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Original Article

Dentistry Section

The Comparison of Shear Bond Strength Between Fibre Reinforced Composite Posts with Three Different Composite Core Materials – An *In vitro* Study

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ABSTRACT

Aim: The aim of this study is to compare the shear bond strength between fiber reinforced composite post with three different composite core materials.

Materials and Methods: The materials used for the study were: 30 maxillary central incisors, pre fabricated fiber reinforced composite post (postec plus posts), Multi-core heavy body, Ti-core, Fluoro-core, Etchant gel, Silane coupling agent, Dentin bonding agent, Standardized gutta percha points, Rely-X dual cure composite resin. A total of 30 human maxillary central incisor were selected for this study. They were divided into three groups of 10 specimens each namely A, B and C.

Results: The results obtained were analyzed by using one way analysis (ANOVA) and Tukey Honestly Significant Difference and they showed highest mean shear bond strength for group C when compared with group A and group B. There is no significant difference in the shear bond strength values between group A and group B.

Conclusion: The teeth restored with multicore HB showed highest shear bond strength. The teeth restored with Fluoro core showed lowest shear bond strength. No statistically significant difference exists between the shear bond strength values between Ti-core and Fluoro-core.

Keywords: Shear bond strength, Multicore heavy body, Ti-core, Fluorocore, Fiber Reinforced Composite (FRC) post

INTRODUCTION

Historic evidence dating back to 600 A.D. reveals that man has always wanted to retain tooth for function, aesthetics and physiological comfort [1]. This persistent desire has resulted in great innovations in material science and various treatment trends [2]. We, being a part of the dental fraternity feel the same as M.M. Devan that "It is more important to preserve what already exists than to replace what is missing". In this era of conservation, one of the methods of retaining tooth is by endodontic treatment [3].

The endodontic treatment makes the tooth non-vital rendering it extremely fragile [4]. Following successful root canal treatment, the tooth can remain as a functional unit within the dental arch provided the coronal tooth structure has been adequately restored. The design of the definitive restoration depends very much on the amount of remaining tooth structure, the morphology of the tooth and its position in the dental arch. When there is minimal coronal tooth structure present, posts are required to improve the retention of the core material. The use of posts was originally thought to reinforce weakened, endodontically treated teeth and increase their fracture resistance. Traditionally, prefabricated or custom made metal posts and cores were available. Recently, non-metal alternatives such as ceramic and fibre posts have been introduced [5]. The present study was designed for evaluating the management of root canal treated teeth which are restored using FRC post and different composite core materials.

MATERIALS AND METHODS

The present study was conducted to compare and evaluate the shear bond strength between fiber reinforced composite post (FRC posts) and their three different composite core materials.

A total of 30 human maxillary central incisors were selected from a collection of extracted teeth stored in a solution of neutral buffered formalin for less than three months at room temperature. Tooth with root caries, restorations, previous endodontic treatment and cracks observable at magnification of 2X were not included.

Thirty teeth were divided into three groups of 10 specimens each namely A, B and C. The posts used were FRC postec plus [Table/Fig-1], size 1 with a maximum diameter of l.5mm. Ten samples each were prepared for all the three experimental groups (A,B,C) consisting of an FRC post and three different types of resin core materials.

All the 30 samples were ready for core buildup procedure using 3 different core materials. All the specimens were loaded at 135° to their long axis in order to simulate the contact angle in class I occlusion between maxillary and mandibular teeth.

Group A: Fluorocore (Dentsply - Int) [Table/Fig-2]

Group B: Ti-core (Essential dental Systems) [Table/Fig-3]

Group C: Multi core HB (IVOCLAR VIVADENT) [Table/Fig-4]

Evaluation of shear bond strength

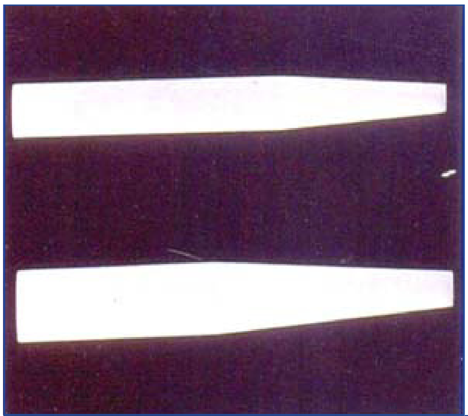
The shear bond strength was evaluated using an instron universal testing machine using custom made jig [Table/Fig-5]. The load was applied onto each specimen at a cross head speed of 6.35 mm/ minute. The maximum load at which the failure of the core occurred was noted from the software attached to the universal testing machine. The same procedure was repeated for all the thirty samples. The shear bond strength for each sample is calculated using the formula

