

# Comparative Evaluation of Shear Bond Strength of Bracket Bonded To a Debonded Tooth Surface with Conventional and Self Etching Adhesive System on Repeated Bonding-An Invitro Study

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## Abstract

**Aim:** The purpose of this study was to evaluate and measure the effect of repeated bonding on the shear bond strength(SBS) and adhesive remnant index (ARI) of orthodontic brackets bonded using conventional primer(CP) and self etching primer(SEP).

**Materials and Methods:** Twenty eight maxillary first premolars were collected and divided into two equal groups. In group I, the teeth were etched with 37% phosphoric acid, a sealant was applied, and the brackets were bonded with Transbond XT (3M Unitek). In group II, the teeth were etched with self etching primer (Transbond Plus,3M Unitek) and bonded with Transbond XT. In each group, the teeth were bonded and debonded 3 times with the same adhesive.The brackets were debonded using Universal testing machine(Instron) and for each sequence the SBS was measured.Independent t test and one way ANOVA test were used to compare the SBS between group and within each group respectively.

**Result:**During the first,second and third debonding sequences, the mean shear bond strength values were 14.5,13.4 and 12.7 MPa respectively for CP and for SEP the values were 13.4,11.8 and 10.7 MPa which indicated that there was statistical significant difference( $p < 0.05$ ) in SBS for both groups during each debonding sequence. Most or all adhesive remained on the tooth after bracket debonding indicating no statistical significant differences in ARI.

**Conclusion:** The CP had a higher SBS than SEP. The highest values for SBS were obtained after the initial bonding. Rebonded teeth had significantly lower shear bond strength. There was no significant difference in ARI for both the groups.

**Keyword:** Repeated Bonding,Shear Bond Strength,Transbond XT,Transbond Plus.

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## I. Introduction

The field of orthodontic dentistry has been revolutionized by the advent of acid etching technique by Buonocore in 1955<sup>1</sup>.In 1970 bonding of orthodontic brackets had become an accepted clinical technique which has many advantages over banding.Conventional adhesive technique is considered as a standard method for bonding of orthodontic brackets<sup>2</sup>.It has an enamel conditioner,a primer solution and an adhesive resin to bond bracket to enamel.After etching of enamel surface,the adhesive resin is applied which flows into the porosities forming mechanical bond which will provide the adequate strength to keep the brackets attached to the tooth surface during application of orthodontic force.

A major problem faced by orthodontists is debonding of brackets.In a busy practice cleaning,preparing and bonding a new bracket can be undesirable and prolong the treatment time.Approximately 11.3-19.2  $\mu\text{m}$  of enamel surface is lost during cleaning using rotary instruments and 10-50  $\mu\text{m}$  of the enamel is further lost during re etching<sup>3</sup>.

Inorder to simplify the procedure and reduce the chair side time, Self Etching Primers(SEP) were introduced which combine the etching and priming steps.The amount of residual adhesive after debonding is also decreased due to the use of acidic primers<sup>4</sup>.

In Transbond Plus selfetching primer, all the steps are combined into a single application which produces highly porous surface on prismatic enamel which produce excellent mechanical interlock by

simultaneous etching and priming. Bishara in his study reported that when SEPs were used there was a gain of time by 10.2 seconds per tooth, which makes 204 seconds (3.4 minutes) when 20 teeth were bonded<sup>5</sup>.

Various studies has been done regarding the efficacy of self etching primer as an alternative to conventional primers for initial bonding .But the bond strength and bond failure type of these self etching primers when used on debonded enamel surface are still in question.It is also essential to evaluate wheather the SEPs can provide adequate bond strength when compared to conventional system on multiple debonded surfaces.So this study focuses on the bond strength of brackets bonded with conventional and self etching primers on repeated bonding.

