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The restoration of a maxillary central incisor fracture with the original crown fragment using a glass fiber-reinforced post: a clinical report

CASE REPORT

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Abstract – This report describes an esthetic, conservative, and economical alternative restoration technique for a fractured central incisor using the patient's own tooth crown piece and a bondable reinforcement glass fiber. Although the long-term durability of this adhesive post core restoration remains unknown, it remains successful after 1 year.

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Traumatic anterior tooth fracture is a common type of dental injury, and treatment is an important issue in dentistry (1, 2). Such fractures are more common in patients with increased overjet (3–5). Treatment options for such fractures include fragment removal and immediate restoration, restoration after gingivectomy or osteotomy, forced orthodontic extrusion, forced surgical extrusion, vital root submergence, and extraction of the root (6). A fracture at the cementoenamel junction can be easily diagnosed clinically and radiographically (7). In such fractures, if the fracture line is above the alveolar bone, the fractured part is usually removed and a postcore and crown restoration is carried out following root canal therapy (7, 8). Esthetics, function, and the patient's expectations must be considered when selecting the treatment (8, 9).

When the fractured margin of the tooth is beneath the alveolar bone and has not been separated from the gingiva, the fractured crown may be rebonded to the root (9). Alternatively, the fractured piece may also be restored using a cast post and core (9). However, the extension of a metal post to the crown in this method creates an esthetically unpleasant appearance (9, 10). Prefabricated post systems are another treatment alternative. These include metal and non-metal types. In many instances, the patient and dentist prefer non-metal restorations because of the superior esthetic outcome (9, 10).

Glass fiber posts provide all the advantages of non-metal posts. With the use of bondable glass fibers, the fractured tooth pieces can be bonded to one another. This may concentrate less stress in the tooth and reduce the incidence of catastrophic root fractures (10, 11). In addition, this is a conservative, economic method that yields esthetically satisfying results (10, 11).

Glass fiber is a biocompatible, inert, translucent, and durable material, which includes free radicals that can form chemical bonds. The fibers used for reinforcement are silanized electrical glass (E-glass) fibers and the glass fiber reinforcements are preimpregnated with polymer by the manufacturer (11–13).

Stick (Stick Tech, Turku, Finland) is a glass fiber that is used in the construction of posts along with adhesive and composite resin, especially in maxillary and mandibular anterior teeth. Stick reinforcement is made from continuous unidirectional glass fibers (14–16). Such restorations have a high bond strength, and their compressive strength and elastic modulus are close to those of dentin (17, 18).

Here, we describe the management of a complicated crown-root fracture of a maxillary central incisor using glass fiber-reinforced material to increase retention.

Case report

A 40-year-old woman was referred to our clinic complaining of jaw pain within hours after a traffic crash. Clinical examination revealed that her maxillary mature left central incisor had a crown-root fracture with pulp exposure, although the fractured fragment remained in place (Fig. 1). She also had a mandibular ramus fracture. Before pulpectomy and root canal preparation, the fractured piece of the crown was bonded to the adjacent teeth with composite resin. The patient refused to use a rubber dam during the treatment period to allow her to relax in the dentist's chair.

After treating the mandibular fracture, the fractured crown was removed and the root canal was filled with gutta-percha and resin sealer (AH Plus™; Dentsply De Trey, Konstanz, Germany) using the lateral condensation technique. We proposed restoring the tooth after orthodontic extrusion of the root, together with all the alternative treatment options, but the patient refused.

Gingivectomy was achieved in the lingual region after making an external bevel incision under local anesthesia (Ultracain; Astra Zenica, Istanbul, Turkey). Gingivoplasty was performed using periodontal scissors and knives to shape the gingival contours appropriately. The fractured piece of the crown was kept in physiological saline solution during this procedure. After a 10-day healing period following gingivectomy, the fractured crown part was re-evaluated to determine whether it fits the root part correctly and to examine the occlusion to avoid primary contact with the other teeth. The coronal root canal filling material was removed to the apical one-third of the root (Fig. 2). Then, the fractured piece of the crown was placed in its original position. The length of the glass fiber-reinforced post was measured using a periodontal probe. The fiber that was to extend into the crown was designed to cover the hole in the crown so that the length of the fiber in the root exceeded that in the crown.

