

## 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:** A total of 30 newly extracted premolars were bonded to 0.022 SS brackets and equally divided into two groups based on adhesive used: (1) Rely-a-Bond (self-cure adhesive, Reliance Orthodontic Product,) (2) Transbond XT (light-cure adhesive, 3M Unitek.) Data was collected. For evaluation and result was analysed using SPSS software. **Results:** Transbond XT (15.85 MPa) attained the highest bond strength. Self-etching adhesives (Transbond Plus, 11.87 MPa) showed clinically acceptable SBS values and almost clean enamel surface after debonding. **Conclusion:** All adhesives yielded SBS values higher than the recommended shear bond strength.

**Keywords:** Transbond XT, adhesives, bond strength.

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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. <sup>1</sup>Klocke et al. stated that contamination during bonding procedure reduces the bond strength. <sup>2</sup> 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. <sup>1,3</sup>

Conventional bonding of orthodontics brackets with filled diacrylate adhesives involves <sup>4</sup> distinct stages. First, the enamel surface is polished with slurry of pumice in water with a slow speed hand piece. It is then conditioned with 37% of phosphoric acid for 30 s, followed by washing with water and air-drying until the enamel is frosty white. Finally, a primer is painted on the etch enamel, the bracket is placed on the teeth, and the adhesive is cured. Recent studies have questioned the need for some of these stages.

Pumicing has been shown to be unnecessary because it has no effect on in vivo bond failure rates before conventional etching. Laboratory studies on measured bond strength. have found that a primer has no effect with either chemically cured or light-cured diacrylate. Sealants have also been suggested as a means of reducing enamel decalcification during treatment. Although clinical studies have found that commonly used low-viscosity sealants have no effect. <sup>4,5</sup> Shear bond strength (SBS) is the main factor, which has to be concerned in the evolution of bonding materials. The bond strength of the orthodontic bracket must be able to withstand the forces applied during the orthodontic treatment. Reynolds stated that 5.9–7.8 MPa resistances are sufficient to withstand masticatory forces. <sup>6</sup> Bishara et al. compared bond strengths of an acidic primer and composite resin with a conventional adhesive system and found mean bond strengths of 10.4 and 11.8 MPa, respectively. <sup>7</sup> The SBSs of self-etching primers can vary widely, ranging from 2.8 to 16.6 MPa. <sup>6</sup> Hence, this study was conducted to evaluate the effect of type of orthodontic adhesive on shear bond strength of orthodontic brackets.

## MATERIALS & METHODS

A total of 30 newly extracted premolars were bonded to 0.022 SS brackets and equally divided into two groups based on adhesive used: (1) Rely-a-Bond (self-cure adhesive, Reliance Orthodontic Product,) (2) Transbond XT (light-cure adhesive, 3M Unitek.) Evaluation of effect of type of orthodontic adhesive on shear bond strength of orthodontic brackets were considered and compared. Data was collected. For evaluation and result was analysed using SPSS software.

## RESULTS

Transbond XT (15.85 MPa) attained the highest bond strength. Self-etching adhesives (Transbond Plus, 11.87 MPa) showed clinically acceptable SBS values and almost clean enamel surface after debonding. The analysis of variance ( $F = 11.45$ ,  $P < 0.0001$ ) 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

**Table 2: Mean SBS values (MPa)**

Groups	n	Mean	SD
I Rely- a- bond	10	12.33	1.12
II Transbond XT primer + adhesive	10	15.85	2.14
III Transbond plus primer + Transbond XT adhesive	10	11.87	1.69

## 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,<sup>8</sup> direct bonding of orthodontic brackets to enamel was made a reality by Buonocore,<sup>9</sup> Bowen,<sup>7</sup> and Tavas and Watts.<sup>10</sup> 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,<sup>11</sup> and visible light-curing adhesives have evolved from these early efforts.<sup>12</sup> New technologies using novel materials are constantly evolving to improve the quality of the bond between the brackets and tooth or artificial subjects.<sup>12,13</sup> Hence, this study was conducted to evaluate the effect of type of orthodontic adhesive on shear bond strength of orthodontic brackets.

In the present study, Transbond XT (15.85 MPa) attained the highest bond strength. Self-etching adhesives (Transbond Plus, 11.87 MPa) showed clinically acceptable SBS values and almost clean enamel surface after debonding. A study by Shaik JA et al, studied 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 debonding the bracket was done with universal testing machine. The debonded specimens were examined at  $\times 10$  magnification to check site of bond failure and remaining adhesive on tooth using adhesive remnant index (ARI). 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.<sup>14</sup> In the present study, the analysis of variance ( $F = 11.45$ ,  $P < 0.0001$ ) tests revealed significant differences among groups. Another study by Eslamian L et al, evaluated the effect of incorporating silver nanoparticles (AgNPs) into conventional orthodontic adhesive on its antibacterial activity and the shear bond strength (SBS) to stainless steel orthodontic brackets. Thirty-four extracted premolars were randomly allocated into two groups ( $n = 17$ ). Orthodontic adhesive (Transbond XT, 3M Unitek) was blended with AgNPs (50 nm, 0.3% w/w) to form a nano-adhesive. In order to bond stainless steel twin brackets (0.022-inch, American Orthodontics), Transbond XT ( $n = 17$ ) and nano-adhesive ( $n = 17$ ) were used in each group, respectively, after acid etching (37% phosphoric acid, 30 s) and rinsing with water (15 s). SBS and the adhesive remnant index (ARI) scores were recorded. The ARI scores on the Transbond XT and nano-adhesive showed no statistically significant difference ( $p = 0.322$ ). Nano-adhesive with AgNPs showed significant antibacterial activity against *Streptococcus mutans* at 24 h and 30 days ( $p < 0.001$ ). In both groups, no significant decline in the zones of inhibition was detected after 30 days ( $p = 0.907$ ). The findings suggest that SBS decreased after incorporation of AgNPs [0.3% (w/w)], but was still above the recommended SBS of 5.9-7.8 MPa. The nano-adhesive showed significant antibacterial activity which did not change much after 30 days.<sup>15</sup> The ARI is one of the most commonly used methods of assessing the quality of adhesion between the composite and tooth as well as between the composite and bracket base.<sup>16,17</sup> Transbond XT showed higher ARI scores of 2 and 3, indicating that all or more than half of the adhesive remained on tooth surfaces. Therefore, the greatest percentage of mixed failures (85%) found in this group. Similarly,

Rely-a-Bond also showed ARI scores of 2 and 3 (65%), whereas, less residual adhesive was found in Transbond Plus with Transbond XT and Xeno V and Xeno Ortho, and there were less ARI scores of 2 or 3 in these groups. This could be clinically advantageous, since, when brackets fail at the enamel-adhesive interface, less adhesive remains, and tooth cleanup is likely to be easier and faster.<sup>18,19</sup>

## CONCLUSION

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

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