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ANATOMICALLY CUSTOMIZED FIBER POST TO RESTORE FLARED ROOT CANALS – A CASE SERIES

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ABSTRACT

Successful outcome of endodontically treated teeth depends on adequate fluid tight seal of the root canal system followed by appropriate post endodontic restoration. There are several methods explained in literature to treat flared root canals which may be caused due to extensive caries, pulpal pathogenesis or iatrogenic mishaps. In all these cases there is a mismatch between post space and the shape of the fiber posts. One of the methods to overcome this situation is to customize the fiber post with composite resin. This method increases the adaptation of the customized post to the root dentinal walls and decreases the resin cement thickness. In this case series, how iatrogenic misadventures were managed by anatomical customization of fiber post has been discussed.

Introduction

Post endodontic restoration has a remarkable impact on the prognosis of endodontically treated teeth. The use of intra-radicular post becomes indispensable in order to support the coronal restoration and to resist crown-root fracture in tooth with greater loss of coronal structure. An appropriate post-core system and a proper coronal restoration will minimize leakage of fluids and bacteria into the root canal space leading to subsequent secondary infection.[1] The post used must have physical properties similar to that of dentin to achieve long term success.[2] Fiber posts are considered as the usual choice as it has physical properties similar to that of dentin.[3] Rathke *et al* (2009) and Balbosh *et al* (2006) have demonstrated the advantages of glass fiber posts (GFP) over other posts.[4,5] The glass fiber posts are recommended in tooth with sufficient coronal tooth structure.[6] The treatment plan is not only based on the material, but also formulated based on the design of the post and the remaining tooth structure that determines the fracture resistance of endodontically treated teeth.[7] Prefabricated cylindrical posts may not be ideal for severely enlarged or elliptical root canals which are commonly encountered by clinicians. In such cases, alternative methods such as anatomically customized fiber post can be considered which might provide better adaptation inside the canal. The following three case reports explain how flared canals were treated with anatomically customized fiber posts.

Case report 1:

A 43-year-old female patient came to the department with the chief complaint of pain in upper front tooth for the past 2 months. Patient revealed a history of decay, associated pain and swelling one year back. On objective evaluation, the tooth did not respond to pulp vitality tests. It was

diagnosed as non-vital with asymptomatic apical periodontitis in tooth number 12.

In the first visit, access opening was done using Endo Access bur (Dentsply, USA) under rubber dam isolation and the canal was explored with DG 16 (GDC, India). The root canal orifice was enlarged using gates glidden drills # 4, 3 (Mani Inc., Japan). Working length of the root canal was determined with a K-file (Mani Inc., Japan) ISO number 10 and confirmed with a radiograph. Biomechanical preparation was done using hand K-files up to size 55 with intermittent irrigation using 30 G irrigating needles with apical opening (NaviTip; Ultradent Products, USA). The irrigants used were 5 ml of 3% sodium hypochlorite (NaOCl) (Prime dental products Pvt, Ltd., India), 5 ml of 17% ethylene diamine tetraacetic acid (EDTA) (Prevest DenPro, India) and 5 ml of 0.9% saline (Fresenius Kabi Private Limited, India). Calcium hydroxide ($Ca(OH)_2$) (Calplus, Prevest DenPro Limited, India) intra-canal medicament was placed for one week to disinfect the root canal. The canal was sealed with temporary coronal restorative material (Cavitemp, Ammdent, India).

On the second appointment, temporary coronal restoration was removed and the canal was flushed thoroughly using 2% Chlorhexidine (CanalPro CHX 2%, Coltene, Switzerland). Paper points (DiaDent, Europe) were used to dry the canal and obturation was done using gutta percha (Diadent, Europe) coated with zinc oxide eugenol sealer (DPI, India) by cold lateral compaction technique. Subsequently after 72 hours, post space was prepared using peezo size #3 (Mani Inc., Japan) leaving 4 mm of intact apical seal. On radiographic evaluation, iatorgenically enlarged and flared post space was detected. (Fig 1A) Hence, we considered anatomically customized fiber post to improve the prognosis of the tooth.

