

CASE REPORT

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Surgical alternative for treatment of vertical root fracture: A case report

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Abstract: Vertical root fracture (VRF) has been a great challenge in dentistry; most fractures often result in tooth extraction. Inflammation of tissues around the fractured root is the main reason for tooth extraction. Based on the strategic importance of some fractured teeth, treatment may be necessary and often complicated. However, performing a proper repair or even splinting the fractured segments may result in tooth preservation. Accordingly, in this case we report a new method for fractured tooth preservation. The surgical exposition of the fracture tooth was carried out through the radicular portion of the element via ultrasonic preparation, filling with composed resin and a synthetic hydroxyapatite graft. All these were performed around the tooth which received five sections of low-power laser. The patient was followed for two years with no signs or symptoms of inflammation and gingival recession. In conclusion, the used treatment protocol could be considered as 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.

Keywords: Diagnosis; Surgical endodontic; Tooth fracture; Treatment

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Introduction

Vertical root fracture (VRF) is an extremely compromising event for the tooth and heavily influences treatment protocol. Usually, this leads to loss of dental elements. The main factors that lead the treatment towards extraction of the fractured tooth are bacterial infiltration and subsequent inflammation in the fracture area, resorption of nearby alveolar process and being substituted with defensive cells [1].

Diagnosis of VRF is challenging and complicated; this is due to unclear signs and symptoms which are mostly without any clinical evidence [2]. Clinical characteristics of VRF can be presented with pain, edema, mobility, and periodontal diseases [3]. The prevalence of VRF has been reported to vary

from 2 to 5% [2, 4-6]. The etiology could be several iatrogenic factors *e.g.* post placement [7-9], excessive forces during the gutta-percha condensation [10-11], excessive masticatory forces [12], and extensive dental preparations [2,13]. Although in some cases of VRF, the causes are unclear [3].

Some therapeutic alternatives have been studied for the VRF looking in order to introduce more conservative treatment for these cases. Mineral trioxide aggregate (MTA) [14], bone grafts [15], hydroxyapatite grafts [16], laser therapy [17], glass-ionomer cement [18], dentin-bonded resin [19-20], and other materials have been already used for stabilizing the bone loss associated with VRF.

The aim of this case report was to present a successful treatment of a VRF using dentin-bonded resin to fill outer space of the fracture.

Case Report

A 58-year-old female with no contributing medical history was referred to the Endodontic service of the Universidade do Estado do Rio de Janeiro, complaining about pain in the region of the upper right canine tooth.

In the clinical examination, edema was verified in the buccal and apical region and no periodontal pocket was observed. Radiographic examination revealed a previous endodontic treatment. The first treatment option consisted non-surgical retreatment following by inspection with surgical microscope.

Root canal filling materials were removed and after the root canal preparation, a meticulous inspection with the surgical microscope was accomplished (D.F. Vasconcellos, Rio de Janeiro, Brazil). No alteration in the internal walls of the tooth was observed. The root canal was then filled and the patient was followed-up after 7 days. She complained of persistent local sensibility. Clinically, edema and pus were observed draining in the vestibular of inserted gum. Also, a 10 mm deep periodontal pocket was observed, and after a tracking test in the gingival fistula (Figure 1), we opted for an exploring surgery to detect the origin of the pus.

A full-thickness flap was elevated and a granulation tissue was observed at the root buccal surface; also, a total absence of the alveolar bone was observed in this area all through the tooth length except for 3 mm of the radicular apex (Figure 2A). After removing the inflammatory tissues, it was possible to verify the presence of a VRF in the buccal surface of the tooth (Figure 2B). A schematic drawn shows the fracture in detail (Figure 2C).

