 1999 CDA Outstanding Leadership and Grassroots
- Actions, 1998 Delta Sigma Delta, Distinguished Service and
- Meritorious Award, 1998 UOP Outstanding Teaching and Leadership
- Qualities—Presented by the Senior class, 1992

Publications

A number of publications in the area of adhesive and esthetic dentistry

Hobbies/Personal Interests

Competitive sail boat racing, mountain biking, skiing

Notable Contribution(s) to Dentistry

Has volunteered in numerous leadership positions in organized dentistry over the last 22 years to help promote quality care and ethics throughout our profession

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Masters of Esthetic Dentistry

Adhesive Dentistry. A Full Time Practitioner's Perspective

JEFF BRUCIA, DDS*

dhesive dentistry has provided techniques and materials for conservative and esthetic options in every restorative practice. The understanding of the process of etching to form microscopic undercuts and infiltrating these gaps with resin to create an adhesive interface between tooth and restorative material has demonstrated long-term durable and well-sealed interfaces, resulting in excellent clinical results. It has offered a potentially reversible and repairable restoration that may be completed with little to no discomfort to our patients (Figures 1-3).

How has it changed since 1955 when Dr. Buonocore first presented these concepts to the dental world?¹

In North America, adhesive dentistry in the 1960s–80s was completely dependent on the covering of any exposed dentin structure prior to the use of a phosphoric acid solution or gel on the enamel for periods of a minute or more. This treatment cleaned the surface and created microscopic undercuts in the underlying enamel. Rinsing and drying the surface produced a large, high-energy porous surface that was ideal for bonding. This junction was most durable if completed in a completely dry environment.

Early studies of the action of different acid concentrations revealed some interesting findings. It was demonstrated that the concentration of phosphoric acid below 30% resulted in poorer enamel adhesion. The testing confirmed a surface layer that was insoluble and would remain as a contaminant on the enamel surface. In concentrations above 30%, a soluble monocalcium salt was formed, which was easily removed by rinsing. The conclusion for ideal enamel etching therefore was a solution of between 30% and 40% placed for 1-2 minutes, rinsed well, and dried completely. An intermediate layer of low-viscosity unfilled resin was placed to improve surface penetration and adaption of the composite restorative material.²⁻⁵

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Figure 1. Adhesive procedure successfully applied to replace an older restoration.



Figure 2. Adhesive materials combined with minimally invasive procedures to improve the esthetics.

The early 1990s welcomed the North American approval by dentists of acid treatment on both enamel and dentin. Referred to as "total etch," phosphoric acid could be placed on the dentin surface to form micro porosities within the intra-tubular dentin for resin penetration and micro-mechanical attachment. Just like enamel, the exchange process for dentin adhesion was the removal of the inorganic tooth material and the replacement with a synthetic resin. Etching dentin with 30–40% phosphoric acid removes almost all of the calcium phosphate and leaves the collagen nearly completely deprived of hydroxyapatite.^{6–8}

The first systems to successfully adhere to this demineralized dentin surface were the three component systems, also known as the multiple-bottle etch and rinse systems. Table 1. The first component was the 30–40% phosphoric acid gel. The second was the primer, and the third, adhesive. The key material in the primer is a bifunctional monomer in a volatile solvent. A bifunctional monomer has a hydrophilic end and a hydrophobic end. Examples would be HEMA (2-hydroxyethyl methacrylate) or 4-META (4 methacryloxyethyl trimellitic acid). The hydrophilic end can infiltrate the demineralized



Figure 3. Adhesive techniques used to conservatively treat a traumatic injury.

dentin structure with the help of the solvent. The hydrophobic end promotes the attachment of the adhesive resin. The third component is the adhesive resin. It is an unfilled or partially filled resin that binds to the primer to form a resin reinforced hybrid layer.⁷

Reviewing the research will support the belief that this delivery system still represents the *gold standard* in adhesive dentistry today. The newer systems available present a different mode of action. One marketed as a faster or more simplified technique.^{9,10}

The first change in this direction was the combination of the primer and adhesives into one bottle (Table 2). Phosphoric acid was still used on all surfaces of the tooth followed by the combined primer/adhesive solution.

TABLE 1. ETCH AND RINSE MULTIPLE-BOTTLE SYSTEMS.		
Material	Manufacturer	
Optibond FL	Kerr	
Scotchbond multi purpose plus	3M/ESPE	
PermaQuik	Ultradent	
All Bond II	Bisco	

TABLE 2. ETCH AND RINSE SINGLE BOTTLE SYSTEMS.	
Material	Manufacturer
PQ-1	Ultradent
Prime & bond	Caulk/Dentsply
Optibond solo plus	Kerr
Singlebond	3M/ESPE

Even though the marketing implied a faster application time, years of clinical and lab testing have demonstrated that application time may be equal to or longer than the three component systems if used with techniques to achieve maximum potential. Multiple coats are often necessary to achieve adequate resin thickness as the polymerization stresses increase at the adhesivecomposite junction.¹¹ Concern also has been shown when used under dual or self-cured composite.^{12–14} Evidence of an acid-base reaction and hydrolytic degradation demonstrated poor adhesion in these clinical situations. Long-term studies show more rapid

TABLE 3. SELF-ETCHING MATERIAL CATEGORIZED BY PH.			
Material	рН	Manufacturer	
Strong pH < 1.0			
Tyrian	0.4	Bisco	
Surpass	0.6	Apex	
Prompt L-Pop	0.8	3M/ESPE	
Moderate pH 1–2			
Peak SE	1.2	Ultradent	
AdheSE	1.8	Ivoclar-Vivadent	
iBond	1.9	Heraeus/Kulzer	
Mild $pH > 2.0$			
Clearfil SE	2.0	Kuraray	
G-Bond	2.3	GC America	
Optibond all-in-one	2.6	Kerr	

breakdown of the adhesive junction when these mixed systems are used.¹⁵⁻¹⁷

The complex chemistry of these "simplified" systems produced an increase in the post-operative sensitivity as seen by many practitioners. This observation was a major driving force for the introduction of a different mode of action.

