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A successful treatment of vertical root fracture: a case report and 4-year follow-up

CASE REPORT

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Abstract – This case report describes a successful treatment of vertically fractured tooth which was reconstructed with a self-etching dual-cured adhesive resin cement and intentionally replanted without using rotation in conjunction with a bio-absorbable barrier membrane. At a follow-up consultation 4 years later, the tooth was asymptomatic, and attachment gain and bone regeneration were observed. In addition, no ankylosis was detected clinically or radiographically.

Vertical root fracture (VRF) occurring in oblique or longitudinal fashion in crown, root or both of the endodontically treated teeth is a complication, which may result in extraction (1). Statistically, 11–20% of VRF cases were reported to be referred for extraction (2, 3). Excessive biomechanical preparation, overzealous widening of the canal for post placement (4, 5), exposure to occlusal forces beyond normal limits (6), increased stress caused by lack of sufficient periodontal support or presence of internal root resorption or both (7), moisture loss in pulpless teeth (8), previous cracks in the dentin occurring during compaction of root filling materials (9–11) or loss of healthy tooth substance because of large caries and trauma (12) are the predisposing and iatrogenic etiologic factors of VRF.

Some cases of successful treatment of VRF were reported to have been carried out by extracting the fractured tooth atraumatically, bonding the fragments, and then replanting the tooth with a 180° rotation (13–15). The rotation of the tooth leads to connection of the remnants of the healthy periodontal membrane, remaining of the root, with the connective tissue in the periodontally involved socket wall (16).

In the past, glass–ionomer cement (17) or cynoacyrlate cement (18) was used for bonding fractured teeth. Nowadays, successful cases treated with adhesive resin cement have been reported in VRF (13, 14, 19, 20). A self etching dual-cured adhesive resin cement (Bistite® II DC; Tokuyama America Inc., Burlingame, CA, USA) has been used for cementation of precious and non-precious metals, ceramics, porcelain, cured composite crowns, inlays, onlays, bridges and veneers. A high bond and tensile strength were reported using this material (21, 22).

The aim of this case report was to present the successful treatment of a vertical root fracture by intentional replantation without rotation of the tooth bonded with a self-etching dual-cured adhesive resin cement and its checks over 4 years.

Case report

In January 2004, a 51-year-old male, with no systemic health problems, was referred to Suleyman Demirel University, Faculty of Dentistry complaining of pus draining and chronic dull pain in the right anterior region of the maxilla. In the clinical examination, fixed crown restorations in the upper central incisors were observed. Probing of this region revealed periodontal pockets deeper than 4 mm all around the central incisors. An 8-mm deep periodontal pocket was detected in distobuccal side of upper right central incisor and a 7-mm deep periodontal pocket was determined in the mesial side of upper left central incisor. The clinical attachment level and probing pocket depth were measured in six sites around the teeth and the mean values were calculated. The mean clinical attachment level (CAL) of the right central incisor was 4.8 mm and that of the left central incisor was 4.2 mm. There was no mobility in the upper left central incisor. The mobility of the upper right central incisor was determined at 2°. Moderate chronic periodontitis was diagnosed in the clinical examination. Radiographic examination revealed a vertical fracture in the distal aspect of the upper right central incisor, which had been endodontically treated. Also, a vertical bone defect in interdental septum between the central incisors was detected (Fig. 1).

The fracture was obvious in the distal aspect of the upper right central incisor when the crown restoration was removed. The periodontal probe could be penetrated between fractured tooth fragments (Fig. 2).

A full-thickness flap was elevated from the upper right canine to the upper left canine and granulation tissues in

the region were removed. The fractured tooth fragments were extracted gently using dental forceps (Fig. 3) and immediately immersed in saline solution. It was observed that fracture line crossed obliquely from distal third in cemento-enamel junction to mesial margin of the apical third of the tooth 11. Only the socket wall neighboring the fracture region was gently curetted with Gracey curettes and irrigated with saline solution for debridement of the bone surfaces. The debris and remnants of the gutta-percha and cement inside the root canal were removed with gates-glidden (Mailefer, Dentsply, Switzerland) and irrigated with saline. A dual-cured adhesive resin cement (Bistite® II DC; Tokuyama America Inc.) was applied to the fractured surfaces of the fragments according to manufacturer's instructions for both bonding the fragments and filling root canal space. After the attachment of the fragments, the resin was cured all around the tooth for 4–5 min using a light curing unit at 400–450 mw (Degulux; Degussa AG, Frankfurt, Germany). The resin remnants and granulation tissues around the root were removed gently with a Gracey curette. The tooth was rinsed with saline and replaced into the socket in its original position. The total time, extra-orally, was less than 30 min. A bio-resorbable barrier membrane (Epiguide Curasan; Pharma Gmbh AG, Lindigstrab, Germany) was placed on the interdental septum between the central incisors to treat the bone defects around the incisor teeth (Fig. 4). The flap was sutured in its original position. The former crown restorations were temporarily cemented to the teeth. The teeth were splinted from the upper right central incisor to the upper left central incisor with a composite resin (Admira; Voco, Cuxhaven, Germany). A metranidazole and penicillin combination (Alfoxil® 500 mg; Fako, Istanbul, Turkey and Biteral® 250 mg; Roche, Istanbul, Turkey for 5 days), as well as a chlorhexidine digluconate mouth rinse (Klorhex; Drogsan, Istanbul, Turkey), was prescribed.

