



## Dissimilar Sequelae Caused by Single Dental Trauma: A Case Report with Long-Term Follow-up

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### Article Type: Case Report

Received: 08 Apr 2024

Revised: 14 May 2024

Accepted: 23 May 2024

Doi: 10.22037/iej.v19i3.44264

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Immediate care and accurate diagnosis are essential for treating dental trauma. This report presents a 7-year-old boy suffered a bicycle accident with direct trauma to the mouth and extrusive luxation of teeth #11 and #21. The emergency treatment was performed within the first hour. Clinical examinations showed that both teeth exhibited 3 mm extrusion from comparing their incisal edges to their neighboring teeth, had edematous gingiva, showed grade 3 mobility and were painful to percussion. Radiographic exams showed incomplete root formation, widened periodontal spaces along their entire lengths and absence of bone or root fractures. The treatment consisted of immediate repositioning and semi-rigid splinting. After 15 days, tooth #11 exhibited no clinical signor symptom and tooth #21 was diagnosed with pulp necrosis, with an acute dentoalveolar abscess and intraoral edema. Immediate endodontic treatment was initiated (intracanal dressing with calcium hydroxide paste). At 30 days, another pulp sensibility test was performed on tooth #11, which had a negative response. In the same visit, the intracanal dressing of tooth #21 was replaced. The Ca(OH)<sub>2</sub> medication was replaced every 6 months until the formation of an apical barrier. The final dressing consisted of gutta-percha and Grossman's sealer and was placed two and a half years after the first dressing appointment. The extrusive luxation resulted in two different sequelae: complete root obliteration in tooth #11 and anomalous root development after the formation of an apical barrier in tooth #21. The patient received orthodontic treatment after 6 years from the initial treatment with no negative outcome. After 18 years follow-up, both teeth were stabilized with no symptom or sign. It's important to follow the evolution of every trauma case continuously because the sequelae can be unpredictable.

**Keywords:** Dental Trauma; Endodontics; Extrusive Luxation

### Introduction

Traumatic dental injuries of permanent teeth are frequent in children and young adults [1] with a 10 to 17% prevalence in the population [2-4]. Dental trauma often results from (bike/skate) falls or traffic- or sport- related accidents [5]. Extrusive luxation consists of partial displacement of the tooth out of its socket with a rupture of the periodontal ligament fibers and possible interruption of the pulp's neurovascular supply. Clinically, the tooth often appears extruded in the incisal direction, with palatal displacement of the crown. The radiographic exam reveals an increase in the periodontal space's width at the root end [6].

The favorable prognosis of these cases is directly related to fast and efficient first aids to the traumatized patient, followed by an adequate diagnosis and treatment plan [5, 7]. Treatment consists of repositioning the extruded tooth, at the first opportunity, with a semi-rigid splint for up to 3 weeks [8]. In cases where the tooth cannot be repositioned due to blood clot formation or as a result of delayed treatment, a different option for repositioning the tooth can be considered.

Long-term follow-up is of paramount importance in cases of extrusive luxation, particularly in immature teeth. Despite the extensive care provided, the sequelae resulting from traumatic injuries can be unpredictable, with complications potentially





**Figure 1.** Clinical and radiographic follow ups of teeth #11 and #21 from 2005 to 2023: A) March, 2005 clinical photograph at the immediate post-trauma appointment; B) March, 2005 digital periapical radiograph at the immediate post-trauma appointment; C) 15 days after immediate procedures; D, E) 2005 digital periapical radiographs of endodontic procedures; F) 2006 follow up digital periapical radiograph; G) 2007 follow up digital periapical radiograph; H) 2008 follow up digital periapical radiograph; I) 2011 follow up digital periapical radiograph; J) 2015 follow up digital periapical radiograph; K) 2019 follow up digital periapical radiograph; L) 2020 follow up digital periapical radiograph; M) 2021 follow up digital periapical radiograph; N, O) 2023 follow up digital periapical radiograph and clinical picture

arising weeks, months, or even years later. The healing process is influenced by factors such as the degree of root development, the extent of damage to periodontal tissues, and the presence of bacterial contamination. Among the most severe types of trauma affecting dental supporting tissues are luxation and avulsion. Consequently, sequelae arising from neurovascular disruption, pulp necrosis, and bacterial contamination tend to occur more frequently in such cases. [9].

Immature teeth have a higher probability of maintaining pulp vitality despite the extrusive luxation, due to the great width of the foramen, and consequently, better vascularization. It is possible that pulp remains vital and continues the root development, although pulp obliteration may take place in 15-64% of the cases [10]. If pulp necrosis occurs, treatment options advised by the International Association of Dental Trauma include apexification and regenerative endodontic procedures [7].

