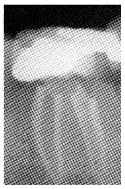
International Endodontic Journal

doi:10.1111/j.1365-2591.2011.01922.x



CASE REPORT

Intentional re-plantation of a vertically fractured tooth repaired with an adhesive resin

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Abstract

Unver S, Onay EO, Ungor M. Intentional re-plantation of a vertically fractured tooth repaired with an adhesive resin. *International Endodontic Journal*, **44**, 1069–1078, 2011.

Aim To present the successful treatment of a vertically fractured tooth by intentional re-plantation after root canal treatment and repair with an adhesive resin.

Summary Vertical root fracture is a challenging problem in respect of diagnosis and management options. In this case, a vertically fractured maxillary premolar was treated by intentional re-plantation after repairing it with 4-Methacryloxyethyl trimellitate anhyride/methacrylate-tri-n-butyl borane (4-META/MMA-TBB) resin cement. At the 36-month follow-up, the tooth was asymptomatic, radiographically sound with reduced deep periodontal pockets and vertical bone loss.

Key learning points

- Intentional replantation after repairing fractured fragments with an adhesive resin extraorally is a treatment option.
- Long-term follow-up is necessary to evaluate the outcome of this technique.

Keywords: bonding, intentional replantation, treatment, vertical root fracture.

Received 14 December 2010; accepted 20 June 2011

Introduction

Vertical root fracture (VRF) is defined as a partial or complete fracture line that extends through the long axis of the tooth (Tamse *et al.* 1999). It is considered as a challenging problem in respect of diagnosis, treatment options, and particularly for survival of teeth. It usually originates from the apical end of the root and continues coronally. Considerable loss of tooth structure during instrumentation, excessive compaction forces during canal filling procedures, overpreparation of post-space, wedging effects of endodontic posts, corrosion and expansion of posts, exposure to occlusal forces beyond normal limits have been reported as the most likely causes of VRF (Holcomb *et al.* 1987, Tamse 1988, Dang & Walton 1989).

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The reported common clinical symptoms of VRFs are presence of dull pain, gingival swelling and sinus tract. VRFs also lead to deep localized periodontal pockets and vertical bone defects (Lommel *et al.* 1978, Meister *et al.* 1980, Pitts & Natkin 1983).

The prognosis of teeth with VRF is poor, and these teeth usually require extraction. Additionally, a VRF in one root in multirooted teeth can be treated by root resection (Pitts & Natkin 1983) and intentional re-plantation of a tooth after bonding the fractured fragments extra-orally (Sugaya *et al.* 2001). The distance between separated fragments, vertical bone defect localisation, the position and the extent of the fracture are important factors to determine the treatment modality (Ozturk & Unal 2008). There are several reports in the literature describing the intentional re-plantation of vertically fractured roots after repair with a dentine-bonded resin extra-orally which could be an alternative treatment, rather than extraction or root resection (Sugaya *et al.* 2001, Hayashi *et al.* 2002, Kawai & Masaka 2002, Kudou & Kubota 2003, Arikan *et al.* 2008, Ozturk & Unal 2008).

Vertical root fracture usually occurs in root filled teeth (Fuss *et al.* 2001). VRFs in teeth without root filling are relatively uncommon and have been reported to occur primarily in Chinese populations. This type of VRF is confined to the root surface and distinct from those which are apical extensions of coronal fractures. Several case series have described VRF in non root filled teeth (Yang *et al.* 1995, Yeh 1997, Chan *et al.* 1998, 1999, Wang & Su 2009). Root fractures in non root filled teeth are also observed as apical extensions of coronal fractures associated with cracked or split teeth (Cameron 1964, Gher *et al.* 1987). VRFs in non root filled teeth should be differentiated from root fractures that began as coronal fractures.

The objective of this report was to present the intentional re-plantation of a vertically fractured tooth that had not been root filled previously, after repair with an adhesive resin.

Case report

A 41-year-old female patient was referred to Baskent University, School of Dentistry with the primary complaint of discomfort in her maxillary right first premolar. Although the tooth had no restorations and was seemingly intact, clinical examination revealed a fistula on the adjacent attached gingiva and a 10 mm periodontal pocket on the mesial side of the tooth (Fig. 1). Radiographic examination revealed vertical bone loss on the mesial aspect of the root (Fig. 2). Root canal treatment was indicated since the pulp was necrotic. After access cavity preparation, a fracture line that was located mesiodistally and extending through the

Figure 1 Clinical view of fractured tooth with sinus tract.

