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Assessment of shear bond strength of orthodontic ceramic and metal brackets bonded to fluorosed teeth

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ABSTRACT

Background: Bonding orthodontic brackets is a crucial procedure in orthodontics, ensuring that braces are securely attached to the teeth for effective treatment. The present study was conducted to compare shear bond strength of orthodontic ceramic and metal brackets bonded to fluorosed teeth.

Materials & Methods: 40 (20 fluorosed and 20 nonfluorosed) extracted premolar teeth were divided into four groups I, II, III and IV. 3M Espe In group I, metal brackets were bonded to fluorosed teeth, in group II, ceramic brackets were bonded to fluorosed teeth. In group III, metal brackets bonded to non-fluorosed teeth and in group IV, ceramic brackets were bonded to non-fluorosed teeth. An Instron testing device was used to debond and measure the shear bond strength (SBS).

Results: The mean SBS in group I was 8.3 MPa, in group II was 15.2 MPa, in group III was 13.7 MPa and in group IV was 11.5 MPa. The difference was significant ($P< 0.05$).

Conclusion: In orthodontics, metal and ceramic brackets bonded to fluorosed teeth can be utilized effectively.

Keywords: Bonding, fluorosed, orthodontic brackets

INTRODUCTION

Bonding orthodontic brackets is a crucial procedure in orthodontics, ensuring that braces are securely attached to the teeth for effective treatment.[1] The process involves several steps, using specific materials and techniques to achieve optimal adhesion and long-term stability.[2] The type of adhesive used, the braces' shape and design, the enamel conditioning process, and the enamel surface all affect how well orthodontic brackets bind.[3] The foundation of orthodontic bonding is the mechanical locking of an adhesive to imperfections in the tooth's enamel surface and the formation of mechanical locks in the orthodontic attachment's base.[4] It has been determined that during clinical use, the required shear bond strength (SBS) that the orthodontic attachment should sustain is between 5.9 MPa and 7.8 MPa. There have been reports of enamel damage during debonding in situations when the tensile bond strength was greater than 14.5 MPa. High-purity aluminum oxide is used to make ceramic brackets, which come in monocrystalline and polycrystalline varieties.[5] It is significant to remember that polycrystalline ceramic brackets have been observed to have a greater SBS than metal brackets made of stainless steel. Despite being more attractive and having a stronger attachment, aesthetic ceramic brackets have certain drawbacks from a clinical standpoint. They could lead to more wear and fractures in the enamel during the debonding process.[6] The present study was conducted to compare shear bond strength of orthodontic ceramic and metal brackets bonded to fluorosed teeth.

MATERIALS & METHODS

The present study was conducted on 40 (20 fluorosed and 20 nonfluorosed) extracted premolar teeth which were divided into four groups I, II, III and IV. 3M Espe Single Bond was used as an orthodontic adhesive to bond brackets on the buccal surface of each tooth. In group I, metal brackets were bonded to fluorosed teeth, in group II, ceramic brackets were bonded to fluorosed teeth. In group III, metal brackets bonded to non-fluorosed teeth and in group IV, ceramic brackets were bonded to non-fluorosed teeth. An Instron testing device was used to debond and measure the shear bond strength (SBS). Data thus obtained were subjected to statistical analysis. P value < 0.05 was considered significant.

RESULTS

Table I Distribution of specimens

Groups	Group I	Group II	Group III	Group IV
Method	metal brackets fluorosed teeth	ceramic brackets fluorosed teeth	metal brackets non-fluorosed teeth	ceramic brackets non-fluorosed teeth
Number	10	10	10	10

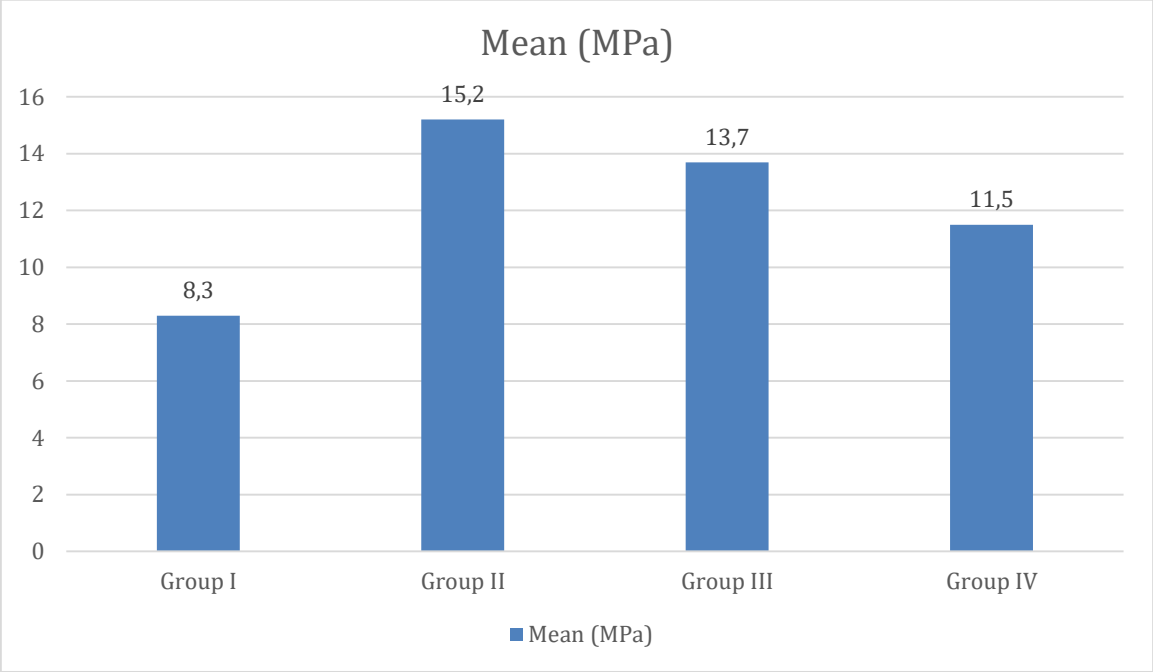
Table I shows distribution of specimens in 4 groups.

