

Case Report Article

Pulp neurovascular plexus response as a result of crown-root horizontal fracture and uncomplicated crown fracture in permanent dentition: a case report

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Abstract

Introduction: Dental trauma often have severe and complex injuries to the dentoalveolar system. **Objective:** To report the treatment of crown-root horizontal fracture and uncomplicated crown fracture in permanent dentition. **Case report:** Child patient attended the dental trauma service 30 days after the fall. On clinical and imaging examination, an uncomplicated crown fracture in the right central incisor and crown-root fracture in the left central incisor was possible to identify (tooth 11 and tooth 21 respectively). The conventional restorative treatment (tooth 11) and repositioning (tooth 21) were performed. The endodontic treatment was performed at 6 months of follow-up (tooth 11). At the new imaging exam, cement neoformation was evidenced between the fragments of the crown-root fracture (tooth 21). After 24 months of follow-up, there was a decrease in periapical lesion (tooth 11), and maintenance of pulp vitality (tooth 21). **Conclusion:** There is a possibility of maintaining pulp vitality in crown-root fractures and highlights the importance of follow-up in non-complicated fractures.

Introduction

Dental trauma often have severe and complex injuries to the dentoalveolar system [28]. They are considered as a special urgency not only for dental involvement and its future repercussions, but also for the emotional, physical and economic impact on the quality of life of those affected [1, 19]. These characteristics make dental trauma a major public health problem [19].

The worldwide prevalence of dental injuries is estimated in 15% in permanent dentition [23], in which, horizontal root fractures constitute less than 3% of all dental injuries and occur more frequently in the middle third of the root, followed by the apical and cervical regions [20]. However, despite uncommon, root fractures at the cervical level generally have an unsatisfactory prognosis causing tooth loss [10]. When associated with the coronal structure, involving tooth enamel and dentin, the traumatic injury is called a crown-root fracture or high cervical root fracture [18, 27]. Due to the subgingival positioning, it constitutes a challenge for clinical practice, where the invasion of biological space can cause gingival inflammation, with consequent loss of insertion and bone loss [12].

Regarding to uncomplicated crown fractures, the prevalence can reach up to 20% in permanent dentition in children [13]. These data indicate that uncomplicated crown fractures are the most common traumatic injuries in dental practice [5]. Nonetheless, uncomplicated crown fractures are not a risk for tooth loss. Some studies even highlight an approximately 2% risk of pulp necrosis [7, 12]. The prevalence of pulp necrosis is higher in teeth with incomplete root formation (6%) [9], specially when combined with other dental injuries [2, 24]. The prognosis of uncomplicated crown fractures runs synchronously with the location of the fracture line and the time that the dentinal tubules were exposed to the external environment [14].

Currently, some long-term clinical studies report on the healing of pulp tissues after dental trauma [2, 3, 12]. In crown fracture the immune systems play an important role in dental pulp healing whereas in root fractures the neurovascular plexus can be restored through proper tooth immobilization [2]. thus, the aims is to report the treatment of crown-root horizontal fracture and uncomplicated crown fracture in permanent dentition.

Case report

A 9-year-old female patient with good general health attended the FORP/USP Dental Trauma Service, referred by the Basic Health Unit in her municipality, after 30 days of a fall at home. During the clinical examination, it was possible to observe traces of a laceration of the epithelial structure in the lower region of the face, uncomplicated crown enamel, and dentin fracture in the right central incisor (tooth 11) and moderate mobility in the left central incisor (tooth 21). Both teeth without color change (figure 1). The guardian did not report gingival bleeding at the time of the fall. After periapical radiographic imaging examination (unpublished images), a radiolucent region could be seen in the periapex of the maxillary incisors, suggestive of incomplete root formation. In tooth 11, the uncomplicated enamel and dentine fracture was confirmed. In tooth 21, a horizontal radiolucent image was observed at the cervical level, confirming the clinical suspicion of horizontal root fracture. As way of complementing and showing the extent of the root fracture, the imaging exam using Cone Beam[®] computed tomography (CBCT) was requested. Therefore, it was possible to observe that the root fracture had an extension on the buccal surface of the crown. Complementing the diagnostic as crown-root fracture (figure 2). As mediate treatment, we opted for rehabilitation with composite resin and repositioning and stabilization of the crown-root fracture. The restorative step was performed from the protection of the pulp tissue with calcium hydroxide-based material, followed by glass ionomer cement and restoration in composite resin in a conventional manner. The crown-root fracture, on the other hand, was repositioned and stabilized with flexible splints with 0.4 mm diameter wire, covering central, lateral, and upper canine incisors. The splints were carried out for a total period of 4 months [8]. The patient continued clinical and radiographic follow-up on a monthly, without pathological changes.