A glass fiber post size #2 (Fig 1B) (Angelus, Europe) was conditioned with 37% phosphoric acid gel (Total Etch, Ivoclar Vivadent, Liechtenstein) for 15 seconds, followed by rinsing and drying. The fiber post was coated with silane coupling agent (Angelus Silano Angelus, Europe) for one minute, and the surface was gently air-dried for five seconds. The two-step etch and rinse adhesive system (Tetric N-Bond, Ivoclar-Vivadent) was applied and light-cured for 10 seconds (Bluephase, Ivoclar-Vivadent). It was further coated with a nanohybrid composite resin (Tetric N-Ceram, Ivoclar-Vivadent), and the whole assembly (fiber post reinforced with composite resin) was inserted into the canal. This procedure was repeated twice and excess cervical resin composite was removed. Radiographic evaluation was done to check the fit of anatomically customised post and curing was completed outside the canal. (Fig 1C and 1D)

Before cementing, the canal was etched with 37% phosphoric acid gel (Total Etch, Ivoclar Vivadent, Liechtenstein) for 15 seconds. The bonding agent was coated into canal and light cured for 20 seconds. A dual cure resin cement (Variolink N, Ivoclar Vivadent) was coated into the root canal space and on the surface of the post. The customized anatomic fiber post was luted and it was light cured for 40 seconds. (Figure 1E) After post cementation, nanohybrid composite was used for core build up.

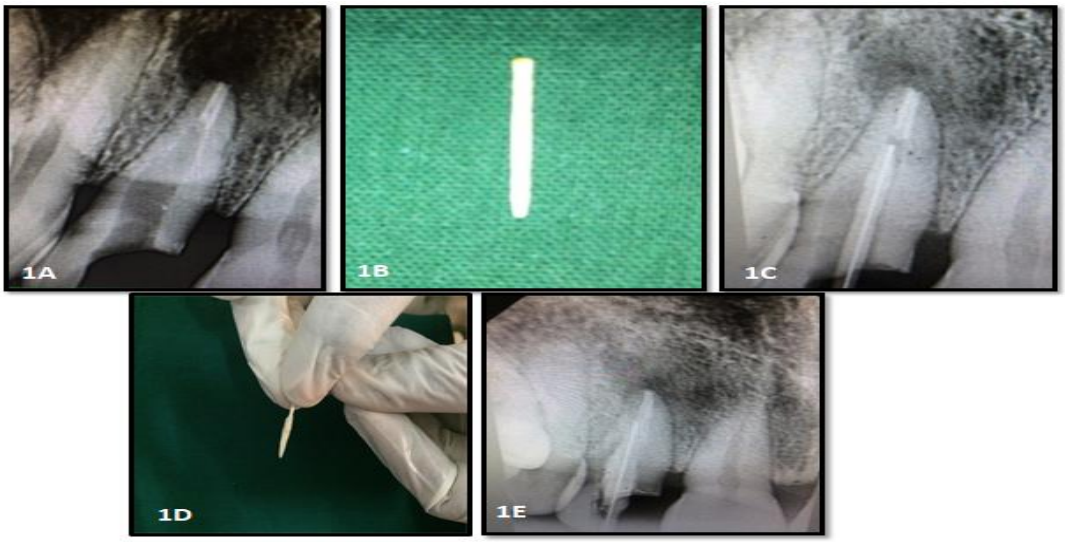

Figure 1: Iatrogenically enlarged root canal space (1A), Glass fiber post size- 2 (1B), Glass fiber post size- 2 was checked for the fit (1C), Anatomically customized fiber post (1D), Post- operative radiograph after luting anatomically customized fiber post (1E)

Case report 2:

A 52 years old male patient reported to the department with a chief complaint of fractured upper front tooth. (Fig 2A) Patient revealed a history of previously root canal treated upper front tooth with no associated pain or swelling. On radiographic evaluation, it was diagnosed as previously treated root canal in 21. On keenly observing the radiograph, it was seen that the canal were excessively wide with poor obturation. Since root canal treatment alone cannot suffice the prognosis of 21, it was decided to custom fabricate the fiber post for better adaptation and prognosis post re-treatment. Post space preparation was prepared using peezo size #3 (Mani Inc., Japan) leaving 5 mm of intact apical seal. Quartz fiber post size #2 was used in this clinical case. (Fig 2B) The customization of anatomic fiber post and cementation procedure was done similar to that of case 1. (Fig 2C and 2D)

Figure 2: Fractured 21 (2A), customized anatomical fiber post (2B), Post-operative radiograph after luting customized anatomical fiber post (2C), Post-operative clinical photograph (2D)

CASE REPORT 3:

A 25 years old female patient presented to the department with the chief complaint of discoloured upper front tooth. The patient revealed a history of trauma in upper front tooth 10 years back. On clinical examination, Ellie's Class III was detected in tooth number 12. Radiographic examination revealed a radiolucency in the periapical region with external root resorption. (Fig 3 A and B). From the vitality tests and radiographic assessments it was diagnosed as non-vital 12 with asymptomatic apical periodontitis. The treatment plan designed for this clinical scenario was to perform root canal treatment with placement of MTA in the apical region followed by anatomic post-core system. On first appointment, access cavity preparation was done in 12 using Endo Access bur (Dentsply, USA) under rubber dam isolation. Working length was determined with a K-file (Mani Inc., Japan) ISO number 10 and confirmed with a radiograph. Cleaning and shaping was done using hand files up to size 55 K files (Mani Inc., Japan). Canal was irrigated using 3% NaOCl and normal saline. To obtain canal disinfection prior to MTA placement, canal was dried with paper points (Dentsply Maillefer, Ballaigues, Switzerland) and $Ca(OH)_2$ (Metapex; Meta Biomed Ltd, Cheongju City, Chungbuk, Korea) was placed. The access was closed with a sterile cotton pellet followed by a provisional restorative material (Caulk, Dentsply, Milford, DE). The patient's appointment was scheduled after 1 week.

