



FRACTURE STRENGTH OF ENDODONTICALLY TREATED MAXILLARY PREMOLARS SUPPORTED BY DIFFERENT HORIZONTAL POST SYSTEMS: AN IN VITRO STUDY

Dental Science

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ABSTRACT

Introduction: The purpose of this study was to evaluate the effect of different horizontal post systems on the fracture strength of endodontically treated maxillary premolars with mesioocclusaldistal (MOD) cavities. Methods: Thirty six extracted intact upper premolars were collected, treated endodontically and divided into 3 test groups (n = 12) depending on the restoration type: Group 1 (MOD preparation with a horizontal glass fiber post), Group 2 (MOD preparation with a horizontal carbon fiber post), Group 3 (MOD preparation with a horizontal stainless steel post only). The specimens were stored in normal saline at 37C for 10 days. Then specimens were quasi-statically loaded in a universal testing machine until fracture occurred. Failure loads were then analyzed with one-way analysis of variance, followed by multiple comparisons by using post hoc significant difference test. The mode of failure was determined by visual inspection. Results: Mean (standard deviation) failure loads for groups ranged from 1094.333 (± 137.9193) - 1205.400 (± 217.7758) N. One-way analysis of variance showed significant differences between fracture resistances of groups. All groups showed almost catastrophic fracture mode within the apical third of the roots. Conclusions: Under the conditions of this in vitro study, a horizontal carbon fiber post in a MOD cavity increased significantly the fracture resistance of the endodontically treated upper premolars.

KEYWORDS

INTRODUCTION

Root canal treatment is often necessitated by pulpal infection after hard tissue loss by caries or after tooth preparation for crowns. Endodontically treated teeth are structurally weakened due to loss of physical characteristics like loss of tooth structure, cusps, ridges and the arched roof of the pulp chamber.¹ This structural loss is often a result of caries, trauma, access cavity preparation and radicular preparation.² Certain iatrogenic factors like effect of chemicals and intracanal medicaments, non-iatrogenic factors like history of recurrent pathology, anatomical position of the teeth and effect of ageing on the dentinal tissues can also result in fracture of endodontically treated teeth.²

Long term survivability of root canal treated teeth not only depends on the success of the endodontic treatment but also on the amount of remaining dentine thickness and post endodontic restoration.³ Studies have shown that endodontically treated teeth have reduced level of proprioception^{4,5} and hence impaired normal protective reflex.

Considering the lack of consensus on the restorative alternatives for endodontically treated teeth, we aimed in this in vitro study to investigate The Effect of Three Different Horizontally Transfixed Post Systems on Fracture Strength of Endodontically Treated Maxillary Premolars. The Null Hypothesis that there will be no significant difference in the Fracture Strength of Endodontically Treated Teeth Restored Either with Glass Fiber, Carbon Fiber or Stainless Steel Posts.

MATERIALS AND METHODS

The present study was carried out in the Department of Conservative Dentistry and Endodontics, Seema Dental College and Hospital, Rishikesh, Uttarakhand and Bistrani Test House, Ghaziabad with an aim to evaluate the Effect of Three Different Types of Horizontally Oriented Post Systems on Fracture Strength of Endodontically Treated

Maxillary Premolars.

Preparation of Samples

Thirty Six Non Carious and Periodontally Compromised Freshly Extracted Human Permanent Maxillary Premolars were cleaned of adherent tissue tags and hard deposits using ultrasonic scalers. The teeth were stored in 0.9% Sodium Chloride containing 0.2% Sodium Azide solution for preventing bacterial growth in an incubator at 37°C until used.

Teeth were randomly distributed into 3 groups of 12 teeth each.

Group 1: Extensive MOD cavity preparation was prepared using a cylindrical diamond point. The buccolingual width of the occlusal isthmus were one third the width of the intercuspal distance, and the buccolingual width of the approximate preparation were one third of the buccolingual width of the crown and this width were maintained till the floor of the pulp chamber. The gingival cavosurface were located 1 mm above cemento-enamel junction. The depth of the cavity was 4 mm without proximal steps and flat floor.

