Case Report

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Modern Day Endodontics with Root Canal Treatment and Fibre Reinforced Composite Core Built up as a Means of Avoiding Crown Placement in a Single Appointment – A Case Report

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ABSTRACT

Single visit root canal treatment option is recently considered to be best for irreversible pulpitis and aymptomatic apical periodontitis cases. Also when gross coronal tooth structure has been destroyed by caries, post enodontically it is important to give a restoration which would reinforce the remaining tooth structure and resist fracture against heavy occlusal loading. So, in this particular case, single visit root canal treatment was opted and fibre reinforced nanohybrid composite system was used for reinforcing the coronal tooth portion. Follow up of 2 years showed no signs of any fracture of the crown portion without any symptom related to the root canal treatment.

Keywords: Nanocomposites, Polyethylene fibres, Root canal preparation, fracture, Tooth crown.

INTRODUCTION

Recently, the significance and trend of single visit root canal treatment has come up with great success with insignificant differences from multiple visit treatment when apical periodontitis is concerned. The quest for an effective scientifically supported one-visit procedure has been approached from principally two angles: (1) the exclusion of an antibacterial intra canal dressing and thereby preventing any microleakage between appointments through the temperory restoration; and (2) convenient for the patient as the cumbersome treatment finishes in single visit.

Also most of the recent studies show that no significant differences in periapical healing rates and post-operative pain is present in single versus multiple visit root canal treatments.

It has also been proven that it is logically sound to do single sitting root canal treatment in irreversible pulpitis and asymptomatic apical periodontitis cases avoiding complications of multiple appointments as discussed earlier.

The development of fibre-reinforced composite (FRC) technology has led to substantial improvement in the flexural strength, toughness and rigidity of dental resin composites. In recent times, fibre splint has found itself a role in post systems but till date very few research have been carried out for its use in grossly destroyed teeth as core built up. Few in-vitro studies that have been carried out in past 8-10 years show the favourable mechanical properties of using fibres in restorative dentistry. Both glass as well as polyethylene fibres are used for the purpose. In this study we have used polyethylene fibres owing to its high modulus of elasticity property. Thus, purpose of the case report was to minimize the complications of the multiple visit appointments and maximize the advantage of fibres as post endodontic restorative material for strengthening the weakened crown structure.

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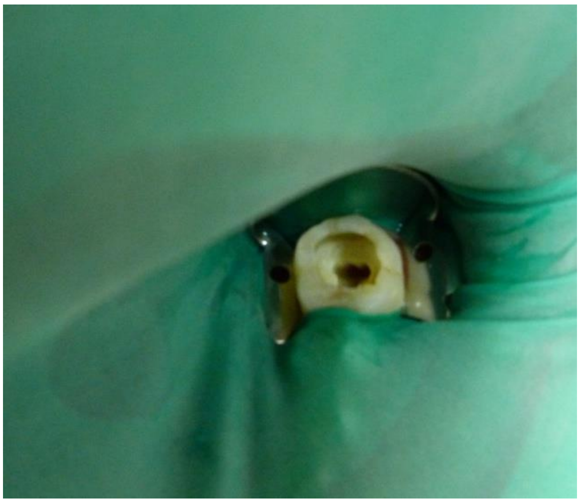

Fig 1A: Grossly destructed coronal tooth structure.

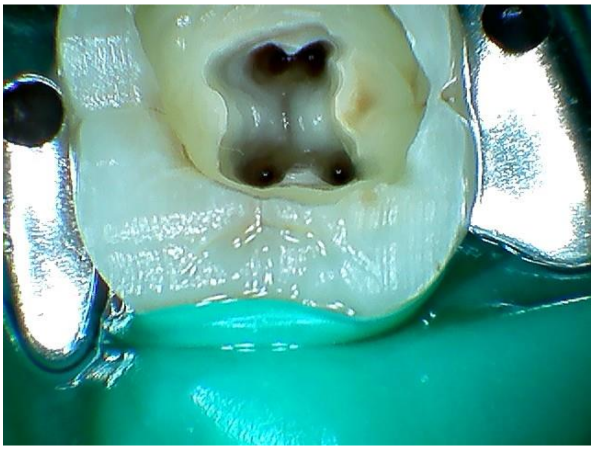

Fig 1B: Close-up view taken by intraoral camera after cleaning and shaping of the canals isolated under rubber dam

