Revista Portuguesa de Estomatologia, Medicina Dentária e Cirurgia Maxilofacial

REV PORT ESTOMATOL MED DENT CIR MAXILOFAC. 2023;64(3):123-127

Clinical Case Report

Healing of oblique tooth root fracture concomitant with coronal fragment extrusion in permanent dentition: A case report

Lucimara Aparecida Propheta[1,*], *Isabela Ribeiro Madalena*[2,3], *César Penazzo Lepri*[2], *Flares Baratto-Filho*[3], *Emerson Tavares de Sousa*[4], *Carolina Paes Torres*[5]

[1] *Private practice.*
[2] *Department of Biomaterials, University of Uberaba, Uberaba, MG, Brazil.*
[3] *Department of Dentistry, University of Joinville Region, Joinville, SC, Brazil.*
[4] *Department of Preventive and Restorative Dental Sciences, UCSF School of Dentistry, San Francisco, CA, USA.*
[5] *Department of Pediatric Dentistry, School of Dentistry of Ribeirão Preto, University of São Paulo, Ribeirão Preto, SP, Brazil.*

ARTICLE INFO

Article history:
Received 31 March 2023
Accepted 26 July 2023
Available online 27 September 2023

Keywords:
Adolescent
Permanent dentition
Tooth extrusion
Tooth injuries
Tooth Root

ABSTRACT

This case report describes a favorable healing outcome of the immediate management of an oblique tooth root fracture in the middle third concomitant with coronal fragment extrusion in a permanent maxillary left central incisor of a healthy 14-year-old female patient. The clinical exam showed incisal irregularity, local bleeding, increased mobility, and axial displacement of the maxillary left central incisor. The coronal fragment was repositioned and stabilized with a flexible splint for four weeks. The parents and the patient received medication prescriptions and instructions. Clinical and radiographic conditions remained satisfactory at the 4-week, 6-month, and 12-month follow-ups. Thermal and percussion tests confirmed pulp vitality after 12 months. Hard tissue formation between segments was observed in the radiographic examination and cone-beam computed tomography. In conclusion, the immediate conservative therapeutic showed satisfactory clinical and radiographic results. (Rev Port Estomatol Med Dent Cir Maxilofac. 2023;64(3):123-127)

* Corresponding author.
E-mail address: lupropheta@gmail.com (Lucimara Aparecida Propheta).
http://doi.org/10.24873/j.rpemd.2023.10.1067

Cicatrização de fratura dentária radicular oblíqua concomitante à extrusão do fragmento coronal na dentição permanente: Um relato de caso

Palavras-chave:
Adolescente
Dentição permanente
Extrusão dentária
Traumatismos dentários
Raiz dentária

RESUMO

Este relato de caso descreve resultados de cicatrização favorável para o tratamento imediato de fratura dentária radicular oblíqua no terço médio concomitante à extrusão do fragmento coronal de um incisivo central superior esquerdo permanente de uma paciente saudável de 14 anos de idade. O exame clínico demonstrou irregularidade incisal, sangramento local, aumento da mobilidade e deslocamento axial do incisivo central superior esquerdo. O fragmento coronal extruído foi reposicionado e estabilizado com contenção flexível por quatro semanas. Prescrições de medicamentos e instruções foram dadas aos pais e ao paciente. As condições clínicas e radiográficas permaneceram satisfatórias nos acompanhamentos de 4 semanas, 6 meses e 12 meses. A vitalidade pulpar foi confirmada por testes térmicos e de percussão após 12 meses. A formação de tecido duro entre os segmentos fraturados foi observada no exame radiográfico e na tomografia computadorizada de feixe cónico. Em conclusão, a terapêutica conservadora imediata apresentou resultados clínicos e radiográficos satisfatórios. (Rev Port Estomatol Med Dent Cir Maxilofac. 2023;64(3):123-127)

Introduction

Dental trauma is considered a particular health emergency. The physical impact on dental and support tissues directly affects the functionality and aesthetics of the stomatognathic system and disrupts emotional and economic aspects of life.[1,2] A recent systematic review based on 102 studies and 109 data sets reported that traumatic dental injuries to permanent teeth have a global prevalence of 15.2%, representing an estimated 892 million individuals.[3] This evidence[3] highlights the importance of dental trauma worldwide, which would occupy the fifth place in the Global Burden Disease 2015 if included in the list of major chronic diseases and injuries. Surprisingly, the World Health Organization only considers dental caries, periodontal disease, and oral cancer in the oral health section. Thus, dental trauma is a neglected condition that should be included in the public health and research agenda.

