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Aesthetic Rehabilitation Using a Customized Anatomical Fiber Post: A Case Report

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Abstract

Restoration of endodontically treated anterior teeth with excessively flared or irregular root canals presents a significant clinical challenge. Conventional prefabricated fiber posts often fail to adapt adequately to enlarged canals, resulting in thick cement layers that may compromise retention and increase the risk of debonding. This case report describes the rehabilitation of a maxillary right central incisor with a broad and irregular root canal using a custom-adapted fiber-reinforced composite post. Following root canal treatment, post space preparation was performed using a heated downpack device. A prefabricated glass fiber post was anatomically customized with composite resin to closely adapt to the canal morphology. After etching and adhesive application to both the canal walls and post surface, the customized post was cemented using a dual-cure resin cement. Composite core build-up was completed, followed by tooth preparation, definitive impression, and full-coverage crown placement. The customized fiber post achieved excellent canal adaptation while minimizing resin cement thickness, providing a conservative and predictable restorative solution for structurally compromised anterior teeth.

Keywords: Anatomical fiber post, Flared canal, Custom post, Composite adaptation, Dual-cure resin cement, Maxillary central incisor

Introduction

Endodontically treated anterior teeth frequently require post-retained restorations because of the extensive loss of coronal tooth structure. The success of these restorations depends on adequate retention of the post while preserving the remaining radicular dentin. However, restoration becomes particularly challenging in teeth with broad, flared, or irregular canals, where prefabricated fiber posts do not conform closely to the canal anatomy.

When a conventional fiber post is placed in an oversized canal, the resulting thick resin cement layer is more susceptible to polymerization shrinkage, void formation, and adhesive failure, potentially compromising the long-term prognosis of the restoration. The anatomic post technique, which customizes fiber posts with resin composite to perfectly fit flared or irregularly shaped root canals, was introduced by Boudrias et al. in 2001.[1] It has been proposed to improve adaptation, reduce cement thickness, and achieve more uniform stress distribution owing to the favourable elastic modulus of fiber-reinforced posts. [2,3]

This case report presents the clinical management of a maxillary central incisor with a broad and irregular canal using a customized fiber post fabricated with composite resin and luted with dual-cure resin cement.

Case Report

A 21 year old patient reported to the Department of Conservative Dentistry and Endodontics with the chief complaint of a fractured upper front tooth associated with compromised esthetics. The patient gave a history of trauma to the maxillary anterior region approximately four months earlier following a fall. No history of pain, swelling, or sinus tract formation was reported after the injury. The patient sought treatment primarily for esthetic rehabilitation.

Clinical examination revealed an Ellis Class IV fracture involving the maxillary right central incisor (11), with extensive loss of coronal tooth structure. The patient gave history of initiation of root canal treatment with 11 one month back. Percussion and palpation tests elicited no tenderness. Radiographic examination along with CBCT scan demonstrated an immature, broad, and irregular root canal. Based on the clinical and radiographic findings, root canal treatment was planned.

Following administration of local anesthesia and isolation with a rubber dam, the existing access cavity was refined to obtain straight-line access to the root canal system. Canal patency was established using a #10 K-file, and the working length was determined using an electronic apex locator and radiographs.

Because of the broad and irregular canal morphology, minimal mechanical enlargement was performed to preserve the remaining radicular dentin. Circumferential filing was carried out using hand K-files to remove necrotic tissue and debris while maintaining the original canal anatomy. Copious irrigation was performed throughout instrumentation using 3–5.25% sodium hypochlorite along with ultrasonic activation.

Following canal preparation, the smear layer was removed using 17% ethylenediaminetetraacetic acid (EDTA) for one minute, followed by a final rinse with sterile saline. The canal was dried with sterile paper points, and calcium hydroxide intracanal medicament was placed to enhance disinfection. The access cavity was sealed with a temporary restorative material.

At the subsequent appointment, the patient remained asymptomatic. After rubber dam isolation, the temporary restoration and intracanal medicament were removed using copious irrigation with sodium hypochlorite and saline. The canal was dried thoroughly, and master cone adaptation was verified radiographically. Root canal obturation was completed using gutta-percha and an epoxy resin-based endodontic sealer with a warm vertical compaction technique, ensuring a dense three-dimensional seal while preserving approximately 4–5 mm of apical gutta-percha for maintenance of the apical seal.

The access cavity was temporarily restored, and a postoperative radiograph confirmed satisfactory obturation with adequate apical sealing. Owing to the extensive loss of coronal tooth structure and the presence of a broad canal, a customized fiber-reinforced composite post and core restoration followed by definitive full-coverage crown rehabilitation was planned.

A prefabricated glass fiber post was selected according to the canal dimensions. Owing to the irregular and oversized canal, the post was anatomically customized by adapting a layer of composite resin around its surface to closely replicate the internal morphology of the canal. The customized post was tried repeatedly until passive seating with intimate canal adaptation was achieved.

