

A Comparative Evaluation of Fracture Resistance of Endodontically Treated Teeth Restored by Glass fibre Post System and Zirconia Post– An in vitro Study

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Abstract

Objectives: The purpose of this in vitro study was to evaluate the fracture resistance of endodontically treated teeth restored by different post systems. **Method:** 40 maxillary canines with anatomically similar root segments were taken and then decoronated at the cemento-enamel-junction. After establishing the working length 1mm short of the apex, the canal was prepared by crown down technique using rotary protaper followed by obturation. After 24 hours, post space preparation was done using Pessio reamer. All the specimens were then being divided into 2 groups {Group 1: Glass Fiber Posts, Group 2: Zirconia Posts}. The posts were then cemented into the tooth using a resin sealer and acrylic resin cylinders were obtained using cylindrical molds. Specimens were subjected to increasing compressive load (N) until fracture. **Results:** There was statistically significant differences were observed between the two groups and it indicated that Zirconia posts have the better fracture resistance capacity. **Conclusion:** Within the limitation of this study it is concluded that the Zirconia posts has the better fracture resistance than Glass fiber posts.

Key words: Endodontically treated teeth, Fracture resistance, Glass fiber post, Zirconia post

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Introduction

The restoration of endodontically treated teeth has been a concern of dentists for more than 100 years⁽¹⁾. It is known that those teeth are generally weaker because of dental structure loss, cavities, filling preparation and root canal instrumentation. It is also important to point out that dentin moisture decrease would lower their strength properties making them more susceptible to fractures⁽²⁾. The role of moisture loss, the nature of dentin, alterations in strength caused by architectural changes in the morphology of teeth, concepts of biomechanical behavior of tooth structure under stress, and changes in the collagen alignment are considerations when restoring endodontically treated teeth⁽³⁾. Patients and dentists have been making increasing demands on the aesthetics of

dental restorations and the biocompatibility of the materials used in recent years. Industry has reacted by introducing several innovative post-and-core systems for restoring non vital teeth⁽⁴⁾. The success achieved with esthetic restorative techniques has resulted in increased patient demands for these treatments, particularly for anterior teeth. Consequently, there has been a significant increase in the use of all-ceramic crowns, as well as endodontic post and core materials that do not affect the esthetic results. Many dentists prefer to use prefabricated post systems because they are more practical, less expensive and in some situations, less invasive than customized post and core systems⁽⁵⁾. Therefore, the purpose of this in-vitro study was to compare the fracture resistance of endodontically treated teeth restored with two

different post systems namely Glassfibre post and Zirconia post.

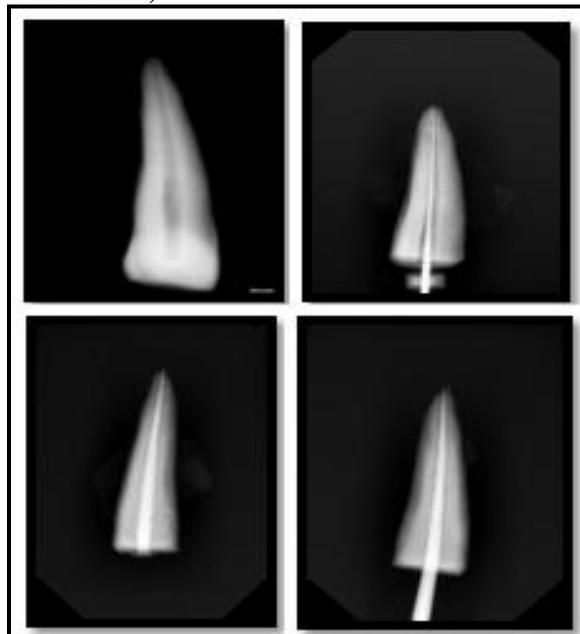
Materials and Methods

Forty maxillary canines freshly extracted for periodontal reasons, with straight root canals, anatomically similar root segments, and fully developed apices, were used for this study. Soft tissue and calculus were mechanically removed from these teeth and then stored in saline solution.

The teeth were then decoronated at the cemento-enamel-junction using a slow-speed diamond disc. After pulp tissue was removed, the canal lengths were visually established by placing a #10 file into each root canal until the tip were visible at the apical foramen. The working lengths were established 1 mm short of the apex. The canal was prepared by Crown Down technique using rotary Protaper (Dentply, Mallifer).

During instrumentation, canals were irrigated with 5.25% Sodium Hypochlorite solution and 17% EDTA. Before obturation, the canal was dried with paper points. The obturation was performed using guttapercha and zinc oxide eugenol sealer with lateral condensation. A radiograph of each specimen was taken to confirm satisfactory obturation of the canal (Figure- 1).