Figure 1 - Initial clinical image obtained in the first dental appointment at the Dental Trauma Clinics at FORP/USP

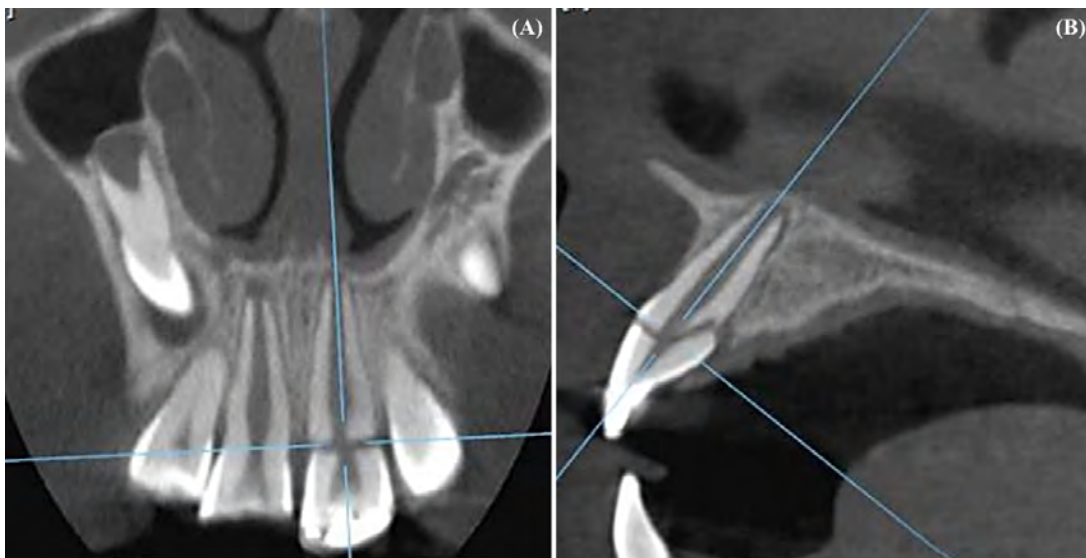


Figure 2 - Image by CBCT obtained in the first dental appointment at the Dental Trauma Clinics at FORP/USP. Note in figure (A), in tooth 11 fracture of enamel and dentin and incomplete rhizogenesis. In (B), in tooth 21, a horizontal radiolucent image is noted at the cervical level, confirming the clinical suspicion of horizontal fracture of the crown root

At 6 months of follow-up, a new CBCT was performed to monitor the prognosis, since an increase in the radiolucent region in tooth 11 was observed in the periapical radiographic imaging exam. Therefore, radical treatment of the root canal was performed. As for the crown-root fracture, it was possible to observe, using a coronal section, the decrease in the radiolucency of the fracture line. In a sagittal section, in addition to decreasing the radiolucency of the fracture line by the buccal surface, there was probable healing of the connective tissue and cement neoformation between the fragments by the lingual surface (figure 3).