A tooth root fracture is caused by a longitudinal, transversal, or oblique force that results in a pattern of fracture that can be vertical, transversal, oblique, or a combination of these. The tooth root fracture's diagnosis is challenging because its clinical aspect mirrors the extrusive luxation, and its radiographic aspect may confuse the classification into transversal or oblique tooth root fracture.[4] Thus, its diagnosis is given by the complementary evaluation of a periapical radiographic image, two angled horizontal radiographic images, and an occlusal radiographic image. Such exams can be challenging due to the x-ray beam incidence positioning and the patient's behavior.[4,5] The complementary examination by cone-beam computed tomography (CBCT) is also possible, but its availability is still limited.[5]

The tooth root fracture's prognosis depends on the injury's location (apical, middle, or coronal third of the tooth root), stage of root development, degree of displacement (not mandatory), distance between the fragments, and pulp damage.[6] These fractures have an estimated 1.2% to 7.0% prevalence in permanent dentition, where the transversal pattern and the cervical third location are the most frequent.[7]

Since randomized clinical trials are not feasible for reproducing traumatic situations, case reports can provide valuable information about intervention and prognosis, mainly when the traumatic injuries affect the periodontal tissues. This case report aimed to describe a case of immediate management of an oblique tooth root fracture in the middle third concomitant with coronal fragment extrusion in permanent dentition.

Case report

A 14-year-old female patient with good general health attended the dental office immediately after an accident during physical education class. The clinical examination showed incisal unevenness, local bleeding, increased mobility, and displacement of the permanent maxillary left central incisor tooth from its alveolus (Figure 1A). The radiographic assessment demonstrated increased periodontal ligament space and a transverse line in the middle third of the root with coronal fragment extrusion (Figure 1B).

The immediate therapeutic approach was cleaning the traumatized region with 0.9% saline solution (Sorimax®, Farmax, Divinopolis, MG, Brazil), repositioning the extruded coronal fragment about the other teeth' incisal plane, and stabilizing the occlusion with flexible splints with composite resin (Filtek Z250 XT®, 3M Brasil, Sumaré, SP, Brazil) and 0.3-mm stainless steel wire (CrNi Steel Wire, Morelli, Sorocaba, SP, Brazil) for four weeks. The periapical radiographic imaging exam

Figure 1. Clinical (A) and radiographic (B) aspects immediately after dental trauma.

Figure 2. Clinical (A) and radiographic (B) aspects after 12 months of follow-up.

