Case Report

Introduction to Fiber Reinforced Composite (FRC) Post, A New Era in Reinforcing Esthetics: A Case Report

CM Jan[1], F Rashid[2], NA Nomann[3], AJ Rashid[4]

Abstract

The restoration of a root canal treated or, endodontically treated teeth, is often can be achieved with post and core because of the significant loss of tooth structure. Until the mid-1980s, the safest way to restore an endodontically treated tooth was considered to be the cast-metal post, made indirectly by a dental technician. Also prefabricated metal posts in combination with different core materials under artificial crowns were used. The development and use of fiber reinforced composite (FRC) root canal posts over metallic posts make possible of the attachment & reinforcement of the crown with maximum esthetics. This paper illustrates a technique for rehabilitation of an endodontically treated maxillary central incisor of both sides (UL1 & UR1) with a fiber reinforced composite post (FRC post) & discusses the advantages, disadvantages of metallic post over fiber reinforced composite (FRC) posts.

Key words: *Fiber reinforced composite (FRC) post, Cast-metal post, Root fracture, Esthetics, Modulus of elasticity.*

Introduction

Crown and bridge restorations are often used to restore endodontically treated teeth. The restorations are supported by individually cast core or, a prefabricated metal post-and-core system[1]. However, the difference in elastic modulus between dentin and metallic posts induced stress in the root structure, thereby increasing the risk of root fracture[2] and loss of the tooth. Since post design, materials used and the post space preparation has significant influence on vertical fracture prevalence, broad investigation is in progress to find out the optimum procedure. Furthermore, the dark/grayish color of metallic posts impairs the esthetic aspect of the restoration, thus resulting in failure in reinforcing esthetics. During the last decade many new prefabricated passive posts were introduced for post-endodontic restorations, using carbon fiber posts mainly.

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The physical properties of carbon fiber posts and the composite core are very close to those of dentin[3]. Fiber reinforced composite (FRC) posts are composed of uni-directional carbon or glass fibers embedded in a resin matrix[4], and they have two favorable characteristics. First, the elastic modulus of carbon fiber reinforced composite (FRC) posts (82 GPa)[5] [GPa standing for Gigapascals / kN/mm2] is approximately the same as dentin (15 GPa)[6] & enamel (50-84 GPa)[6] combined, whereas metallic posts have an elastic modulus of 177-202 GPa[6], which is nearly 20 times greater than the elastic modulus of dentin. Second, FRC posts are superior in esthetic quality. Such advantages make FRC posts a good alternative to metallic posts[7,8].

Overview to Fiber Reinforced Composite (FRC) Posts

The introduction of esthetic fiber reinforced composite posts, in the 1990s, challenged conventional treatment modalities in the same way posterior composites threatened amalgam alloy[9]. This procedure seems to be a good alternative to traditional cast metal dowel/cores or metal prefabricated posts. Their main proposed advantage was that they were more flexible than metal posts and had approximately the same modulus of elasticity (stiffness) as dentin. When bonded in place with resin cement, it was thought that forces would be distributed more evenly in the root, resulting in fewer root fractures. This is generally born out with a vast amount of study.

The original carbon fiber posts were dark, which was a potential problem when considering post-restorative esthetics, as discussed previously. More recent versions are white. They are relatively easy to remove[10] by boring through the middle of the post with an ultrasonic or rotary instrument. The orientation of the fibers helps keep the removal instrument in the proper alignment.

Other types of fiber posts also are available, including quartz fiber, glass fiber, and silicon fiber posts (Figs. 1 and 2). They are claimed to offer the same advantages as the carbon fiber posts, but with better esthetics. Because they are newer, there is currently less research available on them than carbon fiber posts. Most fiber posts are relatively radiolucent and have different radiographic appearance than traditional posts (Figs. 2 and 3).

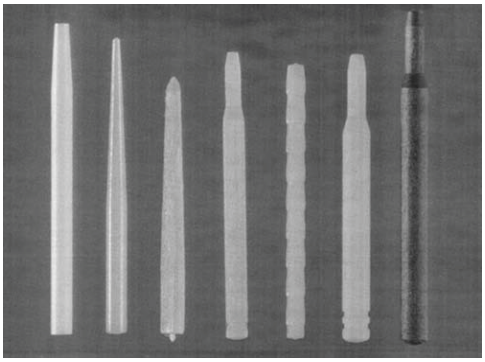

Fig 1: Examples of nonmetal posts.

