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CASE REPORT

Root fracture of mature permanent maxillary incisor and followed up at 14 months – A case report

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ABSTRACT

Root fractures are uncommon traumatic injuries involving the dentin, cementum, pulp, and periodontal ligament of permanent teeth. This case report describes the management of a horizontal mid-root fracture associated with external inflammatory resorption in a mature maxillary central incisor in a 26-year-old patient following trauma. Clinical and radiographic examination revealed an oblique crown fracture, extrusive luxation, loss of pulp sensibility, and a displaced fracture in the middle third of the root. Immediate passive splinting was performed, followed by endodontic treatment restricted to the coronal fragment. After chemo-mechanical preparation and intracanal medication with calcium hydroxide, obturation was completed using a calcium silicate-based bioceramic sealer. At the 14-month follow-up, the tooth remained asymptomatic and stable, with no evidence of periapical pathology. Radiographic findings indicated favorable healing between the root fragments. This case highlights the effectiveness of a conservative approach and supports the use of bioceramic materials in the management of root fractures.

Keywords: Bioceramic filling material, external resorption, permanent maxillary central incisor, pulp necrosis, root fracture.

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1. INTRODUCTION

Root fractures are not very common, representing between 0.5% and 7% of traumas in the permanent dentition [1]. Horizontal root fractures occur mainly in the anterior region of the maxilla, generally due to a frontal impact, are more frequently observed in fully erupted teeth with complete root formation, and most often occur in the middle third [2,3]. This case report presents the treatment of a horizontal root fracture with external root resorption in the middle third of a permanent maxillary central incisor in a 26-year-old young adult.

The aim of this case report was to describe the conservative management of a horizontal root fracture in a mature permanent maxillary central incisor using bioceramic material and to assess its 14-month clinical and radiographic outcome.

2. CASE PRESENTATION

A 26-year-old young adult presented to the dental clinic at the Department of Conservative Dentistry and Endodontics of the CHU Tlemcen due to a painful sensation in the upper right central incisor following an accidental fall at a car wash station approximately three days earlier, according to the patient. The patient's medical and family history was non-contributory. No facial or head injuries, nor any neurological signs or symptoms, were noted. Intraoral examination revealed a fistula in relation to the upper right central incisor.

However, the injured tooth presented a non-penetrating oblique crown fracture with evident displacement (extrusive luxation). The tooth was highly sensitive to vestibular palpation, with painful percussion and a dull sound, and the pulp vitality test was negative. The periapical radiographic examination revealed a simple oblique crown fracture of the upper right central incisor, along with a complete and displaced oblique horizontal root fracture extending from the mesial to the distal side at the middle third of the root (Figure 1), with a radiolucent image visible on both sides of the diastasis. All the anterior maxillary teeth showed complete root development, including the traumatized tooth.

The treatment plan was explained to the patient, and informed consent was obtained. Resistance to repositioning the displaced coronal fragment was noted, and reduction of the fracture line was impossible; however, passive immobilization was immediately carried out using a 0.25 mm stainless steel braided wire bonded with light-cured resin (Figure 2).

Fig 1. The initial radiograph of the mature maxillary incisors showed a horizontal mid-root fracture on the right central incisor with external inflammatory resorption, as indicated by the yellow arrow.

Fig 2. Clinical view of the splint on the day of the emergency consultation.

Due to the condition of the pulp and the presence of external inflammatory resorption, endodontic treatment was initiated. A round carbide bur was used for the access opening, and cleaning and disinfection with NaOCl were performed only for the coronal fragment (Figure 3). An intracanal calcium hydroxide dressing was placed, followed by a provisional coronal restoration using zinc oxide eugenol.

Dietary and hygiene instructions were provided to the patient at the end of the emergency visit, along with the importance of adhering to regular clinical and radiographic follow-ups. The splint was removed after 4 weeks, the sinus tract disappeared, and the tooth mobility was assessed. After isolation, the working length was determined with a radiograph showing the file in place (Figure 3). The coronal fragment of the root was prepared using a chemomechanical method with intermittent irrigation using sodium hypochlorite. Final irrigation was performed with 17% ethylenediaminetetraacetic acid (EDTA). Additionally, ultrasonic irrigation was also performed. The obturation was carried out using the mixed single-cone technique with the use of a bioceramic root canal sealer based on calcium silicate (Figure 4), and the canal was sealed only at the coronal fragment level.

During the follow-up visit at 14 months, the patient was asymptomatic, and no mobility or periapical changes were observed (Figure 5). Thus, healing between the root fragments was observed, and the radiolucency along the fracture line had diminished.

