

EFFECT OF AN ADHESION BOOSTER ON THE BOND STRENGTH OF NEW AND RECYCLED BRACKETS

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ABSTRACT

This Study was undertaken to study if adhesion boosters could improve bond strengths of new and recycled orthodontic brackets. **Materials and Methods:** The sample consisted of one hundred freshly extracted non carious human premolars extracted for orthodontic purpose were divided into four Groups Group-I: New Brackets bonded with no mix adhesive. Group-II: New brackets bonded with no mix adhesive and all bond-2 (an adhesion booster). Group-III: Recycled brackets with no mix adhesive. Group-IV: Recycled brackets with no mix adhesive and all bond-2. Shear bond strength was tested using a Universal Testing Machine (Instron Corp, Figure-4) **Results:**The mean bond strength of different groups are Group I-10.4470Mpa, Group II-14.2465Mpa, Group III- 6.5395Mpa, Group IV-10.2220Mpa. **Discussion:**There was a significant increase in bond strengths in the groups bonded with all bond-2 compared to groups without all bond-2. The mean bond strength of recycled brackets without all Bond-2 (6.5395 MPa) was significantly lower than the mean bond strength of recycled brackets with all bond-2 (10.22 MPa at P<0.05 level P=0.49635). **Conclusion:** In order to increase bond strength of recycled brackets, all bond-2 can be used. As the bond strength of recycled brackets with All bond-2 is close to that of new brackets without adhesion boosters, bonding all bond-2 on recycled brackets is as good as bonding new brackets.

KEYWORDS :- Adhesion Booster, Bond Strength, Recycled Bracket

INTRODUCTION

Advances in the development of orthodontic adhesives have allowed orthodontist to bond brackets to the tooth surface quite successfully. Still bond failures do occur in the orthodontic practice. Studies show that 5-7% of brackets bonded undergo bond failure due to reasons like poor bonding techniques, accidental dislodgement, occlusal trauma especially in mandibular premolar region and lack of chemical bond between adhesive bracket interface. In addition, in few instances the clinician may decide to debond a bracket intentionally and then rebond it in a better position. Thus, rebonding is quite a common procedure. For this purpose, the orthodontist needs to recycle or recondition the bracket. Many studies have shown that the recycled brackets do have a poor bond strength compared to new brackets¹, and the very purpose of recycling will not be served if the bond strength is not sufficient.^{2,3}

Traditionally, adhesion booster, advocated by *Bowen* to increase the bond strength of composite resin is available in dentistry for many years. Recently to enhance the adhesion of composite to enamel, dentin, metal and porcelain, some adhesion boosters have been introduced and the effect of such boosters has also been

studied.⁴ *All bond-2* is a dentin bonding agent manufactured by *Bisco*, *Schuamberg* and this study is undertaken to study its effect on bond strength.

Materials and Methods

One hundred freshly extracted non carious human premolars extracted for orthodontic purpose were collected, and were cleaned and stored in distilled water at 37°C. Premolar brackets with 0.022" slot and roth prescription, with a welded foil mesh base were used and the surface area was estimated using *Toolman's microscope* and was found to be 13.5 mm². The adhesive used was *rely-a-bond*, no mix adhesive.

The adhesion booster used for this study is *All Bond-2*, a fourth generation dentin bonding agent by *Bisco*, *Schaumberg*. It consists of two primers A and B. It contains 2% NTG GMA (N-Tolyglycine glycidyl methacrylate and 16% BPDm (Bisphenol dimethacrylate) in ethanol or acetone. It bonds not only to dentin but also to other surfaces like enamel, casting alloys and porcelain.



Fig.1 Adhesive used for the test



Fig.2 Primer A & B of dentin bonding agent used for the test



Fig.3 Armamentarium used for the test

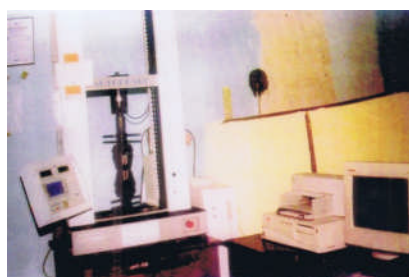


Fig.4 Universal testing Machine (Instron Corp)

The teeth were divided into four Groups

- **Group-I:** New Brackets bonded with no mix adhesive.
- **Group-II:** New brackets bonded with no mix adhesive and all bond-2 (an adhesion booster).
- **Group-III:** Recycled brackets with no mix adhesive.
- **Group-IV:** Recycled brackets with no mix adhesive and *All bond-2*.

