Effect of an Adhesion Booster on Bond Failure Rates: A Clinical Study

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Over the past few decades, advances in the development of adhesives have allowed orthodontists to bond either new or debonded brackets to tooth surfaces more successfully.[1-3] Bowen and colleagues in 1965 advocated the use of Adhesion Booster, a tooth surface primer.[4] In 1995, Newman and colleagues concluded that adhesion promoters and silicoating resulted in an increase in bond strength of as much as 13.3 MPa.[5] In 2000, however, Chung and colleagues, studying the effects of two adhesion boosters on the bond strength of new and rebonded orthodontic brackets, found that an adhesion booster did not significantly increase the shear bond strength of new brackets.[6] Sandblasting the bases of rebonded brackets and using an adhesion booster yielded bond strengths comparable to those of the new brackets.

Vicente and colleagues in 2004 studied the effects on bond strength of Enhance L.C.* Adhesion Booster.[2] They found that Enhance L.C. produced a greater increase in bond strength for Light-Bond* adhesive than for Transbond XT,** but that the increase was not significant in either case. Since it has been shown that bonding systems with no statistically significant differences in strength as measured in vitro can have different clinical failure rates,[7] however, we designed a study to assess the clinical efficacy of an adhesion booster in vivo.

Materials and Methods

Ten orthodontic patients with Class I or Class II malocclusions participated in this clinical investigation. Five patients were bonded with Begg brackets*** and five with the MBT preadjusted edgewise series.† A split-mouth design was used, with the mouth of each patient divided into four quadrants, in a random pattern from patient to patient to eliminate any bias.

A total of 150 brackets (64 Begg and 86 MBT) were bonded. The following steps were performed in every patient:

1. The facial surface of each tooth to be bonded was pumiced with a non-fluoridated paste.
2. The tooth was rinsed with water and dried with an oil-free air spray.
3. The enamel surface was etched with 37% phosphoric acid for 30 seconds and rinsed with water for 10 seconds.
4. The excess water on the etched enamel surface was air-dried, leaving a small amount of moisture without desiccating the enamel.

In the control group, a layer of Light-Bond liquid resin was applied and cured for 10 seconds per tooth. Light-Bond paste was applied to the base of the bracket, which was firmly positioned on the tooth. After excess adhesive was removed from around the base, the bracket was cured for 40 seconds (10 seconds on each of the four sides).

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†Equilibrium mini MBT 22, Dentaurum, 10 Pheasant Run, Newtown, PA 18940. Equilibrium is a registered trademark; MBT is a trademark of 3M Unitek Orthodontic Products.

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In the experimental group, a thin layer of Enhance L.C. was applied to the etched enamel and lightly dried with an air syringe, leaving the surface with a shiny appearance. A thin layer of Light-Bond liquid resin was applied directly over the Enhance L.C. layer and cured for 10 seconds. The bracket was immediately bonded with Light-Bond paste as described above.

Continuous nickel titanium archwires were placed after bonding, and both groups of patients were monitored for 90 days. A data sheet was used to record the date of any bond failure, the tooth involved, and whether the failure was at the adhesive-enamel surface, a cohesive failure, or at the adhesive-bracket interface. The amount of adhesive remaining on the tooth surface was assessed according to the Adhesive Remnant Index (ARI)[8]:

0 = no adhesive left on the tooth
1 = half or less of the adhesive left on the tooth
2 = more than half of the adhesive left on the tooth
3 = all the adhesive left on the tooth

Results

Of the 150 bonded brackets, 13 failed (8.6%)—seven Begg and six MBT. Two of the bond failures (one Begg and one MBT) occurred in the Enhance L.C. group, and the other 11 were brackets bonded with Light-Bond only.

The ARI was 1 in each case, indicating that the failures occurred predominantly at the adhesive-enamel interface, with half or less of the adhesive left on each tooth.

Discussion

The split-mouth design used in this study had the advantage of controlling unknown complicating factors, since the two bonding procedures were performed in an identical oral environment in each patient. In a larger study, Adolfsson and colleagues reported an overall bond failure rate of 7.2%, which is similar to our 8.6%.[9]

The application of Enhance L.C. appeared to reduce the bond failure rate when compared to Light-Bond alone. Failure rates were about the same for Begg and MBT brackets. Furthermore, the adhesion booster did not increase the amount of adhesive remaining on the enamel (ARI = 1). These results agree with those of the previous study by Vicente and colleagues.[2]

It has been suggested that to avoid enamel fracture, the adhesive failure should occur between the bracket base and the adhesive rather than between the adhesive and the enamel. On the other hand, removal of any adhesive left on the tooth after debonding is always accompanied by some loss of enamel.

Clinical research with a larger sample is recommended to verify the results of this trial.

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