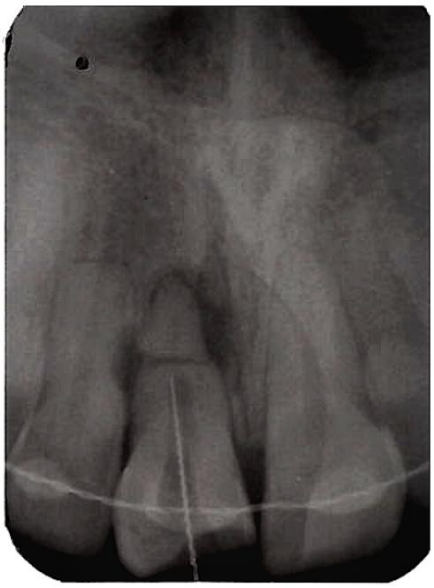

Fig 3. Perioperative radiograph showing determination of the working length.

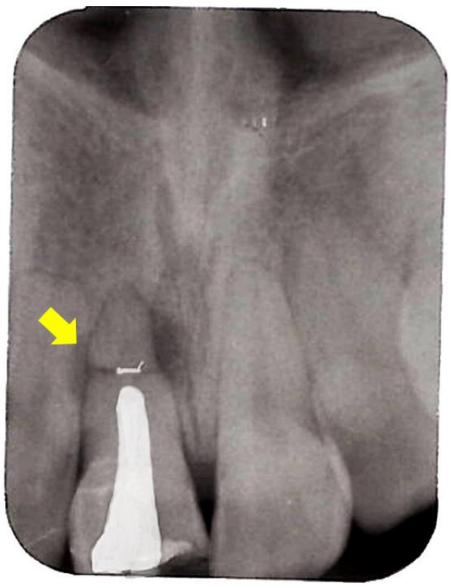

Fig 4. Filling of the coronal fragment with extrusion of the sealer into the fracture line.

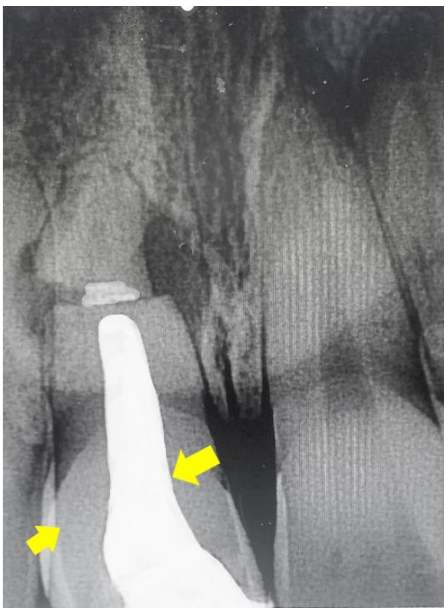

Fig 5. Follow-up radiograph - At 14 months.

3. DISCUSSION

In this study, the limitations of this clinical case primarily lie in the short 14-month follow-up period, which does not allow for assessing potential late complications such as root resorption or apical fragment pulp necrosis, contrary to recommendations for long-term monitoring beyond one year. A further limitation of this case report is the absence of CBCT imaging, which in this clinical context could have provided a more accurate three-dimensional assessment of the fracture line, fragment displacement, and the extent of the resorptive defect. Although this examination was recommended to the patient, it could not be performed because of financial constraints. Consequently, diagnosis and follow-up relied on conventional periapical radiographs. However, the two-dimensional nature of these images limits diagnostic accuracy, particularly in distinguishing between internal and external resorption, owing to anatomical superimposition and variations in projection angle.

The lack of treatment for the apical fragment leaves its presumed vitality uncertain, without direct exploration. The evaluation remains subjective, based on the absence of symptoms and radiographic images, without a quantitative approach for prognosis. Finally, as an isolated case, it lacks generalizability without a control group to validate the effectiveness of the bioceramic protocol. Root fractures are defined as injuries involving dentin, cementum, and pulp, and they represent a challenging clinical situation in dental traumatology [10]. Fractures located in the middle third are the most frequently reported and are generally transverse or oblique in orientation [1].

Root fractures present significant challenges in dental treatment, influencing case selection and therapeutic approaches [19]. Their prognosis depends on several factors, including the location of the fracture line, patient age, stage of root development, degree of luxation, mobility of the coronal fragment, pulpal status, and the width of the separation between fragments [1, 4, 5].

In the present case, several unfavorable prognostic factors were identified, namely complete root formation, displacement of the coronal fragment, associated extrusive luxation, negative pulp sensibility, and radiographic evidence of external inflammatory resorption. Displacement of the coronal fragment may compromise the pulpal blood supply at the fracture site through stretching or tearing of the neurovascular bundle, thereby increasing the risk of pulp necrosis [10].

Pulp necrosis has been reported to occur in 20 to 44% of cases of root fractures, whereas in luxated teeth without root fractures, necrosis occurs in at least 43% of cases [7, 8]. However, the relationship between the coronal and apical segments following the traumatic impact is crucial in determining pulp vitality [9]. This has already been demonstrated in a study where an increase in the distance between fragments was associated with an increased risk of pulp necrosis, where the likelihood of healing of hard tissues decreased [11].

