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Reattachment of fractured maxillary incisors using fiber-reinforced post: Two case reports

Gul Tosun[1]
Esma Yildiz[2]
Mesut Elbay[3]
Yagmur Sener[1]

ABSTRACT

Objective: The reattachment of the crown fragment to a fractured tooth is a conservative treatment that should be considered for young patients with crown-root fractures to the maxillary incisors if the subgingival fracture can be exposed to provide isolation. Gingivectomy, the surgical or orthodontic extrusion of the apical fragment is necessary to expose the subgingival fracture. This report demonstrates the treatment of two cases with the combination of gingivectomy or resective osseous surgery, reattachment of coronal fracture and fiber-reinforced polymer posts and shows three years long term follow-up. Subgingivally extended crown-root fractures of maxillary incisors were restored with a combination of chemically cured resin material, light cured resin material and polyethylene fiber.

Conclusion: Within the limitations of this case report, it was demonstrated that reattachment of tooth fragments can successfully benefit periodontal health, aesthetic needs and normal functioning after three years. (Eur J Dent 2012;6:227-233)

Key words: Crown-root fracture; fiber post; reattachment

INTRODUCTION

A crown-root fracture affects enamel, dentin and cementum and may be classified as either complicated or uncomplicated according to the pulpal involvement.[1] Conventionally crown-root fractures have been treated in different ways depending on the site and type of fracture. In cases of crown-root fractures, surgical exposure of the fracture surface by gingivectomy and osteotomy, the surgical or orthodontic extrusion of the apical fragment are necessary to expose the subgingival fracture.[1] Gingivectomy or sometimes ostectomy is suitable where denudation of the fracture site does not compromise esthetics i.e. fracture with palatal extension. The advantage of the technique is that restoration can be completed soon after injury either using the original fragment or composite resins.[1-3] It has become possible to preserve the fractured segment of a tooth using reattachment techniques. This technique can be applied both

[1] Department of Pediatric Dentistry, Faculty of Dentistry, Selcuk University, Konya, TURKIYE
[2] Department of Pediatric Dentistry, Faculty of Dentistry, Gaziantep University, Gaziantep, TURKIYE
[3] Department of Pediatric Dentistry, Beyhekim ADSM, Konya, TURKIYE

Corresponding author: Dr. Esma Yildiz
Gaziantep Universitesi, Dishekimligi Fakultesi, Cocuk Dishekimligi AD., 27310 Sahinbey, Gaziantep, TURKIYE
Tel: +90 342 3610610
Fax: +90 342 3610346
Email: esma_yildiz@hotmail.com

to simple enamel-dentin fractures and to more complex fractures that involve pulp and periodontium.[4,5] Exact restoration of the crown is achieved and the surface morphology wears at the same rate as that of adjacent teeth. The use of the fractured segment offers better short- and medium-term results than resin composite restorations.[5-8]

Following trauma most of teeth require endodontic treatment.[9] In the case of extensive loss of natural tooth substance in the endodontically treated teeth a post is required.[9] Studies further suggest that a post should be used only when there is insufficient tooth substance remaining to support the final restoration.[10,11] Custom-fabricated cast alloy posts and cores or prefabricated alloy posts and resin composite cores are used for this purpose.[12,13] With the increasing demand for aesthetically pleasing, metal-free restorations, the use of fiber-reinforced polymer posts that caused fewer tooth fractures[14] because the biomechanical properties of fiber reinforced composite posts are reported to be close to those of dentin[15] has increased in recent years.

The following report describes the management of two cases of complicated crown-root fractures, extending subgingivally, involving pulp exposure to the permanent maxillary incisors that required endodontic treatment. In previous reports about similar cases short and medium follow up results were reported. The combination of gingivectomy or resective osseous surgery, reattachment of coronal fracture and fiber-reinforced polymer posts was performed in these cases and three years long term follow-up were shown.

CASE REPORTS

Case 1:

A 12 year-old boy was referred to our clinic one week after a traumatic injury. The extra-oral examination revealed no significant findings. The clinical and radiographic maxillofacial examination indicated that the maxilla, mandible and other facial bones were intact. Intraorally, the maxillary left lateral incisor had a fracture horizontal on the buccal, 3mm above the gingival margin and oblique in the buccal-palatal direction, extending 3mm below the gingival margin on the palatal (Figure 1).

The pulp was totally exposed. The crown fragment was mobile but still in place (Figure1). The apical fragment had no pathologic mobility. In the periapical radiograph, the fracture line was clearly observed (Figure 2). An uncomplicated fracture to the maxillary left central incisor was also observed. Other adjacent teeth had no sign of trauma and were vital. The patient's parents were informed of the risk of tooth loss.