Fiber preparation

After determining the length of glass fiber required, the fiber was cut using special scissors (Fig. 3). Then, the fiber was wetted with bonding resin (Variolink II/Monobond-S; Ivoclar Vivadent, Schaan, Liechtenstein). To wet the fiber completely, two to three drops of bonding agent were added, and the fiber was wrapped in a polyethylene plastic sheet and kept under pressure without being exposed to light. Pressure was applied to remove any excess adhesive from the fiber and to prevent the formation of air gaps. The fiber was kept until it became translucent, when it was considered ready for use. To prevent contamination, contact with the hands was avoided.

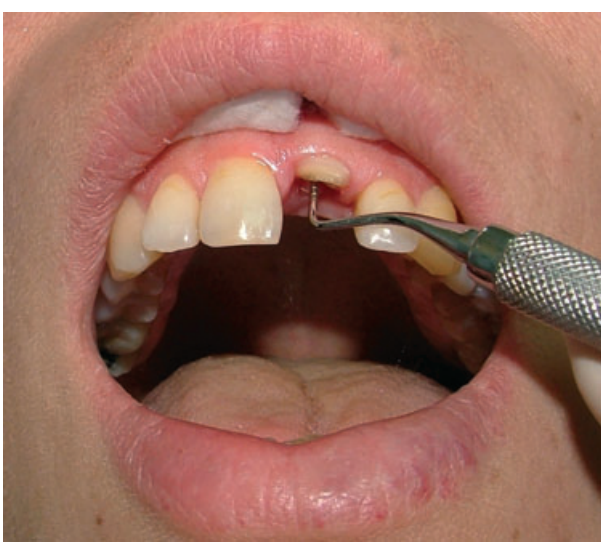

Fig. 1. Preoperative view of the maxillary left central incisor after endodontic treatment.

Fig. 2. Periapical radiograph after removing the material filling the coronal root canal to the apical one third of the root.

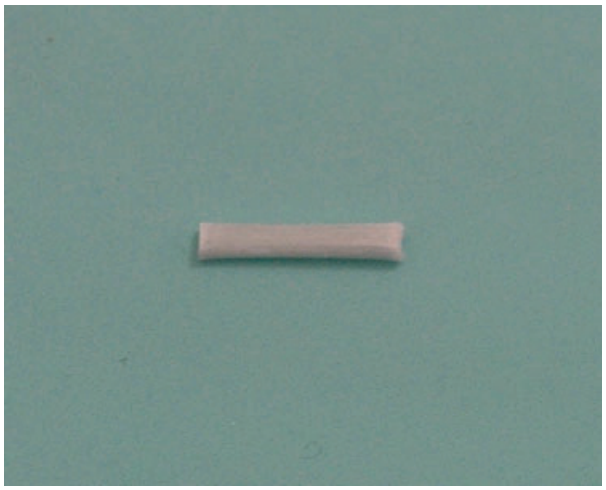

Fig. 3. Unidirectional glass fiber reinforcement (Stick).

Tooth preparation

After acid etching the root canal of the fractured tooth and crown piece for 15 s with 37% orthophosphoric acid gel (3M ESPE, St Paul, MN, USA) (Figs 4 and 5),

Fig. 4. Acid etching of the crown piece.

Fig. 5. Acid etching of the root canal of the fractured tooth.

