

CASE REPORT

Mineral Trioxide Aggregate Apexification followed by Fiber Post reinforced and customized with Ribbond Material in Fractured Immature Maxillary Central Incisor

¹Hoshing Upendra, ²Munavalli Anil, ³Ninad Shah, ⁴Preshit More

ABSTRACT

Traumatic teeth with open apex having necrotic pulp and peri-apical lesion are difficult to treat via conventional endodontic therapy. Revascularization is not always possible due to the long treatment time involved. Apexification followed by the reinforcement of weakened root structures with fiber post is an attractive option. Mineral trioxide aggregate (MTA) is a successful material used for apexification procedures. But for structurally weakened roots with wide canal, to get proper adaptation to canal diameter is a challenging task. Ribbond is one such material that has occupied an important place in dentistry. It is a bondable fiber-reinforced material, made from the same ultrahigh molecular weight polyethylene and ceramic fibers, lowering the risk of catastrophic failures and with better stress distribution. This study describes a case report in which nonvital tooth with wide-open canal is managed using MTA as apexification agent. Original root canal shape was configured with the help of fiber posts covered with ribbond material to enhance the fracture resistance of maxillary central incisor and retention of post.

Keywords: Apexification, Customized fiber post, Immature root apex, Ribbond.

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INTRODUCTION

A common cause for the interruption of root development is trauma. The nature of the injury depends on the location of the tooth, the energy of impact, resiliency, and the angle of the impact.¹ When the root development is not complete, maximum number of injuries occur in young individuals. Luxation injuries appear to be associated

with the greatest risk of incomplete root development with between 15 and 59% of teeth losing their vitality.² The maxillary central incisor is the most frequently affected tooth³ and may have grave consequences like pulp necrosis, pulp canal obliteration, root resorption, and open apex.⁴ The absence of an apical constriction makes root canal treatment difficult because of the inability to obtain a seal with conventional obturation techniques. Moreover, the thin root canal walls render it susceptible to fracture.⁵

The ideal approach for managing this problem allows continued root development and root elongation, thickening of dentinal walls, and induces closure of root apex, thereby reducing the risk of fracture during tooth function is regenerative endodontics. But this may take prolonged treatment time which is a major disadvantage.⁴ So other successful option for affected teeth is the apexification followed by placement of fiber posts for reinforcement. Mineral trioxide aggregate is a successful material used for apexification procedure.

Ribbond is a bondable reinforced fiber consisting of ultrahigh-strength polyethylene fibers. These fibers far exceed the breaking point of fiberglass and are so tough that specially made scissors are required to cut them.⁶ Ribbond bonded on fiber post is used to recreate the lost root dentine, thereby strengthening the weakened tooth structure.

This study describes a case report in which nonvital teeth with wide open canal are managed using MTA apexification followed by fiber post which is reinforced and customized with ribbond material in fractured immature maxillary central incisor.

CASE REPORT

A young 16-year-old female patient reported with the chief complaint of broken, discolored tooth in upper front region since 6 to 7 years. Investigation revealed a trauma (6 years ago) associated with an enamel/dentin fracture. No treatment was performed at that time. Maxillary right central incisor was root canal treated by previous dentist approximately 6 months back. But now patient reported with fracture of crown structure, discoloration, and moderate pain in maxillary right central incisor (Fig. 1).

¹Head and Guide, ²Reader, ^{3,4}Postgraduate Student

¹⁻⁴Department of Conservative Dentistry and Endodontics Vasantdada Patil Dental College, Sangli, Maharashtra, India

Corresponding Author: Ninad Shah, Postgraduate Student Department of Conservative Dentistry and Endodontics Vasantdada Patil Dental College, Sangli, Maharashtra, India Phone: +919970787737, e-mail: ninadshah1989@gmail.com



