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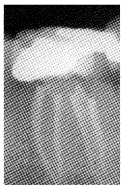

CASE REPORT

Replantation of a vertically fractured maxillary central incisor after repair with adhesive resin

F. Arıkan[1], M. Franko[2] & A. Gürkan[1]

[1]Departments of Periodontology; and [2]Endodontics, School of Dentistry, Ege University, Izmir, Turkey

Abstract

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Aim To describe the replantation of a vertically fractured root-filled maxillary central incisor after repair with adhesive resin.

Summary Root-filled teeth with vertical root fractures are usually extracted as they generally have a poor prognosis. In this case, an 18-month follow-up of a replanted incisor with vertical root fracture is presented with clinical and radiographic documentation.

Key learning points

• Replantation of root-filled incisors with complete vertical root fracture after resin bonding might be a realistic alternative to extraction.

• Practitioners should be aware of the possible disadvantages as well as advantages associated with failure of a replanted incisor with complete vertical root fracture.

Keywords: bonding, replantation, treatment, vertical fracture.

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Introduction

Vertical root fracture represents a partial or complete fracture line that extends through the long axis of the tooth (Tamse *et al.* 1999). Vertical root fractures are mostly observed in root-filled teeth (Fuss *et al.* 2001) as a result of iatrogenic factors such as excessive root canal preparation, overzealous lateral and vertical compaction forces during root canal filling, overpreparation of post-space, overt pressure in post-placement and inappropriate occlusal relations of adjacent teeth (Lertchirakarn *et al.* 1999, Yang *et al.* 2001, Cohen *et al.* 2003, Okitsu *et al.* 2005, Rundquist & Versluis 2006).

Correspondence: Dr Fatih Arıkan, Department of Periodontology, School of Dentistry, Ege University, Bornova 35100, Izmir, Turkey (Tel.: +90232 3881 105; fax: +90 232 3880325; e-mail: fatih.arikan@ege.edu.tr).

Teeth with vertical root fracture that represent particular difficulties in both diagnosis and treatment usually have poor prognosis (Pitts & Natkin 1983, Moule & Kahler 1999, Cohen *et al.* 2003). Molar teeth with vertical root fracture might be partially preserved by surgical removal of the fractured root; however, the treatment of vertical root fracture in a single-rooted tooth is usually extraction. The clinical condition becomes worse if the fractured tooth serves as an abutment as it might lead to major changes in prosthetic planning. Although several methods of treatment have been proposed, (Pitts & Natkin 1983, Trope & Rosenberg 1992, Selden 1996, Dederich 1999, Funato *et al.* 1999, Sugaya *et al.* 2001), none have been established to maintain the vertically fractured tooth in the long term. On the other hand, replantation of root-filled teeth with vertical root fracture reconstructed with resin bonding has emerged as a new promising method in recent years (Sugaya *et al.* 2001, Hayashi *et al.* 2002, 2004, Kawai & Masaka 2002, Kudou & Kubota 2003). Hayashi *et al.* (2004) have reported the prognosis of replanted root-filled teeth with vertical root fractures after reconstructing with resin bonding. Based on their long-term clinical results, this approach might be considered particularly for incisors as an alternative to extraction.

Incisor teeth are critically important in the dentition because of their pivotal role in aesthetics, function and phonetics. Prosthetic replacement of an extracted incisor particularly in the maxilla might be challenging with options including a removable prosthesis, fixed bridgework or an implant fixture. From this point of view, collapse of the alveolar ridge in both vertical and horizontal dimensions and loss of interdental papilla as a result of extraction might complicate prosthetic treatment and necessitate ridge augmentation to place an aesthetically acceptable pontic. This consequence might be prevented by methods which preserve the alveolar socket or by immediate implantation. However, establishment of a treatment method that could maintain maxillary incisors with vertical root fracture in the alveolar socket would be of great value to patients, avoiding surgical procedures and financial costs resulting from extraction.

The objective of this report was to describe the 18-month follow-up of a root filled maxillary central incisor exhibiting complete midline vertical fracture, which was repaired with adhesive resin before replantation.

