DENTAL PRODUCTS REPORT®

EBOOK

Five things you need to know about adhesives

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The changing face of adhesives

Over time, bonding agents have changed—all for the better. With each new generation, clinicians have come to expect better adhesion and less complicated application techniques. The latest generation of adhesives—also known as universal adhesives—are the biggest advancement yet.

1. Adhesive evolution

Adhesives for bonding restorations to teeth have evolved, both in terms of performance and ease of use. Universal adhesives are the latest advancement of the product, combining acid, primer and resin all in one bottle.

- Acid
- Primer
- Resin

... all in one bottle

"Bonding agents have evolved from four-bottle systems to one-bottle systems," says Dr. John O. Burgess, DDS, MS, Professor and Assistant Dean for Clinical Research at the University of Alabama, Birmingham. "In general, these materials have become much simpler, easier to apply, easier to understand and faster. The speed of application is a major advantage because it closes that window of contamination where you may get contamination by saliva or blood, which would then dramatically lower the bond strength. The faster you can place and cure the composite, the more likely you are to have a very durable restoration."

Hand-in-hand with the improved simplicity comes robust usability, allowing bonding to many different materials.

"The evolution of these newer materials has created materials that will bond not only to enamel and dentin, but also to base metal alloys and zirconia ceramic materials, so the systems are being used for multiple clinical situations and for multiple substrates," Dr. Burgess says. "That has made the universal adhesives good materials for directly placed composites and also for indirect restorations. When you need to bond them, these systems, are easy to use, and the more frequently you use these systems the better you become with them and the more consistent they are."

Adhesives are used for direct and indirect bonding applications

Clinicians use adhesives for two types of restorations—direct and indirect bonding. The bonding agents are used differently in each scenario, and doctors must understand how the agents are used for each.

2. Adhesive applications

Direct dental bonding is a procedure where tooth-colored composite restorations are placed on a single tooth or multiple teeth. In this case, the procedure is performed to restore function or shape, or to enhance the shade of the affected teeth. Once the composite is placed, shaped, and smoothed on the tooth or teeth, it is cured.

Photo: Dr. Mario deGoes

Indirect dental bonding is more involved and usually requires the work of a dental laboratory or an in-office milling machine (CAD/CAM). In this application, the preparations are made by the clinician, but generally the restorations are manufactured by a dental laboratory. An elastomeric or digital impression of the patient's affected teeth is taken. Once the impression has been made, it is sent to a dental laboratory and then a lab technician makes the restoration "indirectly." The restoration is returned to the dentist, who then places the restoration on the patient's prepared tooth.

Photo: Dr. Marcos Vargas

Dr. Burgess notes that clinicians most often use more than one type of adhesive, depending on which type of restoration they are using. However, the newest formulation of adhesives—universal adhesives—can be used for both direct and indirect restorations.

> ***"... universal adhesives can be used for both direct and indirect restorations ..."***

"If you look at surveys, most dentists are using more than one adhesive," Dr. Burgess says. "They use an adhesive for indirect restorations—a crown, bridge, or an inlay, onlay—and they also use another for direct restorations—composite resins, Class Is, IIs, IIIs and IVs."

A closer look under the hood

Two of the major components affecting adhesive bond, durability and ease of use are their etching and curing methods. As adhesives have evolved, these two elements have become more efficient and more intuitive for the clinician.

3. Etching

In order for the bonding agent to adhere to enamel and dentin, those surfaces must be roughened using a process called “etching.” This is typically accomplished using phosphoric acid. There are three different types of etching:

Total Etch

Uses phosphoric acid. The enamel and the dentin are both etched.

Selective Etch

Uses phosphoric acid. Only the enamel is etched.

Self-Etch

The etchant is contained in the acidic adhesive. No phosphoric acid etchant is applied or rinsed off.

The obvious distinction between the three etch types is the use of phosphoric acid. While the phosphoric acid methods provide a better enamel etch pattern, they also do not produce more patient sensitivity. There is no difference in cold sensitivity when the restoration is bonded using a total- or self-etch technique.

