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Treatment of a delayed replanted avulsed permanente tooth with root fracture and root resorption: A five year follow-up case report

Tratamento de um dente permanente avulsionado e reimplantado tardiamente com fratura e reabsorção radicular: Relato de caso com acompanhamento de cinco anos

Tratamiento de un diente permanente avulsionado y reimplantado tardiamente con fractura radicular y reabsorción radicular: Informe de un caso de seguimiento de cinco años

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Abstract
Tooth avulsion is a type of dentoalveolar trauma that causes great concern regarding the patient's prognosis. Proper storage of avulsed teeth is essential for treatment success. This article aims to present a case report describing an avulsed tooth successfully treated, which was replanted late and developed extensive external inflammatory root resorption with a root fracture but remained stable and asymptomatic after five years of follow-up due to appropriate therapy.. A 10-year-old female patient suffered an avulsion of tooth 11 during school play. The avulsed tooth was kept in the mouth, and reimplantation was performed at a clinic about two hours later, with semi-rigid splinting and lip suturing. After six months, the patient showed swelling, pain, and extensive root resorption, initiating endodontic treatment. In conclusion, despite the avulsion and severe root resorption, the reimplantation succeeded, and the treatment proved effective in maintaining the tooth's physiological and aesthetic functions.
Keywords: Tooth Avulsion; Tooth Injuries; Root Resorption; Tooth Replantation.

Resumo
A avulsão dentária é um tipo de trauma dentoalveolar que causa grande preocupação quanto ao prognóstico do paciente. O armazenamento adequado dos dentes avulsionados é essencial para o sucesso do tratamento. Este artigo tem como objetivo apresentar um relato de caso que descreve um dente avulsionado tratado com sucesso que foi reimplantado tardiamente e desenvolveu extensa reabsorção radicular inflamatória externa com uma fratura radicular, mas permaneceu estável e assintomático após cinco anos de acompanhamento devido à terapia apropriada. Uma paciente do sexo feminino, de 10 anos, sofreu uma avulsão do dente 11 durante uma brincadeira na escola. O dente avulsionado foi mantido na boca, e o reimplante foi realizado em uma clínica cerca de duas horas depois, com imobilização semi-rígida e sutura labial. Após seis meses, a paciente apresentou edema, dor e extensa reabsorção radicular, sendo iniciado tratamento endodôntico. Em conclusão, apesar da avulsão e da reabsorção radicular grave, o

reimplante foi bem-sucedido e o tratamento se mostrou eficaz na manutenção das funções fisiológicas e estéticas do dente.
Palavras-chave: Avulsão Dentária; Traumatismos Dentários; Reabsorção Radicular; Reimplante Dentário.

Resumen
La avulsión dentaria es un tipo de trauma dentoalveolar que genera gran preocupación en cuanto al pronóstico del paciente. El almacenamiento adecuado de los dientes avulsionados es esencial para el éxito del tratamiento. Este artículo tiene como objetivo presentar un informe de caso que describe un diente avulsionado tratado con éxito, que fue reimplantado tardíamente y desarrolló una extensa reabsorción radicular inflamatoria externa con una fractura radicular, pero se mantuvo estable y asintomático después de cinco años de seguimiento gracias a la terapia adecuada. Una paciente de sexo femenino, de 10 años, sufrió la avulsión del diente 11 durante un juego en la escuela. El diente avulsionado fue mantenido en la boca y el reimplante se realizó en una clínica aproximadamente dos horas después, con inmovilización semirrígida y sutura labial. Después de seis meses, la paciente presentó edema, dolor y extensa reabsorción radicular, iniciándose entonces el tratamiento endodóntico. En conclusión, a pesar de la avulsión y la reabsorción radicular severa, el reimplante fue exitoso y el tratamiento demostró ser eficaz para mantener las funciones fisiológicas y estéticas del diente.
Palabras clave: Avulsión Dentaria; Traumatismos Dentales; Reabsorción Radicular; Reimplante Dental.

1. Introduction

Avulsion is the most severe and complex type of dental trauma. In this injury, the tooth is completely displaced from its socket, resulting in the rupture of the apical neurovascular bundle and periodontal ligament fibers (Hicks et al., 2016).

The etiology is commonly associated with falls, car accidents, sports activities, and physical assaults. Its damage can affect aesthetics, causing psychological and social issues for the patient (Coste et al., 2014).

Regarding prevalence, the most affected group consists of school-aged male children, with the maxillary central incisors being the most commonly involved teeth (Lopes & Siqueira et al., 2020).

When a tooth is avulsed, damage occurs to the periodontal ligament (PDL) fibers and the cementum layer. PDL cells that remain on the root surface can maintain their viability when hydrated, allowing healing after reimplantation without causing significant inflammation (Trope, 2011). Thus, the shorter the extra-alveolar period of the tooth, the lower the drying of PDL fibers.

