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Light Curing the Primer—Beneficial When Working in Problem Areas?

Korkmaz Sayinsu;[a] Fulya Isik;[b] Serdar Sezen;[c] Bulent Aydemir[d]

ABSTRACT

The purpose of this study was to investigate whether Transbond XT with MIP and Assure were affected by light curing the primers before contamination with blood or saliva. The study material consisted of 180 human premolars. The teeth were assigned into 12 groups of 15 specimens each. Metal brackets were bonded to each tooth under five different enamel surface conditions: dry, contaminated with blood or contaminated with saliva after primer application without light curing the primer, and contaminated with blood or contaminated with saliva after primer application with light curing the primer. The shear bond strengths of the two adhesive groups were not significantly different from each other within the same surface condition. There was no statistically significant difference between the groups bonded under dry conditions. On the other hand, curing the primer before adhesive application enhanced the bond strength in the contamination groups. Saliva and blood behaved similarly, showing higher bond strength values when the primer was light cured before contamination. However, they revealed bond strengths of different magnitudes because of the differences in the type and amount of inorganic and organic substances they contained. Under ideal conditions, light curing the primer did not introduce any advantages. However, curing the primer before contamination revealed higher bond strengths. To minimize the negative effect of contamination on bond strength, it would be appropriate for clinicians to light cure immediately after the application of the primer.

KEY WORDS: Shear bond strength, Blood contamination, Saliva contamination, Light cure.

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INTRODUCTION Return to TOC

Etching tooth surfaces with phosphoric acid to bond acrylic resin to tooth enamel was introduced in 1955 by Buonocore[1]. In 1964, Newman[2] suggested an orthodontic use for this technique.

Traditional composite resin bonding materials require completely dry surfaces to obtain clinically acceptable bond strength. A variety of clinical conditions do not permit ideal isolation in the bonding site, especially when bonding attachments to hard-to-reach places. Especially hard-to-reach areas include near the gingival area, around second molars, or when exposing and attaching buttons to partially erupted or impacted ectopic teeth.[3–6]

When etched enamel becomes wet, an insufficient number and length of resin tags are produced. Previous studies that evaluated the effect of saliva and blood contamination on the bond strengths of light-cured composites showed a significant reduction in bond strength values.[4–8] However, none of these previous studies have investigated whether there was any difference in bond strength values when the primer was light cured before the contamination occurred.

The purpose of this study was to investigate whether the bond strengths of two hydrophilic light-cure systems, Transbond XT with MIP (Moisture Insensitive Primer) and Assure, were affected by light curing the primers before contamination with blood or saliva.

MATERIALS AND METHODS Return to TOC

A total of 180 recently extracted human permanent premolars were collected, cleaned of soft tissue, and stored in a solution of 70% (wt/vol) ethyl alcohol. The criteria for tooth selection included intact buccal enamel, no pretreatment chemical agents (eg, hydrogen peroxide), no cracks caused by the extraction forceps, and no caries. The teeth were cleaned and polished with pumice and rubber prophylactic cups for 10 seconds.

The teeth were randomly assigned to 12 groups. Each group consisted of 15 specimens. A total of 180 stainless steel standard premolar brackets with a 0.022-inch slot (DynaLock, 3M Unitek, Monrovia, Calif) were bonded by one operator.

Five different enamel surface conditions were studied: dry, contaminated with blood or contaminated with saliva after primer application without light curing the primer, and contaminated with blood or contaminated with saliva after primer application with light curing the primer. For each enamel surface condition, two orthodontic adhesive systems were used: Transbond XT with MIP (3M Unitek) and Assure (Reliance Orthodontic Products, Itasca, Ill). The bonding procedure for each group is described in Table 1).

The teeth in all groups were conditioned with 37% phosphoric acid for 30 seconds, followed by a thorough washing and drying. In groups where the primer was light cured, the curing time was 10 seconds with a halogen light-curing unit (Optilux, Kerr Corporation, Orange, Calif). The adhesive resins were light cured with the same curing unit for 20 seconds on the mesial side and for 20 seconds on the distal side of the brackets (total cure time 40 seconds), as recommended.[9,10]

To achieve reproducible conditions, the teeth in the blood-contaminated groups were treated with fresh human blood from one male donor. The blood was applied with a brush onto the labial surfaces until they were totally contaminated. The teeth in the saliva-contaminated groups were treated with human saliva from a male donor, who was instructed to brush his teeth and not to eat for one hour before the saliva was collected. Saliva was applied with a brush onto the labial surfaces until they were totally contaminated.

