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To evaluate and compare the retention of glass fibre post with varying lengths luted using resin cement

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Abstract

Background: The primary function of a radicular post is to provide retention for the core, which replaces lost tooth structure and retain the final restoration without compromising apical seal of the endodontic filling. Retention of the post is believed to be a major factor in restoration survival. The length of the post has a significant effect on dowel retention. Fibre-reinforced composite posts are indicated for the rehabilitation of extensively damaged tooth in order to ensure higher retention and support to restorative material, as well as better distribution of masticatory stresses. Among the advantages of glass fiber posts, one may cite their esthetic appearance, high tensile strength and modulus of elasticity similar to dentin, which provides uniform stress distribution along the post length. This in-vitro study is conducted to evaluate and compare the retention of glass fibre post of varying lengths luted using resin cements.

Aim: To evaluate and compare the retention of glass fibre post of varying lengths 5, 8 and 10mm luted using resin cement.

Materials and Methods: 30 single rooted sound, non-carious mandibular 1st premolar were selected. These extracted teeth were divided into 3 groups.

Group 1(n=10): Glass fibre post cemented in post space of length 5mm using resin cement.

Group 2(n=10): Glass fibre post cemented in post space of length 8mm using resin cement.

Group 3(n=10): Glass fibre post cemented in post space of length 10mm using resin cement.

Specimens were mounted on an acrylic block, parallel to long axis of the tooth and was subjected to axial tensile force using a universal testing machine (UTM) until retentive failure. The values obtained were statistically analysed using Shapiro Wilk test.

Result: Mean retention values± standard deviation in Newtons (N) were higher for Group 3= 69.25(± 30.44) followed by Group 2= 46.54 (± 12.87) and Group 1= 27.92 (± 5.55) at P=0.001.Percentage raise in mean retentive values of Group 2 in reference to Group 1= 40.00%, Group 3 in reference to Group 2= 32.79%, Group 3 in reference to Group 1= 59.68%.

Conclusion: The results infer that the mean retention values of the glass fibre post showed a statistically significant increase as the post lengths increase (10 > 8 > 5 mm).

Clinical Implication: Retention of glass fibre post can be increased by increasing the post length.

Keyword: UTM, Glass Fibre Post, Resin Cement, Pull-out test, Retentive Failure

Introduction

The primary function of a radicular post is to provide retention for a core, which replaces lost coronal tooth structure and retains the final restoration without compromising the apical seal of the endodontic filling. Post retention is believed to be a major factor in restoration survival.[1]

Retention of the post depends on various factors including post length, diameter, and design, as well as luting agents and canal shape. Nergiz et al indicated that the post retention is highly influenced by its length.[2] The more apically the post is placed in the root canal, the more retentive it becomes, whereas post diameter has a minimal effect on retention.[1]

The dowel length affects stress distribution and thereby fracture resistance in the canal. Several studies state that the dowel length should reach two-thirds of the entire root length. Dowel placement beyond two-thirds of root depth found to increase stress in the apical region.[3]

The amount of tooth structure that remains after endodontic treatment and post preparation plays an important role in the survival of restored endodontically treated teeth. Over preparation of the post space and large diameter posts decrease the resistance to root fracture and increase the risk of apical pathoses. The ability of a cement to retain a post influences the prognosis of the restoration.[1]

Fibre-reinforced composite posts (FRC) are frequently used to contribute to the support and the retention of coronal restorations and crowns, and are considered a practical and economical option for restoring teeth suffering from increased hard tissue loss. However, post-retained crowns often present failures due to loss of retention. Therefore, retention of posts in root canals is a fundamental property for clinical function.[4]Resin cements are extensively used as luting materials for FRC posts.[4]

Since a few studies were conducted to evaluate the fiber posts retention, the effect of their length on the retention has remained unclear.[2] This study is conducted to evaluate and compare the retention of glass fibre post of varying lengths luted using resin cements.

