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Case Report

Various applications of fibers in Endodontics

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ABSTRACT

Fiber reinforced composites are bondable, biocompatible, aesthetic, translucent and easy-to-use in clinical practice. They have various applications in clinical dentistry due to their wide spectrum of intended properties. Composite is an better esthetic material which has an inherent problem of bulk fracture where cohesive failure occurs within the restorative material. When fibers are incorporated with composites they enhance the cohesive strength and thereby prevents bulk fracture.Some of the fibers which are commonly used in reconstruction procedures in operative dentistry and endodontics are polyethylene fibers, quartz glass fibers, carbon fibers and aramid fibers. This case report enumerates usage of Fiber reinforced composites as an endodontic post and cores material. It can be used as an alternative to conventional treatment in dentistry.

1. Introduction

Composite resin is an esthetic, biocompatible, direct restorative material with proven clinical longevity and predictable success. The fracture resistance of conventional composite material is inadequate to rehabilitate grossly destructed tooth structure. In order to strengthen these composite materials various measures are attempted. One such innovation which has made composites stronger thereby widening the clinical application is fiber reinforcement.[1] These fibers are biocompatible, having high fracture toughness, flexiblity and has better bonding. Application of these fibers has become inevitable as they provide a definitive success of the procedure with predictable longevity. Some of these fibers are commonly used in reconstruction procedures in operative dentistry and endodontics are polyethylene fibers, quartz glass fibers, carbon fibers and aramid fibers. Treatment options with fibers extends from restoring a deep caries to replacing a missing tooth with the help of fibers. The association between fibers along with composite resin restoration makes an excellent team for definitive restorative procedures. This report of two cases highlights various restorative and reconstructive procedures carried with the aid of fibers in operative dentistry and endodontics.

2. Case Report 1

A 30 year old female patient visited the Department of Conservative dentistry and Endodontics with a chief complaint of decayed tooth in the lower front tooth region for past 3 years. Medical history were non contributory. On clinical examination grossly destructed young permanent tooth with caries involving both mesial and distal aspect was seen in 31,41,42. [Figure 1a,b,c] On radiographic examination, radiolucency involving enamel, dentin and pulp was seen with widening of PDL space. [Figure 2a] Ellis class III is a finding and diagnosed as irreversible

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pulpitis and decided to do root canal treatment followed by full coverage restoration in 31,41,42. Treatment plan was explained and informed consent was obtained from the patient. After administration of local anesthesia rubber dam application was done. Caries was excavated. Access cavity prepared and working length was determined. After copious irrigation, the root canals were cleaned and shaped using Protaper universal rotary system upto F1. Master cone was selected and obturation was done. [Figure 2c] Post space was prepared with Size 2 Peeso reamers. [Figure 2d] For each canal, a post (Interlig, Angelus Brazil) of corresponding size is trial fit and adjusted to a distance of 6 mm into the canal and 3 mm outside the canal. Any excessive length of the post was cut with the help of a scissor. Then the root canal was acid etched with 37% phosphoric acid gel, rinsed, dried and coated with a dentin adhesive. Flowable composites was injected inside the prepared post space and a glass fiber post was inserted into the canal and light cured according to the manufacturer's instructions. [Figure 2d] The coronal portion of the fiber was completely covered using resin composite. [Figure 2e] After checking the occlusion and the removal of any interference, crown

Fig. 1: a: Clinical images of 31,41 in occlusion; **b:** Frontal view; **c:** Lingual view; **d:** Interlig fibers luted with flowable composite; **e:** Composite core build up done after root canal treatment; **f:** Zirconia crowns cemented after root canal treatment.