This case report describes the extrusive luxation of two immature maxillary central incisors with different responses to dental trauma, with an eighteen-year follow-up management.

## Case Report

### Immediate treatment

A 7-year-old boy suffered a bicycle accident with direct trauma to the mouth and extrusive luxation of teeth #11 and #21 in March 2005. Clinical and radiographic examinations showed displacement of approximately 3 mm, incomplete root formation in both teeth and absence of bone or root fractures. The patient appeared to be in good health, without any systemic conditions that would interfere with the treatment plan. He and his legal guardians were informed about all details of the treatment, risks, possible negative prognosis regarding tooth loss and the actions that would be taken to assist the patient in all matters. They were informed that the best prognosis was the maintenance of the teeth for a long period of time, but only if they attended all the recall appointments for a close dental observation. The legal guardians signed an informed written consent.

The teeth were repositioned at their initial position because the emergency treatment was performed within the first h after the accident, at the Emergency Room of Cajuru University Hospital-

PUCPR, Curitiba, Brazil. A semi-rigid splint was also placed at that appointment. After seven days, pulp sensibility tests were performed at the dental ambulatory of Pontific Catholic University of Parana and both teeth had a negative response (Figure 1).

#### Mediate treatment

After 15 days, tooth #21 presented an acute dentoalveolar abscess with intraoral edema (Figure 1); therefore, immediate endodontic treatment was initiated (modeling and intracanal dressing with calcium hydroxide (Ca(OH)<sub>2</sub>) paste). At 30 days, a new pulp sensibility test was performed to assess tooth #11 vitality, resulting in a negative response. In the same visit, the intracanal medication of Ca(OH)<sub>2</sub> in tooth #21 was replaced. The Ca(OH)<sub>2</sub> was replaced every 6 months until the formation of an apical barrier. The final dressing consisted of gutta-percha and Grossman's sealer and was placed two and a half years after the first dressing appointment.

#### Follow-ups

Teeth were evaluated monthly for two years (Figure 1). Tooth #11 was regularly submitted to pulp sensibility tests and had no positive responses, and the intracanal dressing for tooth #21 was reevaluated. Tooth #11 presented continued root development and obliteration of the canal, even with a negative response to pulp sensitivity tests. An apical barrier closed the root of tooth #21, thus, it was conventionally filled three years after the trauma (Figure 1 and Table 1).

At the six months recall appointment, radiographic image of tooth #21 suggested a root tip fracture/displacement and after 3 years (2008) the radiographic images implied apical fractures in both teeth. After 7 years, tooth #11 showed a clearer image of substitutive resorption at the distal apical face of the root with complete root obliteration, while tooth #21 had an apical root displacement. Later on, in 2019, after the orthodontic treatment was finished, both teeth showed complete resorption of the root tips.

**Table 1.** Clinical and radiographic parameters evaluated at 18 years follow up

Clinical assessment	Tooth #11	Tooth #21
Pain on percussion	no	no
Pain on palpation	no	no
Spontaneous pain	no	no
Sinus tract or fistula	no	no
Swelling	no	no
Pulp sensibility (cold)	no	no
Radiographic assessment	Tooth #11	Tooth #21
Periapical lesion and area	no	no
Root dentine thickness	yes	yes
Root length increase	yes	no
Apical closure	yes	yes
Pulp obliteration	yes	no

The last follow-up was on November 22th, 2023 when both teeth exhibited good clinical condition, without pain in percussion or palpation, no mobility, no sinus tract or any radiographic signs of a periapical disease.

#### Discussion

Extrusive luxation of immature teeth may result in normal revascularization, pulp obliteration or pulp necrosis; thus, immediate management after trauma may define the prognosis of the tooth [4, 11]. In the presented case, both teeth were treated with the same initial protocol, by the same operator, at the same appointment. Nevertheless, one of them suffered pulp necrosis and the other, pulp obliteration. Andreassen (1979) observed that pulp necrosis occurred in 64% of teeth after extrusive luxation, while pulp obliteration was the sequelae in 24% of teeth after the same type of trauma [12]. After 5 years, another study also presented these two sequelae as the most common for immature teeth [11]. Although, in permanent mature teeth, other sequelae of extrusive luxation are expected; such as root resorption, ankylosis and marginal bone loss [13].

