A LASTING BOND

by Paul Gange Jr.

Paul Gange Jr. has been with Reliance Orthodontic Products since 2008. Following in his father’s footsteps, he has become a leader in resolving difficult technical bonding issues. His passion for research and development has influenced many new Reliance products. Gange Jr. is a published author and lectures internationally at numerous universities, study clubs and constituent meetings as well as the AAO. His greatest fulfillment comes from hands-on training for doctors and staff in private offices.

Technical support calls are the most rewarding aspect of my job. The challenge of diagnosing every individual situation and remediying those specific issues brings fulfillment to my career in orthodontics. One of the most frequent issues I encounter are offices struggling to bond to non-enamel surfaces. With the hassle and headaches that develop from a bond failure, attention to detail in the correct bonding protocol is imperative to success on non-enamel surfaces.

Prophy

One of the primary reasons clinicians will struggle with bonding to artificial surfaces is as simple as starting with a clean surface. A thorough prophylaxis is vitally important to any intraoral bonding sequence, but specifically important on difficult surfaces that yield compromised strengths in even the best scenarios. There are two reasons practitioners are not prophying:
Oversight. It’s a common misconception that when an intraoral microetcher is used to mechanically prepare substrates, prophying isn’t necessary because the abrasive powder will remove any bulk material. This couldn’t be further from the truth, especially when there’s soft material present on the tooth. All debris must be removed before using a microetcher to allow the blast media to reach the substrate itself. Any soft material present will absorb much of the aluminum oxide powder, inhibiting the mechanical preparation that’s so crucial to clinically acceptable bond strength.

(This idea is also understood in a different field by auto-body repair shops. When preparing the sheet metal of a car to be painted, technicians will not try to sandblast grease from the panels because the sand will be absorbed into the grease and the underlying metal will remain unprepped.)

Overcomplication. It’s no secret that a clean surface free of debris, mature pellicle or plaque will generate superior bond strength compared with a contaminated surface. Orthodontic bonding is complicated in and of itself; blatantly ignoring this simple reality will only make the operator’s job more difficult.

A thorough prophylaxis achieved by using a rubber-cup rotary instrument or bristle brush is the foundation for successful bonding. Excessive oral fluids or bleeding may occur from this process if clinicians are not careful when cleaning next to the soft tissue margins. Caution, precision and attention to detail are imperative when using a prophylaxis technique. A small-diameter rubber cup provides the most precise pumice application, resulting in less nuisance oral fluids. Because of the risk of increased oral fluids, some clinicians will forgo prophying. Although possible contamination is reduced, this practice does not address the bulk material present on the tooth—which ultimately reduces the likelihood of a successful long-term bond.

There are numerous pumices in the dental field appropriate as a final step for post-restoration or cleaning.
In orthodontics, the clinician must be conscientious of the residual film some pumices may leave behind. Several flavored pumices contain oil and can leave behind a layer that will complicate the subsequent bonding steps, ultimately sacrificing strength to the tooth.

Air abrasion

Microetch, sandblast, abrade, etc.—if there’s one instrument that has revolutionized the orthodontist’s ability to bond to artificial surfaces, it’s the chairside sandblaster (Fig. 1). The same technology that lab personnel will use to remove adhesive from broken bracket mesh in a self-contained cabinet is now quickly gaining popularity at the chair. To achieve optimal bond strength and reduce the potential of substrate fracture, there is one primary difference between the enclosed cabinet sandblaster and a chairside unit—particle size. Aluminum oxide in the 80- to 90-micron size is appropriate for lab bracket cleaning, while 50 microns is ideal for intraoral surface preparation.

Two types of chairside microetchers are available today—larger units that require a dedicated air line to operate, and handpiece adapters that simply replace a four-hole low- or high-speed handpiece and run off the air already present to operate the handpiece. There are pros and cons to both systems, but the “spark plug”-looking adapters are quickly taking a stronghold on the market because of how precise the flow of abrasives can be controlled. The sandblast adapter tip is placed on one side of the tooth, and high-speed evacuation is placed on the opposite side, eliminating the messy cleanup of a plumbed-in unit.