Report

A 26-year-old male referred to the School of Dentistry, Ege University, Turkey complained of poor aesthetics because of a fracture line on his maxillary right central incisor tooth that had been root filled 1 year before (Fig. 1a). Clinical and radiographic examination revealed a vertical root fracture line extending through the long axis of the tooth towards the apex, separated fragments and deep periodontal pockets on the buccal and palatal aspects (Fig. 1b). The patient reported that the tooth had fractured 3 months before while biting. The medical history revealed no systemic diseases, bleeding problems or other clinical conditions that could negatively influence the process or outcome of surgical procedures. The purpose, procedures and possible failures associated with replantation were explained to the patient in detail and replantation was performed only after the written consent was provided. The patient received scaling and instruction in oral hygiene measures including brushing and flossing before surgery.

Preoperatively, probing depth (PD) and clinical attachment levels at four sites (mid-buccal, distal, mid-palatal and mesial) around the tooth were measured with a Williams probe using the cemento-enamel junction as the reference line. Following local anaesthesia with a solution of 2% lidocaine with 1 : 100 000 adrenaline (Jetokain, Adeka İlaç A.Ş, İstanbul, Turkey) supra-alveolar fibres were dissected circumferentially and the tooth was extracted with particular attention to avoid damage to the periodontium

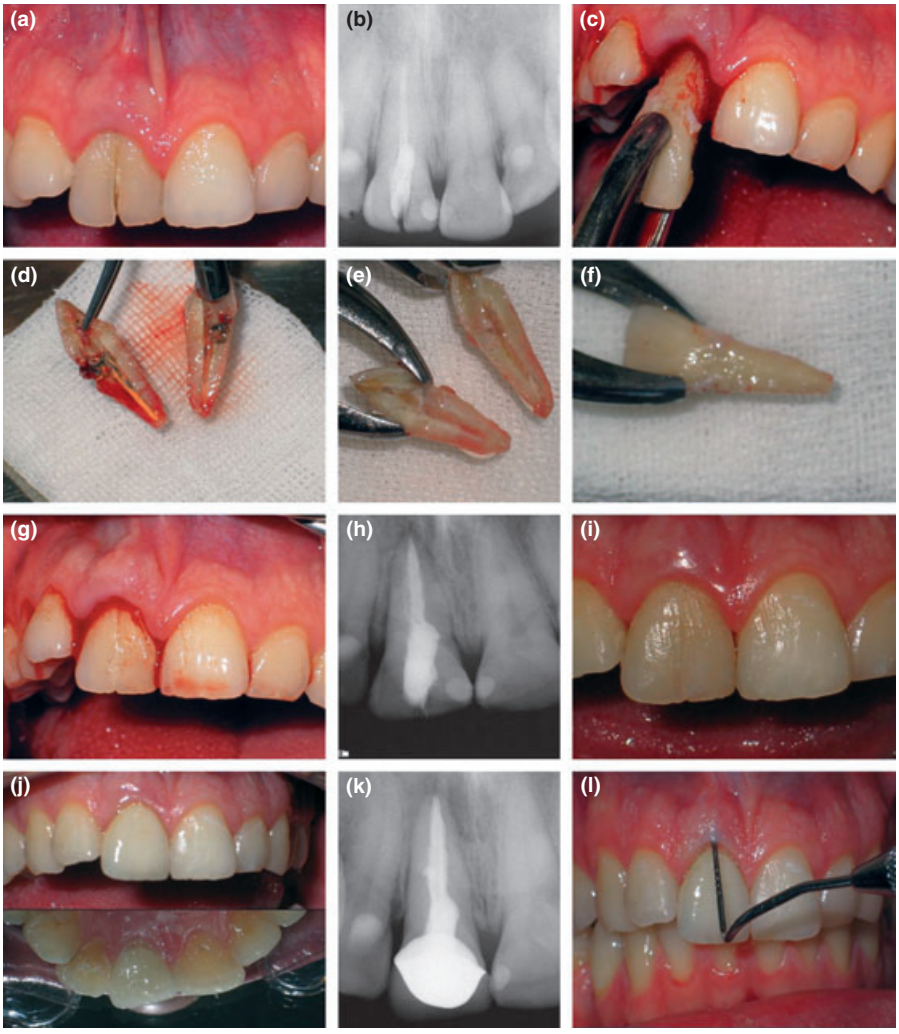

Figure 1 (a) Midline vertical fracture on the right central incisor, (b) preoperative radiographic view of complete vertical fracture extending through the apical region, (c) tooth was extracted with minimal trauma to the surrounding tissues, (d) two separate fragments of the tooth at the time of extraction, (e) root canal filling material was removed with rotary instruments and a shallow preparation was made along the fracture line, (f) two fragments resin-bonded to form one complete tooth, (g) clinical view at 4 weeks following removal of provisional splint, (h) radiographic view at 4 weeks, (i) clinical view at 2 months, (j) vestibular and palatal views of the tooth at 18 months, (k) radiographic view at 18 months, (l) no deep periodontal pockets were present along the fracture line at 18 months.