Therefore, immediate reimplantation, proper treatment of the tooth after injury, and storage in suitable media for cell survival, such as milk, saliva, or Hank's balanced solution, are crucial factors to improve its prognosis (Andreassen et al., 1995; Fouad et al., 2020). External root resorption and pulp necrosis are the most common complications (Schatz et al., 1995; Coste et al., 2020; Demir et al., 2020). The loss of a permanent avulsed tooth, even after its reimplantation into the original socket, is a common issue, requiring careful treatment and follow-up for these patients (Pohl et al., 2005).

Root cracks or fractures are some complications of inflammatory root resorption, but to the best of our knowledge, there were no case reports about the treatment of replanted teeth with resorption and crack/fracture root. Thus, this case report describes the successful treatment of a late-reimplanted avulsed tooth that developed extensive external inflammatory root resorption accompanied by a root crack. However, after appropriate therapeutic intervention, the tooth remained stable and asymptomatic even after 5 years of follow-up

This article aims to present a case report describing an avulsed tooth successfully treated, which was replanted late and developed extensive external inflammatory root resorption with a root fracture but remained stable and asymptomatic after five years of follow-up due to appropriate therapy.

2. Methodology

A descriptive research was conducted, of a qualitative nature and of the specific type of case study (Pereira et al.,

2018; Gil, 2017; Yin, 2015). This study followed ethical criteria with the patient's guardian signing the free and informed consent form (FIC) allowing the disclosure of case information for scientific purposes.

3. Case Report

This is a case report with a descriptive purpose, aiming to highlight its clinical relevance and facilitate further research and new reports on the subject. The study was approved by the Ethics and Research Committee of the School of Dentistry at the Federal University of Bahia under opinion number 4.434.737. The clinical case was conducted only after the signing of the Informed Consent Term (IC).

A 10-year-old female, sought the services of the Group for Study and Care of Traumatized Permanent Teeth at the School of Dentistry of the Federal University of Bahia (UFBA) complaining of swelling and pain upon palpation in the upper anterior region, with a trauma history from 6 months prior, where the right central incisor was avulsed and left central incisor had a subluxation (Figure 1A).

The injury occurred at school during play when the patient collided with a wall. The avulsed tooth was kept in the mouth, and the patient was taken to a nearby Urgent Care Unit. Reimplantation was performed approximately 2 hours after the trauma, with semi-rigid splinting using orthodontic wire and suturing of the upper lip.

A thermal pulp sensitivity test (Endo-Ice/Maquira) was performed, and the central incisors did not respond, while the other teeth showed positive responses. A periapical radiographic examination revealed extensive external root resorption and periapical radiolucency in the right central incisor (Figure 1B). After the initial periapical radiograph, the hypothesis of a root fracture was considered. Consequently, a cone-beam computed tomography (CBCT) examination was requested to confirm the clinical suspicion.

In the first treatment session (6 months after trauma), started with local infiltrative anesthesia followed by rubber dam isolation. The root canal of the right central incisor was accessed and instrumented with hand files under irrigation with 2.5% sodium hypochlorite, up to the working length (1 mm short of the radiographic apex), reaching a diameter corresponding to a K-file #70 (Maillefer, Ballaigues, Switzerland).

After instrumentation, a final rinse with 17% EDTA solution (Bioethics, Bahia, Brazil) was performed, activated manually with hand files for 3 minutes. The root canal was dried with sterile paper points (Dentsply-Maillefer, Ballaigues, Switzerland) and medicated with a paste based on camphorated paramonochlorophenol and calcium hydroxide (Calen, SS White Artigos Dentários Ltda., Rio de Janeiro, RJ, Brazil). The coronal access was sealed with a sterile cotton pellet and temporarily restored with glass ionomer cement (Vitro Fill LC, DFL, Rio de Janeiro, Brazil). The patient was instructed to return for monthly intracanal medication changes until the resorptive process was observed to have stopped.

After 8 months of follow-up, a periapical radiograph of the region (Figure 1C) revealed a reduction in periapical radiolucency and the beginning of bone repair. However, the decision was made to continue intracanal medication changes. During this session, the left central incisor did not respond to the thermal sensitivity test, and endodontic treatment was initiated following the same irrigation and instrumentation protocols.

Follow-up was interrupted due to the COVID-19 pandemic, and when the patient returned after 2 years, she was asymptomatic. However, it was decided to reinitiateroot canal disinfection and change the intracanal medication (Figure 1D). Three additional medication changes were conducted in the following months, and the endodontic treatments for teeth 11 and 21 were completed (Figure 1E).

Three years after the avulsion, tooth 11 was asymptomatic, and the resorption process had halted. Thus, endodontic obturation was performed. The root canal was again accessed and the intracanal medication was removed through 2.5% NaOCl

irrigation which was complemented with an additional ultrasonic activation of NaOCl for 30 seconds and a final rinse with 17% EDTA. Root canal was dried with sterile paper points (Dentsply- Maillefer, Ballaigues, Switzerland) and was obturated with gutta-percha and AH Plus Bioceramic sealer (AHPB; Dentsply Sirona, Charlotte, NC) using the lateral condensation method. The access cavity was sealed with light-cured composite resin (TPH Spectrum Dentsply/DeTrey, Konstanz, Germany) (Figura 1F).