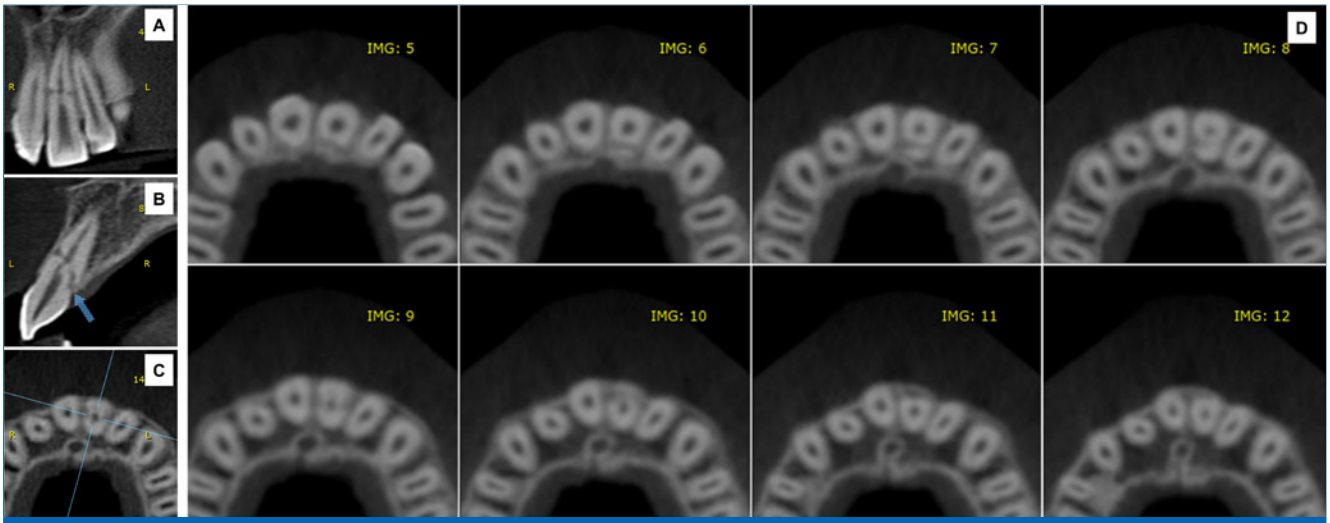

Figure 3. Imaging complementation by cone-beam computed tomography. Bone callus formation is observed between the tooth fragments. (A) Coronal, (B) sagittal, and (C) axial sections.

performed after repositioning the fragment showed the root fracture reduction line. The patient was prescribed a combined therapy of nimesulide (100 mg) 2 times a day for 3 days and amoxicillin (500 mg) 3 times a day for 5 days. Instructions were given to the parents and the patient, especially about refraining from recreational school activities, oral hygiene routine, topical use of 0.12% chlorhexidine gluconate mouthwash, and follow-up visits after 7 days, 4 weeks, 6 months, and 12 months.

After 7 days, the patient was healing well without painful symptoms, fistula, tooth discoloration, or any radiographic aspect of pulp degeneration. Clinical and radiographic conditions remained satisfactory at the 4-week, 6-month, and 12-month follow-ups. Pulp vitality was confirmed by thermal and percussion tests after 12 months (Figure 2A). Signs of repair between fractured segments were observed in the radiographic examination (Figure 2B). CBCT confirmed the diagnosis of oblique tooth root fracture and demonstrated hard tissue formation on the walls of the tooth root canal over the fracture line to unite the fractured segments (Figure 3 A-D).

Discussion and conclusions

Managing dental trauma is challenging, especially when it involves support tissues and is associated with tooth displacement. Even in children and adolescents with well-known positive behavior at the consultation, urgent care in dental trauma cases represents an unusually stressful situation that can affect the behavior of the patient, parents, and dentist. Ideally, urgent consultations should be provided by dentists specifically trained for diagnosis, treatment protocols, and stress-coping strategies in that context. However, in reality, prompt treatment is rarely offered in these circumstances, which may result in unsatisfactory outcomes for both patients and practitioners. In this clinical case, the immediate first aid, the dentist's expertise, and the patient's and parents' compliance with the instructions and follow-up appointments favored the treatment's success. Noteworthy, immediate assistance contributes to a favorable prognosis, mainly in luxations,[8] tooth root fractures,[9] and dental avulsions.[10]

Tooth root fractures involve different dental and periodontal tissues, making the healing process more challenging and more susceptible to complications, especially if the coronal fragment is displaced from the root. In such a scenario, the pulp may be distended or completely sectioned (lacerated) at the fracture site, causing a reduction or cut-off of blood supply. In some cases, the blood supply may recover, and the pulp heal properly. However, in more severe situations, pulpal necrosis associated with root canal infection can occur, and this is more likely to happen if the traumatic incident is associated with a tooth crack, fracture, or dislocation.[11-13] Our case demonstrates that pulp healing is possible even if the coronal fragment is extensively displaced. The patient's age (young dental pulp) and the immediate reduction/stabilization of the tooth root fracture may have contributed to this favorable outcome. In addition, based on the radiographic images, the apical fragment did not appear to have been displaced or damaged during the trauma.