Fig 2A: Clean debris free tooth structure ready to undergo restoration

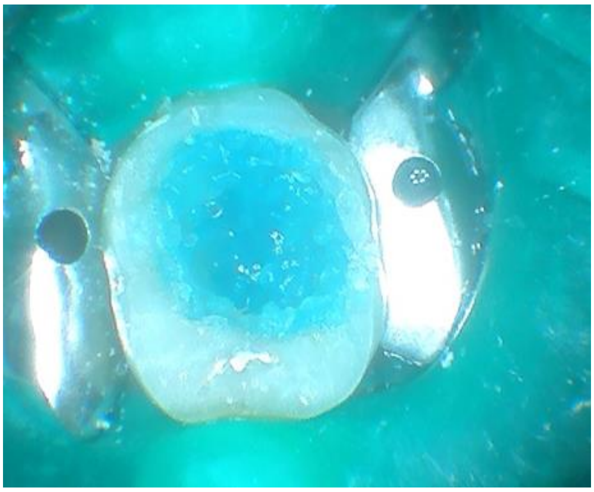

Fig 2B: Application of etchant gel.

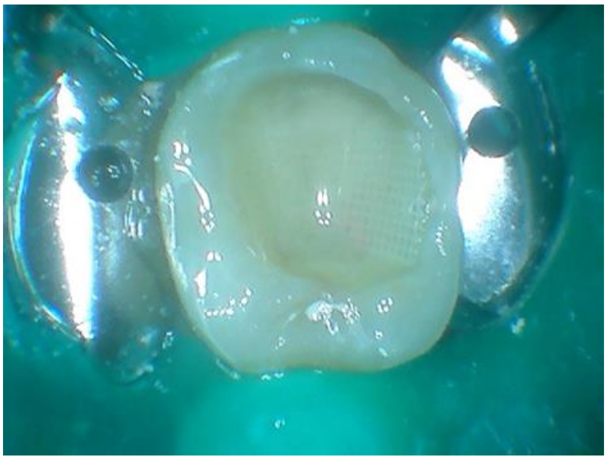

Fig 3A: Placement of polyethylene fibre (U-shaped) bucco-lingually.

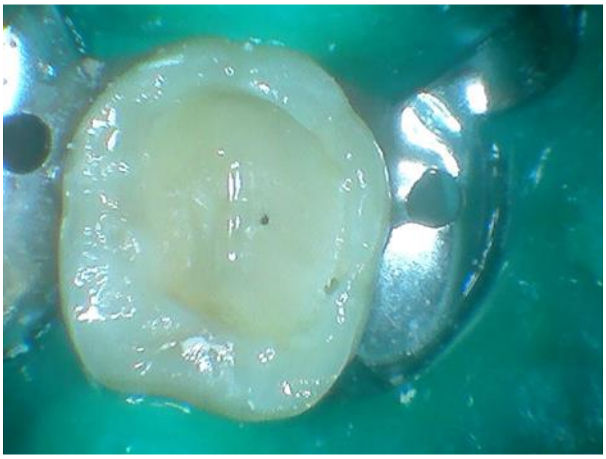

Fig 3B: Incremental layers of nanoceramic composite placed over the fibre layer.

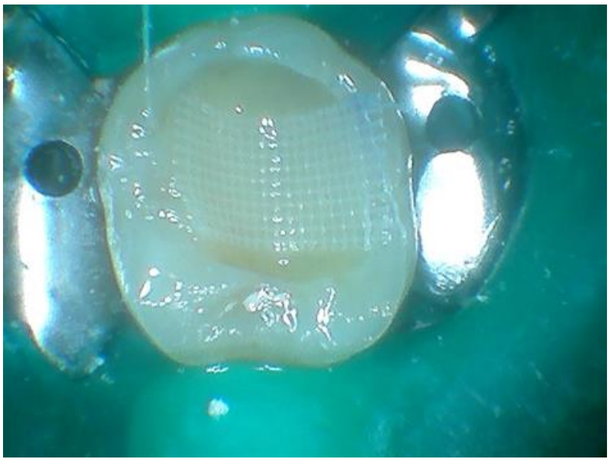

Fig 3C: Shows the placement of polyethylene fibre (U-shaped) bucco-lingually.