Figure- 1: Radiographs- (Pre-Operative to Obturation)



After 24 hours, post space preparation was done using Pessio reamer, by removing guttapercha from the coronal and middle thirds of the roots leaving about 5mm of intact guttapercha. Following the post space preparations the canal was irrigated with saline solution and dried with paper points. Presence of any residual guttapercha in the walls of the post space was checked by radiovisiography (Figure- 2). All the specimens were then being divided into 2 groups:

Group 1: Glass Fiber Posts (GF)

Group 2: Zirconia Posts (ZP)

Figure 2: Radiograph after Post Space Preparation



The posts were then cemented into the tooth using a resin sealer. The post cemented roots were then stored in saline solution at room temperature and acrylic resin cylinders were obtained using cylindrical molds. Then the specimens were mounted on the lower plate of the Universal Testing Machine and a compressive loading was applied vertically to the coronal surfaces of the roots with a loading rate of 1mm/min until fracture occurred and the load at which failure has occurred was recorded and expressed in Newton. Data was statistically analyzed and descriptive statistics, including the mean, standard deviation, standard error were obtained. Significance of statistical test was predetermined at $P < 0.05$.

Results

Results from the experimental groups indicates that Zirconia Post had more fracture resistance than Glass fiber post as the mean for Zirconia post was 501.47 and mean difference was 145.6 between both the groups. The mean difference is statistically significant as the observed p value was less than 0.05 (Table- 1).

Table- 1: Comparison between both the groups

Groups	Mean±SD	Mean Difference
Glass Fibre Post	355.87±29.67	145.60*
Zirconia Post	501.47±13.23	

*P<0.05

Discussion

Reconstruction of endodontically treated teeth is a great challenge in restorative dentistry since the tooth crown is usually totally or partially lost by caries, erosion, abrasion, previous restorations, trauma or endodontic access⁽⁶⁾. If more than half of the coronal structure has been lost, a root canal post is required to provide retention for the restoration. The main objective is monoblock restoration, i.e. achievement of a single biomechanical complex by adhesion between the tooth structure and reconstruction materials (the post, luting agent and filling material) and utilization of materials with similar mechanical properties as the remaining dentine structure⁽⁷⁾. Traditionally, metal posts have been used to restore endodontically treated teeth. Increased esthetic demands as well as possible problems resulting from corrosion of posts made from non-noble alloys led to the development of tooth-colored post systems⁽⁸⁾.

In the present study Glass fiber posts and Zirconia posts were used. Zirconia holds a unique place due to its superior mechanical properties and due to this it has made it a promising material for endodontic posts⁽⁹⁾. Hence zirconia has to be compared with a material that is both aesthetic and has good mechanical properties for use as a restorative material. One such material is Glass fiber which has been used for many years as an aesthetic post material.

In vitro studies have shown that glass fiber posts might possess some benefits over metal posts due to their modulus of elasticity being closer to that of dentin^(10,11). In 2010 Dayalan M et al⁽⁹⁾ compared the fracture strength of the zirconia oxide posts and prefabricated glass fiber post the authors concluded that zirconium oxide posts showed higher fracture strength when compared to glass fiber posts.

The success achieved with esthetic restorative techniques has resulted in increased patient demands for these treatments, particularly for anterior teeth⁽²⁾. A non-vital anterior tooth that has lost significant tooth structure requires restoration with a crown, supported and retained by a core and possibly a post as well. Therefore in this study, maxillary canines were selected in accordance to M Sadeghi⁽¹²⁾ and Giovani AR et al⁽¹³⁾.

Radio-visiography was used to determine the patency of the canal. The crowns were removed with a slow-speed diamond saw at the enamel-cement junction in accordance with Adanir N and Belli S⁽¹⁴⁾. After the post placement the teeth were loaded in an Instron Universal Testing Machine, and loading was applied to the point of fracture. Loading to fracture represented a “worst case” scenario. Although it does not replicate what takes place in the oral environment, where teeth are subjected to forces of mastication that over a long period of time may cause fatigue resulting in tooth fracture. This method of testing has been widely used by previous researchers⁽¹⁵⁾. Since these posts enable them to absorb and dissipate stresses, they were used in the present study.

In the present study Zirconia posts was proven to have better fracture resistance than the other posts system used. Because laboratory testing cannot exactly simulate in vivo conditions, the result of any in- vitro investigation must be viewed with caution. The method evaluated in this study is technique sensitive. So, results may vary according to knowledge and experience of the operator of the technique.

Conclusion

Under the limitation of the present study, it can be concluded that among the three posts system used in the present study, the Zirconia posts showed the maximum fracture resistance as compared to the Glass fiber posts. However long term clinical studies are required to determine the success rate of the Zirconia post.

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