(Fig. 1c,d). The extracted tooth was immediately soaked in physiological saline solution and left there except for the operative procedures. The extraction socket neighbouring the fracture lines was gently curetted to remove inflamed tissues and debris. Inflamed soft tissues on the root were removed with fine scissors. Fracture lines were finely trimmed with rotary instruments and root filling material was removed completely (Fig. 1e). The separated fragments were united using dual-curing adhesive resin cement (Variolink II, Ivoclar Vivadent AG, Schaan, Liechtenstein) in accordance with the manufacturer's instructions. Air drying was only applied to the inner surfaces of the tooth to allow the periodontal ligament on the root surface to remain damp. The adhesive resin cement was then applied to the root canal and fracture lines and the fragments adhered (Fig. 1f).

Particular attention was paid to keep the resin width to a minimum along the fracture lines. Excess cement was removed with hand instruments.

Care was taken to minimize trauma to the periodontal ligament remnants on the root surface and to avoid excessive manipulation time in dry conditions. Blood clot was aspirated from the extraction socket and then the tooth was rinsed with saline and replanted into the socket in its original position with gentle pressure. To ensure correct positioning of the tooth in the alveolus, the patient was instructed to bite in centric occlusion. The tooth was then temporarily splinted to adjacent teeth with a 0.5 mm round wire and light-cured composite resin material. The patient was prescribed 3 × 500 mg amoxicillin and 2 × 550 mg naproxen daily for 1 week and instructed to rinse with a 0.2% chlorhexidine solution and to avoid biting hard food with his anterior teeth. The total time elapsed between the extraction and reimplantation of the tooth to the socket was 23 min.

The healing period following surgery was uneventful. The temporary splint was removed at 4 weeks (Fig. 1g,h) and at 2 months (Fig. 1i) the tooth was restored with a full-coverage crown. Postoperative follow-up including evaluation of clinical (mobility, pain, swelling, presence of fistula, sensitivity to percussion/occlusal load, abnormal percussion sound as a sign of ankylosis) and radiographic (lamina dura, external root resorption, periodontal ligament space) parameters and reinforcement of oral hygiene if necessary was performed weekly for the first month, monthly for 6 months and then at six monthly intervals. Periodontal probing was not performed until the sixth month as it may disturb regenerating periodontal tissues. No clinical or radiographic signs of failure were observed or reported by the patient during the evaluation period. The periodontal condition of the tooth along the fracture lines showed improvement at the 6-month evaluation compared with baseline, whereas proximal aspects remained unchanged (Table 1). At 18 months, periodontal parameters continued to improve, and no refracture was observed. Lamina dura and completely regenerated periodontium were radiographically detectable and the tooth remained in function exhibiting physiological mobility (Fig. 1j,k,l).