Fig. 1: Preoperative intraoral photograph

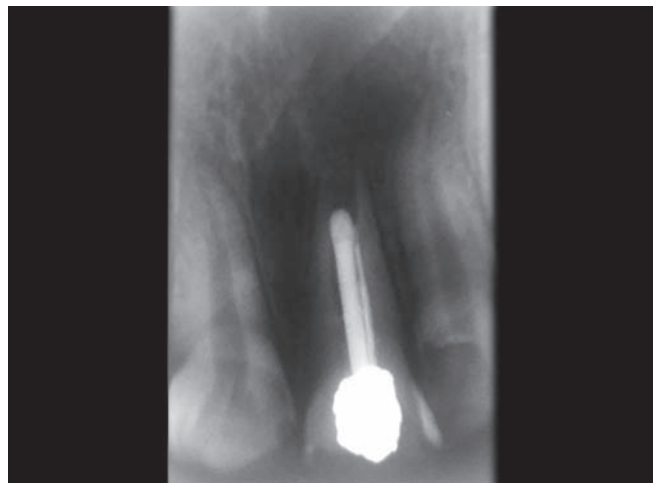


Fig. 2: Preoperative radiograph

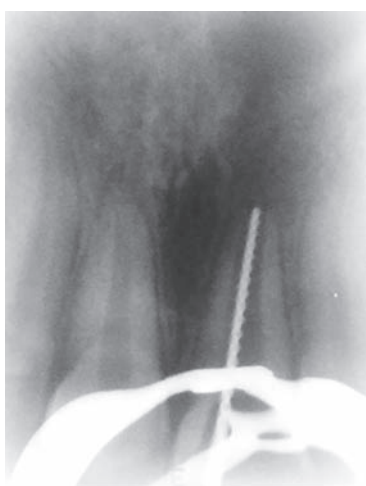


Fig. 3: Working length radiograph



Fig. 4: Radiographic evaluation of calcium sulfate as apical barrier

Radiographic examination revealed immature root apex and wide root canal with periapical radiolucency with maxillary right central incisor; radiograph also showed improper root canal treatment with tooth no. 11 (Fig. 2). According to current guidelines, to get proper apical seal, MTA apexification was planned, and for the reinforcement of the root structure placement of fiber post, ribbon was planned.

Patient consent was taken and under rubber dam isolation access opening with tooth no. 11 was carried out. With the help of H-file all the gutta-percha was removed. Working length measured radiographically 1 mm short of the radiographic apex (Fig. 3). Root canal was irrigated with 5.25% sodium hypochlorite and a side vent needle used to avoid the possibility of extrusion of irrigant. After drying the canal with paper points, intracanal medication triple antibiotic paste containing ciprofloxacin, metronidazole, and minocyclin was placed. Patient was recalled after 3 weeks. Canal was irrigated with normal saline for removal of triple antibiotic paste and dried with paper points.

Apical barrier was created with calcium sulfate (Fig. 4). Calcium sulfate was placed with messung gun. During the placement of calcium sulfate proper care was taken such that it did not touch the walls of the canal as it can interfere with the close attachment of MTA. According to manufacturer's guidelines, MTA (MTA Angelus, Angelus, Londrina – PR, Brazil) was mixed to a thick creamy consistency. Then MTA was placed into tooth no. 11, 1 to 1.5 mm short of the working length with MTA carrier and compaction done using Schilder's plugger. Radiograph was taken for confirmation of apical plug (3–4 mm; Fig. 5). Access cavity was sealed with temporary filling material (Protemp) after placing a cotton pellet inside the canal.

Temporary filling material was removed after 1 week, and a hand plugger was pressed against MTA plug to confirm hard set of MTA. In this case, MTA acts as an apexification and obturation material.

H₃PO₄ gel was applied on whole surface of the post (Fig. 6A); post was then cleaned with distilled water and dried with air. Bonding agent (Prime Dent, USA) was

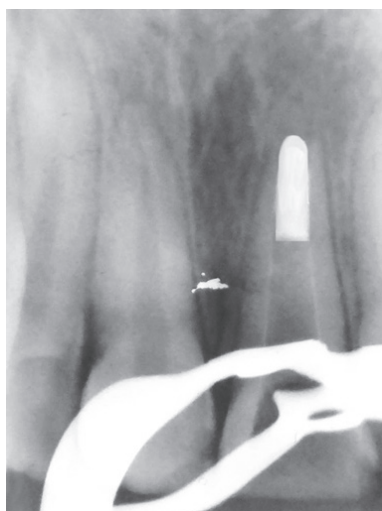


Fig. 5: Mineral trioxide aggregate apical plug radiograph

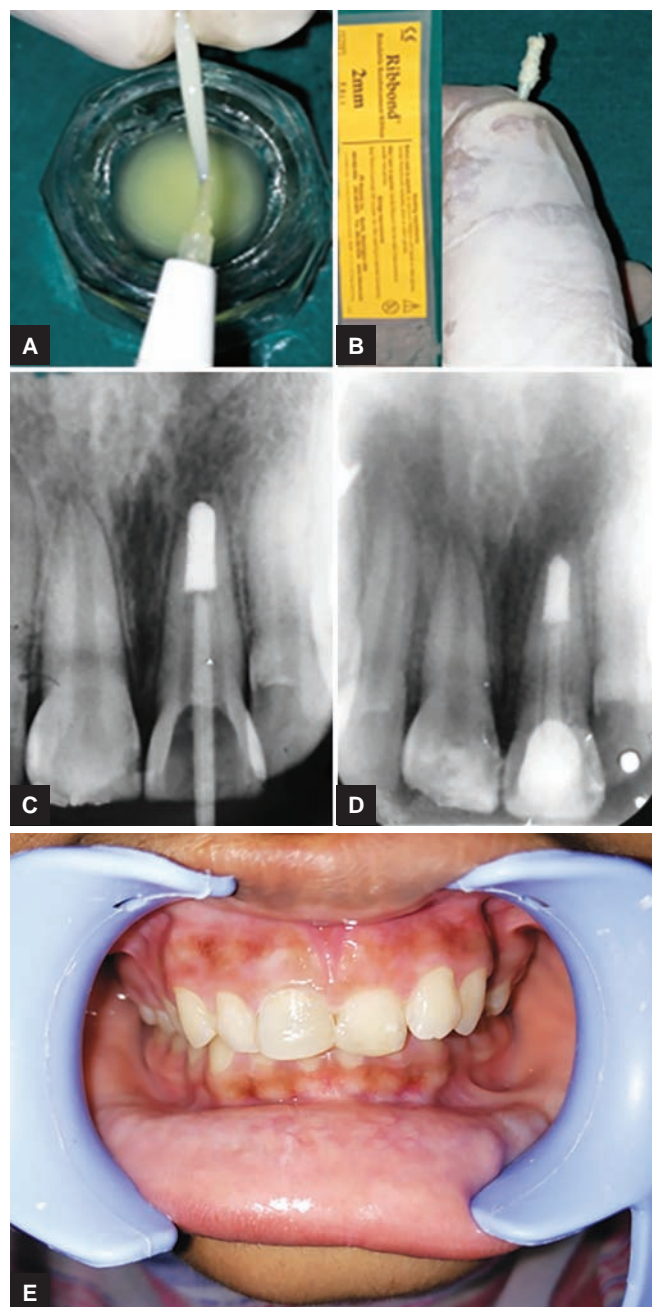
applied on fiber post (Fig. 6B) and ribbon material was coated around fiber post and then light cured (Fig. 6C); adaptation was checked inside the canal and customized fiber post was then luted into the root canals using Rely X Unicem-2 Clicker (3M ESPE AG, Seefeld, Germany) and light activated through cervical portion for 40 seconds (Blue phase C8, Ivoclar Vivadent, Schaan, Liechtenstein, Germany; Fig. 6D). Core buildup was done with composite (Ivoclar Vivadent; Fig. 6E).

