The efficacy of primer on sealant shear bond strength

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Sealants were introduced 30 years ago as a preventive material for minimizing dental caries.[1] The high susceptibility of pit and fissures to carious attack and the rapid onset of the disease at these sites soon after tooth eruption is reported by several researchers.[2-4] Water fluoridation and topically applied fluoride reduce the incidence of proximal caries by about 75% while reducing occlusal caries by only 36%.[5]

Hydrophilic dentin bonding agents are designed to be used on moist enamel and dentin to increase retention of composite resin. Studies have shown an increase in bond strength for wet or moist versus dry teeth.[6] Hitt and Feigal[7] used an adhesive (Scotchbond Dual Cure®, 3M, St Paul, MN) as an intermediate layer under sealants (White Sealant®, 3M, St Paul, MN) on bovine incisors. Bond strength greatly increased when the adhesive was used on moist or saliva-contaminated enamel. In extracted human teeth under salivary contamination, the dentin adhesive (Scotchbond Dual Cure®) markedly improved sealant bond strength.[8] Rosell et al.[9] used Universal Bond III® (Caulk Co., Milford, DE) and Scotchbond Multipurpose® (3M) on extracted premolars with salivary-contaminated enamel and found increased penetration of sealants leading to increased bond strength.

The objective of this study was to compare the bond strength of sealants to bovine enamel without and with primer (primer A and B, All-Bond 2®, Bisco Dental Products, Itasca, IL) as an intermediate layer.

Methods and materials

One hundred, intact, noncarious extracted bovine teeth were used within 1 to 3 months of harvest. The roots of the teeth were removed, and the teeth were stored in distilled water at 4°C to minimize bacterial growth. The teeth were embedded in autopolymerizing acrylic resin (Vitacrilic®, Fricke Dental Manufacturing Co, Villa Park, IL) in a rubber mold and wet sanded with 120 grit sand paper to expose at least 4.4 mm of enamel surface for bonding. The mounted teeth were stored in distilled water for 24 hr at 4°C and then assigned randomly to one of four groups: sealant placement on dry or moist teeth and sealant with primer on dry or moist teeth.

Two procedures were used, one for a primer and sealant and one only for sealants, based on the manufacturers' instructions.

1. The enamel surface was dried with oil-free, moisture-free, compressed air for 5 sec, then etched with 32% phosphoric acid semigel (Uni-Etch®, Bisco Dental Products, Itasca, IL) with a sable brush for 15 sec.
2. The etched surface was washed for 20 sec with distilled water and dried until chalky white (group 1 and group 3).
3. For moist conditions (group 2 and group 4), the etched surface was wiped across once with a facial tissue (Kleenex Softique®, Kimberly-Clark Corp, Neenah, WI) to remove only the excess water. For primer groups (group 3 and group 4), one drop of primer A and one drop of primer B (All-Bond 2®, Bisco Dental Products, Itasca, IL) were mixed and applied to the etched surface in five layers without drying between layers, left undisturbed for 10 sec, and air dried for 5 sec.
4. One-third of a gelatin capsule 4.34 mm in diameter (#5, Eli Lilly and Co, Indianapolis, IN) was filled with light-curing composite (Bisfil®, Bisco), and the remainder of the gel capsule was filled with light-cure sealant (Delton Opaque®, Johnson & Johnson,) and bonded to the prepared tooth and cured for 20 sec using a visible light-curing unit (Visilux II®, 3M, Minneapolis, MN).

For group 1, the standard sealant procedure was etching, drying until chalky white, and placing the sealant. For group 2, after etching, the tooth surface was dried using a facial tissue to remove excess moisture. The sealant was applied and cured. For group 3, after etching, the tooth surface was dried until chalky white, primer was applied, and the sealant was applied and cured. For group 4, after etching, the tooth surface was dried using a facial tissue to remove excess moisture, primer was applied, and the sealant was applied and cured.

The specimens were stored after sealant application in distilled water at 37°C for 24 hr. Sealant shear strength to enamel was tested using an Instron 1125 material testing machine (Instron Corp, Canton, MA)

TABLE. SHEAR BOND STRENGTH (MPa ± SD) BY BONDING PROCEDURE AND SURFACE CONDITION ON ENAMEL SURFACE

Enamel Surface Condition	*N**	*Bonding Procedure* — *Sealant*	*N*	*Primer + Sealant*
Dry	25	12.69 ± 5.21 (group 1) B†	25	15.91 ± 4.56 (group 3) AB
Moist	25	3.93 ± 2.01 (group 2) C	25	19.10 ± 5.52 (group 4) A

* *N* = number of specimens per group.

† Groups connected by same letter were not statistically significant from each other at the 0.05 level using Tukey analysis. An increase in the sample size probably would have demonstrated significant differences between group 4 and group 1 and group 3 and group 1 since the *P* levels were 0.065 and 0.069, respectively.

at a crosshead speed of 2 mm/min as recommended by Drummond et al.[6]

Results

The Table 1 presents the shear bond strength results for the four different testing conditions. A 2x2 ANOVA was used to test the main and interaction effects of bonding procedure and moisture and Tukey's analysis to determine the differences between the groups. Primer under sealant (group 4) had a higher bond strength than without primer (group 2) in moist condition; whereas there was no significant difference between them in dry condition (group 3 versus group 1). Group 2 was significantly different from all other groups. There was a significant difference between group 1 (dry + sealant) and group 4 (moisture + primer + sealant), however there was no significant difference between group 3 and group 4 (primer under sealant dry or moist). The Figure shows the type of interaction for bonding procedure and moisture.

