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RESEARCH ARTICLE

GINGIVALLY OFFSET PREMOLAR BRACKET : A SOLUTION TO BOND FAILURE

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ABSTRACT

Aim: This study is done to evaluate the shear bond strength of gingivally offset premolar brackets with conventional brackets and to compare the enamel surface topographical changes (using scanning electron microscope) after debonding the brackets using EDI index. **Materials and methods:** The study included 30 mandibular premolars divided randomly into two groups. These teeth mounted on acrylic blocks were bonded with conventional standard brackets and gingivally offset brackets which represents GROUP I and GROUP II. **Results and discussion:** Mean shear bond strength of conventional premolar bracket is 13.2 MPa and that of gingivally offset premolar bracket is 15.7 MPa with a standard deviation of 1.39 and 2.16 respectively. The EDI scores are higher with gingivally offset premolar brackets. **Conclusions:** Gingivally offset premolar brackets have superior shear bond strength and causes greater enamel damage than conventional bracket.

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INTRODUCTION

Comprehensive orthodontic treatment requires complex tooth movements which involves placing various attachments to teeth till commencement of the treatment approximately for 2 years. These attachments allow application of desired amount of forces and also helps to withstand masticatory loads .Moreover, it should also be aesthetically pleasing, provides easy removal at the end of the treatment and does not impart damage to hard and soft tissues during application , throughout treatment and on removal. However, due to an increase in bond failure, several manufacturers are still working to improve bracket retentive qualities. Adequate shear bond strength for orthodontic bonding should be 5.6-7.8 MPa[1].

Bond strength of orthodontic brackets is influenced by various material- and tooth- related factors.[2] Material-related factors include type of etching material, etching technique, types of bracket, bracket base design and size and adhesives. Flourosis is one of the teeth-related variables that is considered to have a negative impact on shear bond strength. Bracket debonding is another major problem to be dealt in clinical practice by most orthodontist. Newman[3] quotes a failure rate of 26%.Brackets attached to posterior teeth are found to be more prone to bond failure than anterior teeth. A greater failure rate is noted on mandibular arch and mostly on second premolars than canines and incisors. A study conducted by Vijaykumar et al[4] (2017) concluded that in individual tooth bond failure, mandibular incisors and premolar brackets showed more failure followed by maxillary premolars and canines.

The reasons for frequent bond failure of premolar is primarily because of the enamel pattern i.e, prismless enamel, which is more evident in posteriors . Significant difference is noted in the surface topography of prismatic and aprismatic enamel after enamel conditioning. Penetration into the resin tags will be negligible in aprisamatic enamel. This would have a direct effect on the bond strength of bracket, with reduced strength. Moisture and salivary contamination cause problems on the bonding process. Another reason for bond failure is the poor adaptation of bracket base to the tooth, especially in the posteriors, sometimes uneven composite layers or voids are created which would negatively affect the mechanical properties. Greater masticatory load in posteriors especially for mandibular dentition also causes debonding of brackets. Hence, premolars are considered for the study. In order to reduce this problem a redesigned premolar bracket is available, on which the wings of the bracket are offset gingivally to provide a greater bracket base area. It has an innovative base design , incorporating an 80 gauge mesh bonding base and also matches the curvature of the tooth for maximum contact and bond strength. These brackets have a torque- in- base design which helps to avoid occlusal interference. The manufacturer claims that it provides greater resistance to debonding and reduced incidence of bond failure[5].

MATERIALS AND METHODS

Thirty mandibular premolars (extracted for orthodontic procedures) were collected and stored in 0.1% thymol solution to prevent any microbial growth.They were randomly divided into two groups

GROUP 1: Standard conventional metal brackets(Victory series 3M)

GROUP 2: Gingivally offset premolar bracket(Victory series 3M UNITEK). The experimental sample consisting of 30 extracted mandibular premolars were mounted vertically in acrylic blocks with roots embedded in acrylic. Buccal enamel surface was conditioned with 37% phosphoric acid for 30 seconds ,washed completely dried for 10 seconds with oil free air and water. Bonding agent- Transbond XT(3M UNITEK) applied and light cured for 20 seconds with LED Light (Wood Pecker).The brackets were loaded with the adhesive paste (3M ESPE-) and placed on the buccal surface of the tooth. After removing the excess resin from the periphery of the bracket base with a dental probe, the composite was cured for 10 seconds on each sides of the bracket. Shear bond strength was tested using Universal Testing Machine (Instron 3365) at a speed of 0.5mm/min. Following debonding , each tooth was sectioned and examined under scanning electron microscope with a magnification of 100X to evaluate the surface topography . Enamel damage was calculated using enamel damage index according to Schuler and van Vaes[6].