Since the clinical crown of the tooth was in excellent condition, the patient was notified about tooth extraction as the common treatment in these cases, but she could opt for a more conservative treatment to maintain the tooth, but with no guarantee of success. It was then decided to explore the full extent of the fracture, by complete exposing using an ultrasonic unit (Mini Endo Excellence in Endodontics, USA) and ultrasonic tips for surgery. Then it was made a further 1 mm throughout the length of incomplete fracture. Acid etch was performed for 30 seconds. The acid was removed by vacuum suction followed by another washing with 0.9%



Figure 1. Tracking test in the gingival fistula

saline solution and drying with sterile gauze. Single Bond adhesive (3M, Sao Paulo, Brazil) was then used and it was light cured for 20 seconds. After adhesive polymerization, we filled the cavity with composite resin Tetric Ceran (Ivoclar, Schaan, Liechtenstein), followed by light curing for 40 seconds (Figures 3A and 3B).

Due to the large bone fenestration and possible gingival recession, was decided to fill the bone fenestration with a synthetic hydroxyapatite graft (Intra-Lock, Boca Raton, FL, USA). After accommodation of the graft, the flap was repositioned and sutured with 4.0 silk. In order to accelerate tissue repair, minimize possible gingival recession and an anti-inflammatory response after the surgery, 5 sections of low power laser with a wavelength of 685 nm (Photon Lase, DMC, São Carlos, Brazil) was performed around the tooth with occasional applications at mesial, distal, apical and cervical with intervals of 48 hours between sessions (Figure 3C).

The patient was followed for two years (Figures 4A and 4B). Clinical and radiographic healthy status was observed with no signs or symptoms of inflammation and gingival recession.

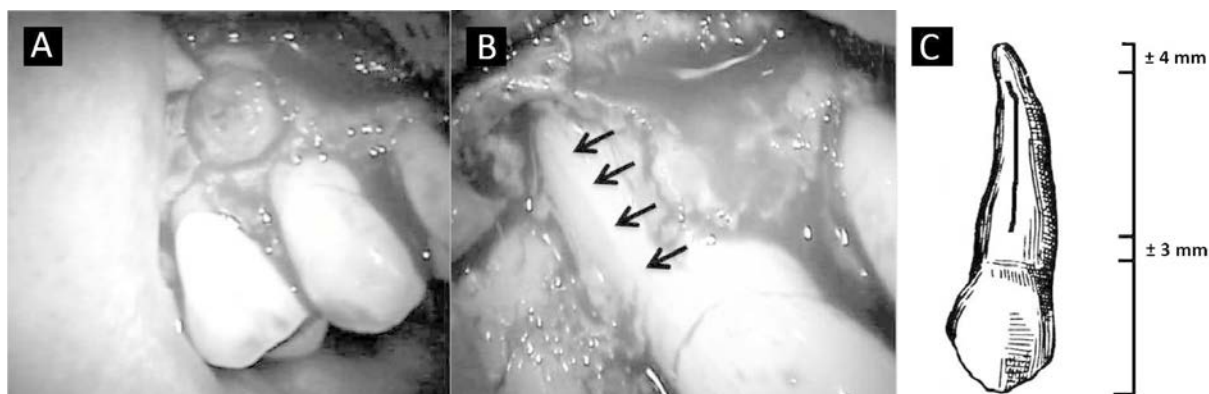


Figure 2. A) Granulation Tissue; B) VRF in the vestibular face of the tooth; C) Schematic fracture drawn