## **II. Materials and Methods**

28 healthy human extracted maxillary premolars were collected.All teeth were extracted for orthodontic reasons and presented no caries,cracks,hypoplastic areas.The teeth were cleaned using periodontal curette,washed with water and stored in 0.1% thymol aqueous solution and stored at room temperature.Teeth were divided randomly into 2 groups of equal size and mounted vertically in orthodontic acrylic resin

**GROUP 1:** 37% phosphoric acid +3M Unitek Transbond XT

**GROUP 2:** Transbond Plus Self Etching Primer +3M Unitek Transbond XT

Group 1 and 2 were bonded.After completion of the bonding procedure,the specimen were stored in distilled water at 37 degree celsius for 24 hours for bond maturation.

After 24 hours,the brackets were debonded using Universal Testing machine(Instron 3365) and the shear bond strength were obtained in kilogram forces and divided by brackets area to convert them into megapascals.

After debonding the adhesive remaining was removed with a tungsten carbide bur in a contra angled handpiece with a speed of 35,000rpm(USA Dental Lab MARATHON micromotor)for 20 seconds.Adhesive removal was considered complete when the tooth surface was felt smooth and appeared free of composite to the naked eye under a dental operating light.The debonded surfaces were washed and completely dried.

The bonding/debonding procedures were repeated 2 more times on the same tooth surface with the same regimen.A new bracket was used for each successive bonding.Shear bond strength were calculated for each debonding.

Adhesive remnant index for each group was estimated using a stereomicroscope at 10X magnification.

## **III. Statistical Analysis**

Data was analyzed using the statistical package SPSS 22.0 (SPSS Inc. Chicago,IL) and level of significance was set at  $p < 0.05$ . Descriptive statistics was performed to assess the mean and standard deviation of the respective groups. Normality of the data was assessed using Shapiro Wilkinon test. Inferential statistics to find out the difference between the 2 groups was done using INDEPENDENT T TEST. Mean comparison between three intervals was done using ONE WAY ANOVA TEST followed by TUKEY'S HSD POST HOC TEST .Proportion of ARI scores was done using CHI SQUARE TEST.

## **IV. Result**

During the first,second and third debonding sequences, the mean shear bond strength values were 14.5,13.4 and 12.7 MPa respectively for CP and for SEP the values were 13.4,11.8 and 10.7 MPa which indicated that there was statistical significant difference( $p < 0.05$ ) for both groups during each debonding sequence. Most or all adhesive remained on the tooth after bracket debonding indicating no statistically significant differences in ARI.

## **V. Discussion**

Bond failure is a major problem in orthodontic practice which may be due to inadequate moisture control,inaccuracy in the bonding procedure or due to excessive occlusal forces. According to Vijayakumar et al<sup>6</sup>, the number of debonds after 6 months of treatment was 9.6% while Miles<sup>7</sup> claimed an average bond failure rate of 1.6% which is significantly lower than most of the other reports.

A routine etching removes 3 to 10  $\mu\text{m}$  of surface enamel. Mark Daniel et al<sup>8</sup> found that a 90 second etch with phosphoric acid resulted in mean loss of 6.9 $\mu\text{m}$  of enamel.So during repeated bonding there is a significant loss of the enamel.

In 2000, self-etching primers became effective in conditioning enamel and dentin.Now they are part of the orthodontic armamentarium because of their lack of rinsing and drying steps,that are necessary with traditional phosphoric acid etching.The etching and priming are merged as a single step leading to fewer stages in bonding procedure and reduction in the number of steps that also reduces the chance of error, resulting in saving time for the clinician.

