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New Approach for the Treatment of Vertical Root Fracture of teeth: A Case Report

Treatment of Vertical Root Fracture of teeth

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Abstract

BACKGROUND

Vertical root fracture (VRF) is one of the most common reasons for tooth extraction, although many methods for saving teeth with VRF have been attempted.

CASE SUMMARY

This case describes a female patient who had a sinus tract on the labial gingiva of the left maxillary central incisor for two months. Periodontal probing revealed an 8-10 mm deep, narrow, isolated pocket on the palatal side of the tooth. Clinical and radiographic examinations confirmed a longitudinal root fracture. A new approach using both resin and iRoot BP Plus through the intentional replantation method was used for the treatment of the tooth. At one-year follow-up, the tooth remained asymptomatic with normal periodontal probing depth, and the radiographic images showed almost normal bone and periodontal structures around the root.

CONCLUSION

This new approach might be developed as an effective method to save teeth with VRF.

Key Words: vertical root fracture; intentional replantation; iRoot BP Plus; resin; teeth; treatment; case report

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Core Tip: This case report proposed a new approach for the treatment of teeth with vertical root fracture (VRF) using both resin and iRoot BP Plus through intentional replantation. It might be developed as an effective method to save the teeth with VRF.

INTRODUCTION

Vertical root fracture (VRF) is a longitudinally oriented fracture of the root and can be classified as an incomplete or complete vertical root fracture based on the degree of separation of the fracture according to Leubke's classification (1-4). VRF is a serious complication with poor prognosis for endodontically treated teeth. The overall prevalence of VRF reported in retrospective studies was 3%-5%, but the prevalence of VRF in extracted endodontically treated teeth was 11%-20% (1,3). Even if extraction is usually the first choice of management for teeth with VRF, many other attempts to preserve the teeth have also been performed in many case reports, such as using adhesive composite resins (4-6), CO₂ lasers and ND:YAG lasers(7), mineral trioxide aggregates (MTAs)(8-9) and biodentine (10-11).

Adhesive composite resin is often used to bond fractures together due to its superior adhesive strength. Intentional replantation combined with fracture bonding by adhesive composite resin has been reported as a successful treatment method for preserving a tooth with VRF. Despite this, due to the poor tissue attachment to the resin surface, deep and narrow periodontal pockets along the bonded fracture could easily recur.

iRoot BP Plus is a ready-to-use calcium silicate-based bioceramic material suitable for repairing various root canal perforations or resorptions due to its ability to induce tissue attachment and mineralization (12-15). Based on its excellent biological features, iRoot BP Plus would be an ideal material for repairing VRF. However, the bonding strength between the iRoot BP Plus and dentin is not as strong as the adhesive composite resin when holding the fractures in position (16).

Based on these concerns, the present case combined adhesive composite resin and iRoot BP Plus to repair a VRF through intentional replantation. This new approach might be developed as an effective method to save teeth with VRF. This case report was prepared according to the Preferred Reporting Items for Case Reports in Endodontics (PRICE) 2020 (17).

Chief complaints

A 27-year-old chinese woman was referred to our department for the treatment of pustules on the labial gingiva of the maxillary anterior teeth.

History of present illness

The pustule occurred two months ago, and the patient said that tooth #9 (left maxillary central incisor) underwent root canal treatment (RCT) and full crown restoration several years ago.

4 History of past illness

The patient denied any previous medical history.

Personal and family history

No special personal and family history.

Physical examination

Intraoral examination revealed that tooth #9 was restored with a full crown and that there was a sinus tract on the labial gingival mucosa near the apical area of tooth #9 (Figure 1A). The tooth was sensitive to vertical percussion and had no response to the thermal test. Periodontal probing revealed an 8-10 mm deep narrow isolated pocket on the palatal side of the tooth (Figure 1B).

Laboratory examinations

The findings of laboratory examinations were normal.

Imaging examinations

CBCT (J Morita Corporation, Kyoto, Japan) images confirmed that the tooth had undergone RCT and that there was a large area of bone destruction around the apical and palatal sides of the root (Figure 1 E). Furthermore, a vertical fracture line on

the palatal side of the root was identified from the cervical area to the apex (Figure 1C and D).

FINAL DIAGNOSIS

Based on the clinical and CBCT examination, the final diagnosis of tooth #9 was VRF.

TREATMENT

After communication with the patient, the intentional replantation method was determined for the treatment of the tooth, and informed consent was signed. The prognosis of this treatment was unpredictable for the moment. The timeline for the treatments and reviews of this case are summarized in Table 1.