Andreasen and Hjørting-Hansen[12] described four prognostic possibilities for root fracture: healing with hard tissue, fibrous connective tissue, or both, or development of infectious granulation tissue. In our case, the fragments' root canal anatomy remained unaltered, while a union of pieces with hard tissue was observed during the follow-up. Thus, we could predict healing based on the formation of reactionary dentin on the root canal walls over the fracture line associated with remodeling of the fracture periphery by reabsorption and new cementum.

A study showed pulp activity starting right after a tooth root fracture in dogs. Furthermore, there is competition between periodontal fibers and pulp tissue.[11] The vitality of the non-extruded root portion's pulp and periodontium could have boosted the healing process of the extruded portion, which was repositioned and stabilized. Therefore, additional measures, such as medication prescriptions and instructions for refraining from recreational school activities, were taken. Insufficient scientific evidence supports treatment success using anti-inflammatory and antibiotic medication. However, the anti-inflammatory and antibiotic were chosen to suppress inflammation and infection caused by the impact, the extension of the extruded fragment, and the level of contamination of the accident environment. The patient was instructed to refrain from recreational activities due to the risk of new trauma in the region and the case's complexity.[4]

CBCT scan significantly complemented the diagnosis of the case. According to Bourguignon et al.,[4] the radiographic protocol requires at least one periapical radiograph, which can be very difficult depending on the child's age and behavior. Still, the radiographic examination can be nonspecific. A study by Bornstein et al.[5] showed the advantage of CBCT imaging over conventional imaging, pointing out that the first contributed to the diagnosis of 70% of root fractures. Furthermore, most root fractures diagnosed by CBCT were not submitted to endodontic treatment, suggesting that earlier diagnosis leads to lower rates of radical treatment.

The scientific evidence regarding the use of CBCT in children and adolescents is scarce. However, Oenning et al.,[14] through a multicenter and multidisciplinary project —DIMITRA (pediatric dentomaxillofacial imaging: an investigation on risks induced by low-dose radiation), gathered state-of-art information regarding image quality and dose, and associating it with DIMITRA's members' expertise, provided an indication-oriented and patient-specific position statement. Among the main indications were the diagnosis and follow-up of traumatic injuries and root fractures. Noteworthy, the safety protocol for protecting the child from ionizing radiation is mandatory.

Finally, perspectives concerning the need and possibility of future orthodontic treatment are important. Risk factors for bad orthodontic outcomes are individual genetic susceptibility, systemic diseases, root morphology anomalies, previous endodontic treatment, and dental trauma. Injuries during orthodontic treatment, such as root resorption, can be prevented by controlling risk factors. Periodic radiographic control during treatment is necessary to detect the occurrence of root damage and quickly reassess treatment goals. Previous history of dental trauma is not an absolute contraindication to starting orthodontic treatment if the treatment duration is as short as possible.[15]

The present case followed the International Association of Dental Traumatology (IADT) guidelines for diagnosing, treating, and following up a tooth root fracture.[4] Although these guidelines were based on information from animal studies, case reports, case series, retrospective cohort studies, and expert opinions, the clinical success of this case reemphasizes their importance in a real-life situation.

The immediate management of an oblique tooth root fracture in the middle third concomitant with coronal fragment extrusion using a standardized approach that includes repositioning the fragment, using a flexible splint, and parents' and patient's compliance resulted in favorable healing with mineralized tissue over the fracture line.

Acknowledgments

This research was funded by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES-Brasil) – PDPG-POS-DOC/Grant – CAPES n.º 88887.755620/2022-00 (Isabela Ribeiro Madalena).

Conflict of interest

The authors have no conflicts of interest to declare.

Ethical disclosures

Protection of human and animal subjects. The authors declare that the procedures followed were in accordance with the regulations of the relevant clinical research ethics committee and with those of the Code of Ethics of the World Medical Association (Declaration of Helsinki).

Confidentiality of data. The authors declare that they have followed their work center protocols on access to patient data and for its publication.

Right to privacy and informed consent. The authors have obtained the written informed consent of the patients or subjects mentioned in the article. The corresponding author is in possession of this document.