Following satisfactory adaptation, the canal walls were etched with phosphoric acid, rinsed, and gently dried. A universal adhesive bonding agent was applied to the canal walls according to the manufacturer's instructions. The customized fiber post surface was similarly treated with phosphoric acid and bonding agent before cementation.

Dual-cure resin cement was introduced into the canal, and the customized post was seated under firm digital pressure until complete seating was achieved. Excess cement was removed, and polymerization was completed with LED light.

Following post cementation, composite resin was used to perform core build-up, restoring the lost coronal structure and providing adequate support for definitive prosthetic rehabilitation. Tooth preparation for a full-coverage crown was carried out while maintaining appropriate ferrule and finish line design. A final elastomeric impression was made, and the definitive crown was fabricated. During the subsequent appointment, the crown was evaluated for marginal adaptation, proximal contacts, esthetics, and occlusion before being permanently cemented.

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The final restoration demonstrated satisfactory esthetics, proper marginal adaptation, and functional stability.

Discussion

Successful restoration of endodontically treated anterior teeth depends on preserving radicular dentin while achieving reliable post retention.[4] In teeth with excessively enlarged canals, conventional fiber posts often produce thick resin cement layers that are susceptible to polymerization contraction stresses, void formation, and adhesive failure.[5]

The anatomical fiber post technique overcomes these limitations by customizing the post to the canal morphology before cementation. This approach significantly reduces cement thickness, improves adaptation, enhances frictional retention, and provides more homogeneous stress distribution along the root.[2,6] Rather than enlarging the canal to accommodate a larger prefabricated post, the post is customized to the existing canal anatomy, thereby minimizing unnecessary dentin removal and maintaining the structural integrity of the root. This conservative approach is particularly advantageous in structurally compromised teeth where preservation of remaining dentin is essential for long-term prognosis.[7]

The direct composite relining technique for anatomical fiber posts offers several clinical advantages over conventional cast post-and-core restorations. The procedure can be completed chairside in a single visit, eliminating laboratory procedures, reducing treatment time, and improving clinical efficiency[8]. In addition, the use of a prefabricated fiber post relined with composite resin provides a cost-effective alternative to custom-cast posts while maintaining favorable clinical performance [9].

The anatomical post technique also exhibits favorable biomechanical behavior. The elastic modulus of fiber posts and composite resin closely resembles that of dentin, allowing for more uniform stress distribution along the root and reducing stress concentration at the post–dentin interface [10]. Consequently, failures are more likely to be reparable, such as post debonding or fracture, rather than catastrophic vertical root fractures associated with rigid metallic posts [10,11]. Furthermore, customization of the post preserves radicular dentin by eliminating the need for additional canal preparation, thereby enhancing the long-term prognosis of endodontically treated teeth [12].

Composite resin plays a key role in the fabrication of anatomical fiber posts by relining the prefabricated glass fiber post to precisely match the internal anatomy of the root canal. Composite resin contributes to more favorable biomechanical behavior by enabling better stress distribution along the root due to its compatibility with the elastic properties of fiber posts and dentin. Furthermore, its tooth-colored optical properties support superior esthetic outcomes, particularly in the restoration of anterior teeth. In addition, composite resin possesses excellent handling characteristics, allowing it to be easily manipulated and sculpted around the prefabricated fiber post to accurately reproduce the morphology of the root canal. Its moldable consistency before polymerization facilitates precise adaptation.[13]

Recent biomechanical investigations further support the rationale for anatomical post systems in weakened roots. A finite element analysis evaluating a reinforced anatomical post system (RAPS) demonstrated that restoration of enlarged canals using composite resin reinforced with multiple prefabricated composite posts generated stress distributions that more closely resembled those of a natural tooth than conventional post systems. The authors observed that increasing the stiffness of the restorative composite and strategically reinforcing it with multiple fiber posts significantly reduced stress concentrations in the cervical and middle thirds of the root while eliminating apical stress peaks in large and irregular canals.[14]These findings suggest that customized anatomical post systems minimize stress concentration within the remaining radicular dentin and consequently reduce the likelihood of adhesive failure and root fracture.[15]

Although the present case employed a single anatomically customized glass fiber post rather than multiple reinforcing posts, the underlying biomechanical principle remains similar. By adapting the post to the canal morphology instead of enlarging the canal to accommodate a prefabricated post, the restorative complex more closely approximates the mechanical behavior of the natural tooth.[16] Furthermore, the reduction in resin cement volume decreases polymerization shrinkage, minimizes

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interfacial defects, and improves stress transfer across the post–cement–dentin interface.[17]

The findings of Grandini et al.[2] also established the clinical feasibility of anatomically relining fiber posts with composite resin to obtain superior adaptation within irregular root canals. Subsequently, Kumar et al.[6] and Singh et al.[7] demonstrated successful clinical rehabilitation of traumatized maxillary central incisors using customized anatomical fiber posts followed by adhesive cementation and definitive ceramic crowns. The present case corroborates these reports by demonstrating successful restoration of a maxillary central incisor with a broad and irregular canal using a customized composite-relined fiber post luted with dual-cure resin cement. Unlike previous reports, residual gutta-percha during post-space preparation was additionally removed using a heated downpack device following Peeso reamer preparation, resulting in a cleaner post space and facilitating intimate adaptation of the customized post before adhesive cementation.[18,19]