3. Case Report 2

A 23 year old female patient visited the Department of Conservative dentistry and Endodontics with a chief complaint of broken tooth in the upper front teeth region before 1 month. Medical history was non-contributory. On clinical examination, there was fractured anterior tooth with pain and tenderness on percussion in 11. [Figure 3a,b] On radiographic examination, loss of tooth structure with exposure of pulp was seen with widening of PDL space. [Figure 4a] Ellis Class III is a finding and diagnosed as pulp necrosis and decided to do root canal treatment. Treatment plan was explained and informed consent from the patient was obtained. After administration of local anesthesia, rubber dam application was done. Caries was excavated. Access cavity prepared and working length was determined.[Figure 4b] The root canals were cleaned and

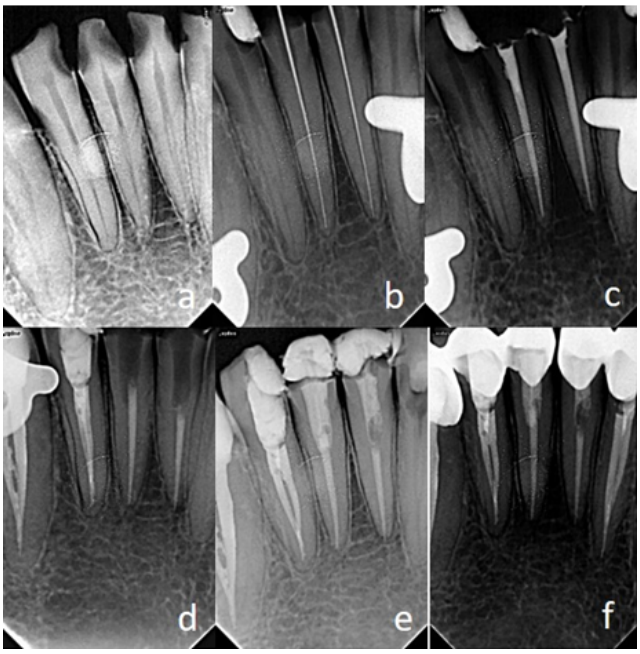

Fig. 2: a: Preoperative radiograph of 31,41; **b:** Working length determination; **c:** Obturation done; **d:** Post space prepared; **e:** Interlig fibers luted with flowable composite followed by composite core build up done after root canal treatment; **f:** Zirconia crowns cemented after root canal treatment.

shaped using Protaper universal rotary system upto F3 with copious irrigation with 3% NaOCl. Master cone was selected and obturation was done. [Figure 4c] Post space was prepared with Size 2 Peesoreamers. [Figure 4d] Then polyethylene fiber was taken and measured and cut and is trial fit and adjusted to a distance of 9 mm into the canal and 3 mm outside the canal. Then the root canal was acid etched with 37% phosphoric acid gel, rinsed, dried and coated with a dentin adhesive. Flowable composites was injected inside the prepared post space and preselected fiber is placed as root canal post and light cured according to the manufacturer's instructions. [Figure 3c, Figure 4e] The coronal portion of the fiber was completely covered using resin composite. The coronal restoration was finished and polished using Super Snap polishing system. [Figure 3d]

4. Discussion

Fiber reinforcement can be a alternative treatment stratergy to prosthesis when they are not recommended in scenarios like before the completion of growth period, high cost prosthesis, requires osseous and soft tissue surgery to attain maximum esthetics, treatment time makes their use limited.[2]

These fibers are available as Unidirectional fiber (FibreKor), Braided (Interlig) and woven (Ribbond) fibers based on their arrangement.[1]

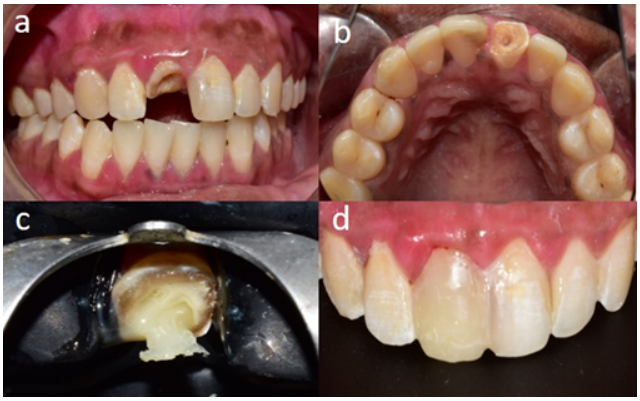

Fig. 3: a: Preoperative photograph - Frontal view; **b:** Occlusal view; **c:** Ribbond fiber luted with flowable composite; **d:** Composite core build up done after root canal treatment.