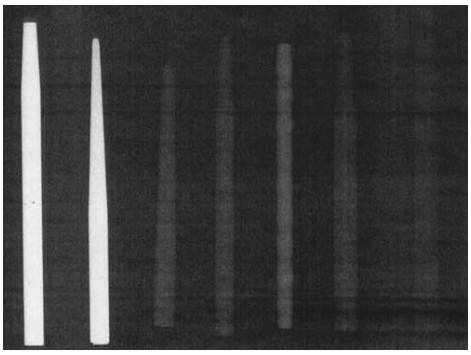

Fig 2: Radiographic images of the posts in Fig. 01. From left: two zirconium posts, two glass fiber posts, two quartz fiber posts, and a carbon fiber post.

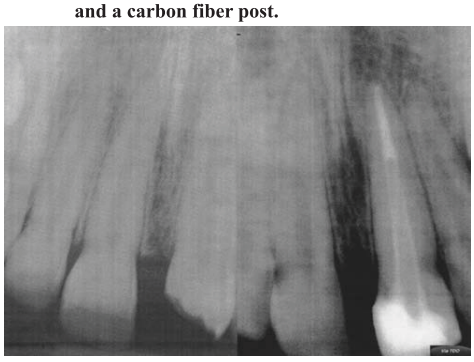

Fig 3: Radiographic view of a glass fiber post in the maxillary left central incisor.

Case Report

A young girl aged 20 years, reported to our clinic **(Hiroshima Dental Clinic, 42, Lake Circus, Kalabang, Dhaka-1205)** with the chief complaint of poor esthetics, due to broken anterior teeth following a long standing caries for more than 3-4 years without any other symptoms rather than complaining esthetics. The soft tissues & hard tissues revealed no abnormalities in both the extra oral and intraoral examination. Clinical and radiographic examination revealed that the crown was destroyed more than middle third in relation to adjacent lateral incisors of both sides (i.e. UL2 & UR2, as radiographs suggest in Fig: 4). The medical history was non-relevant. Pulp vitality test showed both central incisors (i.e. UL1 & UR1) are non vital.

All the possible treatment options were explained to the patient. The patient expressed the desire to maintain the tooth and restore it with a direct resin based composite restoration, due to the lower cost and better esthetics.

Endodontic treatment was done two weeks before the post placement to assure the quality of seal, peri-apical space and root canal dimensions. Endodontic treatment was done through standardized technique.

As the tooth structure was lost till the middle third of the crown or more on both the teeth & the canal was open, so no access cavity was prepared. The canal was only prepared through manual/ hand preparation at working length of 15mm on both the teeth (as radiographs suggest in Fig: 5). Both the canal were prepared up to #80 H-file followed by proper irrigation on every consecutive reaming & filing. Then the carious & unsound tooth structures were removed keeping only sound tooth structures. After proper canal preparation the canals were sealed by #70 GP-cone & sealer (eugenol free sealer) at the obtained working length (as the radiograph suggests in Fig: 6) & lateral condensation was done. Thus after achieving a hermetic seal on both the teeth (as radiographs suggests in Fig: 7) the patient was recalled after 1week later on follow up. During the follow up visit as no complaint was found & all signs-symptoms showed a good seal, then we proceeded for glass fiber reinforced composite (FRC) post preparation phase.

For fiber reinforced composite (FRC) post insertion, with a suitable sized pesos reamer on a slow speed hand-piece, a post space was prepared by carefully removing all obturating materials from the two thirds of the canal and from the canal walls thus removing obturating materials up to (15mm of working length - 04mm of the apically sealed canal left intact) = 11mm of the canal space was cleared for post placement. A minimum of 1.5mm collar on sound tooth structure were left for a ferrule design[11].

i-TFC system post (a product of Sun Medical Inc., Shiga, Japan), a glass fiber reinforced composite (FRC) post of proper /desired diameter (0.13mm) with the length of 11mm was selected, then it was tried into the prepared root canal and cut at the required length with a diamond disc or manufacturer provided fiber post cutting scissor. The working field was then isolated to keep it free from getting contaminated by saliva. The canal was rinsed thoroughly with 5% sodium hypochlorite (NaOCL) solution and dried with paper point. The canal walls and remaining tooth were coated with Primer (supplied by the manufacturer) for 01 minute, which combines single step disinfecting, etching, priming and bonding with the help of micro brush.