After local anesthesia, tooth #9 was extracted carefully with dental forceps only touching the crown of the tooth, and then the root of the tooth was covered with wet gauze saturated with normal saline throughout the procedure. The vertical fracture line could be seen under a dental microscope (Zumax Medical Co. Ltd., Suzhou, China) after the granulation tissue was carefully removed using a curette (Figure 2A). Then, the apical 3 mm of the root was excised (Figure 2B). A 3-mm retrograde canal cavity was prepared with an ultrasonic tip and filled with iRoot BP Plus (Innovative Bioceramix Inc, Vancouver, Canada) (Figure 2C). The vertical fracture line was then evenly enlarged to approximately 1.5 mm in width using a high-speed handpiece with a fissure bur along the fracture line (Figure 2D). To enhance fixation strength, two trapezoidal retention forms were prepared on both sides of the fracture line at the crown 1/3 and apical 1/3 of the line. The width of the outer side of the trapezoidal retention form was approximately 3 mm, and the width of the inner side was approximately 2 mm. The depth of the retention form was approximately 2 mm. After applying the bonding agent, light cure composite resin (Ketac Molar Easymix; 3 M ESPE, St Paul, MN) was filled into the fracture line and the retention form (Figure 2E). After the resin was cured, the surface resin was removed to a depth of approximately 1

mm using a fissure bur, and the rest of the resin surface was covered with iRoot BP Plus (Figure 2F). The tooth was then cleaned with normal saline and replanted into the root socket using gentle pressure (Figure 2G). The tooth was finally fixated to the adjacent teeth using a ligation wire. The occlusal condition after replantation was checked, and through occlusal adjustment, the early contact point in centric occlusion and lateral or protrusive movements was avoided. The posttreatment oral hygiene instructions were made clear to the patient.

OUTCOME AND FOLLOW-UP

An immediate postoperative radiograph (Kavo Focus, Tuusula, Uusima, Finland) was taken to confirm the correct position of tooth #9 (Figure 3A). The follow-up examinations were scheduled for one month, three months, six months and one year after the treatment. At one-month follow-up, the mobility of tooth #9 returned to the normal range, and the ligation wire was removed. The radiograph showed slightly reduced apical radiolucency (Figure 3B). At three-month recall, the radiograph showed that the periapical and periodontal radiolucency was significantly reduced (Figure 3C). At six-month follow-up, the radiograph and CBCT revealed significant bone regeneration around the root (Figure 3D, G and H). The tooth was asymptomatic with a normal gingival appearance, periodontal probing depth and mobility (Figure 3E and F). At the one-year examination, the tooth remained asymptomatic with normal gingival appearance, periodontal probing depth and mobility (Figure 4 A, B). The radiograph together with the CBCT image showed almost normal bone and periodontal structures around the root (Figure 4C, D and E), and the patient was satisfied with the treatment outcome.

DISCUSSION

Intentional replantation is defined as the deliberate extraction of a tooth and replantation into its original socket, and fixation *in situ* after evaluation and treatment (18). This procedure allows the extracted tooth to be treated extraorally, and the infected

tissue can be thoroughly removed under a microscope (6). In this case, the left maxillary central incisor was vertically fractured, and a large amount of granulation tissue was found around the fracture line and apex. To more accurately remove the infected tissue and repair the fracture, the intentional replantation method was determined for the treatment. After tooth extraction, both the root apex and the fracture line were cleaned and treated.

Factors that may affect the prognosis of vertical root fracture treatment include the reattachment of periodontal tissue, alveolar bone regeneration, proper sealing of the fracture line and prevention of refracture. The use of adhesive composite resin has been widely reported in the literature for the treatment of VRF (4-6, 19-23). The ideal bonding and repair material for VRF should have the following features to allow for periodontal tissue attachment: sufficient fixation strength, short setting time, easy application, hydrophilicity, bacteriostaticity and biocompatibility (24). Recently, 4-META/MMA-TBB (4-methacryloxyethyl trimellitate anhydride/methyl methacrylate-tri-n-butylborane) resin, a self-cure adhesive resin cement, has been primarily used for splinting mobile teeth or treating fractured teeth with successful reconstruction outcomes (6,23). In addition to the advantages of adhesive properties to dentin, Tanaka et al. (24) reported that 4-META/MMATBB resin adheres to cementum by inducing the formation of hybridized cementum in the short term, which potentially provides a good seal for the bonding of vertically fractured roots. However, Sugaya *et al* (25) found no cementum-like hard tissue formation on the 4-META/MMA-TBB resin surface, and it was difficult to control the polymerization of the material.