CRediT authorship contribution statement

Lucimara Aparecida Propheta: Methodology. **Isabela Ribeiro Madalena:** Funding acquisition, Writing – original draft, Writing – review & editing. **Emerson Tavares de Sousa:** Writing – review & editing. **César Penazzo Lepri:** Writing – review & editing. **Flares Baratto-Filho:** Writing – review & editing. **Carolina Paes Torres:** Methodology, Writing – review & editing.

ORCID

Lucimara Aparecida Propheta 0009-0002-6973-8276
Isabela Ribeiro Madalena 0000-0002-4486-1318
César Penazzo Lepri 0000-0003-4372-9718
Flares Baratto-Filho 0000-0002-5649-7234
Emerson Tavares de Sousa 0000-0002-4009-8597
Carolina Paes Torres 0000-0003-3924-4494

REFERENCES

1. Antunes LAA, Lemos HM, Milani AJ, Guimarães LS, Küchler EC, Antunes LS. Does traumatic dental injury impact oral health-related to quality of life of children and adolescents? Systematic review and meta-analysis. Int J Dent Hyg. 2020;18:142-62.
2. Milani AJ, Castilho T, Assaf AV, Antunes LS, Antunes LAA. Impact of traumatic dental injury treatment on the Oral Health-Related Quality of Life of children, adolescents, and their family: Systematic review and meta-analysis. Dent Traumatol. 2021;37:735-48.
3. Petti S, Glendor U, Andersson L. World traumatic dental injury prevalence and Incidence, a meta-analysis – One billion living people have had traumatic dental injuries. Dent Traumatol. 2018;34:71-86.
4. Bourguignon C, Cohenca N, Lauridsen E, et al. International Association of Dental Traumatology Guidelines for the management of traumatic dental injuries: 1. Fractures and luxations. Dental Traumatol. 2020;36:314-30.
5. Bornstein MM, Wölner-Hanssen AB, Sendi P, von Arx T. Comparison of intraoral radiography and limited cone beam computed tomography for the assessment of root-fractured permanent teeth. Dent Traumatol. 2009;25:571-7.
6. Andreasen JO, Andreasen FM, Mejàre I, Cvek M. Healing of four hundred intra-alveolar root fractures. 1. Effect of pre-injury and injury fac-tors such as sex, age, stage of root development, fracture type, location of fracture and severity of dislocation. Dent Traumatol. 2004;20:192-202.
7. Majorana A, Pasini S, Bardellini E, Keller E. Clinical and epidemiological study of traumatic root fractures. Dent Traumatol. 2002;18:77-80.
8. Kallel I, Douki N, Amaidi S, Amor FB. The Incidence of complications of dental trauma and associated factors: a retrospective study. Int J Dent. 2020;2020:2968174.
9. Giudice RL, Lizio A, Cervino G, Fabiana N, Francesco P, Ausiello P, et al. The horizontal root fractures. Diagnosis, clinical management and three-year follow-up. Open Dent J. 2018;12:687-95.
10. Fouad AF, Abbott PV, Tsilingaridis G, Cohenca N, Lauridsen E, Bourguignon C, et al. International Association of Dental Traumatology guidelines for the management of traumatic dental injuries: 2. Avulsion of permanent teeth. Dent Traumatol. 2020;36:331-42.
11. Andreasen FM, Kahler B. Pulpal response after acute dental injury in the permanent dentition: clinical implications-a review. J Endod. 2015;41:299-308.
12. Andreasen JO, Hjørting-Hansen E. Intraalveolar root fractures: radiographic and histologic study of 50 cases. J Oral Surg. 1967;25:414-26.
13. Abbott PV. Diagnosis and management of transverse root fractures. Dent Traumatol. 2019;35(6):333-47.
14. Oenning AC, Jacobs R, Pauwels R, Stratis A, Hedesiu M, Salmon B et al. Cone-beam CT in paediatric dentistry: DIMITRA project position statement. Pediatr Radiol. 2018;48:308-16.
15. Smeyers F, Fivez S, Van Gorp G, Willems G, Declerck D, Begnoni G, et al. Evolution of root length throughout orthodontic treatment in maxillary incisors with previous history of dental trauma: a longitudinal controlled trial. Clin Oral Investig. 2022;26:7179-90.