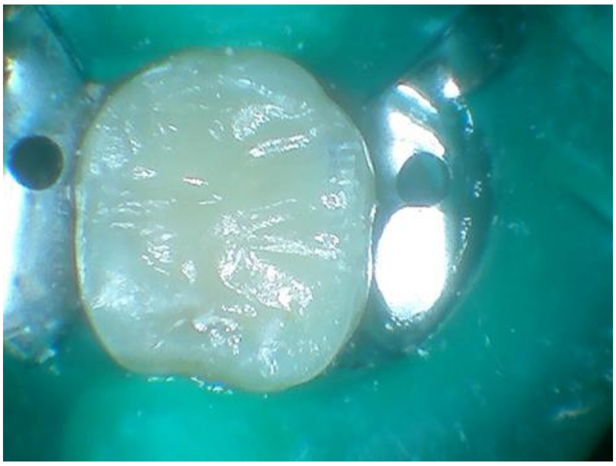

Fig 3D: Finished and polished restoration.

Fig 4: IOPA showing completed treatment.

CASE REPORT

A 20 years old female came to our department (Karnavati School of Dentistry, Uvarsad) with chief complain of sensitivity to cold and hot liquids in lower back teeth region since 2 weeks that lasted for 10 to 15 minutes. Intra oral periapical radiograph was taken and showed signs of apical periodontal ligament widening suggesting of irreversible pulpitis. So the decision was made to do single sitting Root canal treatment in 36. The crown structure destruction was as shown in figure 1(A, B).

Rubber dam was placed, access opening done, working length taken, biomechanical preparation was done manually with hand K-files, master cone radiograph was taken and canals were obturated. Next thing was the post-endodontic restoration.

As when remaining crown structure is less for resisting masticatory forces when in function and also as the patient was young, decision was made to use fibre reinforced composite restorative system to reinforce the remaining crown structure to increase resistance against fracture and improved long term prognosis of the core structure.

Polyethylene fibre spint (Ribbond, Seattle, WA) was used along with nanohybrid packable – Tetric N Ceram (Ivoclar vivadent, AG, FL, Schaan) and flowable – Tetric N Flow (Ivoclar vivadent, AG, FL, Schaan) composite restorative material. Bonding agent used was of the same manufacturer.

Restoration Procedure

After completion of obturation and coronal sealing, the tooth was made completely clean so that none of the sealer or gutta percha is adhered to the floor (figure 2A). Next, etching for 20 seconds was done using 36% phosphoric acid (figure 2B), then rinsed with water for 10 seconds, air dried keeping in mind not to overdry, Tetric Bond bonding agent was applied next and then polymerized using 550 mW LED light (Ledition, Ivoclar vivadent).

Then a piece of polyethylene fibre (Ribbond, Seattle, WA) was cut approximating the width of cavity buccolingually which was about 1 cm. Next the fibre was made wet in the bonding agent, the same time flowable composite was applied onto the bonded tooth, immediately the fibre was placed onto it and tugged into 'U' shape buccolingually as shown in the figure 3(A,B) and then polymerized. Next, incremental layering technique was used to fill the remaining coronal structure with nanohybrid packable material.

Again, a piece of fibre was placed below the most superficial layer of composite as shown in figure 3C. Follow up of 2 years has been done with no pain or removal or fracture of the coronal restoration.

DISCUSSION

Fibre reinforced composites were introduced in 1960s. Fibres act as crack stoppers and enhance the property of composite. The resin matrix acts to protect the fibre and fix their geometrical orientation. Boron oxide, a glass forming agent is present at 6-9 wt% in E-fibres and <1wt% in S-fibres. E-fibres and S-fibres are the most commonly used in dentistry[1].

It was hypothesized that the addition of FRC to the composite would provide an increase in enamel/resin bond strengths. This was thought on the notion that the presence of the glass or polyethylene network would create a change in the stress dynamics at the enamel/ composite/adhesive resin interface. This could then create an environment in which crack initiation and propagation would be less favorable than in the control, where no FRC was present[2, 3].