After bonding, all samples were stored in distilled water at 37°C for 72 hours. Each tooth was oriented with a guiding device, so its labial surface was parallel to the force during the shear strength test. Then, the specially prepared cylindrical metal ring was placed around the tooth. The ring was filled with self-curing, fast-setting acrylic up to 3 mm below the bracket. A 0.016 × 0.022–inch stainless steel wire was placed under the wings of the bracket with the ends of the wire clamped to the self-centering upper jaw of the Zwick Universal Testing Machine. The force was applied to the bracket in a gingival-occlusal direction with a speed of 3 mm/min until failure. A computer electronically connected with the Zwick test machine (Zwick GmbH & Co, Ulm, Germany) recorded the results of each test. Bond strengths were measured in megapascals (MPa) (Figure 1).

Statistical calculations were performed by the GraphPad Prisma Version 3.0 software (San Diego, Calif) for Windows. In addition to standard descriptive statistical calculations (mean and standard deviation), the one-way variance analysis was carried out for the comparison of groups. In the evaluation of subgroups, a Tukey multiple comparison test was performed. An unpaired *t*-test was used in the comparison of two adhesives. The results were evaluated within a 95% confidence interval. The statistical significance level was established at $P < .05$.

RESULTS Return to TOC

The means, standard deviations, and range of shear bond strengths in all groups are shown in Table 2 and Figure 2 . When the results were statistically evaluated, shear bond strengths of the two adhesive groups were not significantly different from each other when performed under the same surface conditions (Table 3). There was no statistically significant difference between the groups bonded under dry conditions. This showed that light curing the primer before adhesive application did not enhance the overall bond strength. However, curing the primer before adhesive application enhanced the bond strength in the contamination groups (Table 3).

DISCUSSION Return to TOC

In this study, two different orthodontic adhesives (Transbond XT with MIP and Assure) were evaluated in five different surface conditions (dry, contaminated with blood or contaminated with saliva after primer application without light curing the primer, and contaminated with blood or contaminated with saliva after primer application with light curing the primer). MIP and Assure primers are hydrophilic materials formulated with alcohol or acetone (or both) as ingredients to displace moisture from the enamel surface and are recommended for use in difficult conditions.[11]

The results of this study showed that, under ideal routine clinical conditions, the mean shear strengths required for bond failure with Transbond with MIP and Assure were 14.45 and 14.17 MPa, respectively. Bond strength values for MIP exhibit a wide range of bond strength failure rates in the literature.[5,7,8,11–13] A very similar inconsistency was observed with the results of studies regarding Assure.[7,14] The results of this study indicate that the additional light curing of the primer did not affect the bond strength significantly under ideal routine clinical conditions (Table 2).

Contamination by oral fluids such as saliva and blood on etched enamel has been reported to reduce the bond strength of direct bonding of adhesive to enamel. If acid-etched enamel absorbs saliva or blood, the surface energy is reduced, leaving most of the porosities plugged and consequently impairing the penetration of the resin.[15,16] In studies regarding blood and saliva contamination, surface contamination is frequently placed on the etched enamel surface or on the liquid primer, before the light cure.[4–8,11–14] However, this study design may lead to very low bond strength values because of the impaired penetration of the resin into enamel porosities.

In this study, saliva and blood behaved similarly. They both showed higher bond strength values when the primer was light cured before contamination. However, they revealed bond strengths of different magnitudes because of the differences in the type and amount of inorganic and organic substances they contain.[17] Our result with saliva contamination on light-cured Assure primer was 10.04 MPa. Webster et al[7] and Schaneveldt and Foley[11] similarly have light cured the Assure primer before saliva contamination and found similar bond strength values, 9.28 and 13.72 MPa, respectively.

