



**ORIGINAL RESEARCH PAPER**

**Orthodontology**

**AN IN-VITRO EVALUATION OF TWO ORTHODONTIC BONDING ADHESIVES USED IN COMBINATION WITH SELF-ETCHING PRIMER (SEP).**

**KEY WORDS:** Bonding adhesive, de-bonding, enamel, self-etching primer.

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**ABSTRACT**

This aim of this in-vitro study was to study and compare the pattern of adhesive remaining after de-bonding for two commonly used orthodontic bonding adhesives. 60 recently extracted maxillary first premolars were divided into two groups of 30 teeth each (Groups 1 and 2) and bonded with pre-adjusted edgewise brackets using Transbond™ Plus SEP followed by Tranbond XT™ (Group 1) and Blugloo™ (Group 2) respectively. After de-bonding, a disclosing agent was applied to the tooth enamel surface and Adhesive Remnant Index (ARI) was scored as proposed by Lrtun and Bergland. Results showed no significant difference between ARI scores for the two groups. Use of both Tranbond XT™ and Blugloo™ in combination with Transbond™ Plus SEP results in a similar pattern of adhesive remnants on the enamel surface in-vitro.

**Introduction**

Bracket bonding in orthodontics is commonly done using composite resins which requires that the adhesive should be strong enough to prevent bond failure during the treatment but also cause no or minimal enamel damage during de-bonding. Traditionally, etching the enamel surface with 37% phosphoric acid was the method of choice before direct bracket bonding<sup>1</sup>. Self-etching primers (SEPs) were developed to combine etching and priming into a single procedure in order to reduce chair time, prevent uncontrolled de-mineralization of enamel and eliminate moisture sensitivity of the bonding procedure<sup>2</sup>.

The aim of this in-vitro study was to study and compare the pattern of adhesive remaining after de-bonding for two commonly used orthodontic bonding adhesives i.e. Tranbond XT™ and Blugloo™ using the Adhesive Remnant Index (ARI). The null hypothesis for the study is that there is no significant difference in ARI scores between the two adhesives.

**Materials and methods**

In this study, we used 60 maxillary first premolars which had been extracted for orthodontic treatment. Any carious, hypo-plastic teeth or teeth which had been restored or had surface cracks were excluded. Immediately after removal, blood or adhering tissue was removed by washing the teeth in running water. The teeth were subsequently stored in distilled water. The 60 specimen teeth were divided into two groups of 30 teeth each according to the bonding adhesive to be used as follows:

1. Group 1 – Tranbond XT™ (3M Unitek)
2. Group 2 – Blugloo™ (Ormco)

Before bracket bonding, the teeth were mounted in a custom-base. The enamel was cleaned with pumice and a self-etching primer (SEP) Transbond™ Plus SEP (3M Unitek) was applied for 10 seconds after removing excess water from the tooth surface. An air spray of 2-3 seconds from an oil-free air source was used to achieve a thin film. Pre-adjusted edgewise brackets with 0.022 slot (Modern Orthodontics) were used in the study. Adhesive specified for the respective groups was used to bond the brackets. Excess adhesive was removed with a probe from around the base of the bracket and the brackets were light-cured using Lediton™ light cure machine (Ivoclar Vivadent) on each side for 10 seconds (460 nm wavelength). A height gauge was used with similar pressure applied while bonding each bracket. All brackets were de-bonded by placing the de-bonding pliers at the outer wings of the bracket. Same orthodontist carried out all the bonding as well as de-bonding procedures. A disclosing agent was then applied to the tooth enamel surfaces in order to allow better contrast between the enamel and remaining adhesive for scoring the Adhesive Remnant Index (ARI) proposed by Lrtun and Bergland<sup>3</sup>. The scoring system for the index is given as under:

- Score 0 = no adhesive left on the tooth
- Score 1 = less than half of the adhesive left on the tooth
- Score 2 = more than half of the adhesive left on the tooth

Score 3 = all adhesive left on the tooth with a distinct impression of the bracket mesh

The statistical analysis was performed with the SPSS software package (version 11.5, SPSS, Chicago). Data obtained was summarized as mean and standard deviations. The difference of ARI score was compared between the two groups using Pearson's Chi-square test. Statistical significance was defined as P<0.05 in all tests.

**Results**

The results of chi-squared analysis of ARI scores for the two groups are given in Table 1. ARI score of 2 was most common for both the groups followed by 3 which indicates that in most cases more than half of the adhesive remained on the enamel surface after de-bonding. Overall, there was no significant difference between the ARI scores of Tranbond XT™ and Blugloo™.

**Table 1**

Group	ARI Score				Number	Significance
	0	1	2	3		
1	3	5	16	6	30	NS
2	2	4	18	6	30	NS

**Discussion**

During bracket de-bonding, failure can occur either between the enamel and the adhesive resin, within the adhesive resin or between the bracket base and the adhesive resin. Removal of remnants in required in case of latter 2 situations, often with rotary instruments, which may cause iatrogenic damage to the enamel. Analysis of the results suggested that there was no significant difference in the pattern of bond failure between two groups and most of the composite was left on the tooth surface during de-bonding as indicated by majority of scores being 2 and 3. This indicates a primary failure at the bracket adhesive interface which is similar to what has been observed in previous studies<sup>4</sup>. The adhesive bond to enamel as well as the cohesive strength of the adhesive was thus, higher than the adhesive bond to the bracket base. A complex array of factors is responsible for determining the region or locus of bracket failure which includes the direction of the force applied, any enamel conditioning, the adhesive itself, as well as the bracket mesh type<sup>5</sup>. This study focussed primarily on the adhesive as the differentiating factor. We did not make any attempt to condition the bracket base before bonding. Sufficient adhesion was achieved during the study duration for both adhesive materials as indicated by no spontaneous de-bonding.

Transbond™ Plus SEP was originally developed for restorative

dentistry but it has been found to be compatible with both the orthodontic bonding materials. In order to reduce the number of steps required in bracket bonding as well as sensitivity of bonding procedure to moisture SEPs were introduced to orthodontics<sup>2</sup>. Several in-vitro as well as in-vivo investigations have found the SEPs to perform equally well when evaluating the bond strengths and bond failures of SEPs versus the conventional etch and prime methods<sup>6-11</sup>.

Similar studies of the locus of bond failure for SEP and bonding adhesive have not led to a consensus. Some studies showed that bond failures occur most commonly at the enamel-adhesive interface while others showed a pattern of bond failure similar to that of conventional etching<sup>12,13</sup>. Less remaining adhesive after de-bonding is helpful during the clean-up as it saves time as well as prevents iatrogenic enamel loss which is beneficial to the patient<sup>3</sup>.

It must be kept in mind that clinical de-bonding rates could be different than those observed in in-vitro studies as a complex interplay of forces as well as cyclic fatigue on the bracket-adhesive-enamel interfaces during chewing results in higher de-bonding rates at the adhesive-enamel interface<sup>14-15</sup>. In addition, temperature and pH changes during intake of food and beverages may also affect adhesive strength<sup>14-15</sup>. Further in-vivo investigations are needed to simulate and document the same.

### Conclusion

The null hypothesis that there is no significant difference in ARI scores between the two adhesives is accepted. Use of both Tranbond XT™ and Blugloo™ in combination with Transbond™ Plus SEP results in a similar pattern of adhesive remnants on the enamel surface in-vitro. The conclusions of this study should be carefully extrapolated to clinical setting.

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