Local anesthesia was administered, and the fractured coronal fragment was detached with minimal force from the soft tissue attachment (Figure 3) and immediately soaked in saline solution to prevent dehydration. A decision was made to place a fiber-reinforced polymer post (Ribbond, Ribbond Inc. Seattle Washington, USA) into the root canal for retention. Following extirpation of the pulp tissues, the root canal was filled with a sealer (Sealapex®, Kerr Corporation, Orange California, USA) and gutta-percha using the lateral condensation technique.

Figure 1. Initial clinical appearance of teeth in case 1.

Figure 2. Initial radiographic appearance of teeth in case 1 at presentation.

The day after the root canal treatment, the gutta-percha was removed from 1/3 of the cervical portion using Gates Glidden burs. The fracture extending subgingivally on the palatal surface was apparent. A gingivectomy was performed to reestablish the gingival margin and expose the subgingival fracture in order to evaluate the posibility for a crown attachment procedure. Before reattachment, the fractured margins were checked to ensure an accurate fit. A small hole was created in the middle of the crown fragment (Figure 4) in which to lay the polyethylene fiber. Polyethylene fiber was cut to a length of 10mm using special nippers after the required length was determined. Isolation with respect to crevicular fluid seepage was achieved with cotton rolls and gauzes. A self-cure dental adhesive (Super Bond C&B, Sun Medical Co. Ltd. Japan) was used to bond the tooth structures to one another. The apical fragment and the coronal fragment were first treated for 10 s with Green Activator from the Super Bond C&B kit for surface treatment, and the fragments were rinsed and dried. Four drops of monomer (Super Bond C&B) and one drop of catalyst (Super Bond C&B) were mixed in ceramic and the bonding surfaces were wetted with the mixture. One small cup of polymer L-Type radiopaque powder (Super Bond C&B) was then mixed into the monomer. The resin cement preparation was applied to the fracture line using a brush and the coronal fragment was reattached to the apical fragment.

After reattachment of the coronal fragment, polyethylene fiber (Ribbond, Ribbond Inc. Seattle Washington, USA) that had previously been conditioned using a self-etching bonding agent (Liner Bond 2V, Kuraray Inc, Tokyo, Japan) according to the manufacturer's instructions was inserted into the root canal through the hole in the coronal fragment. Anaerobic resin-based bonding cement (Panavia F 2.0, Kuraray Medical Inc., Japan) was utilized to cement the polyethylene fiber according to the manufacturer's instructions. Excess resin was removed and light curing was performed through the post. The resin composite (Clearfil AP-X, Kuraray Medical Inc, Tokyo, Japan) was condensed to the remnant cavity for reinforcement. The restoration was finished and polished and the occlusion checked. The maxillary left central incisor was also restored with resin composite (Clearfil AP-X, Kuraray Medical Inc, Tokyo, Japan). Oral hygiene instructions were given to the patient and parents and a diet of soft foods was advised. The patient was scheduled for follow up.

Up to one-year follow-up examinations, no pain symptoms, color changes, mobility or periradicular pathology were observed on the restored teeth. Probing depth and clinical attachment loss were measured and lamina dura was observed. The periodontium was found to be healthy (Figure 5). The case was followed up after three years, at which time the clinical and radiographic results were successful for both the maxillary left central incisor and the left lateral incisor (Figure 6).

Figure 3. Image after the removal of the coronal fragment.

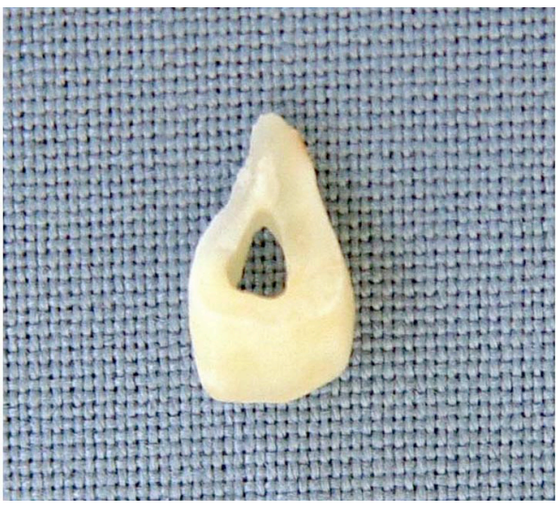

Figure 4. A small hole was created in the middle of the crown fragment in which to lay the polyethylene fiber.