The tensile modulus of elasticity of polyethylene fibers is higher, but the flexure modulus and flexure strength are lower than for S-glass fibers.8 The higher modulus of elasticity and lower flexural modulus of the polyethylene fibers may have a modifying effect on how the interfacial stresses are developed along the etched enamel/resin boundary[4,5]. Kahler et al showed that composite resins have mechanical properties comparable to that of intact sound teeth.[6] However, polymerization shrinkage of composite resins is a major clinical concern, since residual stresses are incorporated into the restored tooth. These stresses have the potential to deform cusps, propagate enamel fractures, and introduce microleakage[7]. Composite resins with a high Young modulus exhibit lower cusp movements under occlusal loading[8] and better tooth protection from fatigue associated with occlusal or thermal loading. Studies[9] showed that the nanoceramic composite restorative material showed reduced shrinkage and the best modulus and hardness values compared to other materials, which could explain the comparable results in the group of teeth restored with nanoceramic material and the nanofilled group.

Also, fibers replace part of the composite, resulting in a decrease in the overall volumetric contraction of the composite and blunt the crack and can act as a barrier to crack propagation and decreasing the shrinkage stress[10,11]. It has been reported that shear bond strength of resin composite to fiber reinforced substrates depends on the load to fiber direction, and it is higher when the load direction corresponds to the fibers direction[12]. So, a reason for the higher fracture resistance in the fiber insert group seems to be the buccal-lingual fiber orientation with the same direction of the applied load which has a splinting effect on the proximal walls in order to prevent separation of cusps under occlusal loading. According to the anisotropic character of the fibers, this kind of orientation permits maximum loading[13, 14].

A ribbon reinforcement material, Ribbond, (Ribbond Inc., Seattle WA) has been available commercially since 1992. This material is composed of pre-impregnated, silanized, plasma treated, leno-woven, ultra high molecular weight (UHMW) polyethylene fibres. Leno-weave is a special pattern of cross linked, locked-stitched threads which increase the durability, stability and shear strength of the fabric[15]. The open and lace like architecture of the leno-woven ribbon allows it to adapt closely to the contours of the teeth and dental arch. The dense network of locked nodal intersections of the material reduces the potential for damage to the fabric architecture by preventing the fibres from shifting during manipulation and adaptation before polymerization. The material has a three dimensional structure due to the leno weave or triaxial braid. These features provide mechanical interlocking of the resin and composite resin at different planes, thereby enabling a wide processing window. In addition, microcracking is minimised during polymerization of the resin[16, 17].

When a composite sample without fibre reinforcement is placed in a flexure, cracks appear on the tensile face and, due to the brittleness of the material, rapidly propagate causing failure. When a fibrous ribbon is placed in the composite resin, the fibres serve as crack stoppers and toughening agents and they provide a set of interfaces that prevent rapid crack growth. Minor cracks that do occur are constrained within areas subtended by interwoven fibres which then restrict their growth to small dimensions[18]. Once the crack reaches the plane of the fibrous reinforcement, its forward path is blunted and it propagates along the weaker interface causing it to change direction. The use of UHMW reinforcement polyethylene fibres in polymethyl methacrylate-based provisional restorations prevents major crack propagation and this therefore becomes an effective method for the reinforcement of interim restorations[19, 20].

During the restoration of teeth, there can be appreciable loss of tooth structure including anatomic features such as cusps, ridges and the arched roof of a pulp chamber. As this loss could weaken the tooth, preservation of tooth structure is important for protection under occlusal loading. Unlike amalgam, bonded composite restorations usually strengthen the tooth. However, polymerization shrinkage remains a problem in extensive direct restoration with composites[21,22]. Modifications that would reduce or eliminate the interfacial stress concentration within the composite restoration may increase the bond strength by increasing the force required to create and propagate a crack through the interfacial composite/adhesive bonding resin complex. The layer of collagen fibrils densely packed with resin may act as an inherent elastic buffering mechanism to compensate for the polymerization contraction of the restorative resin[23,24]. The hybrid layer provides a stress modifying effect under composite or ceramic restorations[25,26.]

Belli et al evaluated the effect of fibres in fracture resistance of root canal treated teeth and showed that use of polyethylene fibres at the bottom and upper part of MOD cavities had a significant effect in increasing fracture strength of the specimens.

Until now, there is no such in vivo study showing the efficiency of such a post endodontic restoration which would be sufficiently strong enough to hold the coronal structure delaying the need of full cast crown and thus avoiding its various complications related to the margins and the surrounding periodontium in long run.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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