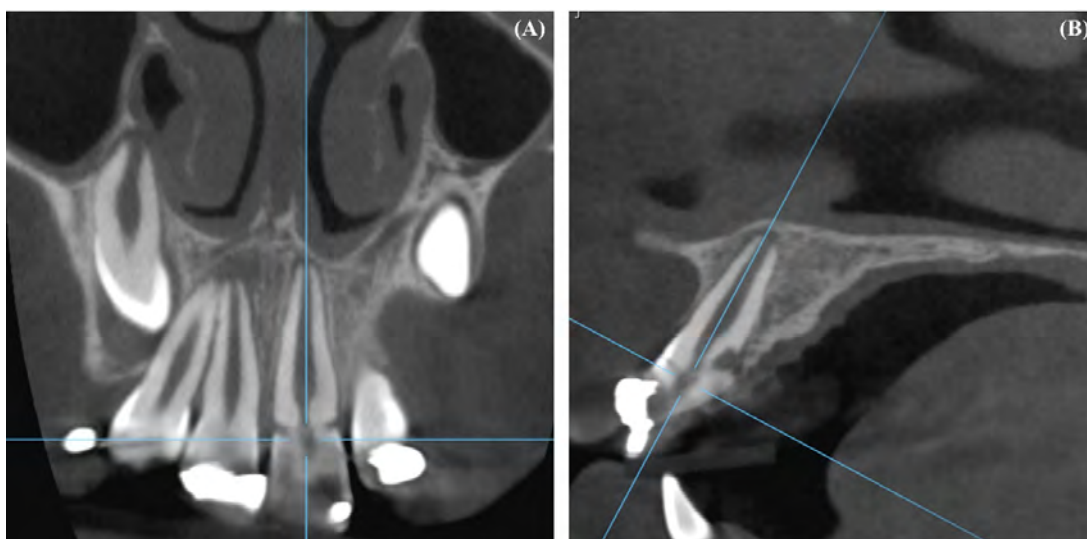


Figure 3 - Image obtained by CBCT after 6 months of follow-up at the Dental Trauma Clinics at FORP/USP. Note in figure (A), in tooth 11, an increase in the radiolucent region suggestive of periapical lesion. In (B), in tooth 21, there is a decrease in the radiolucency of the fracture line through the vestibular surface and a probable healing of the connective tissue and new cement formation between the fragments through the lingual surface

After 24 months of trauma, there was a decrease in apical periodontitis in tooth 11 and a decrease in mobility and maintenance of vitality in tooth 21 (figure 4). Despite presenting a stable clinical and radiographic condition, the patient continues to be monitored.



Figure 4 - Clinical and radiographic image obtained after 24 (B) months of follow-up at the Dental Trauma Clinics at FORP/USP

Discussion

Traumatic dental injuries are an important public health issue in the young population [17]. Therefore, it is important that the dentist is able and updated on the diagnosis and possible conservative protocols [25].

Horizontal crown-root fractures, mainly at the cervical level in particular, although rare, have an unfavorable prognosis and constitute a challenge for

clinical practice [11]. The unfavorable prognosis can be justified by the position of the fracture line that is coincident with the interposition of periodontal soft tissues, which, consequently, can decrease the clinical stability of the crown [3]. Also, the gingival sulcus region could make bacterial communication from the external environment conducive to the neurovascular plexus of the pulp tissues, causing pulp obliteration and/or necrosis [2]. Thus, several studies describe protocols for coronary removal,

gingivectomy surgery with ostectomy, root traction or extraction [4, 29]. In our report, the fractured region could make it impossible to increase the clinical crown performed through periodontal surgery. Accordingly, the tooth with incomplete root formation and root size would make root traction and prosthetic adaptation impossible. Thus, in order to preserve the tooth in the oral cavity, an attempt was made to decrease the fracture line and stabilize with flexible splints. Recent studies believe that teeth with signals of vitality, as initially diagnosed in our report, can induce the healing response of adjacent tissues by inducing calcified tissue and/or inducing fibrous connective tissue [15].

The neurovascular plexus healing of the pulp tissue can occur independently or competitively. If the pulp tissue is intact, it is expected that there is a formation of calcified tissue between the fragments. When the pulp is severely cut or stretched, a revascularization process is initiated and while revascularization is in progress, fractured fragments may join together by interposing connective fragments [3, 15]. The study by Andreassen *et al.* [18] still makes a reservation about of those exposed to contamination by external microorganisms, which will result in the formation of granulation tissue. It is worth noting that in our report, despite not having submitted the patient to pulp sensitivity testes, as she is an infant patient, pulp vitality was confirmed, in subsequent sessions, through observation of clinical aspects and imaging examination [8].

