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ORIGINAL ARTICLE

Study Comparing the Shear Bond Forte of Ceramics with Metal Reinforcement to Unreinforced Ceramic Brackets

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ABSTRACT

Background: In an effort to address the growing need for more aesthetic appliances, ceramic brackets were introduced into orthodontics. The need for more aesthetic and less obvious appliances has risen as a result of adult orthodontic therapy.
Aim: To assess the shear bond strength of the Clarity and Transcend 6000 brackets as well as the bracket breakdown mechanism while utilising shear force with Schimadzu testing equipment, information from this study will be useful for orthodontic participants as well as practitioners.
Methodology: This comparative study was conducted at Orthodontic Department, Bacha Khan College of Dentistry, Mardan from 1st July 2021 to 31st December 2022. A total of 150 brackets (75 reinforced ceramic brackets and 75 conventional ceramic brackets in each cluster) were enrolled. The first premolar teeth that had been pulled in their entirety for orthodontic treatment were chosen to be bonded. Only the first maxillary premolar teeth with undamaged surfaces that had recently been removed and preserved were used. Premolars that had broken down or decayed were eliminated.
Result: There was no statistically significant difference amongst the two brackets evaluated, according to an independent t-test associating the clarity and transcends 6000 ceramic brackets.
Conclusion: The differences in adhesive remnant index ratings and shear bond forte between the Transcend 6000 ceramic and Clarity were negligible.
Key words: Adhesive remnant index (ARI), De-bonding, Shear bond strength

INTRODUCTION

The notion of attaching various resins to enamel has found solicitations in all areas of dentistry, as well as the bonding of orthodontic brackets, with the advent of the acid etch bonding procedures[1]. In an effort to address the growing need for more aesthetic appliances, ceramic brackets were introduced into orthodontics. The need for more aesthetic and less obvious appliances has risen as a result of adult orthodontic therapy[2]. Ceramic brackets have an improved appearance but at the expense of excessive enamel disintegration during de-bonding. Designers created indestructible ceramic brackets with metal bracket holes to enhance their qualities. Despite their diligent efforts, the issues of slot deformation and enamel fracture persist[3].

Ceramic brackets can be removed in a variety of ways. The danger of enamel fracture is increased by the force used by de-bonding tools. Swartz recommended using tiny pliers to remove brackets[4]. There are several ways to remove brackets, including electro thermal, ultrasonic, and laser. The danger of enamel breakage increases when applying stress to both sides at once using pliers, manufacturers have made an effort to enhance de-bonding of ceramic brackets by developing bracket characteristics that would remove or lessen their drawbacks[1]. A polycrystalline mechanically held ceramic bracket through a metal-lined arch wire hole is called the clarity bracket (3M Unitek). The advantage of a stainless steel slot is that it lessens the resistance that arises when ceramic and arch wires come into contact[5]. In order to withstand the everyday orthodontic stresses, was recommended that the metal slot reinforce the brackets. The vertical slit in the clarity brackets is specifically made to facilitate simple bracket de-bonding, much like metal brackets[6].

The current study's purpose was to assess the shear bond strength of the Clarity and Transcend 6000 brackets as well as the bracket breakdown mechanism while utilising shear force with Schimadzu testing equipment, information from this study will be useful for orthodontic participants as well as practitioners.

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MATERIALS AND METHODS

After the approval from IRB of the institution and written consent from the participant the current study was carried out at the Orthodontic Department of Bacha Khan College of Dentistry, Mardan from 1st July 2021 to 31st December 2022. This comparative study was carried out on 150 brackets (75 reinforced ceramic brackets and75conventional ceramic brackets in each cluster). The first premolar teeth that had been pulled in their entirety for orthodontic treatment were chosen to be bonded. Only the first maxillary premolar teeth with undamaged surfaces that had recently been removed and preserved were used. Premolars that had broken down or decayed were eliminated. Patients who had ever received fixed orthodontic treatment were also disqualified. The study made use of the Clarity and Transcend 6000 brackets from 3M Unite 37°C. Light-cured composite was used to attach 75 Clarity brackets and 75 Transcend 6000 brackets to teeth. For 42 hours, all bonded samples were maintained in normal saline at 37^0C. Bonded teeth were preserved in synthetic saliva at 37°C for 24 hours after being unattended for 30 minutes. The synthetic saliva, which has been extensively used in caries exposure programs, was made from deionized distilled water& has the same ratios of H_2O_2 and $CaCl_2$ as those found in human saliva. The enzymes found in normal saliva are absent from artificial saliva, yet it is uniform between samples and has a long ridge life. All samples were subjected to thermal cycling starting at 50°C. To evaluate the shear de-bonding strength, brackets were verified using the AGS-J Schimadzu machine. The Micro-Vu microscope was used to analyze bracket catastrophe spots after de-bonding in all of the teeth at a 30x magnification. The adhesive remnant index (ARI) was used to assess the quantity of enduring bonding following bracket elimination. The data was analyzed with SPSS-24. The Chi square test was used to see whether there were any variances amongst the two clusters.