DISCUSSION

Revascularization and repair of root anatomy is the ideal treatment of choice for necrotic nonvital teeth with wide open canals, but it is not always feasible due to prolonged treatment time required. Strengthening of weakened root structures with fiber post after apexification is a good option.⁴ For single-visit apexification, nowadays MTA is a good option because of its less cytotoxicity, biocompatibility, bioremineralization abilities, osteoconductive properties, and hydrophilic nature.^{5,7} Moreover, MTA manipulation is difficult due to which its placement in the apical area is a difficult procedure. To avoid extrusion of MTA, a matrix can be used in apexification procedures. Matrix placement allows for the accurate and definite placement and proper use of this costly material.⁸ According to Weinberg and Moncarz, calcium sulfate is an inexpensive material, which is biocompatible for hard and soft tissues.⁹

Calcium sulfate has the property of invagination of the epithelium because of which it can induce tissue repair when used for filling large surgical cavities. Calcium sulfate is resorbed after about 4 weeks, thereby assisting in the formation of new bone tissue and more favorable repair.¹⁰⁻¹²

Calcium sulfate may also be introduced using specialized devices, such as the Messing Gun or Dovgan



Figs 6A to E: (A) Acid etching of fiber post; (B) application of bonding agent on fiber post; (C) ribbon fiber material coated around fiber post; (D) customized fiber post placement radiograph; and (E) postoperative intraoral photograph

Carriers. Considerable care is taken to ensure that the calcium sulfate does not contaminate the walls of the canal as it can interfere with the close adaptation of MTA. Ideally, the tip of the delivery syringe should reach beyond the apical aperture. Calcium sulfate is placed in small increments, and the placement is confirmed radiographically. It has a radiopacity, i.e., similar to dentin, and it sets within 1 to 2 minutes. The speed of setting of the calcium sulfate mandates that the tip of the carrier be cleaned as soon as possible to avoid the tube being blocked by the set material.¹³ For restoring the teeth with thin canal walls, a master fiber post and ribbon

was bonded to each other with the help of bonding agent and resin cement. They were made into a single unit (monobloc) that follows the canal configuration. At the end, this customized post was cemented to the canal with resin cement.

Ribbon fibers were introduced in 1992 to the market as bondable reinforced fibers, consisting of ultrahigh-strength polyethylene fibers. These fibers far exceed the breaking point of fiberglass and are so tough that specially made scissors are required to cut them. The key to ribbon's success (and what distinguishes ribbon from the other fiber reinforcements) is its patented leno weave. Designed with a lock-stitch feature that effectively transfers forces throughout the weave without stress transfer back into the resin, ribbon's weave also provides excellent manageability characteristics. The unique fiber design renders the following properties to ribbon: Adaptable and manageable; does not unravel when cut or manipulated; reinforces multidirectionally durable and impact absorbent; transfers stresses efficiently throughout the fiber network. Other properties seen in ribbon are highly bondable ribbon bonds to any composite system.

Adaptation of posts to the canal walls is an important element in the biomechanical performance of the prosthetic restoration. Advantages of customized fiber posts include greater post-to-canal adaptation in the apical and coronal half of the canal, good post retention, and minimal tooth structure removal during canal reshaping.¹⁴ Canal configured fiber posts need minimal thickness for cementing medium, thus reducing polymerization stress caused by a great amount of cement around the post.¹⁵ So in the present case, we customized the fiber post with ribbon material according to canal shape.

CONCLUSION

Mineral trioxide aggregate apexification followed by tooth reinforcement using customized fiber posts with ribbon and composite resin is a successful alternative to cast post and core in necrosed teeth with wide open canals, because of better stress distribution and the lower risk of catastrophic failures.

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