The canal was carefully dried with paper point followed by gentle stream of air to evaporate the volatiles. When the surface appeared glossy, primer was also applied to the clean surface of the post and lightly dried to achieve the gloss, and then it was cured for 40 seconds with Halogen Light. Equal part of base and catalyst paste of dual cure resin cement was mixed and applied over the surface of the post in a thin layer.

The post was carefully seated into the canal using light finger pressure it was light cured for 40 seconds for proper depth cure with Halogen light. Excess cement expressed out of the canal was used as a base for core buildup (as Fig:8 suggests). Light cure packable composite resin was used as a core material. After packing & giving a desired shape it was cured for 30 seconds with Halogen light. After setting, minimal preparation was carried out to finish the margins for crown preparation so that, the margins of the crown extends over the core material and lie on a sound tooth structure. In this way, the crown forms a collar, which surrounds the cervical parts of the root which is called a 'Ferrule'[11]. A ferrule of 1.5 mm was given above the crown margin area, which embraces the circumference of the root, thus protecting it from fracture & ensures the longevity of the artificially prepared & seated crown[12,13,14]. Then an impression was taken & shade was selected to fabricate the all ceramic crown.

Discussion

The metal free post endodontic treatment promises to be the method of choice in cases of destroyed tooth as it enables the achievement of longevity and aesthetics of the restorations[15]. Duret in the year 1990 first introduced metal free carbon fiber reinforced epoxy resin posts.
It showed promising long term clinical results, suggesting that this system can be a viable alternative to metal post and core in future[15]. This technique is single visit, easy to perform and safe for both patient and dentist.

Many laboratory-based studies have shown that these posts have a high tensile strength[16] and modulus of elasticity, similar to dentine[17]. Previously, rigid metal posts resisted lateral forces without distortion and this resulted in stress transfer to the less rigid dentine causing potential root cracking and fracture. It has been hypnotized that fiber-posts flex under load and as a result distribute stresses between the post and the dentine. Currently available fiber-based posts are essentially composite materials. They are composed of fibers of carbon or silica surrounded by a matrix of polymer resin, usually an epoxy resin. Wide varieties of posts are available and include parallel-sided, tapered, smooth and serrated forms. Carbon-fiber posts are black in color and do not blend themselves to esthetic restorations with all-ceramic units. This led to the introduction of the silica-fiber posts which are translucent and more tooth colored. These posts are also called glass-fiber (which has been used in this certain case) and quartz-fiber. It has been suggested by manufacturers that these posts retain similar physical properties to carbon-fiber posts. Stewardson provides a thorough review of the fiber-based post systems available and their properties[18].

The metal post may cause root fracture due to its required excessive tooth removal and direct transmission of stresses from post to the root of the tooth. The metal free post possesses a modulus of elasticity identical to dentin, which increases the strength of the remaining tooth structure[19]. It results in restoration with natural translucency without causing corrosion and discoloration with high biocompatibility. Post selection depends on individual patient needs and dentist's preference[20]. Ceramic posts are strongest but expensive[21]. Metal post often fractures under load. Carbon/Silica based fiber reinforced composite (FRC) posts are adequately strong, cost effective and have acceptable physical properties[19].

Conclusion

Currently, there is an increased demand for clinically convenient post and core system with plethora of simplified one visit post and core restorative options[9]. Carbon fiber reinforced post can easily be used by contemporary esthetic dentist. This technique provides the benefits of root strengthening and natural esthetics when endodontically restoring the compromised tooth. It also successfully combines the adhesive cementation with the metal free core build up procedure[19]. Thus resulting in a much more pleasant esthetics than metal posts would give & resulting with a happy and healthy smile of patient.

Fig: 4---Diagnostic Radiograph

Fig: 5--Radiograph taken for
Working length determination

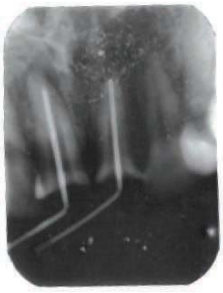

Fig: 6--Pre-seal Radiograph was taken
with #70 master GP inserted

Fig:7--Radiograph taken after root canal seal

Some Photographs of this case

1) Diagnostic Photo

2) Photo taken after Post-core preparation

3) Photo taken after tooth preparation for crown

4) Photo taken after crown insertion