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Comparative study for evaluating the shear bond strength of metal reinforced ceramic and conventional ceramic bracket

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Abstract

Introduction: Ceramic brackets were brought into orthodontics in an attempt to meet the rising requirement for added esthetic appliances. The objectives of this study were to assess and compare the shear bond strength and bond failure location of presently available clarity ceramic and Transcend brackets.

Material and Methods: This comparative study was conducted at Department of Orthodontics, de'Montmorency College of Dentistry Lahore and PCSIR, Lahore for one year from 10th June 2003 to 9th June 2004. Sixty brackets of each type were bonded to 120 extracted human 1st premolar teeth with the similar bonding system. Each bracket type was tested on a Schimadzu testing machine to find out the shear force levels necessary to debond these brackets. All the teeth were examined under an optical and stereo microscope to evaluate the Adhesive Remnant Index (ARI) at bond failure inter phase.

Results: The independent t-test performed for comparing the clarity and transcend 6000 ceramic brackets, indicated that there were no statistically significant difference between two brackets tested (P=0.256). The Result of ARI scores indicated that there were no significant differences between the two brackets. (P=0.312).

Conclusions: Shear bond strength and ARI scores between the Clarity and Transcend 6000 ceramic brackets are insignificant.

Keywords: Clarity; ceramic; Shear bond strength; debonding

Introduction

With the beginning of the acid etch bonding techniques, idea of bonding different resins to enamel has formed applications in all aspects of dentistry including the bonding of orthodontic brackets.[1] Ceramic brackets were brought into orthodontics in an attempt to meet the rising requirement for added esthetic appliances.[1,2] Adult orthodontic treatment has increased the demand for more esthetic and less visible appliance. Ceramic brackets show enhanced look but on the cost of undue enamel breakdown during debonding.[2] In an endeavor to improve their properties, designers made unbreakable ceramic brackets with metal bracket slots. In spite of their hard work, the trouble of slot deformation and enamel breakage are still present.

There are different procedures of removing ceramic brackets. The force applied by debonding instruments increase the risk of enamel fracture.[3] Swartz suggested that brackets should be removed with fine pliers.[4] Applying the force on the two sides concurrently with pliers increase risk of enamel breakdown. Different methods of removing brackets include electro thermal, ultrasonic and laser. Manufacturers have tried to develop the bracket features to eliminate or decrease the disadvantages and improve debonding of ceramic brackets.

The clarity bracket (3M Unitek) is a polycrystalline, mechanically retained ceramic bracket, planned with a metal-lined

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arch wire slot. The benefit of having a stainless steel slot is to reduce the friction that develops as a result of the arch wires coming in contact with ceramic.[5] It was advised that the metal slot strengthen the brackets to resist daily orthodontic forces. The clarity brackets incorporate a vertical slot that is specially designed to create easy bracket debonding similar to metal brackets. In multiple studies no considerable difference were found in the results comparing the magnitude of force needed to deform and debond Clarity brackets and metal brackets.[1,6,7] When the ceramic brackets are removed, lot of composite remained on the enamel, a sequence assessed when removing metal brackets.[7] The aim of present study was to compare and evaluate the shear bond strength of the Clarity and transcend 6000 brackets and bracket breakdown mode when using shear force with Schimadzu testing machine. The facts of this study will be beneficial for both clinicians and orthodontic patients.

Material and Methods

A comparative study was conducted on 120 brackets (sixty conventional ceramic bracket and sixty metal reinforced ceramic brackets in each group), at Orthodontic department, de'montmorency, College of Dentistry, Lahore, during June 2003 to June 2004.

Intact extracted first premolar teeth which were extracted for purpose of orthodontic treatment were selected to be bonded. Only freshly extracted and preserved first maxillary premolar teeth with intact surfaces were included. Decayed, broken down premolars were excluded. Patients with any previous fixed orthodontic therapy were also excluded.

