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THE EFFECT OF A SELF- ETCHING PRIMER ON THE SHEAR BOND STRENGTH OF ORTHODONTIC BRACKETS: AN IN VITRO STUDY

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ABSTRACT

Background: This study evaluated the bond strength of a commercially available self etching primer system and compared it with a conventional etching adhesive system.

Methods: Forty human premolars with stainless steel Begg brackets were used. Transbond plus TM Self Etching Primer and Transbond TM XT Light Cure Adhesive paste (experimental group) was compared to Scotchbond TM etchant, Transbond TM XT Light cure adhesive primer and TransbondTM XT Light Cure Adhesive paste (control group). The maximum load, the breaking loads were recorded. Student t test was used to compare the bond strength between the groups.

Results: The mean shear bond strength was 16.77± 2.87 MPa (control group) as compared to 11.707±2.49 MPa(experimental group). A statistically significant difference was observed in the mean breaking load values between cases and controls ($P < 0.05$).

Conclusions: The bond strength obtained for self etching primer is lower when compared to that of the conventional etching system. But, current advances in orthodontic materials and techniques aims to make orthodontic treatments more patients friendly thereby adding benefits in the field of Orthodontics.

KEYWORDS : in vitro study, self etching primer, orthodontic brackets

INTRODUCTION

Material science related to Orthodontics has seen a sea of change in the last decade. Since inception, bonding in Orthodontics has undergone considerable improvement with time. Conventional adhesive systems used in orthodontic bonding involve 3 different agents (an enamel conditioner, a primer solution, and an adhesive resin). A unique characteristic of some new bonding systems in operative dentistry is that they combine the conditioning and priming agents into a single acidic primer solution for simultaneous use on both enamel and dentin to result in improvement in both time and cost-effectiveness to the clinician and, indirectly, to the patient. This same type of material is now available for orthodontic bonding claiming better bonding to enamel surface claiming better bond strength. This study was carried out to evaluate the bond strength of a commercially available self etching primer system and to compare it with a conventional etching adhesive system.

MATERIALS AND METHODS

This study used 40 human premolar teeth extracted as a part of orthodontic treatment. The selection criteria were as follows: the crowns were grossly perfect, without caries, and had not been treated with chemical agents, such as hydrogen peroxide, alcohol or formalin. The teeth were randomly divided into two groups – experimental group and control group with 20 teeth each. The study was approved by the Institutional Ethics Committee, Govt. Dental College Calicut, Kerala, India and informed consent was obtained from the subjects. After extraction, the teeth were washed, immersed in physiological saline, and embedded in a cylindrical acrylic block of polymethyl methacrylate (PMMA) so that only the coronal portion of the specimen was exposed. The crowns were oriented along the long axes of the block and were stored in distilled water at room temperature in a closed airtight container. The samples in each group were randomly selected from the container. The fluid media was changed at periodic intervals in order to prevent the growth of bacteria and subsequent contamination of the sample.

Forty new Stainless steel contoured Begg (Series 256- 500) brackets of uniform size manufactured by TP orthodontics Inc., LaPorte, Indiana with bondable bases of approximately 3.42mm in length and 3.31mm in width were used for the purpose. The traditional 3M Scotchbond TM etchant (3M ESPE Dental Products, St Paul, Minn) was used in conjunction with Transbond TM XT Light cure adhesive primer (3M Dental Products) and Transbond TM XT Light Cure Adhesive paste for the control group. Transbond plus TM Self Etching Primer was used along with Transbond TM XT Light Cure Adhesive paste (3M Unitek) for the experimental groups.

The teeth in the control group were rinsed with tap water by using an air/water syringe for 20 seconds, cleaned with a nonfluoridated oil free pumice for 30 seconds, rinsed for an additional 20 seconds, and dried with oil-free compressed air for 20 seconds. The traditional 3M Scotchbond etchant with 35% phosphoric acid was applied to the buccal surface for a period of 15 seconds. The teeth were then rinsed for 15 seconds and warm air dried for 5 seconds. A layer of primer was applied to the etched surface and on bracket base before bonding. The adhesive was spread on the base of Begg brackets which were placed on the mid-buccal surface of the crown and firm seating pressure was applied until bracket to tooth contact was achieved.