It is worth noting that, the incomplete root formation of both central incisors was observed. And, although uncommon, it is believed that root fractures in vital teeth with incomplete root formation, there is a greater possibility of formation of a repair tissue in the fracture space if care is taken in relation to splints, fragment dislocation and diastasis between the fragments are taken [10, 16].

Another important point to be discussed about pulp vitality makes us highlight the pulp necrosis observed in the tooth with uncomplicated enamel and dentine fracture. In a retrospective study of 889 injured permanent teeth, crown fractures without pulp involvement were the injuries most commonly found in the population in question, however, pulp necrosis was described in only 3% of cases [15]. According to the study by Ravn [24], necrosis can be justified by the depth, location of the enamel-dentin fracture and the absence of immediate treatment. Due to the tubular structure, dentin is a porous barrier that can be easily penetrated when opened to the oral environment, leading to bacterial invasion of the pulp complex [14, 24].

In an *in vivo* study, it was observed the invasion of dental tubules by bacteria within 1 week of exposure [22]. In our report, we expected that the pulp vitality shown in the initial consultation would be maintained. However, our result corroborates with the aforementioned studies [14, 24], showing the importance of considering the depth, location and absence of immediate treatment. In view of the absence of immediate treatment, it is suggested that the patient could have undergone direct pulp capping or pulpectomy to maintain pulp vitality [2].

Some individual predisposing factors also need to be assessed for treatment success [10]. Our patient had protrusion of the upper incisors and insufficient lip closure. Such characteristics imply an educational strategy within the family about predisposing conditions and prevention of secondary dental trauma in childhood. In a current systematic review, dental trauma was considered a neglected condition that can be classified in fifth place if it were included in the list of the most frequent acute/chronic diseases and injuries in the world [23].

Also in line with the indications of Bourguignon *et al.* [8], we used CBCT to complete the diagnosis. According to Bourguignon *et al.* [8], in cases of root fractures, the radiographic protocol requires at least a periapical radiography, with an incidence perpendicular to the tooth in question, which is a limitation of the technique, especially when performed on children, an occlusal radiography and some radiographs with lateral angulations. Still, the radiographic examination may be nonspecific. In a study by Bornstein *et al.* [6], in addition to highlighting the advantage of the CBCT image over the conventional image, also points out that the diagnosis of 70% of root fractures in the cervical third was acquired through CBCT. In addition, most root fractures, in general, diagnosed by CBCT have not been treated endodontically, which may suggest that high rates of radical treatment performed previously may be due to failures in the initial diagnosis.

There is a lack of literature on the use of CBCT in children. However, the study by Oening *et al.* [21], gathered information, according to DIMITRA (dentomaxillofacial pediatric imaging: an investigation towards low-dose radiation induced risks) that optimize and recommend strategies on the use of CBCT in children. Among the main indications, traumatic injuries in particular, root fractures were cited [21]. The care regarding the radiation dose was also observed and calculated since, the radiation dose in the CBCT varies according to the device's commercial brand and

the technical specifications selected during the procedure such as, field of view, exposure time, milliamperage (mA) and kilovoltage (kVp). The crown-root fracture occurred in the anterior region of the maxilla, a region that requires a lower radiation dose [6].

Finally, this clinical case report encourages three new approaches in pediatric dentistry. The conservative treatment of horizontal crown-root fractures at the cervical level, the importance of the initial approach in uncomplicated crown fractures and the use of CBCT as an aid in the clinical diagnosis of traumatic injuries in childhood.

Conclusion

There is a possibility of maintaining pulp vitality in crown-root fractures and highlights the importance of follow-up in uncomplicated fractures.

Clinical relevance

This study raised the hypothesis about conservative treatments for traumatic dental trauma. In particular, it is suggested that there is a conservative therapeutic approach in crown-root horizontal fracture that can undergo revascularization and maintain pulp and dental vitality.

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