Self-Etch versus Total Etch—First Do No Harm

Do all bonding agents perform the same?

What are the ramifications of premature failure of the bonding agent?

How do I choose?

The above are questions I have personally had to answer many times in my 35 years of practicing dentistry. My journey in adhesive dentistry began in 1977 as alternative options to rebuild fractured teeth in esthetic areas expanded using adhesive composite dentistry that minimized tooth removal. Being able to construct esthetic restorations without the use of metal substructures meant that more tooth could be preserved and the often-seen gum recession revealing the gray line around the crown could be avoided.

I remembered a sixth-grade classmate of mine with a gray front tooth that destroyed her beauty and likely affected her self-esteem. I considered the need for a more conservative esthetic option for restoring a tooth than using porcelain to metal. Fortunately, something better emerged in the form of adhesive products that mimicked in many ways lost tooth material in color and strength. A gold standard for me as I changed from one product and technique to another was to always verify that the new material and technique was clinically proven to be equal or better in performance than what I previously used.

As my adhesive experiences expanded in the early 1980s, I began to use direct composite with predictable success as a replacement material for amalgam. Always remembering, first do no harm, I initially used direct composite for occlusal restorations in posterior teeth that had a perimeter of solid tooth structure for support. I analyzed outcomes closely at recalls. Because the successes I observed were equal or better than what I previously used, I felt comfortable expanding this type of treatment to larger restorations. Figure 1 is a recent clinical recall photo of occlusal composites placed in 1983 that are now approaching 30 years of service. Consider that this was an early generation of bonding agent and composite, and yet at almost 30 years post-op, there is marginal integrity on all restorations with no evidence of brown line microleakage.

I have used the total etch-and-rinse technique since my early years in practice. Seeing patients with consistent clinical successes confirmed the importance of maximizing the perimeter seal of a restoration as the first line of defense against microleakage, a very significant barometer of long-term bonding success because microleakage offers a pathway to establish decay deeper into the tooth. These successes combined with the development of bonding agents that increased dentinal adhesion allowed me to expand my direct composite posterior restorations to eventually include proximal restorations on molars, where the forces of occlusion and deterioration were greater. Figure 2 is a clinical photo at 23 years posttreatment for a molar class two restoration. Again worth observing is the marginal integrity with no sign of brown line microleakage.

As I continued to observe clinical success with adhesive products, I expanded my adhesive options to include indirect porcelain and lab-processed resin restorations that when sealed in a way similar to direct composite offered the possibility of more durability. My first porcelain inlay was done in 1995 on a bicuspid with a mesial-occlusal-distal amalgam that fractured out along with the lingual cusp leaving only a facial cusp. Previous treatment options of choice would have likely included a root canal, post and core, and crown. When considering that the preparation of a crown would remove the facial tooth structure, it is apparent that the retention of the entire restoration would be dependent on the post in the root canal. In my experience

 DOI 10.1111/jerd.12023

restorations depending on the post for retention do not last many years. Restoring this tooth with a minimal prep porcelain inlay that retained as much remaining tooth as possible offered the potential for a lot of reward and not as much risk when considering the alternative. Figure 3 shows the porcelain inlay restoration that was placed at 17 years post-op. Again worth observing is the marginal seal that has been maintained, which I believe to be a significant reason for the longevity of the restoration.

The successes that I observed over years as patients returned for follow-up examinations allowed me the confidence to expand restorations that minimize tooth removal and in my opinion extended longevity. I believed it was possible to replace pieces of missing tooth structure without the need to prepare for retention of the restoration. As an example, Figures 4 and 5 show the repair of chipped edges of anterior teeth that required no retentive preparation, with the post-op photo showing success at 3 years after treatment.

In the mid 1990s, dentistry began to embrace changes in the formulation of bonding agents, with the intent to simplify technique and to address problems some clinicians were having with post-op sensitivity of teeth restored with adhesive techniques. The gold standard of bonding regimens implementing a three-step approach of etch/rinsing, priming, then applying an adhesive which had worked for me without any issues of sensitivity or premature failures throughout my practice was being replaced in many practices with one-bottle adhesives that combined all three steps into one. These products were marketed as not requiring initial etching because the claims were that the bonding agent was acidic enough to etch the tooth. Of concern was that the pH of many of these self-etch systems was around 2.7, replacing the etching in the previous systems that was a pH of 1 or less. What we may fail to consider is that pH is logarithmic, so that a pH change of two points more acidic is really a change of 100 times acidity. Concern was that the pH of these newer products was not sufficient to properly etch enamel and maximize perimeter seal. This study in 2003 adds credibility to early concerns.

FIGURE 1. Direct resin composites at 29 years.

FIGURE 2. Direct resin restorations at 23 years post-op.

FIGURE 3. Bonded porcelain inlay at 17 years post-op.

DOI 10.1111/jerd.12023

FIGURE 4. Pretreatment photo of case with anterior wear.

FIGURE 5. Post-op photo of case with anterior wear.

FIGURE 6. Pre-op of leaking direct composites at 3 years post-op.

FIGURE 7. Decay due to microleakage under direct composite during preparation.