Materials and Methods

Inclusion criteria: Extracted sound permanent mandibular first premolar teeth of patient with similar size, anatomical shape and straight roots.

Exclusion criteria

- Extracted mandibular premolars with
- Restoration
- Caries
- Internal resorption
- Root cracks

- Hypoplasia

This study includes a total of 30 extracted non carious, human mandibular first premolar teeth with similar morphology and randomly divided into 3 groups of 10 teeth each (Figure 1,2).

Group 1(n=10): Glass fibre post cemented in post space of length 5mm using resin cement.

Group 2(n=10): Glass fibre post cemented in post space of length 8mm using resin cement.

Group 3(n=10): Glass fibre post cemented in post space of length 10mm using resin cement.

Specimen preparation

Crowns of the teeth were sectioned using diamond disc in the straight hand piece perpendicular to the long axis of the tooth at the cementoenamel junction (Figure 3).

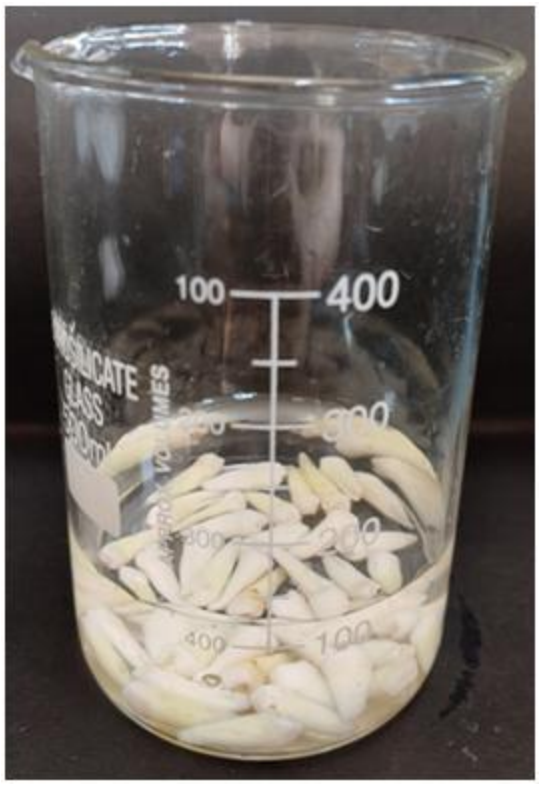


Figure 1: Samples stored in 20% formalin

Figure 2: Mandibular Premolars

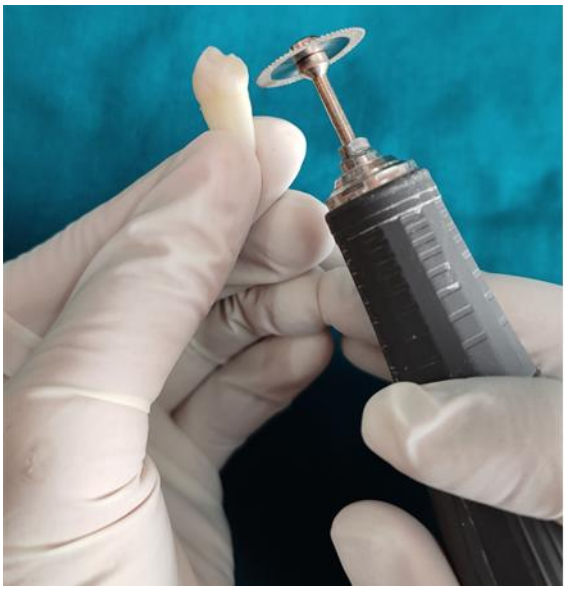


Figure 3: Decoronation of the tooth at cementoenamel junction

Root canal preparation

Root canal was prepared following the standard protocol using K-files(Mani), obturation with gutta-percha cones(Dia-Dent) coated with AH plus sealer using lateral condensation technique(Figure 4,5,6).

