

CASE REPORT

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Endodontically treated teeth with fiber-reinforced composite resins: A case series

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India**Abstract**

Restoration of structurally compromised endodontically treated teeth presents a great challenge due to associated high risk of fracture compared to vital teeth. The conventional invasive restoration techniques with a cast post and core followed by coronal prosthesis increase the risk of tooth fragilization and root fracture. To avoid this, a new alternative to reinforce structurally compromised posterior teeth with the use of fiber-reinforced composites has been developed, so as to replace dentin, improvise strength, and provide biomimetic restoration of teeth thereby alleviating the need of extensive prosthetic needs. The following case series elaborates the technique of reinforcing endodontically treated teeth with two different fiber-reinforced composites.

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Available from: <https://www.jdr.org/text.asp?2022/9/4/310/369584>**Full Text****Introduction**

The success of endodontically treated teeth depends on various aspects, among which coronal restoration plays a crucial role in determining prognosis of these teeth. Coronal destruction due to caries, restorations, and during access cavity preparation predisposes to dentine loss and the weakening of the pericervical dentine during root canal therapy.[1]

The fracture resistance of teeth is governed by three critical determinants, i.e., cavity depth, isthmus width, and configuration.

[2] In one study,[3] it was reported that endodontic access cavity combined with an mesio-occlusal-distal preparation results in maximum tooth fragilization by decreasing its fracture resistance to 69%.[2]

Bonded restorations like resin composite though have an ability to regain lost fracture resistance of teeth by providing an internal splint, their application in restoring large cavities has been controversial. This could be attributed to insufficient toughness, low flexural strength, polymerization shrinkage stress (2%), and lack of crack arresting ability.[4]

To overcome the above drawbacks, fiber-reinforced composites such as polyethylene ribbon and glass fiber-reinforced composites (FRCs) were introduced, which were known to increase fracture strength and marginal integrity of posterior stress-bearing endodontically treated molars, with decreased microleakage.[4] Some of the commercially available products are Ribbond (Ribbond Inc., Seattle, WA, USA), everX Posterior (GC Europe, Leuven, Belgium), everStick Post 0.9 mm (Stick Tech oy, GC member, Turku, Finland), and Interlig (Angelus).

The following case series describes a conservative approach in management of structurally compromised endodontically treated teeth with fiber-reinforced composites.

Case Series

Case report 1

A 25-year-old male patient reported to the Department of Conservative Dentistry and Endodontics of Mahatma Gandhi Dental College with a chief complaint of pain in the region of the mandibular left first molar for 5–6 days. Clinical examination revealed excessive coronal tooth destruction involving both marginal ridges [Figure 1]a. Diagnostic radiograph revealed a widening of periodontal ligament #36 [Figure 1]b. Based on clinical and radiographic findings, a treatment plan was made to initiate endodontic therapy and reinforce compromised tooth structure with fiber-reinforced composite (everStick).[Figure 1]

Endodontic therapy was initiated. The working length was determined with 10K file (Dentsply Maillefer, Switzerland) [Figure 1]c, following which cleaning and shaping was performed in crown-down technique by 25%–4% with Hyflex CM rotary files (Coltene/Whaledent, Mumbai, India). Master cone fit was checked subsequently, and root canals were obturated with respective gutta-percha (Coltene/Whaledent, Mumbai, India) with AH Plus resin-based root canal sealer (Dentsply Maillefer, Ballaigues, Switzerland) [Figure 1]d.

To reinforce remaining tooth structure, everStick Post 0.9 mm (Stick Tech oy, GC member, Turku, Finland) was chosen [Figure 1]e. Adhesion procedure was attained in sequential steps involving pretreatment of tooth surface with 36% phosphoric acid (Conditioner 36, Dentsply DeTrey) for 10s, thorough water spray, and brief blot drying. This was followed by 2-coat application of the total-etch bonding agent (Prime and Bond NT, Dentsply Caulk, Milford, DE, USA) and light curing for 10s. Subsequently, the first increment of flowable composite was placed, which was light-cured for 15s, following which everStick was compacted into the cavity incrementally in mesiodistal direction and was light cured for 20s. The second layer of resin was placed incrementally, following composite (Filtek Z350 XT, 3M ESPE, Germany) was used as a final increment layer so as to ensure coronal seal [Figure 1]f, [Figure 1]g, [Figure 1]h. Final finishing and polishing of the restoration were completed, and postobturation radiograph was taken [Figure 1]i.

Case report 2

A 27-year-old male patient reported to the Department of Conservative Dentistry and Endodontics with a chief complaint of pain in the region of the maxillary left second molar for 2 months. Clinical examination revealed deep proximal caries involving both marginal ridges [Figure 2]a. Diagnostic radiograph revealed widening of periodontal ligament irt #27 [Figure 2]b. Based on the clinical and radiographic findings, a treatment plan was made to initiate endodontic therapy and reinforce compromised tooth structure with fiber-reinforced composite (Interlig Angelus).[Figure 2]

Endodontic therapy was initiated. Working length, cleaning and shaping, obturation, and fiber reinforcement protocols were followed as described in case 1 [Figure 2]c, [Figure 2]d, [Figure 2]e, [Figure 2]f, [Figure 2]g, [Figure 2]h, [Figure 2]i.