Case 2:

An 11-year-old boy was referred to our clinic three days after traumatic injury resulting from a fall. The oral and radiographic examination revealed that the maxillary left central incisor had a complicated oblique fracture 4mm below the gingival margin on the distal, extending subgingivally, with the pulp exposed approximately 3mm (Figure 7, 8). This indicated the necessity for endodontic treatment. Clinical examination showed that the coronal fragment was mobile but still in place. The apical fragment had no pathologic mobility. There was no sign of injury to any of the other erupted teeth. There were no other injuries to the facial or oral tissues and no symptoms of head injury were present. The patient's parents were informed of the risk of tooth loss.

Local anesthesia was administered and the mobile fragment was removed (Figure 9). The coronal fragment was soaked in saline solution. An access cavity to the pulp was drilled from the palatal surface of the tooth. The root canal was filled with a sealer (Sealapex®, Kerr, Orange California, USA) and gutta-percha was applied using the lateral condensation technique.

The decision was made to place polyethylene fiber (Ribbond, Ribbon Inc, Seattle, Washington, USA) into the pulp chamber in order to retain and reinforce the tooth structure. The day after completion of the root canal treatment, the gutta-percha was removed from 1/3 of the cervical portion of the root canal as in Case 1. The fracture line was not clearly visible in the subgingival area. Therefore, a mucoperiosteal flap was raised to expose the limits of the fracture. The fracture line was observed as having an infra-alveolar extension in the distal area. Resective osseous surgery was performed in the vertical axis to reshape the alveolar margin. After the resective osseous surgery was completed, there was good hemostasis therefore a clean and dry surface was achieved with gauze rolls in contact with the bone for the reattachment procedures. The fragments were reattached with a self-cure dental adhesive (Super Bond C&B,

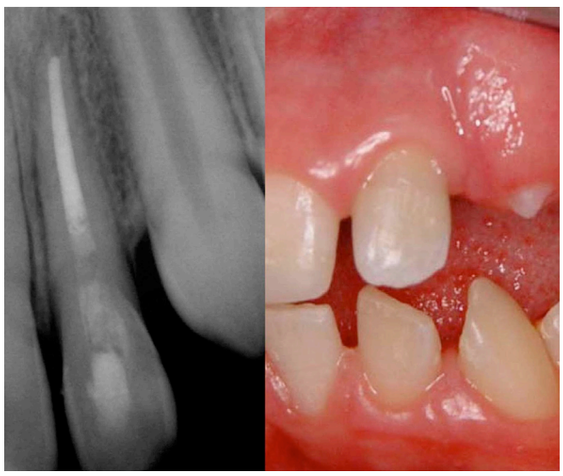

Figure 5. Clinical and radiographic appearance after one and a half years.

Figure 6. Clinical and radiographic appearance after three years.

Figure 7. Initial clinical appearance of upper left central incisor in case 2.

Figure 8. Initial radiographic appearance of upper left central incisor in case 2.

Sun Medical Co. Ltd. Japan) using the technique described in Case 1. Following stabilization of the tooth fragment, the flaps were sutured.

After the operation a seat was constructed on the palatal surface of the crown fragment in order to lay polyethylene fiber. Polyethylene fiber (Ribbond, Ribbond Inc., Seattle, Washington, USA) 12 mm in length was inserted into the root canal extending through the seat on the coronal fragment (Figure 10). To cement the polyethylene fiber (Ribbond, Ribbond Inc., Seattle, Washington, USA), anaerobic resin-based bonding cement (Panavia F 2.0) was utilized, as in Case 1. Restoration was completed by stratifying the composite resin (Clearfil AP-X, Kuraray Medical Inc., Tokyo, Japan). One week later, the sutures were removed and clinical examination revealed proper healing.

Up to one and half years, the restoration was functionally acceptable and aesthetically pleasing (Figure 11). Periodontal tissues were healthy, with no bleeding and no periodontal pocket at the palatal aspect of the maxillary left central incisor.

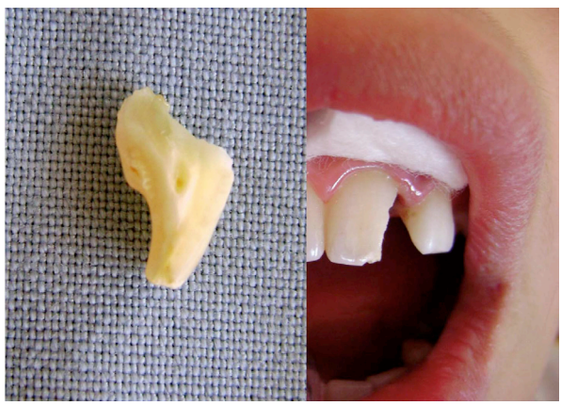

Figure 9. Clinical appearance of tooth after removal of fracture fragment and crown fragment of tooth.