The patient was recalled to perform clinical and radiographic follow-up. Five years after the replantation, the patient was asymptomatic; there was no mobility of the tooth and no crown discoloration (Figure 2a).

The Periapical radiograph showed absence of periradicular radioluscency, inhibition of the root resorption process, and progressive repair of the periodontal ligament (Figure 2b). On tomographic examination, root crack repair with fragment interposition and bone tissue healing were confirmed (Figures 2c and 2d).

Figure 1 – Clinical and radiographic evaluation and endodontic treatment management.

a) Clinical image 6 months after the trauma. b) Initial periapical radiograph. c) Periapical radiograph 8 months after the trauma. d) Periapical radiograph during intracanal medication change months after the trauma. e) Periapical radiograph showing working length determination of teeth 11 and 21. f) Periapical radiograph of root canal obturation for teeth 11 and 21. Source**:** Research data (2025).

Figure 2 – 5-year follow up.

a) Clinical image 5-year follow-up. Absence of fistulas and edema. b) Periapical radiograph 5 years after follow-up. c) Sagittal CBCT section, 5 years after follow-up. d) Coronal CBCT section, 5 years after follow-up. Source**:** Research data (2025).

4. Discussion

The avulsion of a permanent tooth is a complex injury, as it not only causes damage to the pulp and periodontium but also presents a high risk of root resorption or even tooth loss, even after reimplantation (Coste, 2020; Pohl, 2005). In the described case, the anterior teeth and the patient's age align with the groups most frequently affected by dental trauma, according to literature findings (Coste et al., 2020; Hecova et al., 2010). These teeth need to be kept in the mouth for as long as possible, as, in this age group, during the growth phase, definitive rehabilitation with implants or fixed prostheses cannot yet be performed.

The prognosis of avulsed and reimplanted permanent teeth is directly influenced by the actions taken at the time of the accident and long-term treatment, aiming to minimize possible sequelae such as root resorption, pulp necrosis, ankylosis, and obliteration (Pohl, 2005; Goldbeck, 2008; Karayilmaz, 2013; Abbott, 2016).

The ideal emergency procedure is immediate reimplantation, aimed at promoting the reattachment of periodontal fibers and increasing the chances of the tooth remaining in place. However, if this is not possible, it is recommended to store the tooth in liquids that maintain the viability of the periodontal ligament fibers, such as Hank's balanced solution, milk, saliva, or serum (Costa et al., 2014; Hasan et al., 2017; Longo et al., 2018; Fouad, 2020). Regarding extra-alveolar time, studies indicate that the ideal time for reimplantation is within 60 minutes, as after this period, the periodontal ligament fibers on the root surface of the avulsed tooth will become desiccated and nonviable (Trope et al., 2011; Fouad et al., 2020; Lauridsen et al., 2020; Coste et al., 2020; Roskamp, 2023). In the case in question, the reimplantation and stabilization were performed after 2 hours. However, as the patient kept the tooth in her mouth (in a moist environment) until she could be treated, the periodontal fibers likely maintained their viability and were reintegrated, increasing the chances of the tooth remaining in place.

In cases of reimplanted teeth with complete root formation, it is recommended to begin endodontic treatment within two weeks, using anti-inflammatory or calcium hydroxide-based medications to stabilize or prevent external inflammatory root resorption (Fouad et al., 2020). However, in the present case, endodontic treatment was initiated only 6 months after the trauma, which explains the extensive inflammatory resorption present in the reimplanted tooth, weakening the root walls and causing even a crack, confirmed by the follow-up tomography.

Studies show that the release of calcium ions into the root canal promotes stabilization and repair of external inflammatory resorptions (Lin et al., 2022; Abbott, 2016; Karayilmaz et al., 2013). The intracanal medication of choice was calcium hydroxide combined with camphorated paramonochlorophenol, due to its antimicrobial, alkalinizing properties, ability to reduce clastic cell activity, and dissolve resorptive tissues (Shemesh et al., 2017; Asgary et al., 2019; Rotondi et al., 2020). The chosen medication proved to be effective, as periodic changes led to a regression of resorption and bone repair.

In this case, we observed that a late reimplanted avulsed tooth was able to maintain its aesthetic, phonetic, and masticatory functions throughout the follow-up period. Therefore, it is important to emphasize the recommendation of reimplanting all avulsed permanent teeth, even in late cases, to preserve the contour, width, and height of the alveolar bone, with the possibility of future treatments, especially in young patients who cannot undergo implant rehabilitation (Lauridsen, 2020; Bastos, 2014; Teles, 2021).

5. Conclusion

The 5-year follow-up demonstrated the healing of the periapical and periodontal tissues, as well as the stabilization of the external root resorption.

Although root resorption has been a frequent sequel of dental avulsion, when associated to root fracture is not common, therefore, all therapeutic efforts must be directed towards the maintenance of the tooth in order to maintain its normal

functions. As we saw in the case described, replantation and endodontic therapy on a tooth with external resorption and root fracture , can be effectively performed. In addition, good monitoring is essential to establish successful treatment.

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