Figure 2 Pre-operative radiographic view of fractured tooth and vertical bone loss.

Figure 3 Access cavity preparation showing the fracture line.

long axis of the tooth towards the apex was observed (Fig. 3). After working length determination (Fig. 4), the root canals were prepared to a size 30 master apical file using a step-back technique, irrigated with 0.2% chlorohexidine gluconate, medicated with calcium hydroxide (Merck, Darmstadt, Germany) and sealed with Cavit (ESPE America Inc., Norristown, PA, USA). A treatment plan comprising intentional re-plantation following repair of the fractured root fragments was agreed. The patient was informed about the procedures, purpose and possible failures of the intentional re-plantation technique and a written consent was provided. The patient had no systemic diseases that could influence the surgical procedures. Following local anaesthesia, the buccal and palatal segments and

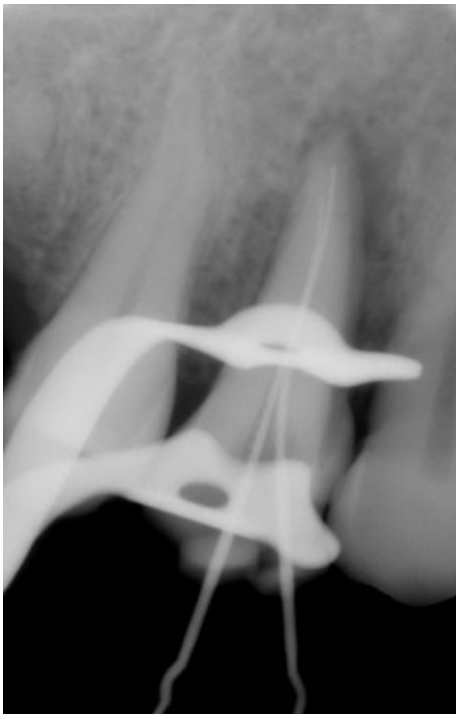

Figure 4 Radiographic view of working length determination.

Figure 5 The fragments of fractured tooth.

roots were extracted separately and gently to minimize the damage to the periodontal tissues. Following the extraction, the tooth was wrapped with gauze soaked with physiologic saline solution (Fig. 5). During the re-plantation procedure, the fractured root fragments of the tooth were kept moist. The root canals of the tooth were filled with Hybrid Root Seal (Sun Medical Co. Ltd., Moriyama, Shiga, Japan) and gutta-percha (Diadent, Chongju, Korea) using lateral condensation extra-orally. 4-Methacryloxyethyl trimellitate anhyride/methacrylate-tri-*n*-butyl borane (4-META/MMA-TBB) resin cement (Super Bond C & B; Sun-medical Co., Moriyama, Shiga, Japan) was mixed according to the

Figure 6 The view of the tooth after repair.

manufacturer's instructions and was evenly spread over the fractured segments and the fractured root fragments were re-apposed. The resin remnants and granulation tissues on the root surface were removed gently (Fig. 6). Following repair, the tooth was rinsed with saline and replaced into the socket in its original position (Figs 7 and 8). The tooth was then splinted temporarily to adjacent teeth with an orthodontic wire and a light-cured composite resin. The occlusal contact of the tooth was removed. An antibiotic (3 × 500 mg amoxycillin) and an analgesic (2 × 550 mg naproxen) were prescribed. The total time elapsed between the extraction and re-plantation of the tooth into the socket was 25 min.

Three weeks later, the temporary splint was removed and at 3 months the tooth was restored with a crown splinted to a fixed bridge (Fig. 9). After 6 months, the periodontal condition of the tooth had improved compared with the pre-operative condition (Fig. 10). The probing depth was 5 mm on the mesial side of the tooth. During the post-operative follow-up period, periodontal parameters continued to improve, and no signs of ankylosis, refracture, periodontal pockets, mobility and abscess formation were observed. At the 24-month follow-up period, the tooth was clinically and radiographically sound. The deep periodontal pockets and vertical bone loss reduced throughout this period (Fig. 11).

Figure 7 Clinical view of the fractured tooth after re-plantation.

Figure 8 Radiographic view after re-plantation.

Figure 9 The mirror image of restoration of the fractured tooth with a crown splinted to a fixed bridge after 3 months.

Periodontal probing depths were 2–3 mm around the tooth. The tooth was still in function with completely healed periodontium at the 36-month follow-up period (Fig. 12).

