Original Article

New Protective Polish Effects on Shear Bond Strength of Brackets

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ABSTRACT
One of the solutions for the problem of white spot lesions has been the application of a polymer coating to the labial enamel surface. The aim of this study is to find out whether the liquid polish BisCover affects the bond strength of brackets bonded with a light-cured system (Transbond XT) and a no-mix system (Unite). Standard stainless steel premolar brackets were bonded to 100 permanent human premolars randomly divided into five equal groups. Two different enamel surface conditions were studied: dry and varnished with BisCover. For each enamel surface condition, two orthodontic adhesive systems were used: a light-cured system (Transbond XT) and a no-mix system (Unite). All teeth were conditioned with 37% phosphoric acid for 30 seconds, followed by thorough washing and drying. The teeth in groups 1 and 2 were bonded with Transbond XT and Unite, respectively. For groups 3, 4, and 5, a thin layer of BisCover was applied to the etched enamel with a brush and light cured for 15 seconds. In group 3, a thin layer of Transbond XT primer was applied, whereas in group 5, no additional primer was used on BisCover. In groups 3 and 5, the brackets were bonded with Transbond XT adhesive resin. Group 4 was bonded with no-mix Unite. Shear forces were applied to the samples by a Zwick Universal test machine, and bond strengths measured in megapascals. The results revealed that shear bond strengths of the groups did not differ significantly from each other. (*Angle Orthod* 2006;76:306–309.)

KEY WORDS: Shear bond strength; Liquid polish; Demineralization

INTRODUCTION

Localized decalcification of the enamel around a bonded bracket is referred to as a white spot lesion, and it may occur within a few weeks of appliance placement.[1–3] During orthodontic treatment, bonded brackets promote dental plaque retention and make oral hygiene difficult to maintain. To obtain sufficient bond strength, acid etching is performed on enamel surfaces. Acid etching has been described as causing damage, including dissolution or defects of enamel.[4–10] This creates a suitable environment for the development of white spot lesions,[11–14] especially when patients fail to comply with oral hygiene instructions. The prevalence of white spot lesions in patients who received orthodontic treatment is in the range of 50–96%.[11,12,14]

One of the potential solutions for this problem has been the application of a polymer coating or fissure sealant to the labial enamel surface.[15,16] A clinical trial has shown that the application of light-cured resin sealants to the labial enamel surface can reduce demineralization by 13%.[17] Another study in 2001 found that the effect of polymeric coating on etched enamel had a greater effect than that on both the control and the chlorhexidine-varnish groups.[18] Joseph and Rossouw[16] investigated the bond strength of brackets bonded to teeth with orthodontic composite resin and various fissure sealants and reported that the application of fissure sealants did not change the bond values. In addition, more bond failure sites were located at the resin/enamel interface than in those teeth with-

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TABLE 1. Bonding Procedure for Each Group

Group 1	37% Phosphoric acid	Rinsing/drying	Dry	—	Bonding—Transbond	Adhesive—Transbond	Light cure
Group 2	37% Phosphoric acid	Rinsing/drying	Dry	—	Bonding—Unite	Adhesive—Unite	Light cure
Group 3	37% Phosphoric acid	Rinsing/drying	BisCover	Light cure	Bonding—Transbond	Adhesive—Transbond	Light cure
Group 4	37% Phosphoric acid	Rinsing/drying	BisCover	Light cure	Bonding—Unite	Adhesive—Unite	Light cure
Group 5	37% Phosphoric acid	Rinsing/drying	BisCover	Light cure	—	Adhesive—Transbond	Light cure

out sealant, thus requiring less cleaning of the tooth surface after debonding. These studies have all shown agreement on the need for further research to develop a material, which would provide greater enamel protection without compromising the bond strength of the brackets.

A new material, BisCover (Bisco Inc, Schaumburg, Ill), developed to totally eliminate the formation of the oxygen-inhibition layer by chemical means, was used to develop a highly reactive, multifunctional, acrylate-based light-cured surface sealant and glaze. Eliminating the oxygen-inhibition layer and converting it to a glaze layer removes any need for further polishing with this new material. The aim of this study is to find out whether the liquid polish BisCover affects the bond strength of brackets bonded with a light-cure system (Transbond XT, 3M Unitek, Puchheim, Germany) and a no-mix system (Unite, 3M Unitek, Monrovia, Calif).

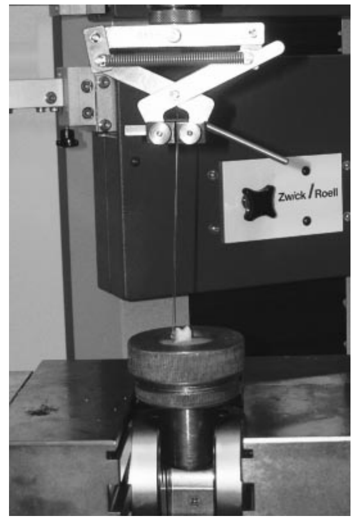

FIGURE 1. Specimen in Zwick Universal Test machine.

MATERIALS AND METHODS

A total of 100 recently extracted human 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 exposure to pretreatment chemical agents (eg, hydrogen peroxide), no cracks caused by the extraction forceps, and no caries. The teeth were cleaned and then polished with pumice and rubber prophylactic cups for 10 seconds.