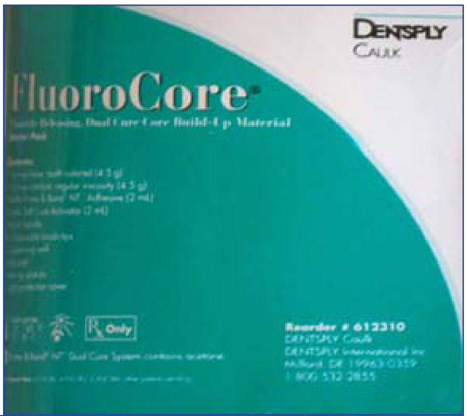
$$\text{Shear bond strength} = \frac{\text{Load (N)}}{\text{surface area (mm2)}}$$

Maximum load in Newton = Kg x 9.81

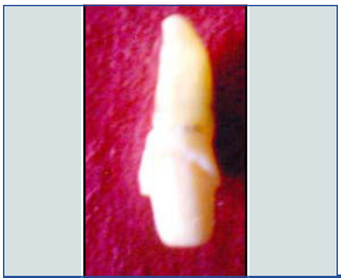
STATISTICAL ANALYSIS

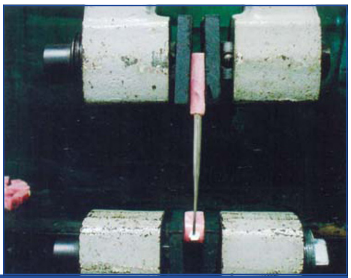
One way analysis of variance (ANOVA) was used to compare the mean loads for each group. The dependant variable was the load required to fracture the specimens. Tukey Honestly significant difference (HSD) Procedure was employed to identify the significant groups at 5% level [Table/Fig-6].





[Table/Fig-1]: Postec plus FRC posts. **[Table/Fig-2]:** Fluorocore. **[Table/Fig-3]:** Ti-core





[Table/Fig-4]: Specimen showing core built-up using multicore HB
[Table/Fig-5]: Fluorocore specimen loaded in universal testing machine

Fluoro core	Ti-core	Multicore HB
0.58	0.72	0.78
0.70	0.76	0.80
0.55	0.44	0.70
0.67	0.68	0.71
0.80	0.58	0.96
0.48	1.07	1.12
0.68	0.57	0.74
0.74	0.48	0.48
0.66	0.77	0.87
0.66	0.77	0.81

[Table/Fig-7]: Specimen showing core built-up using Ti-core
[Table/Fig-8]: Comparision of shear bond strength values in Each Group (in Mpa)

Groups	Post	Core
A	FRC Post	Fluoro Core
B	FRC Post	Ti-Core
C	FRC Post	Multicore HB

[Table/Fig-6]: Experimental Groups

RESULTS

Thirty human maxillary central incisor teeth were divided into three groups of 10 specimens namely A, B and C. All the specimens were endodontically treated and were restored with fiber reinforced composite posts. Three different core materials were used for the study. The specimens of the group A, group B and group C were restored with fluorocore, Ti-core [Table/Fig-7] and multicore HB [Table/Fig-4] respectively. Specimens were tested in an Instron universal testing machine, using custom made jig [Table/Fig-5]. The load values at which they fracture were recorded in units of Newton's and the shear bond strength values were calculated in the units of MPa (Megapascals).

Mean failure loads were calculated for all the groups. One way analysis of variance (ANOVA) was used to compare the mean loads for each group. Tukey honestly significant difference (HSD) procedure was employed to identify the significant groups at 5% level. The highest mean shear bond strength was in group C (0.686 +0.167) followed by group B (0.684 + 0.181) and lowest was in group A (0.651 + 0.093).

Two types of failures occurred in all the 30 samples. Most of the failures are of adhesive mode and the remaining samples failed by cohesive mode. Among group A, i.e, Fluorocore out of 10 samples, 9 of them showed adhesive mode of fracture and only one sample showed cohesive mode of fracture.

Among Ti-Core Specimens 9 of them showed adhesive mode of fracture and 1 specimen showed cohesive mode of fracture. Among group C, containing multicore HB specimens, adhesive mode of fractured occurred in 5 specimens and cohesive mode of fracture occurred in 5 specimens [Table/Fig-8].