In this case report, a different treatment approach was required for each tooth due to the distinct sequelae resulting from the trauma. Following trauma, dental repair initiates at the apex and progresses towards the coronal region [5]. Depending on the pulp-periodontal interface, this process can lead to the maintenance of pulp vitality with the formation of new blood vessels, as observed in tooth #11, or the development of pulp necrosis, as seen in tooth #21. One possible explanation for the divergent outcomes is the potential contamination of tooth #21 during or after the trauma. Similar outcomes were also observed in studies involving two traumatized immature teeth from the same patient, both treated with the same regenerative endodontic protocol. One tooth exhibited continued root maturation, while the other experienced complete pulp obliteration [11, 14]. These findings raise the question about the mechanism of periapical lesions and how it might affect the outcomes of apexification, thereby warranting further discussion.

Absence of response to the pulp sensitivity test does not necessarily mean that the tooth has become necrotic [15]. The pulp tissue may also be damaged due to a traumatic injury by the disorganization of the tissue, and respond in an atypical way. The negative response of tooth #11 to the pulp sensitivity test in addition to the lack of clinical symptoms, such as tooth discoloration, presence of fistula, pain in percussion and palpation did not justify endodontic treatment. On the contrary, control radiographs showed root development and after root formation, an obliteration process began. A case report of root fracture also

showed pulp obliteration, even though the probing depth reached the fracture line after 3 years of follow-up [16]. Another case report showed pulp obliteration of an adult patient that developed pulp necrosis and periapical bone loss [17]. This corroborates with the literature that advocate for long term follow-ups, highlighting their importance, particularly in immature teeth [11, 18].

After 15 days from the traumatic injury, acute dentoalveolar abscess took place in tooth #21 following pulp necrosis. Calcium hydroxide paste for intracanal medication in endodontic treatment is broadly indicated due to its antibacterial action [18-20]. Therefore, in trauma cases, Ca(OH)<sub>2</sub> is recommended by International Association for Dental Traumatology guidelines because it prevents and/or hinders the inflammatory resorption, stimulating the formation of hard tissue barrier in the apical area for posterior root canal filling [21]. The intracanal medication replacement for the conventional filling depends on the formation of hard tissue barrier at the apical region [22].

Teeth that have suffered trauma have periodontal issues considering its possibility to initiate root resorption. To this day, there is no way to predict whether the use of orthodontic gear will or not initiate the root resorption process. If a tooth has been severely traumatized (intrusive luxation/avulsion), there may be a greater incidence of resorption with tooth movement [23]. In a systematic review published in 2022, examining the impacts of orthodontic movement on traumatized teeth, the authors presented guidelines for orthodontic treatment in cases of extrusive luxation [24]. It is recommended to observe for a period of 6 to 12 months before initiating orthodontic treatment, in order to ensure complete periodontal healing and avoid additional inflammatory stimuli that could potentially harm the protective cementum layer and elevate the risk of ankylosis [25]. After 6 years of the accident, the patient received orthodontic treatment without altering its endodontic success, corroborating with a study that showed good prognosis of teeth #11 and #21 after 5 years of follow-ups and orthodontic treatment [26].

Another consideration for immature dental cases is the possible root fracture due to thin and fragile root canal walls [27]. The presented case had extremely thin root canal walls at the time of the trauma and underwent several Ca(OH)<sub>2</sub> renewals without fracturing the root. This gives rise to doubts regarding the need for the search of complete root development, advocated by regenerative endodontic procedures; or root development in width may be more important than in length. What would be the most important site of root width that effectively enhances root strength against fracture, cervical, up to medium or all the way to the apical region? Further studies are required for a definitive conclusion in these topics.

## Conclusions

Two teeth with the same type of trauma, at the same day, presented two different forms of sequelae: pulp necrosis with anomalous root development after the formation of an apical barrier and pulp calcification. This trauma case reports a clinical and radiographic success, both teeth with no clinical symptoms or radiographic signs of active disease and stabilized after 18 years of follow-up. The orthodontic treatment that could influence the long-term outcome, had no negative sequelae. It is important to follow the evolution of every trauma case closely because the sequelae can be unpredictable.

## Acknowledgments

The authors thank the patient and family for all these years of attendance and permission for publishing the case.

## Conflict of interest

None.

## Funding support

None.

## Author contributions

Marisa Nogueira Alencar: development of the manuscript; Tatiana Carvalho Kowaltschuk: organization of case report details; Alexandre Kowalczucka: review of language and edition of manuscript; Everdan Carneiroa: translation / edition of manuscript; Ulisses Xavier da Silva Neto: edition and development of manuscript; Vânia Portela Ditzel Westphalena: departmental head and general support.

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**Please cite this paper as:** Alencar MN, Kowaltschuk TC, Kowalczyk A, Carneiro E, da Silva Neto UX, Westphalen VPD. Dissimilar Sequelae Caused by Single Dental Trauma: A Case Report with Long-Term Follow-Up. *Iran Endod J*. 2024;19(3): 237-41. Doi: 10.22037/iej.v19i3.44264.