In the next appointment, under rubber dam isolation (Fig 3C) the tooth was re-accessed, and $Ca(OH)_2$ was flushed. MTA plus (Prevest Denpro Limited, India) was mixed according to manufacturer's instructions and 3mm apical plug was placed with a fine-tipped MTA carrier. (Fig 3D). A sterile cotton pellet moistened with sterile water was placed over the orifice and the access cavity was sealed with a temporary restorative material (Caulk, Dentsply, Milford, DE) (Fig 3E)

In the following appointment, a size #2 glass fiber post was selected (Angelus, Europe) and was treated with silane coupling (Angelus Silano, Angelus, Europe) agent for 1 minute. Resin composite, (Tetric N Ceram, Ivoclar Vivadent, Liechtenstein) was then coated over the post and inserted into the canal adapting it precisely to replicate the canal anatomy. (Fig 3F) Radiograph was taken to check the fit of the customized post to the canal. (Fig 3G) The custom-made post was then cured outside the canal for 20 seconds. (Fig 3H) Prior to cementation of post, the canal was etched with 37% phosphoric acid gel (Total Etch, Ivoclar Vivadent, Liechtenstein) for 15 seconds followed by rinsing and drying the canal. The bonding agent was coated into canal and light cured for 20 seconds. The canal and the post surface was coated with a dual cure resin cement (Variolink N, Ivoclar Vivadent) and light cured for 20 seconds. After cementation core build up was done with nanohybrid composite and post-operative radiograph was taken (figure 3I).

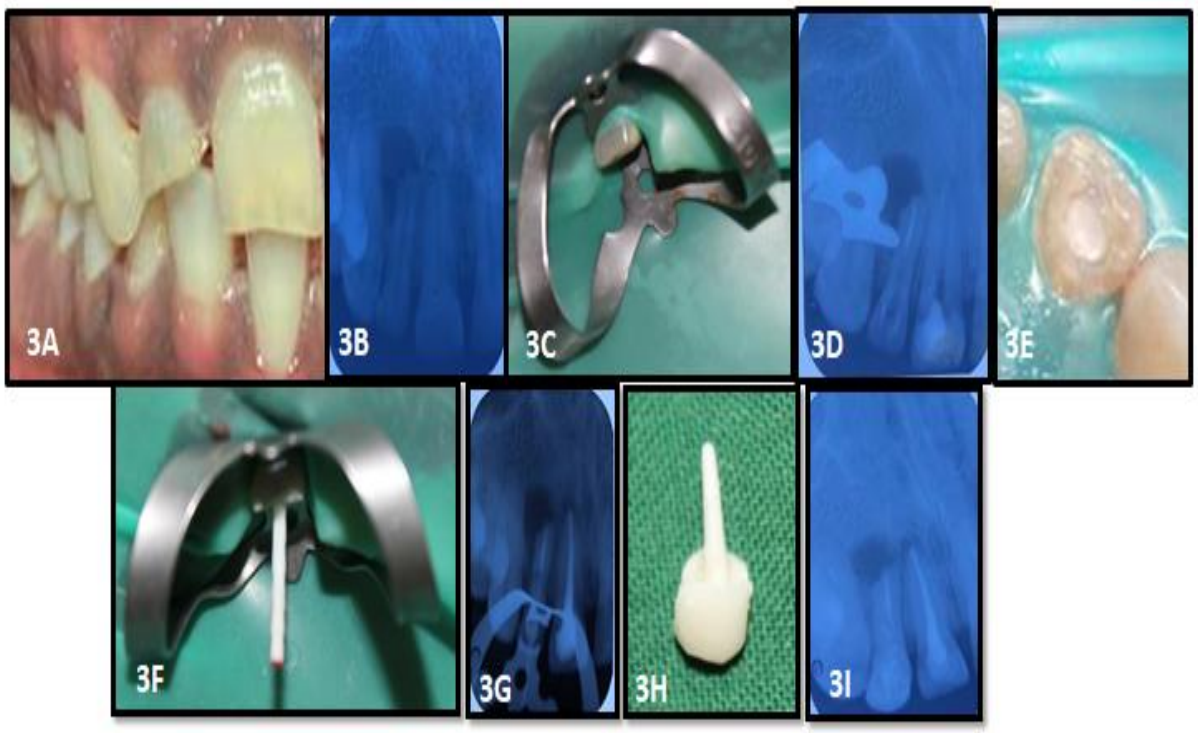

Figure 3: Pre-operative clinical photograph (3A), Pre-operative diagnostic radiograph (3B), rubber dam isolation in 12 (3C), Radiograph showing 3mm MTA plug (3D), Temporary coronal seal established with IRM (3E), Clinical photograph of size 2 fiber post (3F), Radiograph view showing the fit of the post (3G), Aesthetic anatomic post and core assembly after extra oral curing (3H), Radiographic view after post cementation. (3I)