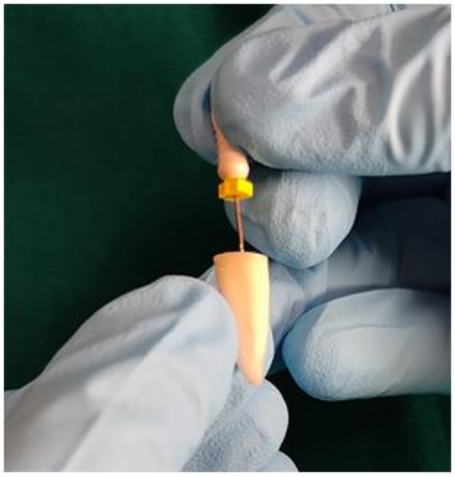


Figure 4: Bio Mechanical Preparation of root canal

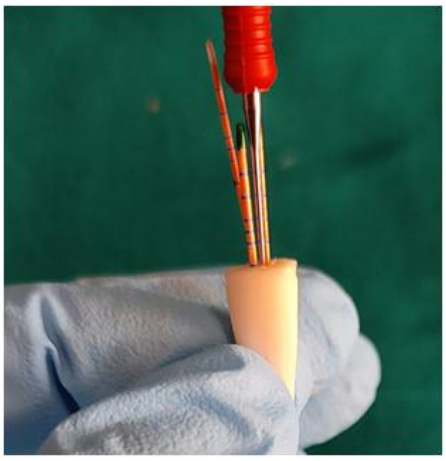


Figure 5: Obturation with gutta percha points

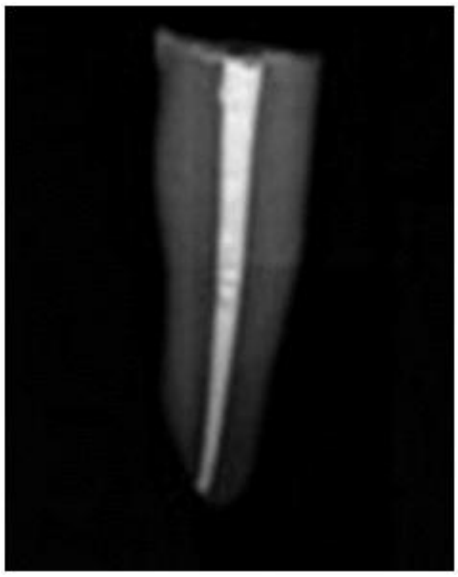


Figure 6: Intra Oral Periapical Radiograph after obturation

Post space preparation and post cementation

Post space was prepared using peeso reamer (Dentsply). The length of the post space preparation varies depending on the experimental groups.

Group A (n=10): Post space of 5mm length was prepared.

Group B (n=10): Post space of 8mm length was prepared.

Group C (n=10):Post space of 10mm length was prepared.

The canal was irrigated with 5.25% sodium hypochlorite solution and dried with paper point(Figure 7,8).

The cement used was RelyX U200 (3M ESPE - USA) which is a self-etch and self-adhesive resin cement, the cement was dispensed on a mixing pad, spatulate and inserted into the canal with the aid of a Centrix syringe with needle tips according to manufacturer's instructions. The glass fibre posts of diameter 1.3mm(Super post fibre) were inserted into the root canal using gentle pressure, the excess of resin cement was removed with an explorer probe and light curing for 40s(Waldent)(Figure 9,10).

Group A (n=10): Glass fibre post was luted using resin cement in post space of length 5mm.

Group B (n=10): Glass fibre post was luted using resin cement in post space of length 8mm.

Group C (n=10): Glass fibre post was luted using resin cement in post space of length 10mm.