The new mode of action was reflected in self-etching or non-rinse adhesive systems. The first systems were two-component products. The first bottle was an acidified primer that was applied to the tooth structure but not rinsed off. Following this, the adhesive resin was placed and light-cured. They are thought to reduce sensitivity for three reasons.¹ The acid is less aggressive as compared to the 30–40% phosphoric acid.² The resin infiltrates the dematerialized dentin during the etching process, decreasing the chance for voids.³ The smear plugs are not removed from the heads of the dentinal tubules.¹⁸

Most of these systems require water to ionize the acid monomer. The mineral component of the smear layer then neutralizes the acidity making it a non-rinse system. It is important to understand that not all self-etching systems work the same.¹⁹

I like to subdivide these based on the aggressiveness of the acids (Table 3). Strong self-etching systems have a pH below 1. They have a similar deep demineralization effect similar to phosphoric acid on dentin. The collagen network is completely exposed and the hydroxyapatite dissolved.

Moderate self-etching systems have pH levels between 1 and 2.

They produce a shallower demineralized zone and acid penetration, but still expose almost all of the collagen and dissolve almost all of the hydroxyapatite.

Mild self-etching systems have pH levels above 2. They have a shallow, partial demineralized effect on dentin with residual hydroxyapatite still attached to the collagen. This surface characteristic has been shown to promote some chemical bonding between the calcium and the carboxylic acid or phosphatebased monomers like Phenyl-P and 10-MDP. It is only in these weak pH systems that both micromechanical and chemical adhesion is seen at the dentin adhesion interface. Maintaining some hydroxyapatite for a chemical bond may protect the collagen matrix against hydrolysis and early degradation of the bond.18,19

The most simplified of all the modes available today are the all-in-one self-etching systems. They claim to accomplish all three steps with a single application. The thinness of the hybrid layer, the aggressiveness of most of these systems, and the incompatibility with dual or self-cured composites should cause concern in many clinical situations. More testing should be completed before this material is recommended for clinical use. Recent publications have supported the use of the two-component mild self-etching systems with the addition of phosphoric acid treatment on the enamel only. This approach may prove to be as good as the early three component systems, but care must be taken to not demineralize any of the underlying dentin with the acid treatment.^{20,21}

Basic understanding of the chemistry combined with some clinical technique pearls can help achieve the very best results in many clinical situations.

- Isolation is a key component to restorative success. Any contamination of the adhesive surface will compromise results.
- 2. Maximize enamel bonding whenever possible. (1) Clean the enamel surface well with pumice and water, (2) Consider the placement of a bevel on the enamel margins, and (3) Consider the use of phosphoric acid on enamel surface as an additional step with a non-rinse adhesive system.
- 3. Avoid over etching all dentin surfaces.
- Evaluate the quality and the depth of the dentin surface and consider the use of a Glass Ionomer base or liner.
- Place multiple layers of the primer solution on all dentin surfaces. Allow to remain on the surface undisturbed for 15+

seconds to aid in the complete saturation of the demineralized zone and the elimination of voids.

- 6. Gently and thoroughly remove the remaining solvent using the lack of fluid movement as an excellent visual tool.
- 7. Avoid over thinning of the adhesive resin. If thinned beyond the material's oxygen inhibition zone thickness, polymerization prior to the placement of the restorative material will be incomplete and will adversely affect adhesion.
- 8. Review the system chemistry for incompatibility concerns. Some adhesive systems are contraindicated under dual- or self-cured restorative materials and cements.
- Place all light cured restorative material in 2 mm increments or less to allow maximum polymerization and reduced shrinkage stress.

A close look at the very best material combined with the perfect clinical technique still shows need for improvement. Degradation of the denuded collagen within the adhesive resin-infiltrated dentin is still a major problem in dentin bonding. This sometimes rapid and other times slow breakdown leads to nanoleakage along the dentinrestoration interface and loss of retention of the composite restoration. What may be in our future to address these areas of concern? I have been following two areas of excitement.

- 1. The use of an antibacterial agent (MDPB) in the primer and sodium fluoride in the adhesive to form an acid-base resistant zone within the interface. This reinforced acid resistant dentin, or super dentin, seen under the hybrid layer could have the potential to inhibit future demineralization and help to form a more stable, longer-lasting bond.^{22,23}
- 2. Use of amorphous calcium phosphate nanoprecursors to remineralize the denuded collagen matrix and strengthen the rein-dentin bond. There is currently work to study a process of guided tissue remineralization using a nanotechnology process of growing mineral-rich crystals and guiding then into the demineralized gaps between collagen fibers.²⁴

As a full-time private practice dentist, I need materials and techniques that will provide the very best results for my patients. I believe the research is clear in its direction. The multiple-bottle, etch and rinse systems are the *gold standards* when used properly.^{10,25} Phosphoric acid etched enamel has shown great results when evaluating composite placement completed more than 30 years ago. I fear that our profession has committed itself to the use of these simplified systems and there is a false belief that old is not as good and that newer must be better. We should be cautious as we read marketing claims of the material of the month. If so many new materials are so good, why will their chemistry need modification in the next year? When money is speaking, the truth may be silent.

I do believe that there continues to be very hard work to improve our ability to provide our patients with the very best care. I would ask that we continue to require long-term testing results to support marketing claims. Our patients deserve the very best, most tested, and proven material available today.

DISCLOSURE

The author does not have any financial interest in any companies whose products are mentioned in this paper.

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