Seven days later, sutures were removed as well as centric and protrusive contacts of the right central incisor. The frenulum causing muco-gingival stress at interdental papillae of the central incisors was removed with frenectomy.

Fig. 1. Preoperative radiograph showing vertical root fracture in the upper right central incisor and a vertical bone defect in interdental septum of central incisors.

Fig. 3. The fragments of fractured tooth.

Fig. 2. The periodontal probe penetrating between fractured crown fragments.

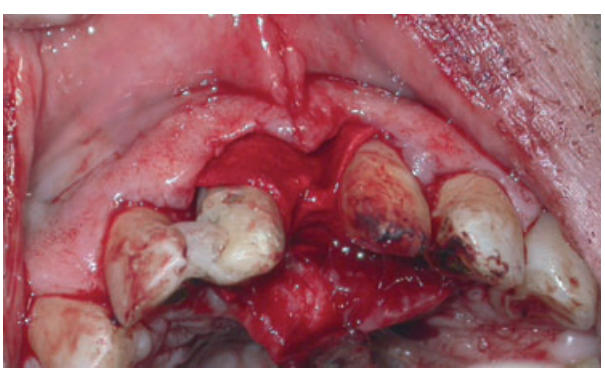

Fig. 4. The view of the barrier membrane placed between the upper central incisors.

The teeth were checked at regular periods. Clinical and radiographic examinations were carried out every month. One month after the replantation, splint was removed for measurement of tooth mobility. Because of standing mobility, the teeth were re-splinted for one more month. As the mobility of central incisors was observed to fall by 1° at the end of the second month, the splint was removed permanently. Six months after the replantation, the upper central incisors were asymptomatic both clinically and radiographically (Fig. 5). The CAL in the distal side of the upper right central incisor was 3 mm, and that in the mesial side of the upper left central incisor was 4 mm. The mean probing depth of the right central incisor and the left central incisor decreased to 2.8 and 2.7 mm, respectively. There was no mobility of teeth. Permanent fixed crowns were made for the central incisors, and then cemented to the teeth. Time lapse between check ups was increased to 3 months. The fractured tooth was asymptomatic for more than 3 years (Fig. 6). Four years after the replantation, there was no mobility in either of the central incisors and the mean probing pocket depths of the right central incisor and the left central incisor were 1.4 and 1.7 mm, respectively. The CALs in the disto-buccal side of right central incisor and the mesial side of the left central incisor were observed to fall dramatically from 8 and 7 mm to 1 and 2, respectively. The gain in attachment in the right and left central incisors was 3.5 and 2.4 mm, respectively. Bone filling in the interproximal area of central incisors was observed in radiographic examination after 4 years (Fig. 7).

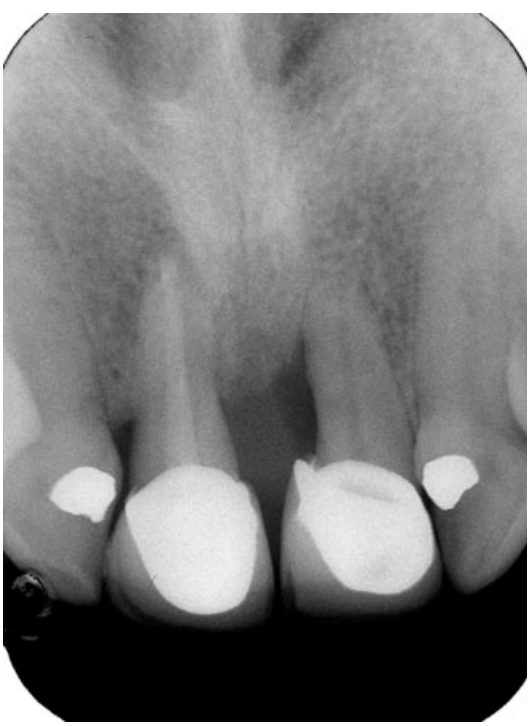

Fig. 5. After 6 months, the healing of periodontium within normal limits surrounding the replanted tooth and the initial bone filling in vertical defect localized in the mesial side of the left central incisor were observed in the radiograph.

Fig. 6. After 4 years, the clinical appearance of the replanted tooth and the neighboring central tooth with permanent restorations.