Discussion

In this case, the aim was to preserve the vertically fractured tooth using intentional re-plantation including extraction and then bonding the root fragments with an adhesive resin extra-orally.

4-Methacryloxyethyl trimellitate anhyride/methacrylate-tri-n-butyl borane resin cement was used for bonding the fractured segments due to its superior adhesive property and

Figure 10 Radiographic view at 6-month follow-up.

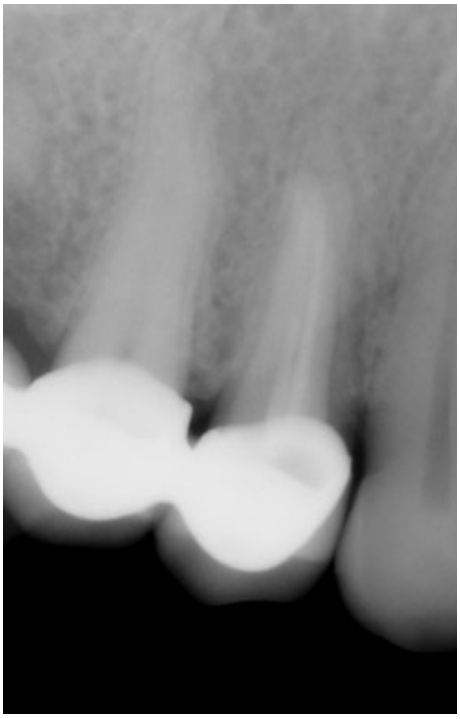

Figure 11 Radiographic view at 24-month follow-up.

Figure 12 Radiographic view at 36-month follow-up.

biocompatibility. It has a high tensile strength and is unaffected by blood contamination (Miles *et al.* 1994, Hayashi *et al.* 2002). A sufficiently high bonding strength of the dentine-bonded resin cement is a critical requirement for long-term success of repaired roots. As the tooth continues to endure masticatory forces the adhesive property of the bonding agent is particularly important. Previous studies have reported successful re-plantation of vertically fractured teeth using this resin cement as the bonding agent (Sugaya *et al.* 2001, Hayashi *et al.* 2002, Kawai & Masaka 2002, Kudou & Kubota 2003).

Rotation of the repaired roots at re-plantation may be an option to promote the generation of periodontal tissue surrounding a fracture line. Rotational re-plantation is suggested to avoid contact with the area where the periodontal ligament and the bone has been lost (Fariniuk *et al.* 2003). However, indications for rotational re-plantation have limitations owing to root curvatures or anatomical structures (Hayashi *et al.* 2004). In this case, re-plantation was carried out without rotation as the replanted tooth had a degree of root curvature. Over time, periodontal regeneration was detected clinically and radiographically.

Given the fact that the bond strength of the resin is not high, additional external strengthening by crowning such teeth is recommended. In this case, to provide additional external support, in the third month following the re-plantation, the tooth was restored with a crown splinted to a fixed bridge. Although it was first intended to replace the missing maxillary right first molar by implant placement, this was not done.

Despite the increased load on the tooth, no problem has been noted during the 3 years following the re-plantation. On the other hand, further follow-up is important to observe the long-term effects of this management option.

In order to enhance healing of re-planted teeth, the preservation of vital periodontal ligament cells remaining on the root surfaces of the extracted teeth is of critical importance (Andreasen *et al.* 1995). On the other hand, ankylosis is a common complication of re-planted teeth leading to a gradual resorption of the tooth tissues and

their replacement by bone (Andreasen 1980, Hammarström *et al.* 1989). The survival of the periodontal ligament cells along the root surface is important for periodontal healing and preventing ankylosis. Therefore, in the present case, maximum care was taken to minimize trauma to periodontal ligament remnants on the root surface. Also during the repair, the extracted tooth was kept moist to encourage maintenance of the vitality of periodontal ligament cells. The deep periodontal pocket and vertical bone loss along the fracture line have improved throughout the follow-up period. Ankylosis is usually diagnosed within the first 2 years after re-plantation (Andreasen *et al.* 1995). Although in the present case, ankylosis was not detected either clinically or radiographically at the end of the 36-month period, a long-term follow-up is still needed as negligible or radiographically undetected resorptive areas may exist. Thus, the possibility of further root resorption cannot be excluded in such cases.

Conclusion

Intentional re-plantation of vertically fractured teeth after repair with an adhesive resin might be an alternative to extraction. Although this method has the potential to preserve vertically fractured teeth, long-term follow-up is necessary to evaluate reliability of this technique.

Disclaimer

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