On the other hand, endodontic repair cement ProRoot MTA (8-9) and Biodentine (10-11) have also been used for the treatment of VRF. These materials showed an effective seal against dentin and cementum and could promote biological repair and regeneration of periodontal tissue. Compared with MTA, Biodentine has a shorter setting time, is resistant to hydrolysis while setting, and releases more calcium and silicon, which is beneficial to the mineralization of bone and dentin (11). Similarly, iRoot BP Plus is also a hydrophilic calcium silicate-based bioceramic material. iRoot BP

Plus has excellent mechanical properties, sealing ability and antibacterial activity (15,26). Moreover, iRoot BP Plus also shows outstanding biological characteristics. Mahmood *et al.* (27) reported high biocompatibility and desired repair of pulpal and periodontal tissue after iRoot BP Plus treatment of lateral perforations in the roots of rat incisors.

Based on the biocompatibility of iRoot BP Plus and the satisfactory bonding strength of adhesive composite resin, this study combined the two materials to repair vertical fractures. Furthermore, repeated stress overloading could result in fatigue failure of the tooth structure. Even normal functional stresses might result in VRF under conditions of tooth structure with reduced mechanical properties caused by aging, pulp necrosis, and endodontic therapy (28). It is crucial to enhance the fixation strength of the vertical fracture line during the treatment of VRF to reduce the possibility of future refracture. However, even though composite resin had stronger bonding strength than that of the bioceramic materials (29), fixation strength was also closely related to the shape of the defect. Studies have confirmed that the retention form is a necessary means to improve fixation strength, and the design of the retention form could effectively increase the contact area and enhance the retention force of the repair materials (30). Consequently, to obtain higher fixation strength and reduce the possibility of future refracture, two trapezoidal retention forms were prepared on both sides of the fracture line (Figure 5). After the fracture line and retention form were filled with resin, a thin layer of surface resin was evenly removed, and iRoot BP Plus was applied on top of it so that both the bonding strength and pro-osteogenic surface could be achieved. In addition, occlusal adjustment was conducted to facilitate the recovery of the replanted teeth.

The difference in the follow-up period might influence the judgment of treatment results. Through a follow-up study of 1,000 cases treated by endodontic surgery, Rud et al. reported that a standard follow-up should be made one year after the operation because most changes took place within the first year after the operation, and very few successful cases at the one-year recall shifted into questionable or failed treatment

outcomes in subsequent follow-ups (31). Therefore, one-year follow-up in this case might be sufficient to demonstrate the primary treatment outcome, although a longer observation period is still necessary.

CONCLUSION

In summary, the new approach in this study successfully combined the resin and bioceramic material to repair an VRF through a retention form on both sides of the fracture and the intentional replantation method. More clinical applications and longer observation time are necessary to further test the outcome of this approach. This approach might provide a new treatment design for the treatment of VRF.

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SIMILARITY INDEX

PRIMARY SOURCES

1 Rud, J.. "A follow-up study of 1,000 cases treated by endodontic surgery", International Journal of Oral Surgery, 1972

40 words — 2%

Crossref

2 Morio Okaguchi, Tienchun Kuo, Yi-Ching Ho. "Successful treatment of vertical root fracture through intentional replantation and root fragment bonding with 4-META/MMA-TBB resin", Journal of the Formosan Medical Association, 2018

30 words — 1%

Crossref

3 Ines Kallel, Eya Moussaoui, Fadwa Chtioui, Nabiha Douki. "Diagnosis and Managment of Maxillary Incisor with Vertical Root Fracture: A Clinical Report with Three-Year Follow-Up", Case Reports in Dentistry, 2018

25 words — 1%

Crossref

4 Xiao Zhou, Mei-Li Duan. "Malaria-associated secondary hemophagocytic lymphohistiocytosis: A case report", World Journal of Clinical Cases, 2021

21 words — 1%

Crossref

5 Saori Tanaka. "Hybrid layer seals the cementum/4-META/MMA-TBB resin interface", Journal of Biomedical Materials Research Part B Applied Biomaterials, 01/2007

19 words — 1%

Crossref

6	f6publishing.blob.core.windows.net Internet	14 words — 1%
7	onlinelibrary.wiley.com Internet	14 words — 1%
8	H. C. Baranwal, Nidhi Singh, Neeraj Kumar, Riya Garg, Jyoti Yadav, Richik Tripathi. "New Approach in the Management of Vertical Root Fracture with the Help of Biodentine and CBCT", Case Reports in Dentistry, 2020 Crossref	13 words — 1%
9	Qian Rao, Jin Kuang, Chuanxia Mao, Jing Dai, Linying Hu, Zhiyun Lei, Guangtai Song, Guohua Yuan. "Comparison of iRoot BP Plus and Calcium Hydroxide as Pulpotomy Materials in Permanent Incisors with Complicated Crown Fractures: A Retrospective Study", Journal of Endodontics, 2020 Crossref	12 words — 1%
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