Section A-Research paper

Comparison of Different Post Systems for FractureResistance: An *in vitro* Study

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ABSTRACT

Introduction: Endodontic restoration becomes a challenging task for the clinician because of severe loss of coronal tooth structure owing to trauma, caries, restorative, and endodontic procedures. The restoration of these teeth requires the use of a post and core as individual units or as abutment supports for fixed or removable restorations in a predictable long-term manner.

Aim: To compare and assess the compressive bond strength of glass, quartz, and carbon fiber posts restored with porcelain-fused-to-metal (PFM) crown.

Materials and methods: A total of 90 upper central incisor teeth having straight root canals, similar anatomically root segments, and fully developed apices were selected. Teeth were divided into three groups of 30 teeth after endodontic treatment. Group I: Teeth inserted with the prefabricated glass fiber post. Group II: Teeth inserted with the quartz fiber post. Group III: Teeth inserted with carbon fiber post. The posts were placed and core was fabricated using composite restoration followed by PFM crown cementation using adhesive resin. Compressive load required to fracture the tooth was measured using a universal loading machine. The difference between the variables was assessed by one-way analysis of variance, followed by Tukey's *post hoc* test.

Results: The compressive strength exhibited by carbon fiber posts was highest with a mean of 673.40 ± 29.401, followed by quartz fiber post (642.72 ± 32.487). Least compressive strength was exhibited by glass fiber post (571.64 ± 28.731). An analysis of variance shows statistically highly significant difference ($p < 0.005$) among the posts used.

Conclusion: This study concluded that the carbon fiber posts had higher compressive strength than other quartz, glass fiber posts.

Clinical significance: Endodontic treatment results in loss of a significant part of the tooth structure. Posts restore these teeth and provide retention.

Keywords: Carbon fiber, Compressive strength, Glass fiber, Porcelain-fused-to-metal, Quartz fiber.

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Introduction

Endodontically treated teeth cause loss of tooth structure and their restoration is an important aspect of dental practice, which needs a range of complex treatment options. Nowadays, cast post–core restorations are the option of choice for endodontically treated teeth,[1] but this kind of restoration, according to many authors, makes teeth fragile and more susceptible to fracture.[2] Prefabricated post systems provide satisfactory results and hence, have become increasingly popular recently.

The endodontically treated tooth causes loss of the tooth structure and is a unique subset of teeth requiring restoration, and there is change in physical characteristics, such as altered collagen cross-linking, dehydration, the altered esthetic characteristics of the residual tooth, and impairment in neurosensory feedback mechanism. It is critically important to ensure a successful restorative outcome for esthetic, functional, and structural rehabilitation of a pulpless tooth. In cases where most of the coronal portion is lost, a common method to restore such teeth is the use of a post and core, onto which a full crown is cemented.[3] Endodontic posts can be preformed and custom-made; metallic and nonmetallic; stiff and flexible; and esthetic and nonesthetic.[4] Today numerous tooth-colored posts are available, such as zirconium-coated carbon fiber post, all zirconium, cerapost, fiber-reinforced light post, and glass fiber post.[5] Root fracture risk is reduced to minimum by fiber-reinforced posts and also revealed significantly higher survival rate. Glass fiber posts integrally bond to the composite core and provide a natural hue, improving the esthetics without compromising much on the strength.[6]

Hence, this study was done to evaluate and compare the compressive bond strength of glass, quartz, and carbon fiber endodontic posts.

Material and methods

Overall 90 maxillary central incisors with straight canals, identical anatomical root sections, as well as completely formed apices removed for periodontal purposes had been chosen for

the study. Endodontic procedure had been conducted on each of them. All the canals had been instrumented to same size i.e. size 60 file. Canals had been irrigated using one milliliters of 5.25 percent sodium hypochlorite throughout instrumentation. At the time of instrumentation, the teeth had been categorized into 3 groups of 30 each. Lateral condensation had been conducted with 60-size gutta-percha as master cone. The root canals had been then dried using paper points prior to obturation and subsequently obturated using a resin sealer. Gutta- percha points had been coated with sealer as well as positioned within the canals to the working length.

Then the teeth were categorized into 3 groups of 30. The first group had teeth inserted with the prefabricated glass fiber post, the second group had teeth inserted with the quartz fiber post whereas the third group had teeth inserted with carbon fiber posts.

At 37°C the gutta-percha filled root canals were kept for 3 days in a humidor.

The specimens were mounted in acrylic resin blocks, with the long axis of the block, midfacial extent of each tooth parallel to the long axis of the block, and the mid- facial extent of cementoenamel junction located 2 mm coronal to acrylic resin. Root length for posts was standardized by reducing the crown of each tooth to a height of 1 mm over the cementoenamel junction.

