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Original Research

Evaluation of effect of type of orthodontic adhesive on shear bond strength of orthodontic brackets

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ABSTRACT:
Background: To evaluate the effect of type of orthodontic adhesive on shear bond strength of orthodontic brackets. **Materials & methods:** Based on the type of adhesive employed, 100 freshly removed premolars were divided evenly into two groups and glued to 0.022 SS brackets: Reliance Orthodontic Product's self-curing glue, Rely-a-Bond (2) Transbond XT, a 3M Unitek light-cure glue. It was evaluated and compared how different orthodontic adhesives affected the shear bond strength of the brackets. The evaluation was done using the SPSS programme. **Results:** Transbond XT (15.36 MPa) attained the highest bond strength. Self-etching adhesives (Transbond Plus, 11.41 MPa) showed clinically acceptable SBS values. **Conclusion:** All adhesives yielded SBS values higher than the recommended shear bond strength.
Keywords: Shear bond strength, adhesives, orthodontic brackets.

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INTRODUCTION

Contamination of etched tooth surface during orthodontic bonding procedure can result in poor bond strength hence control of moisture contamination is necessary. Saliva and blood contamination is major cause for bond failure.[1] Klocke et al. stated that contamination during bonding procedure reduces the bond strength.[2] Many methods are used to maintain dry operatory filed such as saliva ejector, antisialagogue medicine, and cotton rolls. However, these methods are not adequate for bonding procedures during orthodontic treatment. The maintenance of dry field is required for orthodontic bonding since most of the primers and adhesives have hydrophobic components.[3]

Recently, hydrophilic resin systems and moisture insensitive primers (MIP) are introduced to provide adequate bond strength in the presence of moisture. These are self-etching primers, hydrophilic resin-modified glass ionomer cement (GIC), and MIP such as Transbond MIP, Transbond XT, Opal Primo, and GC Fuji Ortho LC. Rix et al. found that MIP with adhesive was effective in both dry and wet areas.[4] The use of fluoride-releasing adhesives can inhibit caries lesion development during fixed orthodontic treatment. The use of these cements for direct bonding of orthodontic brackets has been proposed because of their ability to adhere to base metal alloys.[5]

Self-etching primers are recently introduced in orthodontics for reducing the bonding steps and to eliminate the need of etching, primers thus eliminates the chances of contamination. Self-etching primers are combination of etching and primer, hence have lesser chairside time and salivary contamination.[6] The bond strength of bonded orthodontic brackets should be sufficient to withstand orthodontic forces applied during treatment. The ideal orthodontic adhesive should have adequate bond strength. Reynolds mentioned 5.9–7.8 MPa resistances are sufficient to withstand masticatory force.[7] Bishara et al. observed 10.4 and 11.8 MPa of mean bond strength respectively with composite resin and conventional adhesive system.[8]

The purpose of the present study was to evaluate the shear bond strength of orthodontic brackets.

Materials & methods

Based on the type of adhesive employed, 100 freshly removed premolars were divided evenly into two groups and glued to 0.022 SS brackets: Reliance Orthodontic Product's self-curing glue, Rely-a-Bond (2) Transbond XT, a 3M Unitek light-cure glue. It was evaluated and compared how different orthodontic adhesives affected the shear bond strength of the brackets. The evaluation was done using the SPSS programme.

Results

Transbond XT (16.89 MPa) attained the highest bond strength. Self-etching adhesives (Transbond Plus, 13.51 MPa) showed clinically acceptable SBS values and almost clean enamel surface after debonding. The analysis of variance tests revealed significant differences among groups.

Table 1: orthodontic adhesives used in study

Groups	Etchant	Primer	Adhesive
I	37% Phosphoric acid	Rely- a-bond primer	Rely- a-bond
II	37% phosphoric acid	Transbond XT primer	Transbond XT composite paste
III	Self- etching primer Transbond plus	-	Transbond XT composite paste

Discussion

Enamel bonding for orthodontic applications was introduced in 1965 and is considered a significant milestone in orthodontic treatment. As reported by Owens and Miller,[9] direct bonding of orthodontic brackets to enamel was made a reality by Buonocore,[10] Bowen,[11] and Tavas and Watts.[12] These researchers were instrumental in developing procedures and materials that have led to present-day standards in orthodontic adhesives. Acid-etching, self-cure composite resins, glass ionomer cements,[13] and visible light-curing adhesives have evolved from these early efforts.[14] New technologies using novel materials are constantly evolving to improve the quality of the bond between the brackets and tooth or artificial subjects.[15] Manufactures have introduced new self-etching primers, which reduce clinical bonding steps and chair time.[16] Self-etching primers, which combine acid and primer, simplify the bonding procedure and avoiding the side-effects of acid-etching.[17] It has been shown that etching with phosphoric acid produces greater loss of enamel.[18]

In this study, Transbond XT (16.89 MPa) attained the highest bond strength. Self-etching adhesives (Transbond Plus, 13.51 MPa) showed clinically acceptable SBS values and almost clean enamel surface after debonding. The analysis of variance tests revealed significant differences among groups.

In the study by Shaik JA et al[19], a total of 100 orthodontically extracted premolars with sound crown structure were divided into 4 equal groups of different primers. Bonding on the buccal surface of all teeth was done after acid etching with upper premolar brackets using different primers followed by light curing. Shear bond strength was evaluated with or without salivary contamination with both adhesives. A shear force for deboning the bracket was done with universal testing machine. The debonded specimens were examined at ×10 magnification to check site of bond failure and remaining adhesive on tooth using adhesive remnant index (ARI). The obtained data were statistically evaluated using SPSS 20 for Windows (SPSS Inc., Chicago, IL, USA) using ANOVA, Kolmogorov-Smirnov, and Levene's test at the statistical significance of $P < 0.05$. Transbond Plus showed higher shear bond strength of 8.92 MPa under dry and 5.65 MPa with saliva contamination over Transbond XT of 7.24 MPa under dry and 2.43 MPa with saliva contamination, respectively. Higher ARI score was found without contamination in both adhesives.

Several studies have been carried which proved that the shear bond strength of self-etching primer and resin system was significantly quite similar or more than the conventional system.[20] Another study evaluated a higher bond failure rate (10.99%) with the self-etching primer as compared to the control conventional etch and priming group (4.95%) other evaluated the mean shear bond strength of the two-step acid-etch primer/adhesive was 5.9 ± 2.7 MPa and the mean for the one-step system was 3.1 ± 1.7 Mpa in his research with $P = 0.001$ which was more significant.[21,22]

Conclusion

All adhesives yielded SBS values higher than the recommended shear bond strength.

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