Primer used on moist enamel under sealant had significantly higher bond strength than sealant on dry enamel, but no significant difference was found between using primer on dry and moist enamel. Due to the borderline values of significance between groups 3 and 1 (0.0650) and 3 and 4 (0.069), it is possible that if the sample size were increased, a significant difference would be obtained among all groups.

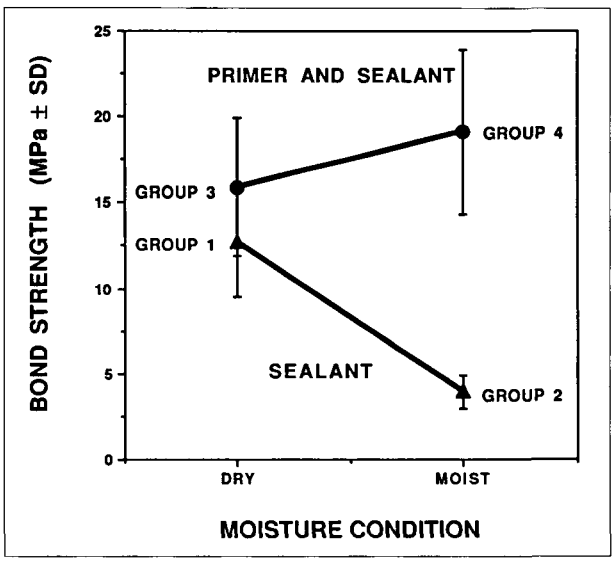

Figure. Mean shear strength of sealant and sealant with primer under dry and moist conditions.

Discussion

The purpose of this study was to compare bond strengths when a primer is used as an intermediate layer and when it is not. The hypothesis was that applying primer under sealant on moist enamel would increase the bond strength of sealants to enamel. The higher bond strength on moist enamel is expected to be due to the hydrophilic property of the primer, which requires water for complete wetting of the bonding surface. A primer, which contains acetone, facilitates penetration of primer into deep pits and fissures by following the water on the enamel surface. Bovine teeth were used instead of human teeth in our study because of availability and the large, relatively flat area of the incisors. Nakamichi et al.[10] compared the bond strength of five dental cements and two composite resins to human and bovine enamel. No statistically significant difference was found in adhesive strength between the two types of enamel.

In this study, higher shear bond strengths were obtained by using primer even though the surface was wet. This study also showed that primer used on moist enamel under sealant had significantly higher bond strength than sealant on dry enamel, but no significant difference was found between using primer on dry and moist enamel. Hitt and Feigal[7] found adhesive used as an intermediate layer under sealants increased the bond strength of sealants on saliva- and moisture-contaminated bovine enamel. Rosell et al.[9] found increased penetration of sealants when adhesives or bonding agents were used under sealants.

The increase in bond strength is expected to result in better retention of sealants in clinical use. Future areas of research would be:

1. Evaluating the moisture level or moisture type using an artificial saliva solution
2. Investigating dental bonding agents that do not contain acetone
3. Determining if the observed increase in bond strength measured on bovine teeth results in better retention rates for sealants in children.

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Hospital patients lack important information at discharge

STUDY FINDS DOCTORS OFTEN ASSUME PATIENTS UNDERSTAND MORE THAN THEY REALLY DO

Many physicians overestimate how much their patients understand about treatment following a hospital stay, according to an article in a recent issue of the AMA's *Archives of Internal Medicine*.

David R. Calkins, MD, MPP, of the University of Kansas School of Medicine in Kansas City, and colleagues surveyed 99 patients and their attending physicians. All of the patients were treated at Beth Israel Hospital in Boston between October 1991 and December 1992 for either pneumonia or acute myocardial infarction, a heart attack. Both conditions have significant postdischarge treatment needs.

The researchers looked at perceptions of physicians and patients concerning the amount of time spent discussing the postdischarge treatment plan, and the patients' understanding of the plan.

They found that doctors reported spending more time talking about postdischarge care than patients did: "Patients and physicians agreed about the amount of time spent discussing postdischarge care only 32.3% of the time. In contrast, 43.1% of the time the patient thought less time had been spent than the physician reported."

Patients and doctors also differed on how much the patients understood about the side effects of medication the patients would be taking after leaving the hospital. "Physicians believed that 88.9% of patients understood potential side effects of postdischarge medication, but only 57.4% of patients reported that they understood," the researchers write.

The researchers also asked physicians and patients about the resumption of normal activities following hospitalization. They found: "Physicians believed that 94.7% of patients knew when to resume normal activities, whereas only 57.9% of patients reported that they knew when normal activities could resume."

The researchers acknowledge that their data cannot answer the question of whether inadequate communication about treatment and overestimation of patients' understanding will adversely affect patient outcome. But they point out: "Inadequate preparation for discharge and noncompliance with treatment plans following discharge have been associated with an increased risk of unplanned readmission. It is certainly possible that better understanding of the side effects of medications and of the appropriate time to resume normal activities would reduce the risk of unplanned readmission or improve other outcomes of care following hospital discharge."

They offer a few suggestions for improving communication between physicians and patients preparing to return home after hospitalization:

- More extended and targeted discussions between patients and physicians.
- Counseling by a pharmacist, or written instructions about medication.
- Comprehensive discharge planning by nurse specialists.
- Telephone follow-up and written reminders.

The researchers conclude: "The role of the physician in discharge planning, particularly in relation to colleagues from nursing and social work, needs to be examined closely. Closer collaboration among all members of the health care team might enhance each member's understanding of the patients' needs and hence enhance the quality of patient care."