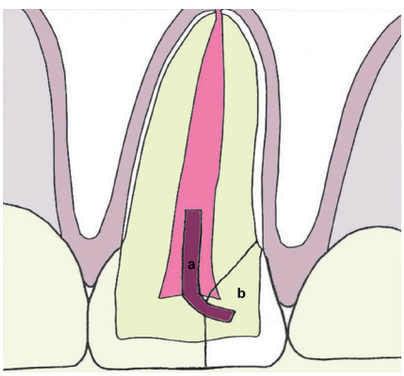

Figure 10. Illustration of treatment with polyethylene fiber that was used to support to the reattached fragments.

Figure 11. Clinical and radiographic appearance after one and a half years.

DISCUSSION

Crown-root fractures have immediate implications for endodontic, restorative and periodontal prognosis due to the subgingival line of the fracture. Fracture of the tooth below the gingival attachment presents restorative problems due to difficulty of access.[4] In such cases, orthodontic or surgical exposure of the fracture is necessary to facilitate further treatment.[1,16] Surgical exposure of the fracture margin can be achieved by gingivectomy with or without osteotomy. This technique is simple and allows restoration to be completed soon after injury. However, surgical exposure in aesthetic regions has unacceptable results and is best used only for the palatal surface of anterior or posterior teeth.[1,16] In the cases presented here, the fragment margins were exposed by gingivectomy in Case 1, and by resective osseous surgery in Case 2. These techniques allowed sufficient exposure, and further orthodontic or surgical extrusion was not deemed necessary. The subgingivally involved fracture sites were at the palatal of the maxillary left lateral incisor in Case 1 and the palatal and distal of the maxillary left central incisor in Case 2. Therefore, gingival aesthetics were not compromised.

Reattachment of a displaced fragment is a simple and low-cost method that has the potential to preserve the incisor tooth structure, providing improved longer-lasting aesthetic results, increased wear resistance and improved function.[17] The best material for bonding fractured fragments is controversial. Sometimes the fracture involves too extensive an area of dentin to be completely polymerized with light-curing through dental tissue. Chemically cured or dual cured material can overcome this problem. Demarco et al[18] found that the

best fracture resistance was obtained with chemically cured composite resin. The lowest fracture resistance was found using dentin bonding agent alone.[18] Therefore, chemically cured resin composite was used in this study. At the follow up, excellent stabilization of the fragments and excellent natural appearance were observed in both cases.

In complicated crown-root fractures, it is advisable to maintain pulp vitality, particularly in children.[2] However, in this case report, complete root canal treatment was carried out in both cases due to the time that had elapsed between injury and referral and the extent of exposure. Moreover, root development was complete in both cases. During follow up examination at three years for case 1 and one and half years for case 2, no periapical pathology had developed.

Biological changes in teeth following endodontic treatment leading to reduced hardness and resistance to shearing have been reported.[19] Restoration with a post following endodontic treatment retains a core to support coronal restoration, particularly when tooth loss is extensive.[20] In recent years, various types of fiber post have been introduced[21,22] and excellent long-term clinical performance of pulpless teeth reported.[23] Ribbond is a biocompatible, aesthetic material made from a high-strength polyethylene fiber. The various advantages of this material include ease of adaptation to dental contours and ease of manipulation during the bonding process. It also has acceptable strength due to good integration of the fibers with composite resin, leading to clinical longevity.[24,25] It has been stated that fiber-reinforced resin, post that is bonded into the root canal of the incisor, provides increased retention of the crown's fractured segment and is less subject to root fracture due to a combination of adhesive and elastic properties.[26] However, the authors strongly recommend regular long-term follow up. In case one of this report, a polyethylene fiber post (Ribbond, Ribbond Inc. Seattle Washington, USA) was used to reinforce the root dentin and the fractured coronal fragment. Neither root fracture nor fracture of the reattached crown was observed at the three-year follow-up. In case two, polyethylene fiber was used to support the reattached coronal fragments, as recommended in the literature.[27] No complications were evident at the one and half years follow-up.

CONCLUSION

The authors recommend the combined technique of polyethylene fiber and resin materials to support reattached tooth fragments in the treatment of subgingivally extended complicated crown-root fractures, particularly for young patients. Furthermore, excellent esthetic results were obtained due to fiber's translucent characteristics.

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