One-Way ANOVA was used to calculate the p-value

Group	Shear Bond Strength	p-value*	Significant Difference # at 5% Level
	Mean ± SD		
A	0.652±0.093		
B	0.684±0.181	0.86 (NS)	Nil
C	0.718±0.167		

[Table/Fig-9]: Mean, Standard deviation and test of significance of mean values between different study groups

Multiple range test by Tukey –HSD procedure was employed to identify the significant groups at 5% level [Table/Fig-9].

Inference

The highest mean shear bond strength was in group C (0.718±0.167) followed by group B (0.684±0.181) and the lowest was in group A (0.652±0.093). The group C specimens (multicore HB) showed highest shear bond strength values. There was no significant difference in the mean values between group A and group B.

DISCUSSION

The present *invitro* study was done to compare the shear bond strength of endodontically treated maxillary central incisors with fiber reinforced composite post and three different composite core materials (Fluorocore, Ti-core and Multicore HB).

The glass fiber post FRC postec plus was the pre fabricated post used in the present study. The reason for using the FRC postec plus post were:

1. A new highly aesthetic, light conducting and radiopaque root canal post made of glass fiber reinforced composite with a conicity of 5˚18'.
2. It transmits the light deep into the root canal, and the post exhibits upto 5-10% Al. Therefore, the post is always clearly visible and easy to distinguish from dentin on X-rays [6].

3. It exerts less stress on the root and thus prevents root fracture [6].
4. The post length of 12 mm was chosen, so that the length of the post was more than the crown as suggested by Soreness and martinoff [7].

The different composite resins were used as the core material because:

1. Of aesthetic reasons
2. Ease of manipulation
3. Rapid setting time
4. The compressive and diametral tensile strength is much greater than the glass ionomer resin cements [8].

The study which compared the shear bond strength of core materials was done by Levartovsky et al. They compared the shear bond strength of three core materials. A light activated Glass inomer cement (Variglass VLC), a fluoride release dual cure composite resin (fluorocore) and a conventional silver reinforced GIC. Analysis of surface fracture sites with SEM characterized the bonding of the core materials to dentin. For the miracle mix cement and Variglass VLC cement, the fracture on the surface of the dentin, which indicated a cohesive fracture. For the fluorocore resin, the bond area showed almost no residual material. So the fracture site was considered adhesive at the dentin material interface and it was interpreted to mean that the mechanical properties demonstrated by fluorocore resin were stronger than the bond to dentin. Where as for other materials, the opposite was true [8].

A study by Cohen in 1994 on composite resin core material showed greater fracture resistance than amalgam and glass ionomer core materials [9].

Bonilla ED, Mardirossian G and Caputo AA in their study compared the fracture toughness of glass ionomer, resin modified glass ionomer, Ti-core composite, fluorocore and amalgam. The results showed that fluorocore resulted in the highest fracture toughness values, and the Ti-core showed lower fracture toughness values than purely composite resin materials [10].

Cho GC et al., in their study compared the diametral and compressive strength of various core materials. They concluded that the light cured hybrid resin composite were stronger than auto cured titanium containing composites [11].

Levartovsky S et al., compared the diametral tensile strength, the flexural strength and the compressive strength of two core materials, Variglass VLC, and fluorocore exhibited higher diametral tensile strength, flexural strength and compressive strength values than the other core materials used in the study [12].

In this study while comparing the shear bond strength of various core materials, most of the fluorocore and Ti-core specimens showed adhesive mode of fracture. Because most of the studies showed almost equal values of mechanical properties, there was no significant difference in the shear bond values between the two.

The shear bond strength of Multicore HB is higher to other two groups. The reason may be probably; this core material is build up on the FRC post in which both are from the same manufacturer.

Hence from the above studies, since the shear bond strength values of multi core HB is higher compared to other two groups, multi core HB is the material of choice for core build-up procedures.

Limitations of this study include the angulation of the prepared post holes and also the variation in the thickness and consistency of resin cement luted.

CONCLUSION

Within the limitations of this study the teeth restored with Multicore HB showed highest shear bond strength than the teeth restored with Fluorocore and Ti core. The teeth restored with Fluorocore showed lowest shear bond strength compared to Multicore HB and Ti core. There is no statistically significant difference between the shear bond strength values of the teeth restored with fluorocore and Ti-core.

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