The premolar teeth were mounted in color coded acrylic blocks such that the anatomical crowns were left outside the block and stored in distilled water at 37°C to prevent dehydration. These mounted samples were subjected to the following procedure.

The facial surface was cleaned with non fluoride pumice paste, placed in a prophy (expand) cup attached to a slow speed hand piece. The tooth was then rinsed and dried with an oil free spray.

The enamel was etched with 37% phosphoric acid for 15 seconds and rinsed with water spray for 30 seconds. Then the surface was air dried to reveal frosty appearance. The groups which were bonded with all bond-2 were not thoroughly dried but subjected to brief burst of air to help retain the moisture on the enamel without desiccating it. The samples were grouped into four groups and color coded.

Samples in Group-I and III were bonded with no mix adhesive in which primer was applied on the bracket base and enamel surface and allowed to dry. Then adhesive paste was applied on bracket base and bonded

and allowed to dry. Samples in Group-II and IV were applied with a layer of a mix of primer A and B of *All bond-2*, slightly dried and then primer of no mix adhesive was applied and subsequently brackets were bonded with adhesive paste.

Brackets were bonded on the buccal surface along the long axis of the crown and bench cured for 1 hour and stored in distilled water for 24 hours. Rebonded brackets were generated by flaming the base of debonded brackets with a soldered torch for 5 seconds to burn off the residual adhesive. The brackets were subsequently quenched in water at room temperature and then cleaned with an ultrasonic scaler.⁵ The armamentarium used for the test are shown in the figures 1, 2 and 3.

Testing of shear bond strength:

Shear bond strength was tested using a *Universal Testing Machine*⁶ (Instron Corp, Figure-4), which was connected to a computer and the debonding force was recorded automatically. The test samples were stressed for debonding at a cross head speed of 5 mm / min and 50 kg load. The force required for debonding was recorded in Newton and converted into Megapascals.(MPa)

ARI Index

The debonding characteristics were investigated using Adhesive Remanent Index (ARI) scores, as given by Artun and Bergland.

Results

The mean bond strength of different groups is as follows:

Group I	10.4470 Mpa
Group II	14.2465 Mpa
Group III	6.5395 Mpa
Group IV	10.2220 Mpa.

Descriptive statistics like mean, SD and Standard error were calculated for all the four groups. The results were completed and the significance of means was tested using one way ANOVA TEST and multiple comparison test.

Discussion

Our data indicates that among all groups, new brackets bonded with no mix adhesive and All bond-2 had highest mean bond strength of 14.2465 (Gr-II) MPa, followed by new brackets with no mix adhesive (Gr-I) with a mean of 10.44 MPa. This value was significantly lower than the new brackets bonded with all bond-2, with a mean difference of 4.024 MPa (at $P < 0.05$; $P = 0.49635$). Thus our results suggest that application of adhesion booster definitely improves bond strength, but this is not necessary as the bond strength offered without application of adhesion booster is sufficient to resist masticatory forces.^{7,8} But when bonding to flourosis teeth, hypocalcified enamel or restorations, all bond-2 may improve the bond strength.⁹

The mean bond strength of recycled brackets without all Bond-2 (6.5395 MPa) was significantly lower than the mean bond strength of recycled brackets with all bond-2 (10.22 MPa at $P < 0.05$ level $P = 0.49635$). However, the mean bond strength of recycled brackets might be clinically acceptable as the range of shear bond strength required to resist masticatory forces is known to be 5.9 – 7.8 MPa. So in order to increase bond strength, all bond-2 can be used on recycled brackets. As the bond strength of recycled brackets with All bond-2 is close to that of new brackets without adhesion boosters, bonding all bond-2 on recycled brackets is as good as bonding new brackets.¹⁰

ARI calculated, showed that the debonding characteristics were similar in all the groups suggesting that similar adhesive clean up could be necessary. It is interesting to find that most of the bond failures occurred at the tooth adhesive interface rather than within the composite or at the bracket adhesive interface which correlates with clinical situations.¹¹ Two enamel fractures were found in the new brackets bonded with all bond-2 group, suggesting careful debonding in such a clinical situation.

CONCLUSION

From this in-vitro study we can come to the following conclusions. When new brackets are bonded using all bond-2 the shear bond strength is improved significantly. Recycled brackets generated by direct flaming of debonded brackets, when bonded without All bond-2 showed significantly less bond strength than new brackets.

All bond-2 significantly improves the bond strength of recycled brackets to values comparable to that of new brackets.

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