Fig. 6. Glass fiber-reinforced post placed after preparing the root canal.

bonding resin (Monobond-S; Ivoclar Vivadent) was applied, air-dried for 10 s, and polymerized using a 500 mW mm^{-1} intensity halogen light source (Hilux Ultra; Benlioğlu, Ankara, Turkey) for 10 s (Fig. 6). The root canal was filled with adhesive resin (Rely X-ARC; 3M ESPE). The glass fiber was also covered with adhesive resin and placed in the canal. Then, the fractured crown was placed on the root with the fiber passing through the access cavity in the crown piece. The fit of the fractured crown piece to the root was evaluated, and the excess resin cement was removed from the cementoenamel junction; the remainder was polymerized with the same light unit for 20 s. The lingual surface of the crown was restored with restorative composite filling material (Filtek Z-250; 3M ESPE), and polymerized for 20 s. Then, the composite was polished with composite polishing discs (Nos 2382C, 2381C, 2382M, 2381M, 2382F, 2382 SF; 3M ESPE) and a composite polishing kit (Soflex Contouring and Polishing kit; 3M ESPE). The occlusion was adjusted carefully to avoid any primary contacts or traumatic occlusal forces to the restored tooth.

No signs of debonding or discoloration were observed at the initial 2-week follow-up or subsequent follow-ups at 6 months and 1 year, and the patient was satisfied with the result. The labial view of the final restoration is shown in Fig. 7 and the radiograph of the final restoration is shown in Fig. 8.

Discussion

This case report describes the management of a complicated crown-root fracture of a maxillary central incisor using glass fiber-reinforced material to increase retention as an alternative method for restoring the esthetics and function of traumatized teeth.

The most common type of traumatic injury affecting the permanent dentition is a crown fracture (19–21). Majority of dental injuries involve the anterior teeth, especially the maxillary central incisors (19–23).

The reattachment of the crown fragment to a fractured tooth is considered the most conservative treatment for crown fractures of the anterior teeth (24).

Fig. 7. Labial view of the definitive glass fiber-reinforced post and fractured crown.

Fig. 8. Periapical radiograph after bonding the glass fiber-reinforced post and crown fragment.

Reattachment of the original tooth provides enhanced fragment adaptation to the remaining tooth in addition to good stability and biocompatibility of the natural tooth surface with the periodontium (25). In 1964, Chosack and Eidleman managed a complicated crown fracture in which the crown was completely fractured, by recementing it to the tooth with a post after conventional root canal treatment (26–28). Since 1978, the technique has been modified to avoid the use of pins and posts, replacing them with adhesives (26). The dental reattachment technique has been improved with the development of acid conditioning and dentin adhesives (29–31). Techniques used to improve dental fragment retention after reattachment involve enamel bevels, internal enamel or dentin grooves, chamfers, and overcontouring (27). Although adhesive techniques and preparation modifications are still being developed, the reattachment of the fractured piece of the tooth still requires improvement.

Failure of the teeth restored with metal posts and cores typically shows root fractures (32–34), which are often related to the stiffness of metal posts. In comparison with metal posts, fiber posts are less stiff and result in a better stress distribution in the root, which may result in fewer severe fractures after failure (35–38). In addition to the similarity in elasticity to that of dentin (39), the ability to cement glass fibers with adhesive is very important, along with the good esthetic results (40). Moreover, Fidel et al.(41) used glass fiber and composite resin to restore a vertically fractured tooth. In our case, glass fiber was used to increase retention of the reattached crown fragment.

In such cases, extraction of the tooth and a single tooth implant is another treatment option. Torabinejad et al. (42) concluded that the initial endodontic treatment has a high long-tem survival rate for periodontally sound teeth that have pulpal or periradicular pathology; similar long-term survival rates have also been reported for extraction and replacement of the missing tooth with an implant-supported restoration. However, expense for the treatment, lack of time, patients' fear of surgery, and potential esthetic problems often prompt clinicians to choose more conservative treatment options first. Reattaching the fractured crown with a fiber post was successful clinically in this case based on a limited 12-month follow-up.

Improving the success of treatment in such cases requires good occlusal relationships before and after treatment. Physical trauma, occlusal prematurities (43), repetitive heavy stressful chewing (44), and iatrogenic dental treatments may all cause vertical root fractures. The guidelines for good occlusal practice should also reduce the risk of damage to the bonded restorations. A deep bite or bruxism would contraindicate this technique in patients requiring a long-term solution. Restoration failure may also occur due to uncontrolled forces. Avoiding primary contacts and setting correct relationships with the neighboring and opposite teeth will help increase the survival of restorations in the mouth.

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