Post spaces had been formed for all teeth using special preparation drills. The posts had been positioned as well as core had been fabricated with composite restoration and later by PFM crowns cementation adhesive resin.

Tukey's *post hoc* test had been conducted for statistical analysis. P value of less than 0.05 had been considered as numerically substantial.

Results

Table 1: illustrating the post systems used.

Sr. no.	**Post systems**	**Number of teeth**
1.	Glass fiber posts	30
2.	Quartz fiber posts	30
3.	Carbon fiber posts	30

Table 2: illustrates the mean compressive strength exhibited by different posts before fracture.

Post	**Mean ± SD**	**P value**
Glass fiber posts	571.64 ± 28.731	0.0001
Quartz fiber posts	642.72 ± 32.487	
Carbon fiber posts	673.40 ± 29.401	

The compressive strength possessed by carbon fiberposts was found to be the greatest with a mean of 673.40 ± 29.401 followed by quartz fiber post. Least compressive strength had been possessed by glass fiber post.

The Tukey's post hoc test displayed a numerically considerable variation among glass fiber post vs quartz fiber post, glass fiber post vs carbon fiber posts, as well as quartz fiber post vs carbon fiber posts ($p < 0.05$).

Discussion

Root canal–treated teeth with less tooth structure are often restored with the crowns. In teeth with substantial hard tissue loss resulting from cavities or trauma, posts are often necessary for providing sufficient retention for the core material. Although posts have been recommended to strengthen the teeth, several investigators have cautioned that posts with inadequate resistance to rotational forces can weaken the teeth.[7] In cases where most of the coronal portion is lost, a common method to restore such teeth is the use of a post and core, onto which a full crown is cemented.[8] Hence, this study was conducted to evaluate and compare any significant difference in the fracture resistance of endodontically treated teeth restored with three different post systems.

In the present study, the compressive strength possessed by carbon fiber posts was found to be the greatest with a mean of 673.40 ± 29.401 followed by quartz fiber post. Least compressive strength had been possessed by glass fiber post.

The Tukey's post hoc test displayed a numerically considerable variation among glass fiber post vs quartz fiber post, glass fiber post vs carbon fiber posts, as well as quartz fiber post vs

carbon fiber posts ($p < 0.05$).

Vadavadagi SV et al[9] assessed the compressive bond strength of glass, quartz, and carbon fiber posts restored with porcelain fused-to-metal (PFM) crown. A total of 90 upper central incisor teeth having straight root canals, similar anatomically root segments, and fully developed apices were selected. Teeth were divided into three groups of 30 teeth after endodontic treatment. Group I: Teeth inserted with the prefabricated glass fiber post. Group II: Teeth inserted with the quartz fiber post. Group III: Teeth inserted with carbon fiber post. The posts were placed and core was fabricated using composite restoration followed by PFM crown cementation using adhesive resin. Compressive load required to fracture the tooth was measured using a universal loading machine. The difference between the variables was assessed by one-way analysis of variance, followed by Tukey's post hoc test. The compressive strength exhibited by carbon fiber posts was highest with a mean of 673.40 ± 29.401, followed by quartz fiber post (642.72 ± 32.487). Least compressive strength was exhibited by glass fiber post (571.64 ± 28.731). An analysis of variance shows statistically highly significant difference ($p<0.005$) among the posts used. This study concluded that the carbon fiber posts had higher compressive strength than other quartz, glass fiber posts.

Türker SA et al[10] compared the bond strength and the fracture resistance of different post systems. 60 mandibular incisor and 60 mandibular premolar teeth were used for the bond strength and fracture resistance test respectively. For each test, three groups ($n = 20$) were formed according to the posts used zirconia posts (ZR post), individually formed glass fiber reinforced composite posts with an (Interpenetrating Polymer Network—IPN post) and cast metal posts. Then groups were randomly assigned into two subgroups according to the post design: 1-parallel sided and 2-tapered ($n = 10$/group). All posts were luted with a self-adhesive luting agent. Cast metal posts showed the highest retention ($p < 0.05$); however, IPN and zirconia posts showed similar results. No significant difference was found between parallel sided or tapered designs of post groups in terms of bond strength ($p > 0.05$). In terms of fracture resistance, IPN post groups showed lowest fracture resistance (p 0.05). There was no relationship between the bond strength and fracture resistance of the post systems ($r = – 0.015$, $p > 0.700$). Post type had effect both on the fracture resistance and retention of the posts used. However, post design had effect only on the fracture resistance of the post systems.

Conclusion

This study concluded that the carbon fiber postshad higher compressive strength than other quartz, glass fiberposts.

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