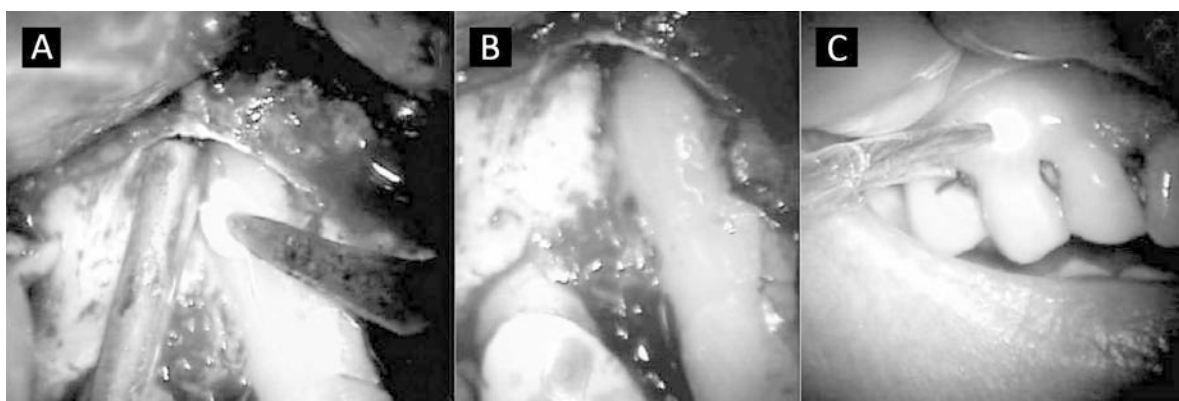


Figure 3. A) Filling of the cavity with composite resin; B) Cavity with composite resin; C) Low Power laser treatment

Discussion

Tooth fracture has been described as a major complication in dentistry and is the third most common cause of tooth loss, after dental caries and periodontal disease [21]. A VRF extends to the periodontal ligament, and soft tissue grows into the fracture. Separations between fractured fragments increase and resorption areas enlarge over time, negatively affecting the possibility of further treatment in the affected area [22]. Rapid diagnosis of a VRF is required and important to prevent additional bone loss that will further impede reconstruction.

The final diagnosis of VRF is, at times, difficult, but quick decision making is necessary to stop rapid bone loss once the fracture communicates with the oral environment [23]. A definitive diagnosis of VRF can be achieved by an exploratory flap, as done in the present study. The treatment of complete or incomplete vertical fracture is healing the disease process and preventing the progress of the resorption of the alveolar bone. The procedure indicated in these

cases is the extraction of the fractured tooth contaminated and thus eliminating the pathological agent. Considering that it is a radical step, because of its irreversibility, some conservative alternatives have been studied in order to preserve the fractured element, maintaining the function and the healthy appearance [14, 18, 24-26], as done in this study.

MTA has been used as a biomaterial for reconstruction of the fractured area [14]. The properties of the MTA and its biocompatibility with periradicular tissues, low toxicity, good marginal sealing, hydrophilicity and high pH [27-29], make it an effective material in treatment of root fractures; however, poor handling and high setting time of this material make it hard to be used in some cases.

Attempts for conservative treatment of teeth with VRF also reported as treatment of 26 vertically fractured roots using replantation and reconstruction with 4-methacryloxyethyl trimellitic anhydride in methyl methacrylate initiated by tri-n-butyl borane dentin bonded resin [30]. The authors found that 18 cases were

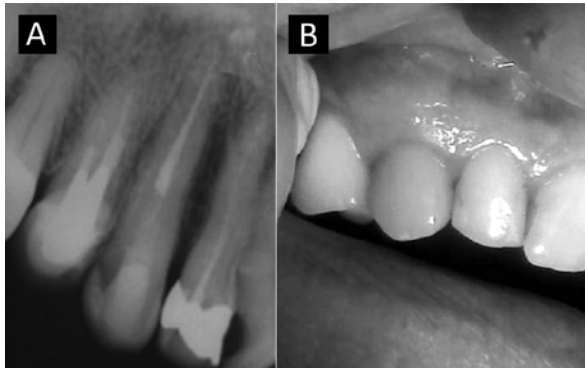


Figure 4. Two years follow-up; A) Radiographic; B) Clinical

functional and retained and 6 were fully successful after observation periods ranging from 4 to 76 months. They found that teeth with longitudinal fractures extending more than two-thirds from the cervical portion toward the apex and posterior teeth showed significantly lower longevity. In the present study the tooth showed incomplete VRF without separation of segments.