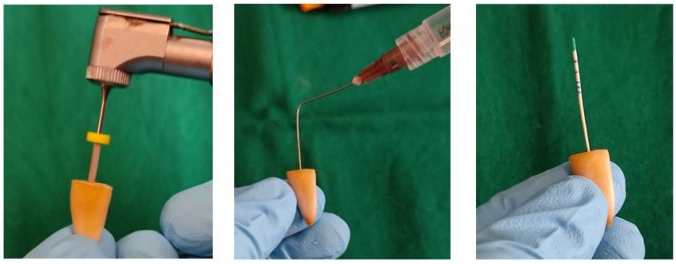


Figure 7: Post space preparation using peeso reamer, Irrigation with 5.25% Sodium hypochlorite, Post space dried using absorbent paper cones

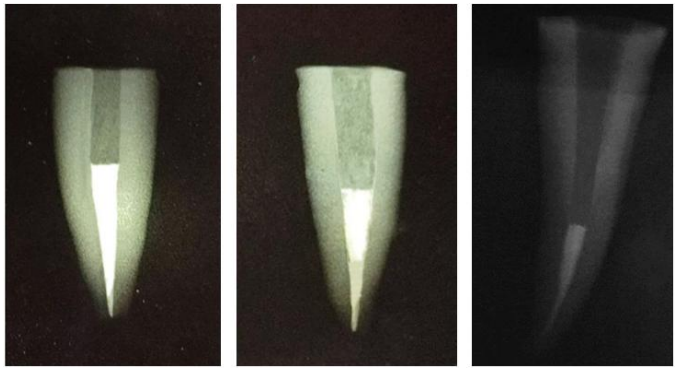


Figure 8: Intra Oral Periapical Radiograph after post space preparation to a depth of 5mm, 8mm and 10mm

Figure 9: Resin cement dispensed into canal using auto-mixing tip and spread on glass fibre post

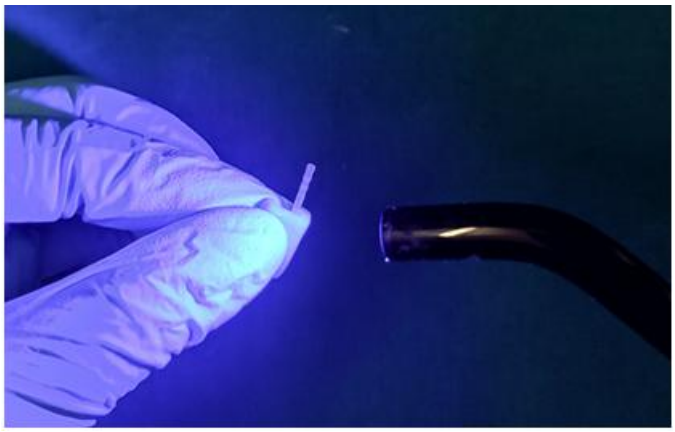


Figure 10: Glass fibre post placed in post space preparation and cured for 40secs

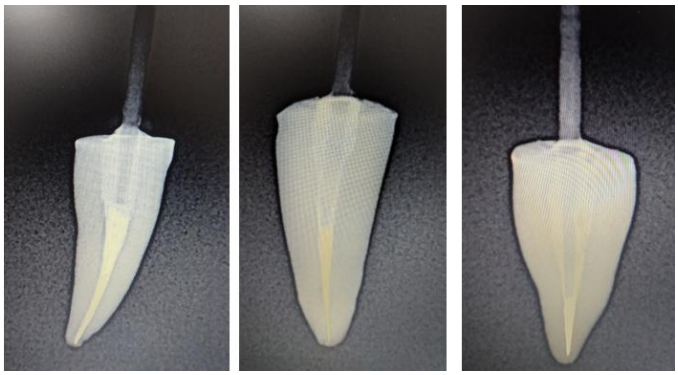


Figure 11: IOPAR after post cementation 5mm, 8mm and 10mm

The specimens were mounted in self-cure acrylic resin block (DPI), parallel to the long axis of the tooth, up to 1mm below cemento-enamel junction (Figure 12).

The samples were subjected to pull-out force using a universal testing machine (Multitest 10i) with a cross head speed of 0.5mm/min until retentive failure and values were noted down(Figure 13).