Proper adhesive protocols remain essential for long-term success. Etching and bonding of both the canal walls and the customized post improve micromechanical retention, while dual-cure resin cement ensures adequate polymerization throughout the depth of the canal where light transmission is limited.[20]

The bond between a glass fiber post, resin cement, and root canal dentin is fundamental to the long-term success of post-endodontic restorations. Ideally, these three components form a cohesive "monoblock", allowing stresses to be distributed uniformly throughout the tooth and minimizing the risk of post debonding or root fracture. Bond strength depends on effective adhesion at both the post–cement and cement–dentin interfaces, making proper surface treatment of the fiber post and adequate dentin bonding essential for clinical success. [21]

Glass fiber posts possess an elastic modulus similar to that of dentin, which enables them to flex with the root structure and transfer occlusal forces more evenly than rigid metallic posts. When luted with adhesive resin cements, they provide superior retention and reduce stress concentration within the root canal.[22]

Anatomical customization of the fiber post using composite resin significantly improves adaptation to the canal walls, produces a thinner and more uniform cement layer, and nearly doubles the push-out bond strength compared with conventional prefabricated posts.

In addition to its biomechanical advantages, the customized fiber post technique offers significant esthetic benefits, particularly in the rehabilitation of anterior teeth. Unlike cast metal posts and cores, which can impart a grayish discoloration to the cervical region and compromise the translucency of all-ceramic restorations, glass fiber posts possess optical properties that closely resemble those of natural dentin. Their translucency allows improved light transmission through the restoration, resulting in a more natural shade, enhanced vitality, and superior esthetic integration with adjacent teeth.[23]

Collectively, the available clinical reports and biomechanical evidence indicate that anatomical customization of fiber posts offers significant advantages over conventional prefabricated post systems in enlarged canals. The technique preserves radicular dentin, reduces cement thickness, improves adaptation, promotes more homogeneous stress distribution, and decreases stress concentrations within the root. Although long-term randomized clinical trials remain limited, the current evidence suggests that customized anatomical fiber posts constitute a conservative, biologically favorable, and mechanically sound restorative approach for structurally compromised endodontically treated anterior teeth.

Conclusion

Customized fiber-reinforced composite posts represent a predictable and conservative treatment option for endodontically treated teeth with broad and irregular canals. Anatomical customization improves post adaptation, minimizes resin cement thickness, and enhances the adhesive interface without further weakening the root. When combined with meticulous adhesive procedures, dual-cure resin cement, composite core build-up, and definitive full-coverage crown restoration, this technique offers an effective approach for long-term rehabilitation of structurally compromised anterior teeth along with favourable esthetics.

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Fig 1. Preoperative clinical radiograph with 21

Figure 2. Preoperative CBCT showing irregular flared canal with 21

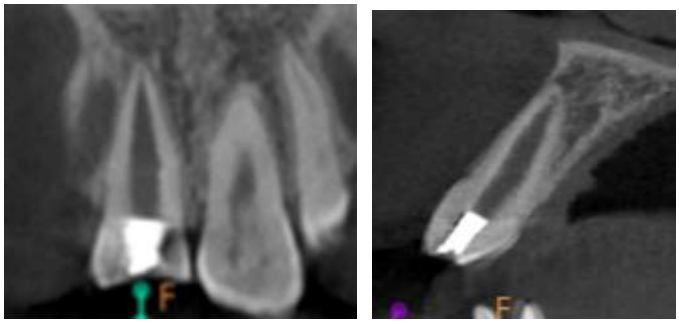

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Figure 3. Access opening under rubber dam isolation

Figure 4. Working Length determination RVG with 21

Figure 5. Master Cone RVG with

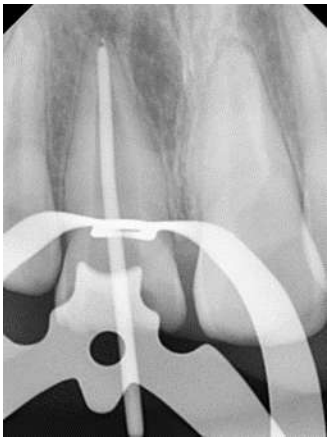

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Figure 6. Post obturation

Figure 7. Post space prepared with 21 with the help of downpack

Figure 8. Composite resin adapted to the canal after treatment of the fiber post

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Figure 9. Post fit checked and RVG taken

Figure 10. Etching of the anatomical post with 37%phosphoric acid followed by application of bonding agent

Figure 11. Anatomical post luted with dual cure resin and core buildup done with composite resin

Figure 12. Post cementation RVG

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Figure 13. Crown preparation done with 21

Figure 14. Impression Taken with 21, cast poured and prosthesis made with 21

Figure 15. Postoperative photograph with 21

Figure 16. Postoperative radiograph with 21

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