In this case we used a composite resin which showed success after a period of two years for follow-up. The choice of resin was based on several previous studies that showed the effectiveness of resin materials in the reconstruction of teeth with VRF [19-20,22-26]. In several studies the periodontal condition was monitored clinically and radiographically for a long time, and the results were promising.

Oztürk and Unal, reported a case of complete VRF in the tooth that was extracted, the fracture was restored with resin cement, and then implanted in the alveolus [31]. In the present report we chose to not extract the tooth, relying on the results of the previous study [19] that noted no statistical difference when the reconstruction of teeth with FRV was performed after extraction tooth or with the unit held in its socket.

Hayashi *et al.*, reported no failure in vertically fractured incisors treated with this method, although failures did occur in premolars and molars [20]. The authors suggested that the posterior teeth were negatively affected by strong occlusal forces. The morphology and location of anterior teeth also facilitate the maintenance of gingival health, a further reason for positive outcomes after VRF treatment. The authors also reported that success in treatment of VRF is defined as clinically acceptable when the tooth showed no clinical symptoms, demonstrating

periodontal tissue healing/regeneration, and improvements in periodontal probing at the fracture site. According to these criteria, this case report presents success after a period of two years of follow-up.

The overall esthetic result has recently become a fundamental factor in the evaluation of treatment success [32-33]. In the present case, it was considered of utmost importance, because the teeth were located in the anterior maxilla. At 24 months follow-up, the tooth was functional and the patient was satisfied with the esthetics.

Further research and better knowledge about alternative treatments for complete and incomplete root fractures are needed to provide the basis for a more accurate and reliable evidence, in order to establish a more conservative solutions and thus avoiding the loss of the fractured element.

Conclusion

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.

Conflict of interest: None declared.

References

- [1] Liapatas S, Nakou M, Rontogianni D. Inflammatory infiltrate of chronic periradicular lesions: an immunohistochemical study. *Int Endod J.* 2003;36(7):464-71.
- [2] Meister F, Lommel TJ, Gerstein H. Diagnosis and possible causes of vertical root fractures. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 1980;49(3):243-53.
- [3] Tamse A. Iatrogenic vertical root fractures in endodontically treated teeth. *Dent Traumatol.* 1988;4(5):190-6.
- [4] Bergman B, Lundquist P, Sundquist G. Restorative and endodontic results after treatment with cast posts and cores. *J Prosthet Dent.* 1989;61(1):10-5.
- [5] Morfis A. Vertical root fractures. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 1990;69(5):631-5.
- [6] Fuss Z, Lustig J, Tamse A. Prevalence of vertical root fractures in extracted