MICROTENSILE BOND STRENGTHS OF ONE- AND TWO-STEP SELF-ETCH ADHESIVES TO BUR-CUT ENAMEL AND DENTIN

De Munck J, Van Meerbeek B, Satoshi I, Vargas M, Yoshida Y, Armstrong S, Lambrechts P, Vanherle G.

http://www.ncbi.nlm.nih.gov/pubmed/15002958

Results

The microTBS to enamel varied from 10.3 MPa for the one-step self-etch adhesive AQ bond to 49.5 MPa for the total-etch adhesive Prime & Bond NT. The microTBS to dentin varied from 15.5 MPa for the one-step self-etch adhesive Reactmer to 59.6 for the three-step total-etch adhesive OptiBond FL. The microTBS of the total-etch adhesives to enamel was significantly higher than that of the one-step self-etch adhesives. Comparing the dentin microTBS, only OptiBond FL performed significantly better than the one-step self-etch adhesives. Specimen failure during preparation occurred with each one-step adhesive, but more frequently when bonding to enamel than to dentin. Most one-step self-etch adhesives failed predominantly adhesively between the tooth substrate and the bonding layer in contrast to the two- and three-step adhesives that revealed generally more mixed adhesive-cohesive failures.

Although I have always used the gold standard etch-and-rinse systems throughout my practice career with consistent success as related to sensitivity issues and microleakage, I began to notice more and more patients coming into my practice with bonding leakage leading to premature and catastrophic failure. I could only assume that products and techniques being used were very different because I had not been seeing the same outcomes. The case I show in Figures 6 and 7 is an example of many that I have seen over the last 10 years. These restorations were approximately 3 years

 DOI 10.1111/jerd.12023

old at the time of examination and the patient had no other signs of other proximal lesions or rampant decay. What lay beneath the restoration was extensive decay and catastrophic.

More recent studies continue to support early concerns that the weaker acidic self-etch products are not creating a maximized perimeter seal for bonded restorations. The study below demonstrates that etch-and-rinse techniques create a superior acid resistant hybrid zone than self-etch.

PHOSPHORIC ACID-ETCHING PROMOTES BOND STRENGTH AND FORMATION OF ACID-BASE RESISTANT ZONE ON ENAMEL

Li N, Nikaido T, Alireza S, Takagaki T, Chen JH, Tagami J.

Oper Dent. 2012 Jun 4.

http://www.ncbi.nlm.nih.gov/pubmed/22663196

This study examined the effect of phosphoric acid (PA) etching on the bond strength and acid-base resistant zone (ABRZ) formation of a two-step self-etching adhesive (SEA) system to enamel. An etch-and-rinse adhesive (EAR) system Single Bond (SB) and a two-step SEA system Clearfil SE Bond (SE) were used. Human teeth were randomly divided into four groups according to different adhesive treatments: (1) SB; (2) SE; (3) 35% PA etching→SE primer→SE adhesive (PA/SEp + a); (4) 35% PA etching→SE adhesive (PA/SEa). Microshear bond strength to enamel was measured and then statistically analyzed using one-way analysis of variance and the Tukey honestly significant difference test. The microshear bond strength to enamel of the SE group was significantly lower ($p < 0.05$) than that of the three PA-etched groups, although the latter three were not significantly different from one another. The ABRZ was detected in all the groups. In morphological observation, the ABRZ in the three PA-etched groups were obviously thicker compared with the SE group with an irregular wave-shaped edge.

SUMMARY

Let's revisit the questions that opened this article and now answer considering observations and studies I have presented.

Do all bonding agents perform the same?

Studies indicate that they do not perform the same. Lower acidity etch-and-rinse bonding agents and techniques create the opportunity for optimal perimeter seal and resistance to microleakage, which can be critical to long-term success.

What are the ramifications of premature failure of a bonding agent?

Bonding agent failure can cause catastrophic results that threaten the long-term retention of a tooth. Once microleakage is established, a pathway through dentin deeper into the tooth can cause significant destruction leading to pulp pathology and potential tooth loss.

How do I choose?

It is becoming accepted belief that the integrity of the perimeter seal of an adhesive restoration is essential to resist microleakage and enhance long-term success. Products and techniques that properly etch and seal the perimeter are critical and should be chosen over those that do not.

Unfortunately, it is often difficult to discern what is best with so many new products available. Clinical success is ultimately the best test. Here is my advice when choosing based on studies like those I have cited in this publication combined with clinical observations over 35 years. Although some of this advice is anecdotal, it can serve as a guide for decisions in choosing products that maximize success. Trust but verify.

1 Request long-term clinical recall photos from those who advocate for products and ask if they routinely use them.

DOI 10.1111/jerd.12023

2 Clean prepared teeth of all debris and handpiece oil to improve bonding performance.
3 Using etch-and-rinse systems that etch enamel better than milder acidic self-etch systems can result in improved sealing of enamel and resistance to microleakage.
4 Alcohol/water-based primer/adhesive systems perform better on drier dentin than acetone-based systems, which can be critical as related to post-op sensitivity.
5 Drying the primer layer properly to evaporate the solvent is important in insuring a fully cured seal of the dentin.
6 Self-etch cements that do not use a bonding agent do not perform as predictably in creating a seal as those using an etch-and-rinse bonding agent because dentin adhesion requires the hydrophilic primer/adhesive to interact with moist dentin and penetrate the surface for optimal hybridization.
7 Become a continual student of adhesive dentistry if you want to stay on the cutting edge and not fall off.

In closing, predictable adhesive dentistry can expand the options you make available for your patients when solving and preventing problems for them. When done with proper products and techniques, it will enhance clinical outcomes that both you and your patient will enjoy and find amazing.

Bruce J. LeBlanc, DDS, Private Practice, General Dentistry

Reprint requests: Bruce J. LeBlanc, DDS, Private Practice, 7612 Picardy, Suite M, Baton Rouge, LA 70808, USA; Tel.: 225-757-1885; email: bjleb@cox.net

 DOI 10.1111/jerd.12023