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Comparative Evaluation of Shear Bond Strength and Surface Topography of Debonded Enamel Surface Bonded With Bracket Using Two Different Composites- An Invitro Study

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ABSTRACT
Background and objectives: *The aim of this study was to measure the shear bond strength of brackets bonded with two different bonding systems on a debonded enamel surface under in vitro conditions and evaluate the surface topography by comparing the ARI scores*
Materials and methods
The study was done on 42 maxillary premolar teeth ,which was divided into two groups of 21 teeth each. Each group were bonded with two different bonding systems,group1-conventional bonding system,TRANSBOND XT and group2-single bonding system,FIX
The initial shear bond strength of the two groups were measured using universal testing machine(instron).The bonding procedures were repeated on the same debonded tooth surface and shear bond strength were measured.After debonding the samples were sectioned and viewed under scanning electron microscope to evaluate the surface topography and compared using Adhesive Remnant Index
Results
Transbond XT showed greater shear bond strength than Fix on initial and secondary bonding.The initial shear bond strength of TransbondXT and Fix was 13.81 and 11.8 respectively.Both groups showed reduced shear bond strength on debonded enamel surface .Mean value was 12.528 and 11.025 .Most of the adhesives remained on the tooth after debonding for both the groups ,indicating no statistical difference in ARI.
Conclusion
The shear bond strength of Transbond XT was significantly high on a debonded enamel surface than Fix and hence it is considered to be one of the suitable bonding material on a debonded enamel surface
Keywords
TransbondXT, Fix, debonded enamel surface

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I. Introduction

Bonding of brackets is an essential step in orthodontic practice. In 1955, Buonocore[1] introduced the acid-etching technique and started a new era in the field of orthodontics which led to dramatic changes in the practice. In 1965 Newman[2] pioneered the use of epoxy resin for direct bonding of orthodontic brackets to the enamel surface. Bonding of brackets are now widely preferred over banding because of superior esthetics, greater patient comfort,decreased chairside time and improved oral hygiene.

Conventional adhesive systems use three different agents for bonding orthodontic brackets to the tooth,namely an enamel conditioner, a primer and an adhesive system. The traditional 3-step procedure has been used to successfully bond orthodontic brackets to teeth for many years. Many changes have occurred in the last few decades, including the introduction of numerous new adhesives, sophisticated base designs, new bracket materials, faster curing methods, self-etching primers, fluoride-releasing agents ,sealants etc.

The practice of orthodontics is constantly being improved with the use of new techniques and materials.Thus, two-step orthodontic adhesives, without prior application of primer have been introduced in orthodontics to simplify the bonding process thereby eliminating the need for priming,hence reduce the risk of contamination and saves chairside time . 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[3] stated that 5.9–7.8 MPa resistances were sufficient to withstand masticatory forces.

Bond failure during orthodontic treatment is relatively frequent and the orthodontist have to rebond the bracket many times during treatment period.Sorebonded shear bond strength of a newly introduced adhesive is equally important as that of initial shear bond strength. The bond strength of debonded enamel surface is always questionable.Numerous studies were performed by various authors to evaluate the shear bond strength of composite with and without primer,but their effects on debondedenamel surface is not known.Literature provides inadequate evidence regarding the shear bond strength of these two on a debonded surface. Hence; the present study was undertaken for assessing the shear bond strength of two different bonding materials bonded with and without primer on a debonded enamel surface.

II. Materials And Methods

42 maxillary premolars extracted for orthodontic purpose were selected for this study.Teeth were randomly divided into two groups consisting of 21 samples . The group were as follows:

Group 1 :TransbondXT,3MUnitek

Group 2: Fix

In Group 1 samples, buccal enamel surface was etched and bonding agent applied .A 0.022 bracket was bonded to enamel surface using composite(3M Unitek ,Transbond XT) and cured for 40 seconds. In Group 2 samples, buccal enamel surface was etched and 0.022 bracket was bonded to enamel surface using a composite without primer(Fix)and cured for 40 seconds.

After the bonding procedures, the samples were stored in distilled water at 37^0 C for 24 hours to allow for bond maturation. The brackets were debonded using a universal testing machine (Instron 3365) .The shear bond strength values were obtained in kilogram forces and were divided by the bracket base area to convert them into megapascals .

The bonding procedures were repeated on the debonded tooth surface after cleaning and polishing following the same regimen.A new bracket was used for successive bonding. Surface topography of debonded enamel surface in which bracket is bonded using a composite with and without primer was evaluated under scanning electron microscope at magnification of 35x.

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**. **Inferential statistics** to find out the difference between the groups was done using **INDEPENDENT T TEST**. Proportion of ARI scores was done using chi square test.

IV. Results

Conventional bonding system ,Transbond XT shows higher initial shear bond strength and on debonded enamel surface than Fix.

Transbond XT and Fix shows reduced secondary bond strength than primary bond strength, but both groups have sufficient bond strength on debonded tooth surface

Transbond XT and Fix shows higher ARI scores and there is no statistical difference between both .

V. Discussion

The basic demands for a bracket-bonding system are to obtain an acceptable bond strength between the orthodontic brackets and enamel with a low failure rate . Various factors are involved in the success of bonding , including proper bonding technique,types of adhesives used,prevention of contamination,avoiding occlusal interference and the most important is the type of adhesive used.

Frequent debonding is the biggest challenge that orthodontist face in the clinical practice. In a busy orthodontic practice, a significant number of teeth will need to be rebonded.Backet failure or inaccurate placement may necessitate repeated bracket bonding during orthodontic treatment which increases the duration of treatment ,cost , additional patient visits ,chairside time and enamel demineralization. As a result, it is critical to better understand what to expect when a tooth is rebonded more than once, because the literature provides contradictory findings about the shear bond strength of rebonded attachments[4].