- endodontically treated teeth. *Int Endod J*. 1999;32(4):283-6.
- [7] Angmar-Månsson B, Omnell K, Rud J. Root fractures due to corrosion. 1. Metallurgical aspects. *Odontol Revy*. 1969;20(3):245.
- [8] Petersen K. Longitudinal root fracture due to corrosion of an endodontic post. *J Can Dent Assoc*. 1971;37(2):66.
- [9] Gerstein H, Burnell S. Prefabricated precision dowels. *J Am Dent Assoc*. 1964;68:787.
- [10] Pitts DL, Matheny HE, Nicholls JJ. An in vitro study of spreader loads required to cause vertical root fracture during lateral condensation. *J Endod*. 1983;9(12):544-50.
- [11] Gher Jr M, Dunlap R, Anderson M, Kuhl L. Clinical survey of fractured teeth. *J Am Dent Assoc*. 1987;114(2):174.
- [12] Lynch CD, Burke FM. Incomplete tooth fracture following root-canal treatment: a case report. *Int Endod J*. 2002;35(7):642-6.
- [13] Guzy GE, Nicholls JJ. In vitro comparison of intact endodontically treated teeth with and without endo-post reinforcement. *J Prosthet Dent*. 1979;42(1):39.
- [14] Erdem AP, Ozdas DO, Dincol E, Sepet E, Aren G. Case Series: root healing with MTA after horizontal fracture. *Eur Arch Paediatr Dent*. 2009;10(2):110-3.
- [15] Rajesh J, Nandakumar K, Varma H, Komath M. Calcium phosphate cement as a "barrier-graft" for the treatment of human periodontal intraosseous defects. *Indian J Dent Res*. 2009;20(4):471.
- [16] Yukna RA. Osseous defect responses to hydroxylapatite grafting versus open flap debridement. *J Clin Periodontol*. 1989;16(7):398-402.
- [17] Dederich DN. CO₂ laser fusion of a vertical root fracture. *J Am Dent Assoc*. 1999;130(8):1195.
- [18] Hommez GM, Browaeys HA, De Moor RJ. Surgical root restoration after external inflammatory root resorption: A case report. *J Endod*. 2006;32(8):798-801.
- [19] Sugaya T, Kawanami M, Noguchi H, Kato H, Masaka N. Periodontal healing after bonding treatment of vertical root fracture. *Dent Traumatol*. 2001;17(4):174-9.
- [20] Hayashi M, Kinomoto Y, Miura M, Sato I, Takeshige F, Ebisu S. Short-term evaluation of intentional replantation of vertically fractured roots reconstructed with dentin-bonded resin. *J Endod*. 2002;28(2):120-4.
- [21] Kishen A. Mechanisms and risk factors for fracture predilection in endodontically treated teeth. *Endodontic topics*. 2006;13(1):57-83.
- [22] Fuss Z, Lustig J, Katz A, Tamse A. An evaluation of endodontically treated vertical root fractured teeth: impact of operative procedures. *J Endod*. 2001;27(1):46-8.
- [23] Tamse A. Vertical root fractures in endodontically treated teeth: diagnostic signs and clinical management. *Endodontic topics*. 2006;13(1):84-94.
- [24] Al-Assaf K CM, Palaghias G, Karanika-Kouma A, Eliades G. Interfacial characteristics of adhesive luting resins and composites with dentine. *Dent Mater*. 2007;23(7):39.
- [25] Ozer SY, Unlu G, Deger Y. Diagnosis and treatment of endodontically treated teeth with vertical root fracture: three case reports with two-year follow-up. *J Endod*. 2011;37(1):97-102.
- [26] Taschieri S, Tamse A, Del Fabbro M, Rosano G, Tsesis I. A new surgical technique for preservation of endodontically treated teeth with coronally located vertical root fractures: a prospective case series. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod*. 2010;110(6):e45-52.
- [27] Ghoddusi J TAJ, Donyavi Z, Brook A, Disfani R, Esmaeilizadeh M. Cytotoxic effect of a new endodontic cement and mineral trioxide aggregate on L929 line culture. *Iranian Endodontic J*. 2008;3(2):17-22.
- [28] Amini Ghaznavi S ATM, Kobarzadeh F, Akbarzadeh Baghban Ar, Asgary S. Ion release and pH of a new endodontic cement, MTA and Portland cement. *Iranian Endodontic J*. 2009;4(2):74-8.
- [29] Moazami F SS. The cellular behavior and SEM evaluation of ProRoot and Root MTAs on fibroblast L929. *Iranian Endodontic J*. 2006;1(3):87-92.
- [30] Lustig JP, Tamse A, Fuss Z. Pattern of bone resorption in vertically fractured, endodontically treated teeth. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod*. 2000;90(2):224-7.
- [31] Ozturk M, Unal GC. A successful treatment of vertical root fracture: a case report and 4-year follow-up. *Dent Traumatol*. 2008;24(5):e56-60.
- [32] Taschieri S, Laster Z, Rosano G, Weinstein T, Del Fabbro M. Surgical decision making in coronally located vertical root fracture. *Minerva Stomatol*. 2009;58(9):399-413.
- [33] Morgano SM RA, Sabrosa CE. Restoration of endodontically treated teeth. *Dent Clin North Am*. 2004;48(2):397-416.