The growing popularity of self-etch adhesive systems has produced controversy on their effectiveness and suitability for daily clinical use. The numerous generations and capabilities of both self- and total-etch systems can make it difficult to determine which is most appropriate for a given indication. While a number of adhesives may be suitable, it is important for clinicians to understand the chemistry and application of these materials and to select the one most compatible with the clinical situation to best serve the patient.

Understanding the Difference

An understanding of total-etch adhesive systems is necessary to appreciate the properties of newer self-etch systems. While some think self-etch systems have made total-etch systems largely unnecessary, this is clinically untrue. Total-etch systems offer the advantage of being clinically proven for more than 12 years, a record that no self-etch system can match. There are also some clinical situations for which a total-etch adhesive is a more appropriate choice.

To determine when to use a total-etch system, it is important to understand its characteristics. Bonding agents can be divided into four currently used generations, fourth- and fifth-generation total-etch systems, and sixth- and seventh-generation self-etch systems. Fourth-generation, or two bottle total-etch, adhesives etch, rinse, prime and bond the prepared tooth surfaces. Fifth generation adhesives also simultaneously etch enamel and dentin, rinse, prime and bond the etched surface. Fifth generation adhesives also simultaneously etch enamel and dentin, rinse, prime and bond the prepared tooth surfaces. Fifth generation adhesives also simultaneously etch enamel and dentin, rinse, prime and bond the prepared tooth surfaces. Fifth generation adhesives also simultaneously etch enamel and dentin, rinse and apply primer bonding agent combined into a single bottle which are dried and cured. Both fourth- and fifth-generation adhesives use phosphoric acid to demineralize enamel and dentin. Acid etching improves the bond of the adhesive to enamel by creating porosities and allowing the adhesive to penetrate and form resin tags. On dentin, acid etching improves bonds by exposing the network of collagen fibers underneath the smear layer into which the adhesive can penetrate and form an interlocking layer. Approximately 40 percent of the bond strength is produced by dentin tubular penetration of the adhesive, while 60 percent is produced by hybrid layer formation.

The network of collagen fibers exposed during acid etching requires bonding to moist dentin when using a total-etch system. When the collagen fibers are first exposed by the etchant, they are water supported. If the etched surface is over dried, the fibers collapse, causing the subsequent layers of primer and adhesive to bond to the surface of the collapsed fibers rather than infiltrate the exposed collagen fiber and the tubules. Later, when saliva contacts the fibers, a space is formed between the etched surface and where the primer has infused. This can contribute to poor adhesion and can also lead to post-operative sensitivity, a concern with total-etch adhesives.

Applying the bonding agents with agitation and to moist dentin are essential steps in limiting cold sensitivity. These products have 12- and 13-year clinical studies supporting their use, providing good bond strengths which can produce very effective clinical results when used correctly.

With sclerotic dentin, total-etch systems may be particularly helpful. The hypermineralization on the dentin surface produces reduced numbers and size of dentin tubules which lessens bond strength. It is especially difficult for higher pH self-etch adhesives to bond effectively to unground enamel and sclerotic dentin unless they have a chemical bond to dentin.

Another indication for total-etch, single-bottle bonding agents is with bonded ceramic restorations. Bonds to dentin are improved when the bonding agent is light cured separately and then the dual-cured resin cement-filled restoration is applied and light cured. If the bonding agent has a significant film thickness like most two-bottle systems, the cured bonding agent will not allow complete seating of the ceramic restoration. Therefore fifth-generation (total-etch, one-bottle) adhesive systems are recom
mended when bonding crowns, inlays, onlays and fixed partial dentures.

**The Simplicity of Self-Etch**

Self-etching adhesives are available in one-, two- and four-bottle systems, so they are not necessarily “simpler” than total-etch systems. However, as their name indicates, these systems do not require a separate etch and rinse step like total-etch systems. Sixth- and seventh-generation adhesives are self-etch systems, with the sixth-generation systems typically using two components while seventh-generation materials are generally one-bottle systems.

Self-etch one- and two-bottle systems are often classified by their pH into mild, moderate and strong etching materials. Self-etching bonding agents improve technique sensitivity and control the tooth wetness issue by simultaneously etching and priming as they are applied. As the material surrounds and encases exposed collagen fibers in the dentin, a thin hybrid layer is created whether the dentin surface is wet or dry.

Because most one-component self-etch bonding agents mix hydrophilic and hydrophobic agents in the same bottle, they are generally not as acidic as some other adhesives and can therefore perform poorly on unground enamel and sclerotic dentin. Single-bottle self-etching materials have pH levels around 1.1 to 2.7. (Phosphoric acid, which is used with total-etch systems, has a pH of 0.3 and etches unground enamel and sclerotic dentin very well.) Highly mineralized, mainly tubular dentin does not allow the same dentin tubule penetration compared to normal cut dentin, which compromises the adhesive’s bond strength.

The difficulty with formulating one-bottle systems is maintaining stability with a mixture of components. The clinical benchmark that self-etch materials are compared against is Clearfil SE Bond, which has a five-year clinical effectiveness compared to total-etching technique. Den Mater 18:359-369, 2002.

**References**


**Author’s Bio**

Dr. John O. Burgess graduated from Emory University School of Dentistry and completed his graduate training at the University of Texas Health Science Center. He has presented more than 800 continuing education programs nationally and internationally, and is an active investigator on clinical trials. He maintains a part-time practice in general dentistry in Birmingham, Alabama.