The teeth were randomly assigned to five groups. Each group consisted of 20 specimens. A total of 100 standard stainless steel premolar brackets with a 0.018 inch slot (DynaLock, 3M Unitek, Monrovia, Calif) were bonded by one operator. Two different enamel surface conditions were studied: dry and varnished with BisCover. For each enamel surface condition, two orthodontic adhesive systems were used: a light-cured system (Transbond XT) and a no-mix system (Unite). 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 thorough washing and drying. The teeth in groups 1 and 2 were bonded with Transbond XT and Unite, respectively, as recommended by their manufacturers. In the first group, Transbond XT resin was light cured with a halogen light-curing unit (Optilux, Kerr Corporation, Orange, Calif) for 20 seconds on the mesial side and for 20 seconds on the distal side (total cure time 40 seconds), as recommended by Oesterle et al.[19] For groups 3, 4, and 5, a thin layer of BisCover was applied to the etched enamel with a brush and light cured for 15 seconds per tooth at close range (0–2 mm). In group 3, a thin layer of Transbond XT primer was applied on light-cured BisCover, whereas in group 5, no additional primer was used. In groups 3 and 5, the brackets were bonded with Transbond XT adhesive resin. Group 4 consisted of specimens bonded with Unite adhesive.

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 (Zwick GmbH & Co, Ulm, Germany). The force was applied to the bracket in a gingivoocclusal direction at a speed of 3 mm/min until failure. A computer electronically connected with the Zwick test machine recorded the results of each test (Figure 1). The bond strengths were measured in megapascals (MPa).

TABLE 2. The Result of One-way Variance Analysis

	Mean	SD	Maximum	Minimum
Group 1	13.029	2.401	16.99	9.55
Group 2	15.37	1.964	18.51	11.43
Group 3	12.792	2.168	18.29	8.62
Group 4	14.167	2.217	17.87	10.16
Group 5	12.792	1.575	15.40	9.93
P value	.0003			
Significance	***			

*$P<.05$; **$P<.01$; ***$P<.001$

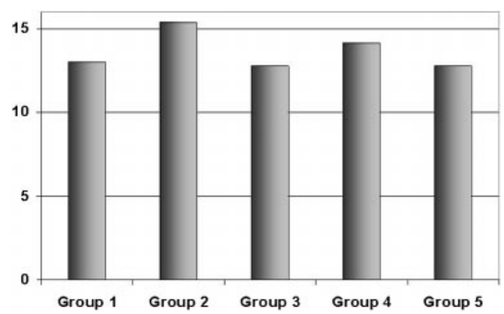

FIGURE 2. Bar graph of shear bond strength of groups.

TABLE 3. The Results of Tukey Multiple Comparison Test

	Group 1	Group 2	Group 3	Group 4	Group 5
Group 1		<0.001			
Group 2			<0.001		<0.001
Group 3					
Group 4					

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

RESULTS

The means, standard deviations, and highest-lowest values for shear bond strengths in all groups are shown in Table 2 and Figure 2. When the results were statistically evaluated, the shear bond strengths of groups 1 and 2, 2 and 3, and 2 and 5 differed significantly from each other (Table 3). All the groups presented strong bond values when tested for shear bond strengths.

DISCUSSION

To prevent decalcification of the enamel around the bonded bracket, application of a polymer coating, a fissure sealant, or a light-cured resin sealant to the labial enamel surface has been recommended.[15–18] Bjarnason et al[20] reported a striking decrease in the prevalence of demineralization with surface sealants, and Hughes et al[21] have also stated that this application would make the enamel more acid resistant than normal enamel.

When fissure sealants are placed, an oxygen-inhibited layer is present. This layer has a low mechanical strength and is liquidlike or sticky on the surface and harmful or even toxic.[22] Furthermore, the complete polymerization of resin primers may be prevented by oxygen inhibition. Bond strength of the orthodontic bracket to the enamel may be negatively affected by this incomplete resin polymerization.[23] BisCover is a new bonding agent that does not have an oxygen-inhibited layer and, therefore, is advantageous when compared with other bonding agents. Furthermore, the elimination of the oxygen-inhibition layer converts the surface to a glazed layer, which may decrease the retentiveness of the area around the bracket.[24]

In a study that evaluated the bond strength of brackets bonded to teeth with orthodontic composite resin (Concise) and various fissure sealants, it was concluded that the application of fissure sealants did not change the bond values.[16]

In this study, the shear bond strengths of two different orthodontic adhesives (Transbond XT and Unite) were evaluated with or without the application of liquid polish BisCover. The results of the study revealed that the application of BisCover did not have an effect on the bond strength of brackets bonded with a light-cured system (Transbond XT) or a no-mix system (Unite) and that all samples exhibited shear bond strength values that were well above the accepted bond strengths for bracket bonding.[25] This study also confirmed that no additional bonding resin was required when BisCover was used.

CONCLUSIONS

- The use of liquid polish BisCover did not change the bond strength values for a light-cured (Transbond XT) or a no-mix system (Unite) for orthodontic bracket bonding.
- No additional bonding resin was required when BisCover was used.

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