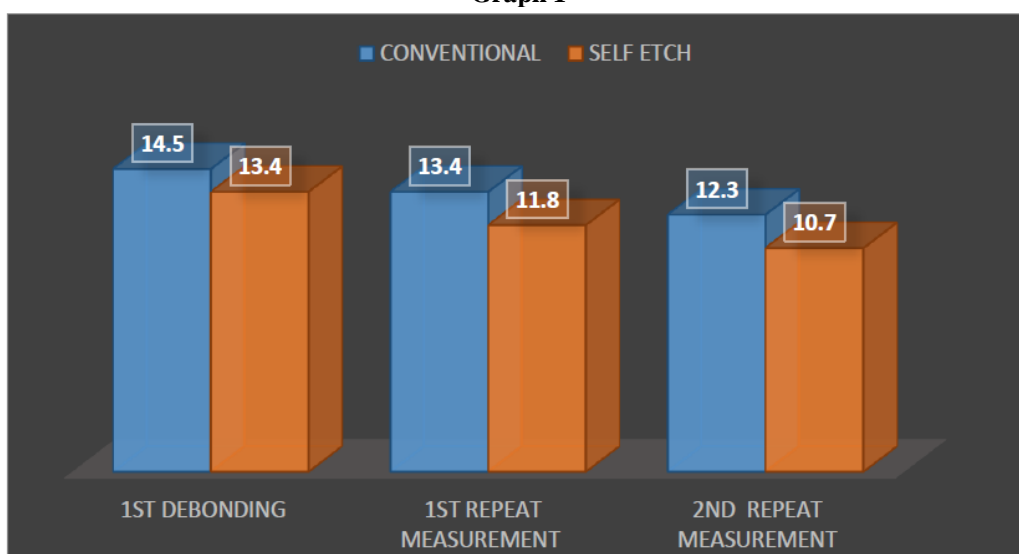
Unlike phosphoric acid , self etching primers are not rinsed off from the surface of the teeth. It has been extensively reported that the use of SEPs produce a milder etch pattern than 37% phosphoric acid. Conventional acid etching of the enamel surface leads to more enamel loss than does the use of SEPs. SEPs seem to produce a milder etching pattern than the phosphoric acid because of their relative higher pH thus minimizing the potential for iatrogenic damage to enamel<sup>9</sup>.

**Table 1**

GROUP	INITIAL DEBONDING	SECOND DEBONDING	THIRD DEBONDING
TRANSBOND XT	14.8 MPa	13.4MPa	12.3 MPa
TRANSBOND PLUS	13.5 MPa	11.8MPa	10.3MPa

Table 1 shows the mean values of shear bond strength obtained during the first, second and third debonding sequences. During the first debonding the mean SBS values were 14.8MPa for CP while SEP shows a value of 13.5MPa. The second debonding sequence shows a mean SBS value of 13.4MPa for CP and 11.8MPa for SEP. A mean value of 12.3MPa was obtained for CP while SEP shows a mean value of 10.3MPa during third debonding sequence. This shows that there was a statistically significantly difference in SBS between first, second, third debonding sequences and within each group on repeated bonding (Graph 1).

**Graph 1**



In this study, the mean SBS values of both CP and SEP were greater than SBS generally required for orthodontic purposes which is considered to be 6 to 8 MPa<sup>10</sup>, suggesting both primers can provide satisfactory bond strength for initial and repeated bonding.

In the current study there was a significant difference in SBS for CP and SEP for all the three bonding/debonding sequences. CP showed higher SBS than SEP for the first debonding sequences suggesting that better bond strength can be achieved with CP for initial bonding. During the second debonding sequence the SBS values for both CP and SEP were decreased compared to the initial debonding suggesting that the bond strength will be reduced when brackets are rebonded. During the third debonding sequence the SBS values for both the groups were even lesser compared to the second debonding sequence which indicates repeated bonding can only reduce the shear bond strength of brackets regardless of the technique used for bonding of the two groups.

When bond strength for all the three bonding/debonding sequence were considered it was seen that there was a general reduction in SBS for both the groups.

**Table 2**  
**ARI SCORE FOR GROUP 1 AND GROUP 2**

SCORE	CONVENTIONAL	SELF ETCH
0	1 (7.1%)	1 (7.1%)
1	3 (21.1%)	3 (21.1%)
2	8(57.1%)	8(57.1%)
3	2 (14.2%)	2 (14.2%)

Orthodontic bracket bonding on tooth is a temporary process; the bracket is removed after the active orthodontic therapy. The amount of adhesive left on the enamel is calculated. The adhesive remnant index score were recorded according to Artun and Bergland scale<sup>11</sup>.