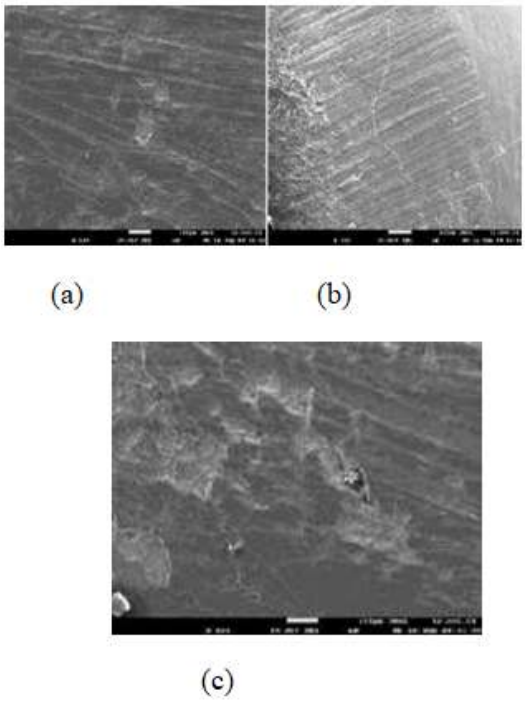
STATISTICAL ANALYSIS

Data was analyzed using the statistical package SPSS 22.0 (SPSS Inc., Chicago, IL) and level of significance was set at $p<0.05$.

RESULTS

The results show that gingivally offset premolar brackets have more shear bond strength than conventional brackets (TABLE 1).The EDI SCORE of GROUP 1 is comparitavely lesser than GROUP 2 . Among GROUP 1 ,66.7 % of samples had EDI score of 1 and 33.3% with score 2.Within GROUP 2 ,26.7% had EDI score 2 , 53.3% with score 2 and 20% with score 3.

GROUPS	NUMBER	MEAN	SD
GROUP 1			
	15	13.26	1.39
GROUP 2	15	15.72	2.16



SEM IMAGES OF GROUP 2 SAMPLES WITH (a)GRADE 1(b)GRADE 2 (c)GRADE 3

DISCUSSION

To achieve desired tooth movements through orthodontic therapy, orthodontists require a reliable method of attachments to the tooth. It must allow delivery of forces, withstand occlusal loads, should be aesthetic, ensure easy removal at the end of the treatment and cause minimal damage to the hard and soft tissues. Orthodontic brackets serves this purpose and remains as the integral armamentarium in orthodontic practice. It is inevitable to know about the design and morphology of bracktets and their influence in bond strength[7]. Enamel surface and its various intrinsic factors also affect bond strength. Enamel has two distinct layers: an outer “prismless” enamel layer and an underlying prismatic layer. Etching is supposed to remove the outer aprismatic layer and expose the underlying prismatic rods. This prismless enamel structure tended to have a stronger resistance to acid than a prismatic enamel surface[8]. There are quantifiable differences in etch quality between teeth and between regions of teeth, with more prismless enamel and worse quality of etch in the cervical regions, especially of the premolars and molars[9].This is stated as the main reason behind increased bond failure of premolars. Manufacturers are repeatedly modifying the bracket design and features to improve their mechanical properties.In this study one such modification is being studied and has shown positive correlations to the increased bond strength.

Gingivally offset premolar brackets is a redesigned mandibular premolar bracket available with the wings of which are offset gingivally, and it has a larger bracket base area occlusal to the wings. The manufacturer claims that this arrangement provides greater resistance to debonding, thus reducing the incidence of bond failure[10]. The gingivally offset bracket helps to redistribute occlusal forces. It is due to the greater bracket base area. These brackets have a 25% greater bracket base area than the standard bracket. The bracket base areas are reported as 10.57 mm^2 for the standard bracket and 13.96 mm^2 for the gingivally offset bracket[11]. Another feature of gingival brackets is that the wings of the bracket are offset gingivally. It is added as a convenience feature to avoid occlusal interferences, which is the main reason for bond failure .It also has a additional advantage of easy bonding to partially erupted premolars and their faster eruption. Bracket base morphology can influence the strength of the bracket cement interface by determining the geometry (depth, size, and distribution) of the cement tags and stress distribution within the cement bracket interface. In addition,the penetration of light, and polymerization of light activated materials could be influenced by base morphology. The gingival offset premolar brackets used for the study has a 80 gauge mesh considered a main factor for its better bond strength. Hence ,the better bond strength of gingivally offset premolar brackets than the conventional bracket is due to its unique features i.e wider bracket base area ,bracket base mesh design ,gingivally offset tie wings. with procedures like surface etching, application of primer, bonding of adhesive and removal of remenants after debonding. It producing scratches, cracks, grooves, removal of fluoride-rich external enamel layer, and increasing the enamel roughness.