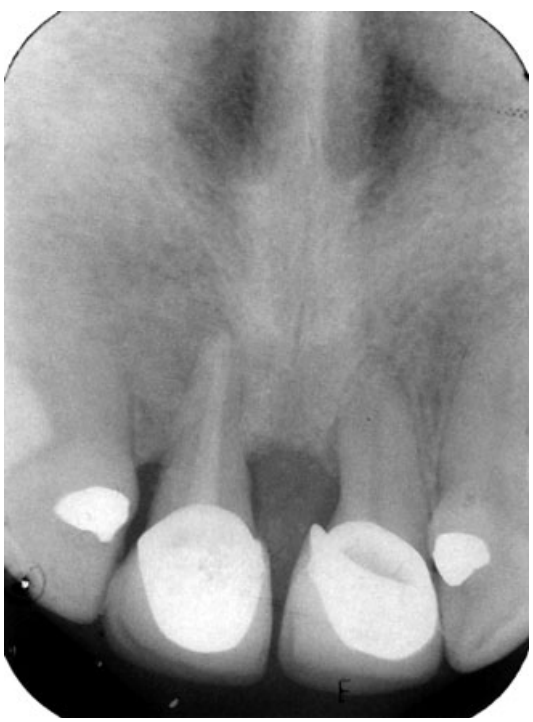

Fig. 7. The marked bone filling is observed in periapical radiograph after 4 years.

Discussion

This case report follows the long-term treatment and check ups of an intentional replantation of a vertically fractured root after reconstruction with a self-etching dual-cure adhesive resin different from 4-META/MMA-TBB resin cement and the successful regeneration surrounding the fractured root with a barrier membrane.

In recent studies, 4-META/MMA-TBB (Super-Bond C&B; Sun Medical, Kyoto Japan), self-cure adhesive resin cement, has been found to be effective for bonding tooth fragments (14, 16, 19, 20, 23). The difficulties in polymerization control of 4-META/MMA-TBB resin cement constitute a disadvantage for clinical application. For this reason, a dual-cured adhesive resin cement (Bistite® II DC; Tokuyama America Inc.) was preferred

to 4-META/MMA-TBB resin cement for bonding the vertically fractured fragments, as it has a controlled polymerization and is easy to apply.

The adhesive resin cement used in the reconstruction of VRF has been successful for a period of 4 years, like 4-META/MMA-TBB. The adhesive resin cement used in this case has been successful in the reconstruction of VRF like 4-META/MMA-TBB over the 4-year period.

The intentional replantation of a vertically fractured tooth with a simultaneous flap operation was preferred to a normal extraction without a flap reflection, because of the vertical bone defect localized in the interproximal region of the central incisors and deep periodontal pockets neighboring the vertical fracture. The bio-resorbable membrane was placed between the upper central incisors to promote bone filling in the vertical bone defect following the replantation of the fractured tooth.

It is advocated that the deep and narrow periodontal pockets along the fracture line usually remain in intentional replantation of vertically fractured teeth without rotation (24). Recently, the intentional rotational replantation has been suggested to avoid contact with the area where the periodontal ligament was lost and the area where the bone was lost in the treatment of VRF (16). In the present case, intentional replantation was performed without rotation as there was moderate attachment loss all around the upper right central incisor in addition to the deep periodontal pocket along the fracture line. The residual deep periodontal pocket along the fracture line was not examined during the 4-year follow-up period. In addition, periodontal regeneration of the surrounding bone was detected radiographically.

The application of a bio-resorbable membrane on root surfaces reinforces the periodontal healing allowing for regeneration of periodontal ligament cells around the upper central incisors. The membrane placement over the curetted root surfaces aims to prevent any gingival connective tissue making contact with the root surfaces during healing, and provides a space for the ingrowth of periodontal ligament tissue (25). Trope and Rosenberg (26) reported that the replantation of a vertically fractured tooth, after bonding the fragments in conjunction with guided tissue regeneration by a barrier membrane, was a successful approach for a 1-year observation period.

Ankylosis is a common complication of replanted teeth leading to a gradual resorption of the dental hard tissues and their replacement by bone (27, 28). The vitality of the periodontal membrane was reported to be of critical importance in preventing ankylosis. Therefore, using extreme care only the granulation tissues and adhesive resin remnants were removed in this case. Ankylosis is usually diagnosed within the first 2 years after replantation (29). In our case, it was not detected either clinically or radiographically at the end of the 4 years. The reason for this may be the placement of the membrane between the upper central incisors covering buccal and palatinal surfaces of the teeth. The barrier membrane forms a space between epithelium or connective tissue cells and cementum. As ankylosis can, in rare cases, be diagnosed between 5 and 10 years (29), the present case needs to be monitored carefully for the foreseeable future.

Hayashi et al. (21) stated that success in VRF treatment was defined as being clinically acceptable in all characteristics without any clinical symptoms, demonstrating regeneration of surrounding periodontal tissue radiographically and improvement in the periodontal probing depth at the fracture site. According to this statement, the treatment in our case has been successful for a period of 4 years.

We observed that a bio-resorbable membrane used for the ingrowth of the vertical bone defect in the neighboring tooth was conducive to the dual-cured adhesive resin cement. This suggested that controlled clinical application may prove advantageous in VRF cases.

In conclusion, the treatment protocol used in this case is a promising approach for VRF treatment, especially in cases where there is advanced or moderate bone loss in the surrounding sites of the fractured tooth.

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