Discussion:

Restoration of endodontically treated teeth is a controversial subject and a challenge because of the range of opinions presented by dentists and scientists, which makes it difficult to select the most appropriate restorative option.[8] Determining best restorative plan following endodontic therapy requires good understanding of tooth anatomy, physical and biomechanical properties, and a sound knowledge of endodontic, periodontal, restorative, and occlusal principles.[9]

According to the concepts of minimally invasive dentistry, pursuing the criterion of maximum preservation of remaining sound tooth structure to

increase resistance, direct adhesive composite restorations are considered a valid option for treatment. This minimally invasive approach for root- filled teeth has become a valid choice due to the good quality of bonding adhesive systems on enamel and dentin and the high-performance properties of resin composite materials.[10]

A favourable occlusal design that withstands various occlusal loads is very important factor for long-term prognosis of endodontically treated teeth. Bonded intra-coronal restorations are foremost choice for restoring endodontically treated teeth with normal functional occlusal load and minimal loss of tooth structure. Newman *et al* (2003) compared the fracture resistance of two GFP containing different weight percentages of glass fibers. The GFP has been reported to exhibit high fatigue strength, high tensile strength, and a modulus of elasticity closer to dentin.[11]

In a study done by Jayasenthil A *et al* (2016) stated that post design that has good fracture resistance and produces least damage the tooth is preferred over the post that has maximum fracture resistance and damages the tooth when the post fails.[12] Reinforcing of composite to the fiber post are reported to have modulus of elasticity closer to dentin.[13,14] In a study done by Sundaresan *et al* (2019), it was observed that the glass fiber posts should be etched with 5% hydrofluoric acid and treated with silane coupling agent before applying bonding agent for a better bond strength between composite and the GFP.[15]

In clinical scenario, dentist occasionly encounter overly prepared or large canals. In such cases the prefabricated fiber post might not be in close adaptation to the canal walls. Large space between the prefabricated post and the canal wall will lead to thickened cement line which would cause displacement of post.[16] Kremeier *et al* (2007) demonstrated that thick layers of luting material will produce more shrinkage strain, creating more stress during polymerization which in turn reduces the bond strength. In such cases anatomically customised fiber post can be used. The advantage of customized post is that it adapts more closer to the canal with a thin layer of the resin cement in between. [17] The polymerization shrinkage will be least as the resin cement used is minimal. The anatomically fabricated post tends to increase the hydraulic pressure which is exerted on the cement against the dentinal walls, resulting in better contact between the customized post and the dentin.[18,19] This pressure reduces blister formation in the cement which increases better penetration of resin into demineralized dentin. Hence it produces in uniform hybrid layer, with greater resin tags.[20] This case series is in accordance to a study done by Rocha AT *et al* (2017) who stated that the customized anatomical post showed greater bond resistance and a more uniform cement layer.[21]

The reduced amount of resin and maximum bulk of anatomically fabricated post provides a monoblock. In case report 3, MTA apexification was carried out because it forms an impervious osteoconductive apical barrier with antimicrobial properties and acts as an obturation itself.[22] The fabrication of customized posts depends on the volume of core, the size of the canal and the surface area of post bonding to the canal. This is because flared canals allow the placement of composite reinforced fiber post.[11] Cross-sectional area at the post-core junction will be wide and customized post may lead to increased strength of the post-core systems.[23]

In all the three cases, the patients had an overly widened root canal space, which benefitted for the use of customized post. This provides an effective and minimally invasive restoration with a successful clinical outcome. Another advantage of customized posts is the ability to save tooth structure and increase the longevity of restorations at a lower cost. [24] This technique is relatively easy as only a few additional steps are required beyond those needed to conventionally lute a fiber post. It can be applied for direct as well as indirect techniques of aesthetic restorations with the aim of increasing the bond strength between the post-root interface and minimizing the risk of fractures commonly observed with cast-metal posts.

Conclusion:

These case series illustrate the simplicity of custom fabrication of glass fiber posts. It is a viable alternative to multiple posts placement and cast posts fabrication in coronally widened irregular canal.

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