“The etch pattern developed by phosphoric acid to enamel is very pronounced, very strong, very definite,” Dr. Burgess observes. “Whereas, when you move to materials that have a pH of 2.3 to 3.2 (the range for universal adhesives), those materials give you a very indefinite enamel etch pattern. That results in leakage around the enamel margins, and then, ultimately, the failure of that restoration.”

Universal adhesives can use any of the etch types and still deliver good bonding, and selective- or total-etch provides the best, most durable bond and seal.

"The beauty of the universal adhesives is that they can be used with either a self-etch, a total-etch or a selective-etch technique," Dr. Burgess says. "Self-etch would just use the components and the acidity in the bonding agent itself, whereas a total-etch would use a phosphoric acid to etch enamel and dentin simultaneously, and the selective-etch would etch enamel only with phosphoric acid."

4. Curing

Resin cements are used when bonding indirect restorations. Commonly, three curing methods with these resin cements are available. When the adhesive is applied to the tooth structure and the final restoration is cemented over it, the adhesive must cure before reaching their ultimate hardness. This is also known as polymerization. Curing is accomplished in one of three ways:

Chemical Cure

Will cure totally in the absence of light.

"Clinicians are using those, dominantly, when they could not gain light access or they were fearful of not being able to penetrate tooth structure or the thickness of material that was being used and couldn't get a good bond," Dr. Burgess explains.

Light Cure

Requires a light-curing unit, and generally the composite contains camphorquinone as the polymerization photoinitiator.

Dr. Burgess notes that the best bond and color stability is achieved through light curing.

Dual Cure

Contains chemistry of both.

Can be used with or without light curing.

Clinicians must be mindful of the adhesive's curing method because light- and chemical-cured components cannot be mixed. Dual curing can help bridge the two.

"There's a difference in the systems that are used, and some of these systems are not compatible," Dr. Burgess says. "If you're using a light-cured adhesive and then place a chemical-cured material on top of that, those systems are not compatible. The exception is All Bond Universal, because of the adhesive's high pH (3.2). Therefore, dual-cure activators were developed. These dual-cure activators are mixed with the bonding agent. They are not meant to create a bonding agent that is dual cured, they are meant to make the bonding agent dual-cure compatible with a dual-cured material."

How to make the best choice

With so many variables involved in adhesives, it can be overwhelming to make the right choice. Dr. Burgess suggests looking to products that have proven themselves in clinical studies.

5. What to look for in an adhesive

"I would look for a material that has a good bond strength, that is compatible with the technique the clinician is using and has good clinical testing," Dr. Burgess says. "I am a strong believer in advocating materials that have good, long-term clinical success. If the bonding agent does not have valid clinical studies to support its use, then I would be reluctant to use that material for my patients." Unfortunately, few of the universal adhesives have long-term clinical studies demonstrating their success. 3M™ Single Bond Universal Adhesive has three studies ranging from 2 to 3 years that report clinical retention rates greater than 94 percent in unprepared, Class V restorations.

> ***"... has good bond strength***
>
> ***... is compatible with your technique***
>
> ***... has long-term clinical success***
>
> ***... can be used for many applications***
>
> ***... can be used for multiple substrates."***

Further, he says adhesives—like universal adhesives—that can be used for many applications are not only simpler to use, but, because they are used more often, there is less chance for confusion.

"I would select a material that I could use for multiple substrates, which is the universal materials," Dr. Burgess says. "If you can use it in multiple applications, both you and your support staff understand the way in which that material is supposed to be used. I can't tell you how many times people come up to me during lectures and say, 'I thought I was supposed to mix this material with that material,' and you look at them and you say, 'No, you're confused. That material doesn't go with this material.' With multiple-bottle systems, it's very easy to get confused with the application procedure. But with universal materials, they simplify it, shortening the application time, and those are the materials that I think are going to be very successful over the long haul."

Adhesives continue to evolve and improve, and the latest generation of universal adhesives seems to be the best yet, providing strong, durable adhesion along with easy-to-use systems.