The drawback to the handpiece adapter design is that it utilizes a nonrefillable tip that contains the aluminum oxide powder. To avoid cross-contamination, a new tip must be used for every patient or the tip can be sterilized with a sanitizing wipe between patients (given this sterilization technique is accepted). The primary benefit to a sandblaster utilizing a dedicated plumbed-in air source is a significant reduction in abrasive material costs because of bulk availability. In addition, the volume of abrasive powder contained in the refillable jar eliminates the need for changing preloaded tips. When mechanically preparing only a crown or two, abrasive volume becomes a nonissue.
**Chemically etching artificial substrates**

If clinicians decide not to use a sandblaster to prepare ceramic surfaces, the bonding protocol is significantly lengthened. First, the glaze must be mechanically removed with a diamond bur to achieve initial rough-surface retention. The rotational movement of a bur will only create shelves and gouges through the crown (Fig. 2), so more retention is needed. To further the mechanical retention of a diamond-bur-roughened surface, hydrofluoric acid must be placed on the tooth for four minutes to chemically etch the glass filler in both porcelain and lithium disilicate. Hydrofluoric acid is very caustic and the soft-tissue margin must be protected with a barrier gel before any acid is applied in the mouth. Once four minutes has expired, the etch is carefully wiped off the tooth and rinsed into suction. Utilizing this method generates shear values almost half the strength of using a microetcher.

Clinicians may also be under the impression that they’re bonding to a porcelain surface, but the substrate ends up being zirconia. When hydrofluoric acid is placed on a zirconium substrate, the surface will not etch. (See Figs. 3 and 4.) Thus, the clinician must forgo the typical step of applying silane or wait long enough for hydrolyzed silane to evaporate off the tooth—without interfering with the final primer step.

There are two scenarios where a clinician may encounter a dual surface of artificial and enamel in the bonding area: amalgam and composite restorations.

When bonding to a dual surface, the enamel must be chemically etched and the artificial surface properly roughened. However, there is a common misconception that phosphoric acid will simply “clean” the tooth surface. This often stems from the restorative protocol of using phosphoric acid to clean the inside of a crown after trying-in and removing from the patient’s mouth. (Any blood and salivary proteins that have adhered to the crown are neutralized by phosphoric acid and bonding can commence.) In orthodontics, however, this method of “cleaning” a non-enamel surface with phosphoric acid can be disastrous on one surface. Phosphate ions have an affinity for metal and will bond to zirconia—preventing the following bonding agents from adhering to the zirconium substrate. If there is no enamel present, do not etch.
Silane

Silane coupling agents are an integral part of bonding chemically to the glass filler contained in porcelain and lithium disilicates. Hydrolyzed silane has one major benefit and one major disadvantage. It has reduced the headache of diagnosing a glass-containing porcelain surface from a glass-free zirconium surface. Because of accelerated evaporation, hydrolyzed silane will evaporate off a zirconia crown in 60 seconds without interfering with the subsequent priming steps. Because this chemical is volatile, porcelain conditioners must be stored in refrigeration and used within the dated expiration. Finally, a warm air dryer is a great addition to any bonding protocol to eliminate contamination from a water/air syringe. Tooth dryers are also very effective in exciting hydrolyzed silane, resulting in optimal bond strength.

Artificial primers

In the past, several different primers were needed to have a complete toolbox for bonding to various non-enamel surfaces found in the mouth. Metal primers utilize the monomer 4-meta in bonding to metal surfaces. Monomer, or methyl methacrylate, is effective in placing attachments on plastic- or resin-based composite surfaces. Silane couples with glass and reduces loss of brackets on porcelain and lithium disilicate. Zirconia-dedicated primers, often borrowed from restorative dentistry (at a significant price increase), provide clinically acceptable strength.

All the products above need an additional coat of sealant to finalize the priming step. Non-enamel priming technology has seen a revolution with breakthroughs from manufacturers releasing products that combine not only the prime and seal step but multiple primers in the same bottle.

Debond

Similar to debonding a case from enamel, the mechanical steps to debonding an appliance from an artificial substrate are very similar. Most clinicians will use bracket-removing pliers to initially break the bracket free from the tooth. Next, a high-speed carbide bur is used to remove the bulk majority of composite, yet leaving a thin layer. Finally, a rubberized point is used to not only remove the residual composite film, but also to initiate the restoration polishing process. For artificial substrates, a diamond polishing paste can be prophied onto the tooth with a rubber cup as a finishing touch to restore a natural look to that tooth (Fig. 5).

Although there have been multiple chemical breakthroughs in the bonding world, technique is still the most important aspect for case-long success. The basics of bonding—starting with clean surfaces, isolation, uniformity and attention to detail—are invaluable to any surface preparation. Once these simple steps are followed, clinicians now have the convenience of relying heavily on the primer technology available today.