The Clarity and transcend 6000 brackets (3M Unitek) were used in the study. Sixty Clarity brackets and sixty Transcend 6000 brackets were applied to teeth using light cure composite. All bonded samples were kept in normal saline at 37^0C for 42 hours. Bonded teeth were left uninterrupted for half hour and kept in synthetic saliva for 24 hours at 37^0C. The artificial saliva, which has been used largely in caries detection programs, was prepared with deionized distilled water and contained H_2 O_2 mmol/L $CaCI_2$ the ratios found in human saliva. Artificial saliva does not have enzymes found in natural saliva, but it is consistent across samples and has a comprehensive shelf-life. Thermal cycling of all specimens was performed at temperatures from 5^0C.

Brackets were tested on AGS-J Schimadzu machine, to determine the shear debonding strength. Spots of bracket failure after debonding were examined in all the teeth, by using the micro-Vu microscope (Micro-Vu Corp, Japan), with 30x magnification. The quantity of residual adhesive after bracket deletion was evaluated according to the adhesive remnant index (ARI).

SPSS version 16 was utilized to analyze the data. Statistical analysis was used to evaluate means, standard deviations, minimum and maximum values. Chi square test was applied to evaluate the existence of differences between two groups.

Results

Mean values and Comparison of the shear bond strength of the Clarity and Transcend 6000 ceramic Brackets are shown in table I. The independent t-test performed for comparing the clarity and transcend 6000 ceramic brackets, indicated that there were no statistically significant difference between two brackets tested (P=0.256).

Table I: Mean values and Comparison of the shear bond strength of the Clarity and Transcend 6000 ceramic Brackets.

	N	Minimum	Maximum	Mean	Std. Deviation	Variance	P-Value
Clarity	60	12.44	37.28	20.5220	5.0568	25.572	0.256
Transcend 6000	60	10.12	24.21	15.9442	3.4454	11.871	

The Adhesive Remnant Index scores for the Debonded brackets are presented in table II. Result indicated that there were no significant differences between ARI scores for two brackets. (P=0.312).

Table II: Adhesive remnant index (ARI) of the Clarity and transcend 6000 Ceramic brackets after Debonding.

Brackets	N	ARI score 1	ARI score 2	ARI score 3	ARI score 4	ARI score 5	P value
Clarity	60	56	3	1	0	0	0.312
Transcend 6000	60	54	4	2	0	0	

Discussion

With the bonding of ceramic brackets, clinicians are apprehensive about the possibility of enamel fracture at the time of debonding. As a result multiple changes have been done in the design of ceramic brackets in an attempt to make the debonding procedure safer.

It was shown that new orthodontic bracket using a polycarbonate base has bond strength comparable to ceramic bracket without a polycarbonate base.[8]

The shear bond strength of new metal lined ceramic brackets and conventional ceramic brackets were tested in present research. Both types of ceramic brackets have characteristics of mechanical retention but new metal lined ceramic brackets have certain superior characteristics. Manufacturers claims that metal lined slot of clarity brackets not only minimizes the augmented friction that occur as a result of arch wire touching ceramic but also helps toughen the brackets to with stand the usual orthodontic forces.[9]

Various researchers have studied bonding strengths of different brackets and the results differ noticeably.[8,9,10] Extremely packed adhesives offer maximum bond, when compared with light filled adhesives.[10]

Olsen, Bishara and Jakobsen evaluated the shear bond strength of ceramaflex bracket and transcend 6000 ceramic bracket and concluded that mean shear bond strength observed for the ceramaflex bracket was considerably less than the transcend 6000 bracket.[11] Although the two bracket types did not exhibit significant differences in the bracket failure location, the ceramaflex bracket exhibited a more consistent bond failure location, specifically between the ceramic bracket and polycarbonate base. This is a more desirable bond failure location because it minimizes the stress on the enamel surface during debonding.

The ARI scores for both clarity and conventional ceramic brackets showed a similar bond failure pattern i.e. all adhesive remains on tooth surface. The result of the present research are in agreement with those reported by Bishara and Olsen who observed that entire bonding material remained on tooth surface.[1,11]

Accurate debonding of ceramic brackets without damaging enamel, despite its high shear bond strength was noted in the present study. Further research is recommended to determine the debonding character of clarity brackets when removed with instruments designed especially for this purpose.

This in vitro study provided good information regarding two types of bracket behavior while debonding. There is further need to conduct similar study on living animals as well as human subjects.

Conclusions

Shear bond strength and ARI scores between the Clarity and Transcend 6000 ceramic were insignificant.

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