Studies<sup>12,13</sup> have debated whether the differences in ARI scores reflect a difference in bond strength between the enamel and adhesive for the different adhesive systems, but adhesive systems that show less adhesive remnant on the tooth has been advocated for easier and safer removal of residual resin after debonding<sup>14,15</sup>.

Analysis of the present study (Table 2) shows that there was no statistical significant difference in the ARI score for the two groups.

## VI. Conclusion

The study concludes that :

- The shear bond strength of conventional primer was higher than the self etching primer for each debonding sequence.
- There was a significant decrease in bond strength for both groups for the second and third debonding sequence.
- There was no significant difference in the ARI score for conventional and self etching primer.

## References

- [1]. Babu NV, Joseph R. Dr. Michael Bunocore-Adhesive Dentistry-1995. *J Conserv Dent* 2005;8(3):43-44.
- [2]. Coronal AB, Varanjo B, Valdiviezo P. Adhesive Systems Used in Indirect Restorations Cementation: Review of the Literature. *Den J* 2019;7(3):71-75.
- [3]. Pus MD, Way DC. Enamel loss due to orthodontic bonding with filled and unfilled resins using various clean-up techniques. *Am J Orthod* 1980 Mar;77(3):269-283.
- [4]. Giannini M, Makishi P, Ayres APA, Vermelho PM, Fronza BM, Nikaido T, Tagami J. Self-Etch Adhesive Systems: A Literature Review. *Brazilian Dental Journal* 2015; 26(1): 3-10.
- [5]. Oonsombat C, Solomon M, Warren JJ, Bishar SE. Comparison of bonding time and shear bond strength between a conventional and a new integrated bonding system. *The Angle Orthodontist*. 2005;75(2):237-242.
- [6]. Vijayakumar RK, Jagadeep R, Ahamed F, Kanna A, Suresh K. How and why of orthodontic bond failures: An in vivo study. *Journal of Pharmacy & Bioallied Sciences*. 2014;6(1):S85-S89.
- [7]. Miles PG. Does microetching enamel reduce bracket failure when indirect bonding mandibular posterior teeth? *Aust Orthod J*. 2008;24(1):1-4.
- [8]. Kanniyappan P, Kumar SK, Manjula W. S. Enamel pretreatment before bonding in orthodontics-A literature review. *Biomed Pharmacol J* 2015;8 (Spl. Edn.):631-640.
- [9]. Dionysopoulos D, Koumpia EK, Kotsanos N, Dionysopoulos P. Correlation between depth of cure and distance between curing light tip and resin surface. *Balkan Journal of Dental Medicine*. 2011;15(2):70-75.
- [10]. Owens SE, Miller BH. A Comparison of Shear Bond Strengths of Three Visible Light-Cured Orthodontic Adhesives. *Angle Orthodontist*. 2000; 70(5): 352-356.
- [11]. Sofan E, Sofan A, Palaia G, Tenore G, Romeo U, Migliau G. Classification review of dental adhesive systems: from the IV generation to the universal type. *Ann Stomatol (Roma)*. 2017;8(1):1-17.
- [12]. Suliman SN, Trojan TM, Tantbirojn D, Velsius A. Enamel loss following ceramic bracket debonding: A quantitative analysis in vitro. *Angle Orthod*. 2015; 85 (4): 651-656.
- [13]. Juntavee N, Juntavee A, Wongnara K, Klomklorm P, Khechonnann R. Shear bond strength of ceramic bracket bonded to different surface-treated ceramic materials. *J Clin Exp Dent*. 2018;10(12):e1167-e1176.
- [14]. Artun J, Bergland S. Clinical trials with crystal growth conditioning as an alternative to acid-etch enamel pretreatment. *Am J Orthod*. 1984 Apr;85(4):333-40.
- [15]. Bhattacharya D, Sharma K, Sahu R, Neha K, Kumari A, Rai A. Comparative evaluation of shear bond strength of brackets bonded with self etching primer/adhesive and conventional etch/primer and adhesive system. *J Pharm Bioall Scr*. 2021;17(13):1168-73.