Any excess material was removed from around the bracket base. The specimens were then light cured (Hilux curing light) for a period of 20 seconds by shining the light for 10 seconds on each side (mesial and distal). After 10 minutes, the teeth were stored in distilled water for 48 hours at room temperature before debonding.

The teeth in the experimental group were rinsed initially similar to the control group and excess water was removed. The enamel was treated with Transbond Plus Self etching primer, which was gently rubbed onto the surface for approximately 3 seconds with the disposable applicator supplied with the system. A moisture-free air source was used to deliver a gentle burst of air to the primer. The primed enamel surface had a uniform shiny appearance. The bracket was bonded within 15 seconds of priming with the same bonding resin and curing light as for the control group.

The bonded samples were then stored in distilled water at room temperature in sealed containers lined with wet paper towels. After 48 hours, shear bond strength of teeth were tested

using a Universal Test Machine manufactured by the Shimadzu Co-operation Japan [AG-1 series]. The testing was done at a temperature of 28°C. The acrylic block with the teeth embedded having bonded brackets were placed at the base of the test machine. The whole unit was stabilized using clamp tightened with screw at base. The blade was directed towards the base of the bracket or the bracket adhesive interface. The blade was moved towards the bracket with a crosshead speed of 1mm/min. The maximum load, the breaking loads were recorded electronically in Newton and converted to Megapascals.

RESULTS

Bonding strength of two groups were calculated and recorded in MPa. The mean, standard deviation, and minimum and maximum values were calculated. The Student t test was used to determine whether significant differences were present in the bond strength between the 2 groups. The p value < 0.05 was considered as statistically significant. The mean shear bond strength was 16.77± 2.87 MPa (control group) as compared to 11.707±2.49 MPa(experimental group)[Table 1]. There was a statistically significant difference in the Breaking Load values (in Mpa) between control group and experimental group was done ($p<0.05$)[Table 2].

DISCUSSION

This study was undertaken to determine whether Self Etching Primer produced a clinically acceptable bond strength compared to the bond strength of a commonly used conventional composite resin.

The mean shear bond strength of the control group in our study was quite higher than the optimum bond strength recommended for clinical use. Cehreli ZC et al in 2005 [1] compared the shear bond strength of 4 self-etching primer and adhesive formulations, a non rinse conditioner and acetone adhesive system, and a conventional Transbond XTTM system. The shear bond strengths of the 5 experimental groups were all significantly lower ($p<0.05$) than that of the control group. Such high values may not be reachable intraorally as obtained in an In-vitro study for the fact that clinically we face more compromised situations and contamination and patients variables. This also leads credence to the fact that Transbond TM XT is one of the top notch products among light cured adhesives.

The mean value of the shear bond strength of experimental group in this study decreased significantly when compared to control group. This indicates that the use of a self-etch primer to bond orthodontic brackets to the enamel surface provided lower, but clinically acceptable, shear bond forces. The exact cause of the decreased bracket bond strength for the Self Etched Primer (SEP) compared with that of the conventional two-stage bonding system is unknown.

Possible reasons may be the difference in chemical composition and concentration of the etchant between the two systems. The mode of etching/priming between the two bonding systems is different (simultaneous etching/priming with the SEP versus separate etching and priming stages for the conventional two-stage bonding system). This pattern was similar to the findings of Bishara et al[2] in which he compared two bonding systems. The shear bond strength of self etching primer used in another study of Samir E Bishara [3,4] was very less compared to the present study. The reason for such low shear bond strength values could be due to the use of orthodontic adhesives non-compatible with the acidic primers. Bishara had used the orthodontic adhesive Transbond XT (3M Unitek) in both the groups bonded with 37% phosphoric acid etching and acidic primer system (Clearfil Liner Bond 2, J.C. Moritta Kuraway, Japan), both these materials are manufactured by different manufacturers and were not recommended to be used together.