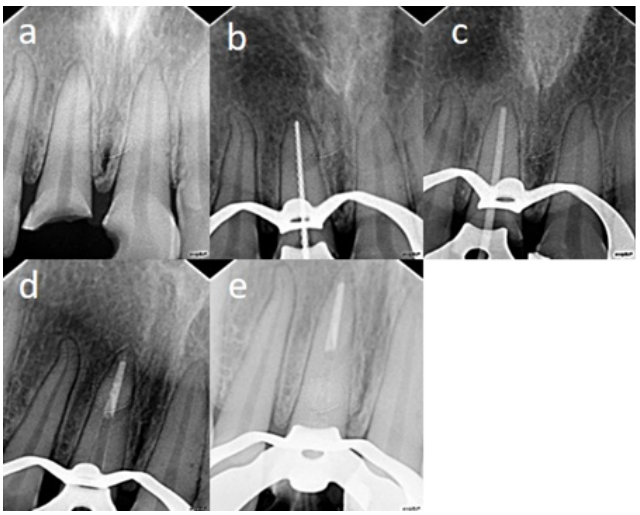

Fig. 4: a: Preoperative radiograph of 11; **b:** Working length determination; **c:** Master cone selected; **d:** Sectional obturation done; **e:** Ribbond fibers luted with flowable composite.

Interlig is a braided glass fiber impregnated with light-cured composite resin. These fibers are biocompatible, esthetic, translucent and colorless and merges within the composite without show-through.[3]

Polyethylene fibers composed of plasma treated ultra-high molecular weight polyethylene woven fibers into three dimensional structure, leno wave or triaxial braid. Higher mechanical interlocking is provided because of their special patterns of cross-linked threads. To ensure this fiber has good chemical bond to resin materials they are cold gas plasma pretreated to reduce the fibers superficial tension. During manipulation these fibers does not spread or fall apart they have dense network of locked-stitched threads preventing these fibers from shifting during manipulation and adaptation before polymerization. These fibers can be bent to sharp angles and woven to obtain tight mechanical interlocking from one thread to another.[4] This lock-stitch feature effectively transfers forces throughout the weave without transferring stress back into the resin.[5]Besides the cracks stops at the node of the leno-lock-stitch weave of the fiber ribbon thus helps in maintaining the integrity of the fiber reinforcement.[6] Ribbond can be adapted to the contours of the teeth and dental arch as they do not have virtual memory.[5]

Composites that are reinforced with polyethylene fibers can result in materials with enhanced properties like stiffness, strength, toughness and less fatigue.[7]Even if trauma occurs in tooth where the fibers have been used to reinforce the root, these fibers will produce a load-enhancing effect on the brittle composite materials by acting as the stress-bearing component and provides a crack-stopping or crack-deflecting mechanisms.[8]

These fibers have high resistance to stretch, distortion and traction that allows them to adapt closely to the contours of the root canal and to properly condense, increasing the content of individually made endodontic post thus decreasing the luting-agent thickness and consequently its polymerization shrinkage.[9,10]

High fatigue resistance, Low elastic modulus similar to that of dentine which is 18-42 GPa, chemically inert, non-toxic, Excellent light conductivity they can be cemented with dual-cure resin cements, Fiber posts translucency give them excellent esthetic, Fiber reinforced post is bonded within the root canal it dissipates functional and parafunctional forces reducing the stress on the root.[11]

Survival rate of fiber post is 3 to 9 years than metal post in restoration of endodontically treated teeth with fewer than two coronal walls remaining.[12]

5. Conclusion

In this case report various fibers application has been emphasized including its advantages and its applications in dentistry. The case selection, type of fibers used, bonding mechanism plays an vital role in the success of treatment as well as the longevity of the restoration.

6. Conflict of Interest

The authors declare no relevant conflicts of interest.

7. Source of Funding

None.

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