According to Mui et al[5], there is no significant changes in the rebond strength and the original shear bond strength, if the enamel surface is reconditioned with a tungsten carbide bur. Rosenstein and Binder[6] found

that rebonding without reconditioning either the bracket or the tooth surface provided the highest shear bond strength. On the other hand, Jassem et al[7] found that thermal recycling of bonded and rebonded orthodontic attachments adversely affected both shear and tensile bond strength.

The constant queries for better bonding systems to reduce the technique sensitivity of the adhesion procedures, to improve the bond strength, minimise enamel loss and to reduce the number of clinical application steps as well as chairside time has resulted in innovation of a large number of adhesives . Trites B et al[8] stated that materials used in the oral cavity should be strong enough to withstand both short-term and long-term forces. Fix is a newly introduced bonding system in which there is no need of application of primer separately, thereby reducing one step and time.

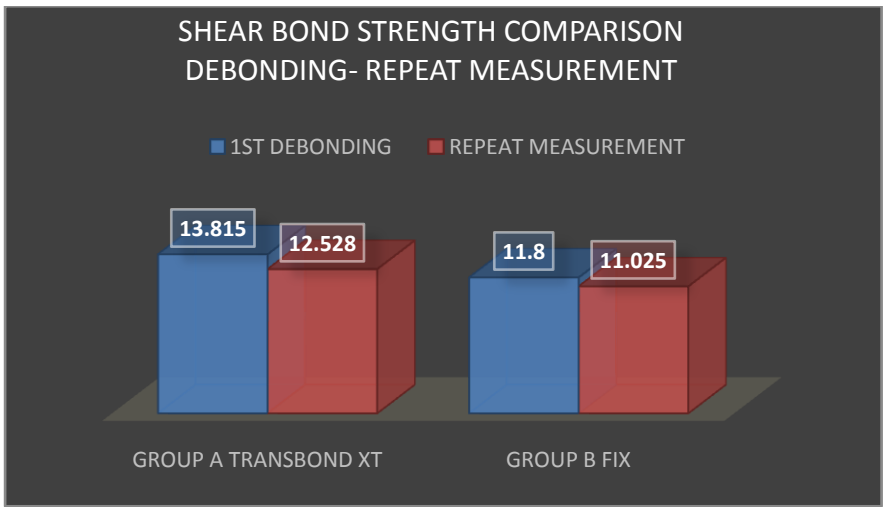
Mean shear bond strength of fix was evaluated and compared to the conventional adhesive system . Transbond XT have a mean shear bond strength of 13.8 whereas fix have a mean value of 11.8 . The test result shows that shear bond strength values of Fix was less than Transbond XT.

Numerous studies were conducted to evaluate the shear bond strength of composite with and without primer. To our knowledge, no studies have compared the shear bond strength of Transbond XT and Fix on a debonded enamel surface. Bond strength of the debonded enamel surface is questionable. It is crucial to know which adhesive have clinically acceptable bond strength in a debonded enamel surface and whether there is any difference between primary and secondary bond strength .

To know the bond strength of these two adhesives on a debonded enamel surface ,the same procedure was repeated on the deboned enamel surface.Conventional adhesive system, Transbond XT shows a mean value of 12.5 whereas Fix shows a mean value of 11.02 on a adebonded surface. Shear bond strength of Fix was reduced when compared with conventional adhesive system.However both the conventional adhesive and Fix shows reduced shear bond strength on debondedsurface.The present findings suggest that a debonded tooth has a weaker shear bond strength than when initially bonded ,but both groups shows sufficient bond strength on a debonded enamel surface. This finding, however, differs from that of Nicolas[9] et al and Endo[10]et al who reported that the secondary bond strength was not significantly different from the primary bond strength

TABLE :1 SHEAR BOND STRENGTH

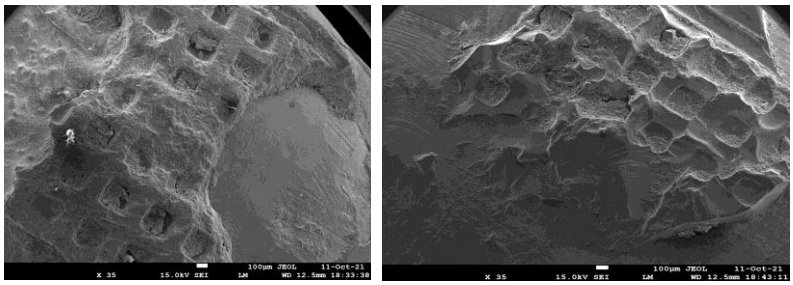
GROUP	INITIAL SHEAR BOND STRENGTH	ON DEBONDED SURFACE
Transbond XT	13.815	12.528
Fix	11.8	11.025



Shear bond strength of Transbond XT and Fix

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[11,12].It was reported that greater bond strength was associated with higher ARI scores[13]and scores were recorded according to the original description of Artun and Bergland[14]

Selected surfaces of each group were also examined under SEM to observe enamel surface after debonding and image was magnified in 35X.In the present study bothTransbondXT and Fix showed higher ARI scores of 2 and 3, indicating that all or more than half of the adhesive remained on tooth surfaces. On comparing ARI scores among group , there is no statistical difference between Transbond XT and Fix



Transbond XT with ARI score of 2 Fix with ARI score of 2

VI. Conclusion

- TRANSBOND XT have greater shear bond strength on initial and secondary bonding
- Both TRANSBOND XT and FIX shows reduced secondary bond strength than primary bond strength, but both groups have sufficient bond strength on debonded tooth surface.
- Transbond XT and Fix shows higher ARI scores and on comparing ARI scores there is no statistical difference between both

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