The reason for a relatively successful bond in the groups where the primer was light cured before contamination is probably the light curing of the bonding material, resulting in resin tags of sufficient numbers and lengths for adequate bond strength before saliva or blood plugged the porosities on the enamel surface (Table 3).

CONCLUSIONS Return to TOC

- Curing the primer before contamination revealed higher bond strengths.
- In noncontaminated ideal conditions, light curing the primer did not introduce any advantages.
- To lessen the negative effect of contamination on bond strength in problem areas, it would be appropriate for the clinician to light cure immediately after the application of the primer.

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TABLES Return to TOC

TABLE 1. Bonding Procedure for Each Group

Group 1	37% Phosphoric acid	Rinsing/drying	Primer			Adhesive	Light cure
Group 2	37% Phosphoric acid	Rinsing/drying/drying	Primer	Light cure		Adhesive	Light cure
Group 3	37% Phosphoric acid	Rinsing/drying	Primer		Blood	Adhesive	Light cure
Group 4	37% Phosphoric acid	Rinsing/drying/drying	Primer	Light cure	Blood	Adhesive	Light cure
Group 5	37% Phosphoric acid	Rinsing/drying	Primer		Saliva	Adhesive	Light cure
Group 6	37% Phosphoric acid	Rinsing/drying/drying	Primer	Light cure	Saliva	Adhesive	Light cure

TABLE 2. Mean and Standard Deviations for Groups

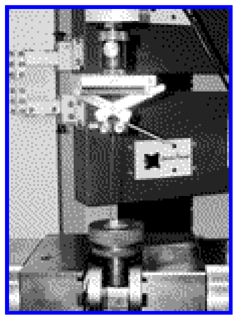
	MIP	Assure	*P*
Group 1	14.45 ± 2.35	14.17 ± 2.11	.736
Group 2	15.16 ± 2.16	14.19 ± 2.33	.245
Group 3	5.04 ± 1.31	4.12 ± 1.5	.087
Group 4	8.12 ± 2.03	7.02 ± 2.05	.149
Group 5	7.08 ± 1.29	6.85 ± 1.25	.629
Group 6	10.72 ± 2.13	10.04 ± 1.61	.331
P	.001	.001	

TABLE 3. Statistical Significance of Differences Between Groups as Calculated With Tukey's Multiple Comparison Test[a]

	MIP	Assure
Group 1/group 2	NS	NS
Group 1/group 3	$P < .001$	$P < .001$
Group 1/group 4	$P < .001$	$P < .001$
Group 1/group 5	$P < .001$	$P < .001$
Group 1/group 6	$P < .001$	$P < .001$
Group 2/group 3	$P < .001$	$P < .001$
Group 2/group 4	$P < .001$	$P < .001$
Group 2/group 5	$P < .001$	$P < .001$
Group 2/group 6	$P < .001$	$P < .001$
Group 3/group 4	$P < .001$	$P < .001$
Group 3/group 5	NS	$P < .01$
Group 3/group 6	$P < .001$	$P < .001$
Group 4/group 5	NS	NS
Group 4/group 6	$P < .01$	$P < .001$
Group 5/group 6	$P < .001$	$P < .001$

[a] NS indicates not significant.

FIGURES Return to TOC



Click on thumbnail for full-sized image.

FIGURE 1. Setup used in testing the material

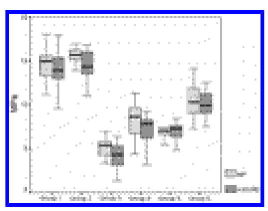


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FIGURE 2. Graph presenting the shear bond strengths in all groups

[a]Assistant Professor, Department of Orthodontics, Yeditepe University, Istanbul, Turkey

[b]Assistant Professor, Department of Orthodontics, Yeditepe University, Istanbul, Turkey

[c]Research Assistant, Department of Orthodontics, Yeditepe University, Istanbul, Turkey

[d]Research Assistant, Tübitak UME (Ulusal Metroloji Enstitü sü), Gebze,Turkey

Corresponding author: Korkmaz Sayınsu, DDS, PhD, Department of Orthodontics, Yeditepe University, Bagdat cd. 238, Goztepe, Istanbul 34730, Turkey (E-mail: drkorkmaz@yeditepe.edu.tr)