Discussion

Replantation of a tooth with a vertical fracture following resin cement bonding is a method that is performed in an attempt to maintain teeth. Hayashi *et al.* (2002, 2004) have evaluated the short- and long-term prognosis of replanted teeth with vertical root fractures bonded with resin cement. The authors evaluated 8 incisors, 14 premolars and 4 molars for 4–76 months and reported no extraction because of failure of incisors and therefore described this method as a predictable treatment for incisors but not for premolar or molar teeth (Hayashi *et al.* 2002, 2004). When the replanted teeth were

Table 1 Probing depth (PD) and clinical attachment (CAL) loss measurements at baseline, 6, 12 and 18 months

	Mesial	Vestibule	Distal	Palatal
PD				
Baseline	2	11	2	10
6 months	2	7	2	6
12 months	2	4	2	5
18 months	2	3	2	4
CAL				
Baseline	2	11	2	10
6 months	2	7	2	6
12 months	2	5	2	5
18 months	2	3	2	4

subgrouped by clinical condition such as the type and extension of the fracture and method of reconstruction, three out of eight incisors, two mandibular and one maxillary exhibiting complete vertical root fracture were bonded and were maintained with a successful prognosis in the long term. In light of the reported good prognosis and clinical procedure guidelines described in the studies of Hayashi *et al.* (2002, 2004) the present case was referred for replantation. The present case also showed no signs of failure during the 18-month follow-up and provided further evidence for such management of maxillary central incisors with complete vertical root fracture. The success of this method in maxillary anterior teeth might be, at least partly, related to their location and morphology, i.e. light bite forces and better maintenance of oral hygiene in the anterior region.

The adhesive resin cement used in this case was selected because of its high bonding strength, good marginal integrity, acceptable biocompatibility and short polymerization time (Federlin *et al.* 2005, de Souza Costa *et al.* 2006, Piwowarczyk *et al.* 2007). The bonding strength and polymerization time of the cement used for luting the fractured fragments is particularly important as the tooth continues to endure moisture and occlusal forces. Moreover, a bonding product allowing short extra-oral working time thus facilitating the preservation of the vitality of the periodontal ligament is critically important for the long-term success of replantation (Andreasen 1981, Blomlof *et al.* 1983, Andreasen *et al.* 1995, Barrett & Kenny 1997, Trope 2002). Previous studies have reported successful results of replanted incisor teeth using 4 methacryloxyethyltrimellitate anhydride/methyl methacrylate-tri-n-butyl borane as the bonding agent (Sugaya *et al.* 2001, Hayashi *et al.* 2002, 2004, Kawai & Masaka 2002, Kudou & Kubota 2003). Therefore, the adhesive resin product used in the present case might be another choice of bonding agent in reconstruction of incisor teeth that are candidates of replantation.

In the present case, deep PDs along the fracture line improved throughout the evaluation period. The existence of vital periodontal ligament cells with proliferative capacity on the reimplanted tooth is decisive for periodontal healing (Pohl *et al.* 2005a). A dry time of less than 15 min is optimal where periodontal healing might be expected (Pohl *et al.* 2005a). Improvement of the periodontal condition in the present case was probably because of the result of the preservation of the tooth in a moist condition, excluding the periodontal surface when air drying and the short working time of the bonding product. Although one might expect external root resorption as the tooth was kept relatively dry during the adhesive procedure, no radiographically detectable resorptive areas were observed in the evaluation period. This consequence might be attributable to the fact that the tooth was previously root filled and therefore there were no toxins from a necrotic pulp to initiate root resorption (Pohl *et al.* 2005b). However, the possibility of further root resorption cannot be excluded; negligible or radiographically undetected resorption areas might have existed particularly along the fracture line. Furthermore, clinicians should be aware of the possible disadvantages including further bone resorption along the fracture line when attempting to preserve an incisor tooth with vertical root fracture. Decision between timely extraction of an incisor tooth with complete vertical root fracture and replacing with immediate/delayed dental implant or replantation with resin bonding should be carefully considered and discussed with the patient before treatment.

Conclusions

Replantation of maxillary incisor teeth with complete vertical root fracture after reconstructing with resin cement might be an alternative to simple extraction. Studies evaluating the long-term reliability of this technique would help to clarify its true potential.

Disclaimer

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