Access cavities were prepared from MOD cavity pulpal floor. Canals were instrumented with ProTaper rotary files to an apical size 25 along with EDTA. Irrigation was performed with 2 ml of 3% NaOCl preceding each file introduced into the canal. Following cleaning and shaping, canals were dried and obturated with ProTaper gutta percha and an sealer using cold lateral compaction. Excess root canal filling material was removed with a hot excavator at the canal orifice. Access cavities were cleaned and dried. Following which, perforations in the teeth were made at the prominent point on the buccal and palatal surfaces at the middle space between mesial and distal. The holes were made using a rounded diamond point in a water-cooled air turbine handpiece. Glass fiber post was horizontally fixed in place by using self-adhesive resin cement. Extremities of post were cut with a diamond point near the buccal and palatal surfaces and the specimens

were left as such. The cavities were then be restored with resin composite using an incremental technique and cured from the occlusal surface for 40 sec. (Figure 1 a)

Group 2: The teeth were prepared as in Group 1, but Carbon Fiber Post was placed in place of Glass Fiber Post. (Figure 1 b)

Group 3: The teeth were prepared as in Group 1, but Stainless Steel Post was placed in place of Glass Fiber Post. (Figure 1 c)

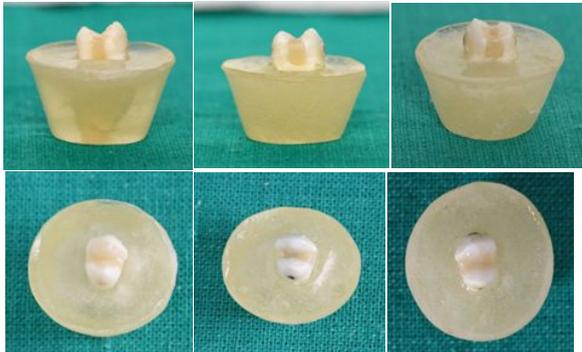


Figure 1: (a) sample of Group 1, (b) sample of Group 2 and (c) sample of Group 3

After the preparation of the samples, the teeth roots were embedded into an auto-polymerizing resin up to 2 mm apical to the cemento-enamel junction. To simulate the periodontal ligament situation, the roots were immersed into melted wax to a depth of 2 mm below the CEJ and were then embedded in acrylic resin blocks. Then all teeth of groups were kept in physiological saline in an incubator at 37° C for 10 days.

Specimens were mounted in Instron Universal Testing Machine for compressive loading of teeth. A 5 mm round metal ball were positioned on the teeth in such a way that it made contact with the occlusal surface of the restoration and buccal and lingual cusps of the teeth. Vertical compressive force was applied by the upper stage of the Universal Testing Machine, moving at a crosshead speed of 0.5mm/min. The failure load of the specimen was determined when the force versus-time graph showed an abrupt change in load, indicating a sudden decrease in the specimen's resistance to compressive loading. The force necessary to fracture each tooth were recorded in Newton (N). Specimens were visually examined for the type and location of failure, as well as the direction of failure. (Figure 2)



Figure 2: Loading of sample

STATISTICAL ANALYSIS

Statistical analysis was performed with SPSS 18.0 (SPSS 18.0 for Windows; SPSS, Inc, Chicago, IL). Analysis of variance (ANOVA) was used to compare fracture resistance means among the 3 groups, followed by multiple comparisons by using post hoc test.

RESULTS

The mean values of the fracture resistance and standard deviations are displayed in Table 1. They ranged from 1094.333±137.9193 - 1205.400±217.7758 N. The highest fracture resistance was recorded for Group 2 (Carbon fiber post) and the lowest one was recorded for Group 3 (Stainless Steel Post).