Figure 12: 30 samples mounted on acrylic block

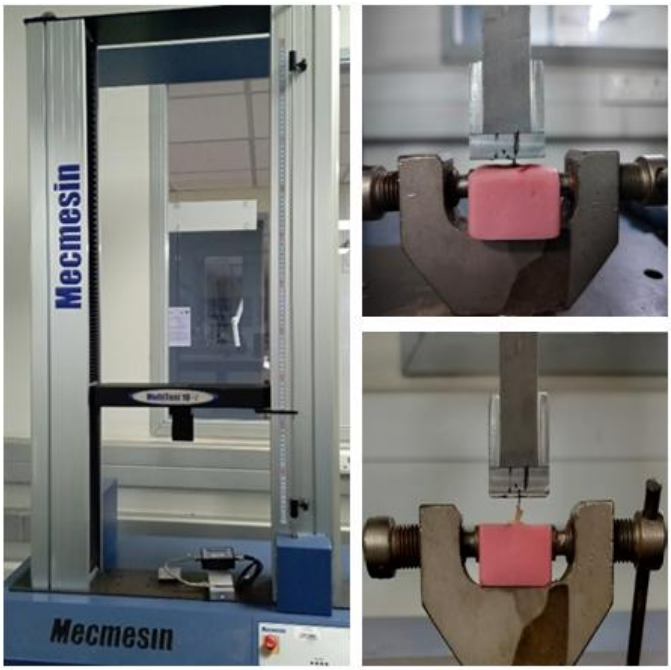


Figure 13: A universal testing machine was used for retentive force testing

To perform the statistical analysis SPSS (Statistical Package For Social Sciences) version 21. (IBM SPASS

statistics [IBM corporation: NY, USA]) was used. Data was entered in the excel spreadsheet. Descriptive statistics of the explanatory and outcome variables were calculated by mean, standard deviation for quantitative variables, frequency and proportions for qualitative variable. ANOVA test was applied to compare the mean retention values among the groups with post-hoc Bonferroni for inter group comparison. The level of significance is set at 5%.

Results

Mean retention values were higher for Group 3- 69.25 ± 30.44 followed by Group 2- 46.54 ± 12.87 and Group 1- 27.92 ± 5.55. ANOVA test was applied to compare the mean retention values among the groups. ANOVA test showed statistically significant difference among the groups with a p=0.001 (Table no.1).

Table 1: comparison of the mean retention values (in newton) among the groups using ANOVA

Groups	N	Minimum	Maximum	Mean (N)	S.D	p value
Group 1	10	16.1	34.3	27.92	5.55	0.001*
Group 2	10	21.7	68.2	46.54	12.87	
Group 3	10	26.8	128.9	69.25	30.44	

Inter-group comparison of the retention values was done by post-hoc Bonferroni. Statistically significant results were seen between Group 1 Vs Group 3 with p value 0.001 and between Group 2 Vs Group 3 with p value 0.042whereas there was no statistically significant difference seen between Group 1 Vs Group 2 with p value 0.122(Table 2).

Percentage raise in mean retentive values of Group 2 in reference to Group 1= 40.00%, Group 3 in reference to Group 2= 32.79%, Group 3 in reference to Group 1= 59.68% (Table 3).

Table 2: inter-group comparison of the retention values using post-hoc bonferroni test

Groups	Mean diff	p value
Group 1 Vs Group 2	-18.620	.122
Group 1 Vs Group 3	-41.330	.001*
Group 2 Vs Group 3	-22.710	.042*

*significant

Table 3: comparison of percentage change in mean retentive values among the group

Groups	Percentage change (%)
% change of group 2 in reference to group 1	40.00
% change of group 3 in reference to group 2	32.79
% change of group 3 in reference to group 1	59.68

Discussion

The bond strength of adhesive systems and resin cements to root dentin have been studied by several authors in recent years. However, the methodology, the preparation of the substrate, the materials used, among other factors show very different values. Few studies, has been conducted to evaluate the influence of the length of the fibre posts on the bond strength.[5]