Table II Assessment of shear bond strength (SBS)

Groups	Mean (MPa)	P value
Group I	8.3	0.05
Group II	15.2	
Group III	13.7	
Group IV	11.5	

Table II shows that mean SBS in group I was 8.3 MPa, in group II was 15.2 MPa, in group III was 13.7 MPa and in group IV was 11.5 MPa. The difference was significant (P< 0.05).

Graph I Assessment of shear bond strength (SBS)



DISCUSSION

In terms of structure, the brackets are stronger and harder than enamel. Prevalence of dental fluorosis is a disorder brought on by consuming excessive amounts of fluoride more than 1-2 ppm during the growth of teeth.[7,8] The enamel structure of teeth that are not fluorosed versus teeth that are fluorosed to varying degrees differs noticeably. In endemic fluorosed regions, orthodontists may face significant challenges due to fluorosed enamel.[9,10] The present study was conducted to compare shear bond strength of orthodontic ceramic and metal brackets bonded to fluorosed teeth.

We found that the mean SBS in group I was 8.3 MPa, in group II was 15.2 MPa, in group III was 13.7 MPa and in group IV was 11.5 MPa. Agarwal et al[11] measured and compared shear Bond Strengths (SBSs) of metal and ceramic orthodontic brackets on fluorosed and non-fluorosed teeth. One hundred and twenty (60 fluorosed and 60 nonfluorosed) extracted premolar teeth were divided into four groups A to D, consisting of 30 teeth in each group.3M Espe Single Bond was used as an orthodontic adhesive to bond brackets on the buccal surface of each tooth. The experimental groups consisted of Group A, in which metal brackets were used and Group B, in which ceramic brackets were bonded to fluorosed teeth. Group C and D consisted of metal brackets and ceramic respectively, bonded to non-fluorosed teeth. An Instron testing device was used to debond and measure the SBSs. SBSs werecompared using ANOVA with posthoc analysis done using Dunnett's C test for pairwise comparisons. Significance was set at P Group C>Group D>Group A. Ceramic brackets bonded to fluorosed teeth had the highest SBS with a mean of 15.78 (SD=9.07) Megapascals (MPa), while metal brackets bonded to fluorosed teeth produced the lowest SBS of 8.41 (SD=4.68) MPa. The SBSs of ceramic brackets bonded to fluorosed teeth was significantly higher than that of SBS of metal brackets bonded to fluorosed teeth, but not significantly different from SBSs obtained from either brackets bonded to non-flurosed teeth. The adhesive if used to bond ceramic brackets to fluorosed teeth can produce adequate SBS for clinical use.

Bishara et al[12] evaluated the use of a sharp-edged debonding instrument on four different ceramic brackets with three different bonding materials and two different enamel

conditioning techniques. The effectiveness of the debonding instrument was determined by evaluating the following variables: the amount of force required to bebond the bracket, the amount of residual adhesive remaining on the enamel surface, the frequency of bracket failure, and the prevalence of any visible enamel damage. The results indicated that the bracket type, the adhesive, as well as the enamel conditioner, all have an effect on bond strengths when using a sharp-bladed debonding instrument. The mean debonding strength values for the different bracket, adhesive, and enamel conditioner combinations ranged between a low of 40 kg/cm^2 and a high of 194 kg/cm^2. Most debonding values were between 60 and 115 kg/cm^2. A number of bracket, adhesive, and conditioner combinations are considered to have clinically adequate bonding strength and are relatively safe. The use of polyacrylic crystal growth enamel conditioner resulted in significantly less adhesive being left on the tooth as compared with the phosphoric acid enamel conditioner.
The shortcoming of the study is small sample size.

CONCLUSION

Authors found that in orthodontics, metal and ceramic brackets bonded to fluorosed teeth can be utilized effectively.

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