Table 1 (Graph 1a& b) shows comparison of fracture strength of Groups 1 (MOD Preparation with Resin Composite Restoration and a Horizontal Glass Fiber Post inserted between Buccal and Palatal Walls), 2 (MOD Preparation with Resin Composite restoration and a Horizontal Carbon Fiber Post inserted between Buccal and Palatal Walls) and 3 (MOD Preparation with Resin Composite Restoration and a Horizontal Stainless Steel Post inserted between Buccal and

Palatal Walls).

Comparison of fracture strength of Group 1, 2 and 3 showed no statistically significant difference. The fracture resistance values of Group 1 and Group 2 did not differ statistically.

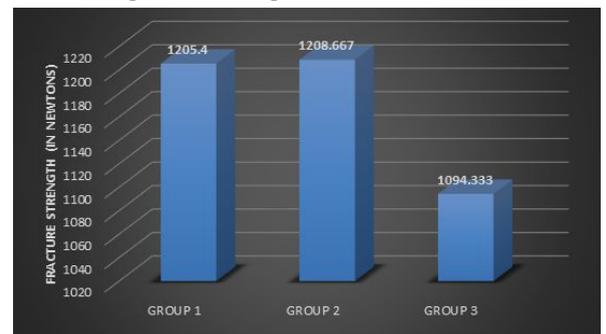
The mode of failure was determined by visual inspection of all specimens. Group 1 & Group 2 had a apical thirds (catastrophic fracture).

GROUP	N	MEAN	STD. DEV.	P VALUE
1	12	1205.400	217.7758	0.00
2	12	1208.667	165.9612	
3	12	1094.333	137.9193	

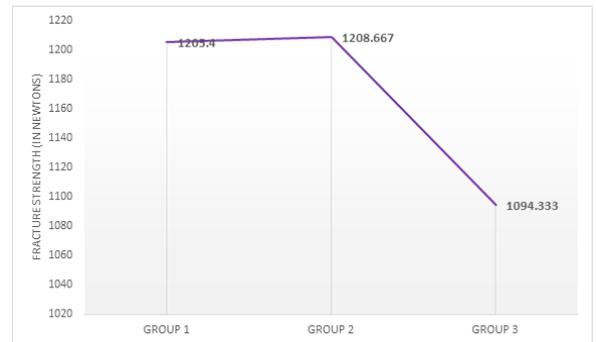
Table 1: Comparison Of The Study Groups

(I) GROUP	(J) GROUP	MEAN DIFFERENCE (I J)	SIG.
1	2	-3.2667	1.000
	3	111.0667	0.822
2	3	114.3333	0.797

Table 2: Comparison of Groups 1, 2, 3



Graph 1 (a): Fracture Strength Comparison Of Groups 1, 2, 3



Graph 6 (b): Fracture Strength Comparison Of Groups 1, 2, 3

DISCUSSION

The present study investigated the influence of different horizontally oriented post systems on the fracture resistance of ETPs.

The use of natural teeth is a reliable methodology in fracture testing and has also been attributed by many authors.6,7,8 Several studies have tried to identify the best technique and materials to be used to increase the fracture resistance of ETT.7,9,10

In the present study, the Carbon Fiber Post Group (Group 2) showed statistically significantly higher fracture resistance than other two groups. On the other hand, the lowest fracture resistance values were found for Glass Fiber Post Group (Group 1). The mode of failure was determined by visual inspection of all specimens. Group 1 & 2 had apical third fracture (catastrophic fractures).

It has been suggested that Carbon Fiber Posts show reduced stress transmission to the root because of similar elasticity compared with dentin. Within the limitations of the results of this study, presence of a Horizontal Carbon Fiber Post can increase the fracture resistance of

ETPs (Endodontically Treated Premolars) against fracture load.

However more in-vitro studies need to be conducted to correlate the results of this study.

CONCLUSION

Within the limitations of this study, a horizontal carbon fiber post in a MOD cavity increased the fracture resistance of ETPs significantly.

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