For many years, the standard assigned optimum length for an intraradical dowel is 2/3 of root length or greater than or equal to the size of the crown. However, some teeth are contraindicated for this pattern due to the anatomy, diameter, and root remnant.[5]

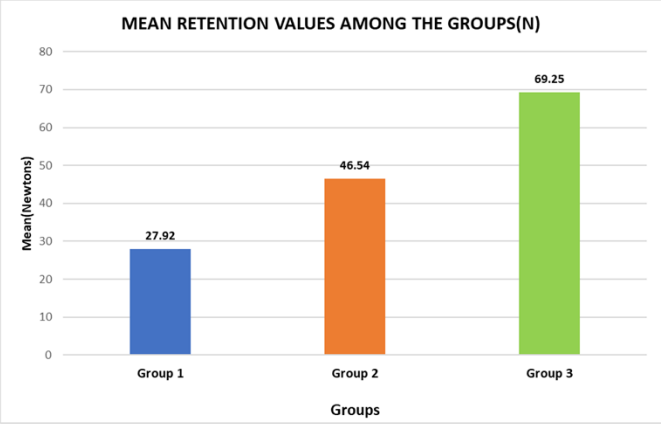
In this study, the centrix syringe was used to dispense the resin cement, following the manufacturer's instructions to promote the best results in cementation.[6]

In this study, the self-adhesive cement RelyX U200 is used, because of its easier clinical application compared with regular resin cements.[9]

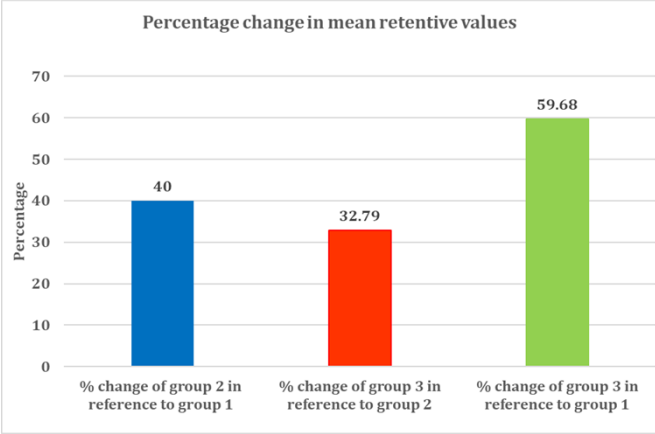
The evaluation of this study, unlike most in the literature, is based on a single variable: The length of the post. The pullout test was chosen, because the results in shear force are comparable to clinically findings. This method better distributes stress, and it is considered to measure the bond strength between the post and root dentin accurately. The pull-out test is more suitable than the push-out when the objective is to measure the holding force of the post along the duct and the type of craze.[5]

The results of this study showed that the mean retention values of the glass fibre post luted with resin cement increased as the post length increases with mean retention values ± standard deviation in Newtons (N) higher for Group 3= 69.25(± 30.44) followed by Group 2= 46.54 (± 12.87) and Group 1= 27.92 (± 5.55). (Graph 1).

Percentage raise in mean retentive values of Group 2 in reference to Group 1= 40.00%, Group 3 in reference to Group 2= 32.79%, Group 3 in reference to Group 1= 59.68% (Graph 2).



Graph 1: Compression of means retention values among the groups



Graph 2: Percentage change in mean retentive values among the groups

With the significant difference between Groups 2 and 3 (8 mm and 10mm in removal procedure, respectively) compared to Group 1 (5 mm removal procedure) it can be concluded that improvement in post retention occurred with increase in post length.

Clinical Implication

Retention of glass fibre post can be significantly increased by increasing the post length luted into the root canal.

Conclusion

There was a significant increase in the retention when the length of glass fibre post was increased. There was an increase in retentive value by 40% when the post length was increased from5mm to 8mm, 32.79% when the post length was increased from 8mm to 10mm and 59.68%when the post length was increased from 5mm to 10mm.

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