An increase of SBS causes greater risk to enamel damage as there will be more adhesive remnant at the base of the bracket.SBS values higher than 11.3 MPa can cause fissures in the enamel surface and values lower than 7.3 MPa are less likely to cause enamel fissures[12]. Analysing the results from this study,it is proved that gingivally offset premolar brackets have better bond strength than conventional brackets hence it can be adopted as a method to reduce bond failures especially in premolars. From the SEM evaluation, enamel damage is more with gingivally offset premolar bracket (graph 1). This innovation can reduce unwanted appointments, save time and costs same as standard brackets. The major concern during bracket debonding is the risk of enamel damage. Improper debonding method, bracket type, mesh type, surface area of the mesh, etching method, or the adhesive system are major reasons for enamel damage. The surface structure of natural enamel has micro-roughness in the range of 0.59 to 0.66 μm[8.] Alteration in its morphology is seen

CONCLUSION

The following observations are made from the study

- Gingivally offset premolar bracket has increased shear bond strength than conventional premolar bracket.
- Gingivally offset bracket causes greater enamel damage than conventional brackets.

Author Contributions

We strongly encourage authors to include author contributions and recommend using CRediT for standardised contribution descriptions. Please refer to our general author guidelines for more information about authorship.

Conflicts of interest: There are no conflicts to declare.

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The acknowledgements come at the end of an article after the conclusions and before the notes and references.

REFERENCES

1. Reynolds IR. 1975. A review of direct orthodontic bonding. Br J Orthod. Apr;2(3):171-8.
2. Bakhadher W, Halaeany H, Talic N et al. Factors affecting shear bond strength of orthodontic bracket-A review of invitro studies. ACTA MEDICA 2015;58(2):43-48.
3. Newman G V. Epoxy for orthodontic attachments. Am J Orthod Dentofacial Orthop.1965;51:901-912.
4. Vijayakumar RK, Jagadeep R, Ahamed F, Kanna A, Suresh K. How and why of orthodontic bond failures: An in vivo study. J Pharm Bioallied Sci. 2014 Jul;6(Suppl 1):S85-9.
5. Thind BS, Larmour CJ, Stirrups DR, Lloyd CH. An ex vivo assessment of gingivally offset lower premolar brackets. J Orthod. 2004 Mar;31(1):34-40.
6. Schuler FS, van Waes H. SEM-evaluation of enamel surfaces after removal of fixed orthodontic appliances. *Am J Dent*. 2003 Dec;16(6):390-4.
7. Gange P. The evolution of bonding in orthodontics. AJODO .01 APRIL 2015;147(4):56-63.
8. Kuroiwa M. Acid resistance of surface ‘prismless' enamel in human deciduous and permanent teeth. Showa Univ J Med Sci. 1990; 2:31–44.
9. Barnhart EC, Campbell PM, Noureldin A, Julien K, Buschang PH. The quality of etched enamel in different regions and tooth types and its significance in bonding and the development of white spot lesions. Angle Orthod. 2021 Sep 1;91(5):576-582.
10. Thind BS, Stirrups DR, Hewage S. Bond failure of gingivally offset mandibular premolar brackets: a randomized controlled clinical trial. Am J Orthod Dentofacial Orthop. 2009 Jan;135(1):49- 53.
11. MacColl GA, Rossouw PE, Titley KC, Yamin C. The relationship between bond strength and orthodontic bracket base surface area with conventional and microetched foil-mesh bases. Am J Orthod Dentofacial Orthop. 1998 Mar;113(3):276-81.
12. Chavez J R et al. 2017. Comparative study of dental enamel loss after debonding braces by analytical scanning electron microscopy (SEM). *Microscopy Research and Technique Jan* 80(7).

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