In the present study we used the materials by same manufactures. Still, the bond strength of acidic primers were significantly lower when compared to conventional system, but clinically acceptable. Iijima M et al 2008[5] assessed the efficacy of two self-etching primer systems (Transbond Plus and Beauty Ortho Bond) on orthodontic brackets. Under SEM examination, both self-etching primers showed a milder etching effect and decreased depth of resin penetration into intact enamel than Transbond XT.

The clinical importance of the present study is that this self-etching primer system had provided a lower bond strength than the conventional bonding system. Reynolds in 1975 suggested that shear bond strength of approximately 5-8 MPa was adequate for clinical success. Although in the present study, the shear bond strength of self etching primer is significantly lower ; it is clinically acceptable, as it is higher than Reynolds value.

In contrast to the conventional bonding system the Self etching primers function both as an etching agent and a Primer. Here the rinsing of enamel is not required after application. Thus the use of Transbond PlusTM Self Etching Primer is thought to simplify the clinical handling of adhesive systems by combining the etching step with primer application in one mix. As the separate acid-etching and water-rinsing steps are eliminated and the application of self etching primer requires only simple drying with air it reduces the clinical steps, saves clinical operation time and increases the patient comfort by reducing the time that the patient has to keep the mouth open while doing bonding procedures. Hence the use of Transbond PlusTM, which is easy and reliable, allows the orthodontist to simplify the orthodontic bonding.

In conventional bonding system, the success of bonding to enamel is negatively affected by contamination with oral fluids such as blood, plasma etc. Possibly, the self etching primer usage would have been a blessing in certain clinical situations like with surgically exposed impacted/unerupted teeth or bleeding from inflamed and hypertrophied gingiva where the chair side time and keeping the field dry is critical. Turk T et al in 2007[6] evaluated shear bond strengths (SBSs) of Transbond Plus to Transbond XT following saliva contamination at different stages of bonding at debond times of 5, 15, and 30 minutes and 24 hours. The highest SBS was obtained at a debond time of 24 hours for the control group. This was significantly different from the other groups.

However, the use of self etching primer system is not recommended in certain clinical situations where the demand for bond strength is higher like class II div 2 malocclusions, cases having occlusal interferences, traumatic occlusions, severe deep bites etc. Also for the patients with deficient and defective enamel which are known to reduce the bond strength over otherwise are not suitable candidates for self etching bonding system. Findings of the study further points to the fact that the improvement of the formulations and techniques of self etching primer system should be done so as to makes its use viable in compromised fields of bonding where reducing the step will be much more beneficial for the patient.

Current advances in orthodontic materials and techniques are to reduce the patient discomfort and to make the orthodontic treatments more patients friendly. From that view point, the self etching primer is definitely an additional development in orthodontic field.

The following conclusions can be drawn from the present study: The bond strength obtained for self etching primer was than the conventional etching system but, was greater than that required for the clinical acceptability; this new material

can be used successfully for bonding in normal cases. However, the use of self etching primers cannot be recommended in certain clinical situations which demand high bond strength and also in the contaminated clinical conditions (where further reduction in bond strength is likely to occur.

Based on the study, the further improvement in the formulations and techniques of self etching primer system (Transbond PlusTM) can be suggested, so that it can be used even in compromised clinical conditions and for cases which demand high bond strength.

Table 1 : Bonding strength in experimental and control groups

Groups	No of specimens	Mean +/- SD Maximum load	Mean +/- SD Breaking load (Newtons)	Mean +/- SD Breaking load (MPa)	Range
Control group	20	191.54+/- 31.02	187.78+/- 32.12	16.78+/- 2.87	10.92
Experimental group	20	129.19+/- 28.47	125.60+/- 30.13	11.71+/- 2.49	10.20

Table 2 : Intergroup comparison

Observation Mpa Baseline	Mean	SD	T value	P value
Control group	16.78	2.87	6.313	<0.001
Experimental group	11.71	2.49		

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