RESULTS

The average values and assessment of the shear bond strengths of ceramic brackets made of Clarity and Transcend 6000. There was no statistically significant difference amongst the two brackets

evaluated, according to an independent t-test associating the clarity and transcend 6000 ceramic brackets (P=0.345) [Table 1]. The ARI results for the de-bonded brackets. According to the results, there were no appreciable variations in the ARI scores for the two ranges. (P=0.201) (Table 2)

Table 1: Mean values and comparison of the shear bond strengths of ceramic brackets made of Clarity and Transcend 6000

Variable	N	Maximum	Minimum	Mean±SD	Variance	P-value
Clarity	75	11.33	26.17	18.75±4.04	19.461	0.345
Transcend 6000	75	9.11	13.01	11.06±2.33	7.760	

Table 2: After debonding, the Clarity and transcend 6000 Ceramic brackets' adhesive residual index (ARI)

Brackets	N	Adhesive Remnant Index Score I	Adhesive Remnant Index Score II	Adhesive Remnant Index Score III	Adhesive Remnant Index Score IV	Adhesive Remnant Index Score V	P-value
Clarity	75	64	3	2	1	-	0.201
Transcend 6000	75	62	5	1	2	-	

DISCUSSION

It has been demonstrated that ceramic brackets without a polycarbonate foundation and new orthodontic brackets employing polycarbonate bases have equal bond strengths. In the current study, the shear bond forte of traditional ceramic brackets &novel metal-lined ceramic brackets was compared. Clinicians are concerned about the potential for enamel fracture during debonding when ceramic brackets are bonded. As a result, several modifications to the strategy of ceramic brackets have been made in an effort to make the de-bonding process harmless. Although new metal lined ceramic brackets have some superior qualities, both types of ceramic brackets have mechanical retention characteristics[7]. According to the manufacturer, metal-lined slots in clarity brackets help toughen the brackets so they can withstand normal orthodontic stresses as well as reduce enhanced friction caused by the arch wire striking porcelain.

The findings of several studies on the bonding strengths of various brackets vary substantially. When compared to adhesives with light filling, those that are extremely packed offer the strongest bond[7-12]. Olsen et al[13] compared the shear bond strengths of the ceramaflex bracket and the transcend 6000 ceramic bracket and came to the conclusion that the ceramaflex bracket's mean shear bond strength was much lower than the transcend 6000 bracket's. The bracket failure locations between the two types of brackets did not differ much, however the ceramaflex bracket showed a steadier bond failure position, especially among the polycarbonate base and ceramic bracket. As a result of less force being placed on the enamel surface during de-bonding, this is a more preferable position for a bond breakdown.

Both traditional ceramic brackets and clear brackets scored similarly on the ARI, i.e. all adhesive is still on the tooth surface. The findings of the current study concur with those made public by Alavi et al[14] noted that the full bonding substance stayed on the tooth surface. Despite having high shear bond strength, accurate de-bonding of ceramic brackets without initiating enamel destruction was observed in the current study. It is advised to conduct more study to learn how clarity brackets de-bond when removed using tools made specifically for use. This in-vitro study gave useful data on 2 different bracket de-bonding behaviours. Additionally, similar research on human subjects and living animals is required.

CONCLUSION

The differences in ARI ratings and shear bond strength between the Transcend 6000 ceramic and clarity were negligible.

Conflict of interest: Nothing to declare

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