

THE FACULTY PERSPECTIVE

METHODS TO IMPROVE THE CLINICAL EFFECTIVENESS OF CURRENT DENTIN-ENAMEL BONDING AGENTS

Alan M. Atlas, DMD*

The recent surge in the number of dentin bonding agents available for clinical use has created a quagmire for the dental professional. Many practitioners are undecided about which adhesive is best to utilize in a particular clinical situation. Even more disconcerting is the fact that the restorative procedure may fail if the application of an adhesive is performed incorrectly.

Dentin/enamel bonding agents are classified as either etch-and-rinse (total-etch with phosphoric acid on enamel and dentin) or self-etch (phosphoric acid not utilized) adhesives.¹ Dental manufacturers have developed simplified versions of each system, reducing steps by combining of primers and bonding resins into one bottle.

However, recent in vitro studies indicate that a nanoleakage phenomenon, described as a leakage pattern occurring within the nanometer-sized spaces around the collagen fibrils within the hybrid layer, may develop primarily with simplified bonding systems. These bonding agents are more hydrophilic in composition and may also attract water from underlying hydrated dentin at the resin-dentin interface. Increased water sorption into the hybrid and adhesive layers may weaken properties of the adhesive, and account for reduced bond strength.² The scientific evidence must, therefore, be examined to determine how the limitations of these bonding agents may be overcome to ensure a successfully executed clinical protocol. Several methodologies have been introduced in the literature to improve the effectiveness of current adhesive systems to dentin and enamel.

Some researchers recommend the placement of a viscous phosphoric acid etch on enamel prior to self-etch bonding agent application, particularly when a mild self-etch (pH of approximately 2) is utilized as a means to increase the bonding effectiveness of self-etch adhesives to enamel.³ It is mandated that the phosphoric acid etch not come in contact with the dentin in this protocol, because it will reduce the bonding effectiveness of the self-etch primer to dentin.

Other methods suggested in the literature to improve the bonding agents' efficacy are multiple applications and agitation of the adhesives.^{4,5} Consecutive applications of adhesive caused a decrease in nanoleakage, possibly due to the removal of more water and the uptake of additional resin into the collagen fibril meshwork. Agitation of the bonding agents resulted in improved bond strength for the dentin structures only. Most important, however, is that the correct time allocated for material placement and drying must be strictly followed according to the manufacturer's directions.⁶

Conclusion

In vitro studies indicate that the application of a phosphoric acid on enamel prior to the application of a self-etch bonding agent may increase the bonding effectiveness of self-etch adhesives to enamel. Other methods to improve the effectiveness of bonding agents to dentin are multiple applications and agitation of the bonding agents. It is most important, however, to strictly follow the manufacturer's directions for use.

These recommendations are based on in vitro studies. It will be necessary, however, to validate their results in long-term clinical studies to better understand bonding mechanisms and their impact on the clinical outcomes.

References:

1. Van Meerbeek B, De Munck J, Yoshida Y, et al. Buonacore memorial lecture. Adhesion to enamel and dentin: Current status and future challenges. *Oper Dent* 2003;28(3):215-235.
2. Reis AF, Giannini M, Pereira PR. Long-term TEM analysis of the nanoleakage patterns in resin-dentin interfaces produced by different bonding strategies. *Dent Mater* 2007;23(9):1164-1172.
3. Van Landuyt KL, Kanumilli P, De Munck J, et al. Bond strength of a mild self-etch adhesive with and without prior acid-etching. *J Dent* 2006;34(1):77-85.
4. Hashimoto M, De Munck J, Ito S, et al. In vitro effect of nanoleakage expression on resin-dentin bond strengths analyzed by microtensile bond test, SEM/EDX and TEM. *Biomater* 2004;25(25):5565-5574.
5. Velasquez LM, Sargent RS, Burgess JO, Mercante DE. Effect of placement agitation and placement time on the shear bond strength of 3 self-etching adhesives. *Oper Dent* 2006;31(4):426-430.
6. Cavalheiro A, Vargas MA, Armstrong SR, et al. Effect of incorrect primer application on dentin permeability. *J Adhes Dent* 2006;8(6):393-400.

*Director of Restorative Dentistry Clinics, Department of Preventive and Restorative Sciences, University of Pennsylvania School of Dental Medicine, Philadelphia, PA. amatlas@dental.upenn.edu