Crown fractures have been identified as significant risk factors predisposing to pulp necrosis, primarily associated with the amelodentin fracture of the crown [13]. The marked influence of root development on pulp healing has been demonstrated earlier in

studies on root fractures. Once root formation was completed, a significantly higher frequency of inflammatory tissue deposition was observed (27%) [11]. It appears that increasing age beyond complete root formation negatively affects the chances of optimal healing. The relationship found between the presence and extent of luxation in this clinical case is similar to that found for luxated permanent teeth, where mature teeth showed pulp necrosis with frequencies ranging from 15 to 55% for subluxated and extruded incisors [12].

Radiographic assessment played a central role in diagnosis and follow-up in the present report. However, conventional periapical radiographs remain limited by their two-dimensional nature. Superimposition of anatomical structures, variations in beam angulation, and other technical factors may reduce diagnostic accuracy, particularly when attempting to distinguish between internal and external resorption. Therefore, radiographic interpretation should always be correlated with clinical findings [16].

Immediate passive splinting was performed in order to stabilize the coronal fragment and promote periodontal healing. A splinting period of approximately four weeks is generally considered appropriate in such situations, depending on the degree of mobility and associated injuries. In the present case, this approach contributed to the resolution of mobility and disappearance of the sinus tract during follow-up [13].

With regard to endodontic management, current recommendations suggest limiting instrumentation and obturation to the coronal fragment in root-fractured teeth that develop pulpal necrosis. In the present case, this conservative approach was adopted because the apical fragment was left untreated in the absence of radiographic signs suggesting apical pathology. The absence of periapical radiolucency at 14 months may indicate maintenance of vitality in the apical fragment [10].

External inflammatory resorption observed in this case was most likely related to the associated luxation injury and infection of the coronal root canal system rather than to the fracture line itself. This finding justified prompt disinfection of the coronal fragment, temporary calcium hydroxide medication, and definitive obturation after adequate canal preparation. Calcium hydroxide has long been used as an intracanal medicament in root-fractured teeth because of its antimicrobial properties and its ability to favor hard tissue barrier formation. Nevertheless, prolonged use may require multiple dressing changes and extended treatment duration [10].

Another remarkable aspect is the type of healing that occurs at the fracture line, which may involve interposition of bone tissue when fragments are significantly separated, interposition of connective tissue, formation of cemental and dentinal callus, a combination of bone and connective tissue, or interposition of granulation tissue (when the pulp becomes necrotic). Hard tissue healing is the most desirable outcome, whereas the presence of granulation tissue represents an unfavorable inflammatory condition [16].

The use of calcium hydroxide paste was previously recommended by several authors as an intracanal medicament in the endodontic treatment of fractured teeth in order to promote a barrier in the apical region of the coronal fragment to accommodate the obturation material. However, this type of medicament requires prolonged treatment and multiple changes of dressing [16].

The main types of root healing with the use of bioceramics include healing by repair, healing by regeneration, and bone-like healing [15]. Bioceramic materials have recently been introduced to the market, showing the advantages of bioceramic formulation, such as the induction of tissue regeneration and antimicrobial properties. These are also ready-to-use formulations that facilitate the removal of the product for on-site preparation and simplify the procedure, thereby saving time [14]. Bioceramics, based on calcium silicate, have been used as an alternative to calcium hydroxide, as they are extremely biocompatible (non-toxic) and also establish a chemical bond with dentin during the setting process, thus forming hydroxyapatite.

Long-term follow-up—extending beyond one year—is crucial in the management of dental root fractures due to the unpredictable nature of healing and the potential for late complications. It is important to keep in mind that the assessment of the tooth's condition is primarily based on the absence of symptoms and a radiographic evaluation of fracture healing [16]. This remains a relatively subjective approach for assessing the prognosis of the tooth in question [17, 18].

Studies with three-year and two-year follow-ups have shown that healing patterns and potential complications, such as pulp necrosis or root resorption, may only become apparent well after the initial trauma and treatment, underscoring the need for ongoing evaluation [20, 21]. A 2021 study reported radiographic healing of an oblique root fracture after 24 months using a calcium silicate bioceramic sealer, preserving tooth structure without surgery. Similar principles apply to horizontal fractures, where bioceramics enable non-invasive pulp vitality preservation [22]. No periapical radiolucency was noted, indicating that the apical fragment may have retained its vitality [17] during the 14-month follow-up period [22].

4. CONCLUSION

Within the limits inherent to a single case report, the present observation suggests that conservative endodontic management of the coronal fragment using a calcium silicate-based bioceramic material may be associated with favorable healing in horizontal root

fracture of a permanent tooth. Early diagnosis, appropriate stabilization, and careful follow-up remain essential in the management of such injuries. However, these findings should not be generalized, and further clinical studies with larger cohorts and longer follow-up are required to clarify the therapeutic value and long-term predictability of this approach.

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