Case report 3

A 30-year-old female patient reported to the Department of Conservative Dentistry and Endodontics with a chief complaint of pain in the region of the mandibular right second molar, for which emergency access opening was performed 1 week prior. Clinical examination revealed excessive coronal tooth destruction [Figure 3]a. Diagnostic radiograph revealed a periapical radiolucent lesion around the mesial and distal root of tooth #47 [Figure 3]b. Based on the clinical and radiographic findings, a

treatment plan was made to initiate endodontic therapy and reinforce furcation area with Biodentine placement, followed by composite reinforcement with fiber-reinforced composite (Interlig Angelus).{Figure 3}

Endodontic therapy was initiated. Working length, cleaning and shaping, and obturation were done, following which reinforcement of furcation area was done with Biodentine, and fiber reinforcement protocols were followed as described in cases 1 and 2 [Figure 3]c, [Figure 3]d, [Figure 3]e, [Figure 3]f, [Figure 3]g, [Figure 3]h, [Figure 3]i.

Discussion

Biomechanics of endodontically treated teeth differ from that of vital teeth. This could be attributed to loss of coronal and radicular tissue owing to either previous pathologies (dental caries, fractured restoration, and trauma) or root canal treatment (access cavity preparation, cleaning and shaping), thereby increasing fragility of endodontically treated teeth.[5],[6]

Previous studies highlighted that one of the most prominent reasons for extraction of endodontically treated teeth is prosthetic failure.[7] Therefore, decision making in restoration of endodontically treated teeth presents a great challenge for clinicians in day-to-day practice.

There exists a direct correlation between residual tooth structure and tooth survival. The minimum tooth structure lost during restoration increases the survival of endodontically treated teeth. Traditional approaches for rehabilitation of structurally compromised teeth have been by use of metal-based restoration like cast coverage restorations and amalgam restorations. The major drawback associated with these nonbonded restorations is invasiveness due to required mechanical retention features (boxes, grooves, slots, and pins), which further weaken the residual tooth structure, thereby creating regions of great stress concentrations and crack formation. Further nonbonded restorations and the residual tooth structure behave as two different entities during function. As a matter of fact, the residual tooth structure is continuously subjected to both occlusal and thermal stresses. Furthermore, cast and glass fiber posts do not offer any mechanical advantage to root canal treated teeth other than retention of core and are associated with catastrophic failures of root fractures.[6]

To overcome this, dentistry witnessed a paradigm shift to more conservative yet esthetic approaches of bonded direct and indirect composite restorations. Although this maximized the bond and minimize the stress between bonded restoration and residual tooth structure,[4] their use in rehabilitation of posterior stress-bearing teeth was still criticized due to associated drawbacks with traditional composite restorations of low flexural strength, polymerization shrinkage, lack of toughness, and microleakage.[6]

To overcome the above drawbacks and assure successful rehabilitation of badly broken posterior teeth, "biobase concept" based on fiber-reinforced composite materials is gradually gaining momentum in dentistry. This concept relies in reconstructing the base of a tooth with materials exhibiting mechanical properties similar to dentin, and optimized adhesive protocols that attempt to reduce the stress generated by the polymerization of resinous materials.[5]

One such dental application based on this concept makes use of fiber insert within composite restoration. The most commonly used fiber-reinforced composites are polyethylene ribbon (Ribbond) and glass FRCs (EverStick and Interlig).[4]

Previous extensive in vitro research has demonstrated superior fracture resistance, toughness, marginal integrity, bonding abilities, decreased microleakage, and polymerization shrinkage FRC compared to conventional composites restorations.[4]

Increased fracture resistance associated was explained by the multitude paths of load generated by short multidirectional fibers, thereby preventing crack propagation and helping in redistribution of occlusal forces.[4]

Decreased microleakage with FRCs is attained by replacing part of the composite increment with glass insert which assist in decreasing volumetric polymerization shrinkage by (1) Resisting pull away of initial increment of composite from the margins toward the curing light. (2) Providing a strengthening effect of the composite margin. (3) Improving marginal adaptation.[4]

Type of fibers, resin impregnation, adhesion with composite resin, and their orientation are crucial determinants for reinforcement of teeth. It has been demonstrated in various in vitro studies that the glass fibers (EverStick and Interlig) placed in buccopalatal/mesiodistal close to the force exertion point (occlusal third) clinically lead to superior bonding properties and fracture resistance when compared to polyethylene fibers (Ribbond).[4],[8],[9],[10]

Based on the above findings, there has been a paradigm shift for restorative approach among clinicians for endodontically treated teeth, from a more invasive, nonbonded to minimally invasive, and adhesive postless or crownless approach.[5] Using fiber reinforcement method, Soares et al.[6] demonstrated a case of crownless and postless approach in management of

structurally compromised teeth with 20-month follow-up. Further, Castro Klenner and Lazari[5] presented a case of minimally invasive postless approach by the use of fiber reinforcement approach in badly broken endodontically treated teeth.

Similarly, in our cases described above, the use of fiber reinforcement was very beneficial, as beside eliminating requirement of the use of posts, it also enhanced coronal reinforcement of teeth by retaining the maximum possible amount of sound tooth structure.

Conclusion

In the following case series, a less invasive yet reinforcing approach of FRC restoration was used as an alternative to cast metal post to restore extensive damage of tooth structure. In spite of extensive *in vitro* research on FRCs, minimal clinical data exist regarding the use of FRCs. Therefore, more *in vivo* studies with long-term follow-ups are required to support these new techniques as an alternative to traditional invasive approaches of cast metal restorations.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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