If you battle with debonding restorations, post-operative sensitivity or microleakage, weak adhesion to dentine could be your problem. There are multiple factors that can affect the quality of dentine bonding, many of which are overlooked or unknown. Furthermore, it can be difficult to see the impact of these factors in a clinical setting.

The research and development team at Ultradent Products has performed tens of thousands of laboratory tests to find the most fool-proof process for effective dentine bonding by introducing different variables. Before approaching these steps, however, it is critical to ensure that some fundamentals are in place.

**Fundamental bonding requirements**

When bonding to dentine, remember that bonding can only be predictably performed on hard mineral dentine. All affected soft tooth structure must be removed to achieve adequate and maximum bond values. Adhesive or minimally invasive dentistry is not dictated by cavity preparation design, but rather by the clinical time and technique.

Control of bleeding, saliva and subcular fluid is paramount to predictable bonding. I cannot imagine performing adhesive dentistry near or under soft tissue without ViscoStat, Astringedent X and the Dento-Infusor tip (all Ultradent; Figs. 1a–d).

A clean and dry air source is required for quality bonding to occur. It is recommended that clinicians use a dedicated air syringe in each operatory to avoid water leakage, which is common in air and water combination syringes.

The most important requirement for ensuring quality adhesion, assuming a quality bonding agent is used (e.g. Peak Universal Bond, Ultradent; or CLEARGUARD SE Bond, Kuraray), is the prevention of contamination. My definition of contamination is any substance that comes between mineral mother dentine and the adhesive (Figs. 2a–f).

Laser-prepared surfaces on both dentine and enamel do not create the ideal surface for bonding. In fact, laser preparation can contribute to a 20 per cent reduction in bond values, on average, due to microscopic fracturing of the surface. In order to regain the highest bond value, it is imperative to freshen every laser-prepared surface with a diamond bur prior to etching.1,2

**Aerolite containing adhesive systems**

Ensure that the dentine surface is glistening with moisture. This can be easily achieved by using a cotton pellet and dabbing off the excess moisture. Adhesives that contain aerolite are particularly sensitive to overdrying. If the tooth surface is not moist prior to adhesive application, a substantial loss in bond strength will result.

**Ethanol containing adhesive systems**

Adhesives that contain ethanol do not require as much moisture. Leave the dentine surface damp by using the air syringe for more than 1 second, blowing off visible surface moisture. Do not direct any substantial sustained air at the surface. A chalky white or over-dried surface will decrease bond value.

**Self etching adhesive systems (water containing)**

Systems that contain water can be placed on slightly drier surfaces. The water in the self-etch adhesive is the carrier for its acid. Thin for 1–5 seconds prior to adhesive application.

**5. Pay attention to application time and technique**

It is important to leave adhesives in place for as long as recommended by the manufacturer. In a busy dental practice, it is easy to count too quickly; watch the clock instead. It is crucial to give the adhesives time to penetrate or wet the deepest zones to be etched. With self etch adhesives being less acidic than phosphoric acid it is, important to leave the adhesive in place for long enough to etch and penetrate the dentine and enamel properly. Also, ensure that you scrub in the adhesive if the manufacturer recommends it. Usually, scrubbing adhesives into dentine will increase bond strength by a few per cent and allow for a much more consistent and reliable bond. Conversely, scrubbing enamel will slightly decrease bond strength. When possible in the same preparation, treat enamel more delicately and dentine more aggressively.

**4. Thin and dry the adhesive properly**

All adhesives should be dried before they can polymerise properly. This means that all adhesives need to be airborne so that they are paper thin (in the case of Peak Universal Bond) and then air-dried.

The best way to accomplish this is with a gentle air stream, using half pressure, at 5–5.5 cm from the surface. A properly thinned adhesive will appear uniformly glossy without pools; pooled product contributes to a substantial decrease in bond strength due to trapped solvents.

Leave the air on for long enough in a gentle stream so that there is no movement in the resin, just drying, to finish volatisating the solvents. This allows monomers to polymerise properly for the highest bond strength possible.

**5. Light cure close to the surface with a compatible light**

Place the curing light as close to the restored surface as reasonably possible. This ensures that the materials are exposed to sufficient energy for a proper cure. At a distance of 25 mm, most lights will only produce 10 per cent or less of the energy than they do at 1 mm.

Only a few of the newest generation of LED lights produce a sufficient light output to mean that they actually emit more than one colour of blue.

This is important owing to the fact that many dental materials contain initiators (light-sensitive chemicals) that react to deeper blue and violet colours.
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[*] Based on research by Strategic Data Marketing.
Dental product categories include chairs, delivery systems, lights, and cabinetry.
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Manufacturers use multiple formulations for their product lines, with incisal enamel shades often containing different amounts or even different initiators to the dentine/body shades. Broadband LED curing lights inspire more confidence in those situations, since they emit several wavelengths, similar to quartz halogen lights. An unsurpassed quality broadband LED is the VALO curing light (Ultradent).

After the first layer has adapted, place standard increments of 1–2 mm in thickness. Another way to improve adaptation to the adhesive layer is to use a flowable composite for the first layer. However, avoid bulk filling owing to stress build-up issues.

7. Never use an expired product
Since all restorative materials contain reactive components, it is important to refrigerate materials that are not used on a daily basis in order to slow the degradation process. The higher the temperature, the faster the chemistry will react and become unsuitable for use. Manufacturers give expiration dates based on data that shows when the product becomes unacceptably degraded.

At Ultradent, we typically set that marker at not less than 90 per cent of new performance, meaning that the product’s performance has not decreased by any more than 10 per cent since it was manufactured. Typically, it is even less than that. When the expiration date arrives, it does not mean that the product has suddenly gone bad, but it means that the product has reached a marker set by that manufacturer.

Products that contain solvent are subject to problems with evaporation. Tighten the lids of these products securely in order to reduce the risk of solvent loss, which could lead to poor product performance.

Conclusion
Many clinicians can increase dentine bond values in their practice by incorporating a few simple practices into their bonding procedures. It is important to start with a solid understanding of bonding fundamentals. After this base has been established, several controllable steps contribute to the final bond value achieved; in combination, this increase or decrease can be dramatic.

Editorial note: A complete list of references is available from the publisher.

Conflict of interest: Dr Dan Fischer is President and CEO of Ultradent Products.

Dr Dan Fischer has been extensively involved in the research and development of many products used widely in the dental profession, with numerous US and foreign patents granted and pending. In addition to his position as CEO of Ultradent Products, he serves as an adjunct professor at Loma Linda University and the University of Texas at San Antonio in the US. He can be contacted at info.my@ultradent.com.