Regenerative endodontic therapy in a case of external inflammatory lateral resorption following a luxation

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Abstract

Background The insurgence of external inflammatory lateral resorption (EILR) is one of the consequences of dental trauma and it can further complicate the prognosis of a compromised tooth.
Long term treatment with Ca(OH)2 is the gold standard to manage EILR, and, recently, regenerative endodontic procedure (REP) has been suggested as an alternative clinical approach. The purpose of this report is to describe a case of post-traumatic EILR treated using REP.
Case Report A 9 years-old girl experienced an extrusive luxation of tooth #11. At the first visit the tooth was asymptomatic and responsive to sensitivity tests. At 3 months follow-up tooth #11 did not respond to cold and EPT, showed tenderness to palpation and a non-active sinus tract on the buccal mucosa. The radiographic examination showed a stage 3 root development, and an EILR in the distal-cervical portion of the root. A REP was performed using a calcium hydroxide medication for three weeks. Upon the second appointment the tooth and periapical tissues were asymptomatic, and the sinus tract had disappeared, medication was removed, intracanal bleeding and coagulum were obtained, MTA was positioned on the coagulum, and the crown restored with composite resin. Follow-up was established every 6 months for the first 2 years, then every 12 months for the next 5 years.
At two years tooth #11 shows lack of symptoms, arrest of the resorption and presence of autologous tissue at the apex and within the root canal.
Conclusions Regenerative endodontic procedures offer a less invasive option for treating immature teeth with EILR. However, the long-term effectiveness of REP is still uncertain and further studies are needed.

KEYWORDS Regenerative endodontics, dental trauma, inflammatory resorption, luxation, open apex.

Introduction

The onset of external inflammatory lateral resorption (EILR) is one possible consequence of dental trauma and represents a pathological process of the lateral surface of the root, which affects the cementum layer, may occasionally extend into bone and dentine, and further complicates the prognosis of a traumatized tooth [Abbott and Lin, 2022]. EILR takes place in two phases: injury and stimulation. Initial injury is caused by a trauma or a long-standing root canal infection which damages the pre-cementum and the pre-dentine, induces an inflammatory reaction on the exposed mineralized tissues of the root, and initiates the resorptive process [Lin et al., 2022]. Stimulation is caused by infective factors, in particular bacteria diffusing from the root canal, which sustain the resorptive process in the absence of treatment. If the stimulation ceases the resorption stops and tissue repair with cellular cementum takes place [Lin et al., 2022]. On the other hand, if root canal infection persists, bacteria and their toxins reach the adjacent periodontal tissues exacerbating inflammation and resorption [Abbott, 2016]. The biological protection mechanisms for preventing root resorption are represented by a healthy periodontium [periodontal ligament -PDL- and cementum] [Andreasen, 1981]. The intact cementum surface offers more resistance than the dentine to the resorptive process and prevents the spread of bacteria and toxins from the tooth to the periodontal ligament [Darcey and Qualtrough, 2013]. Thus, for resorption to occur there must be significant cementum damage [Darcey and Qualtrough, 2013]. EILR typically begins immediately after trauma, but it may sometimes occur later [Abbott, 2016]. The resorptive areas are visible radiographically as a loss of substance on the lateral root surface, combined with a radiolucent lesion within the adjacent PDL and bone [Abbott, 2016]. Radiolucency within the tooth root is usually bowl-shaped, but it can present with different shapes and sizes, depending on the extent of the lesion [Abbott and Lin, 2022], often with the absence of lamina dura. Normally, resorption following traumatic injuries is asymptomatic, therefore follow-up after trauma is crucial. In a long-standing root canal infection, patient may exhibit different signs and symptoms [Abbott and Lin, 2022], typically 2 to 8 weeks following trauma [Andreasen et al., 2007]. IADT guidelines [Bourguignon et al., 2020; Fouad et al., 2020] recommend performing root canal treatment in fully mature teeth affected by avulsion, luxation and fractures. The rationale is that pulp necrosis has a high likelihood of occurring and EILR is likely to take place. In such cases, a preventive approach may involve intra-canal calcium hydroxide

FIG. 1. First appointment. Initial radiograph of tooth #11(a); Off-angle radiograph showing the resorptive defect and the correspondent radiolucency on the distal wall of tooth #11 (b) arrowed. Non active sinus tract on the buccal mucosa in the distal position, arrowed (c).

from 1-4 weeks after trauma, followed by root canal obturation. An alternative protocol suggests using an intracanal medication based on corticosteroid/antibiotic mixture for 6 weeks. In contrast, in immature teeth with open apices, the pulp has good chances of surviving, healing or being revascularized. Therefore, a more conservative approach is reasonable, performing close follow-ups so, and if clinical or radiographic signs of pulp necrosis appear calcium hydroxide or corticosteroid/antibiotic protocol can be initiated. Other authors [Abbott, 2016] advice to use a preventive approach for EILR even in luxated immature teeth. The protocol consists in administering a systemic antibiotic to the patient (tetracycline are preferred, e.g. docycicline 100 mg, 2 tablets on the first day and then 1 tablet daily for one week) after the traumatic event and, after repositioning or replantation, treating the teeth immediately using a mix of corticosteroids/antibiotics (CS-AB) paste (Ledermix™ Paste, triamcinolone acetonide + demeclocycline HCl, Riemser Pharma GmbH, Greifswald, Germany, Neopharma LDT, Petach Tiqwa, Israel) as intracanal medication. The medication should be replaced every 4 weeks for the first 2-3 months and then every 3 months until apexification is detectable. The corticosteroid component of this medication has been identified as the primary preventive and interceptive antiresorptive agent [Pierce and Lindskog, 1987]. In the absence of clinical signs and symptoms, healing of EILR is recognizable radiographically by the arrest of resorptive process and the presence of lamina dura around the tooth. A defect on the root surface, which may decrease with hard tissue apposition, may also persist. In replanted teeth ankylosis can occur at the site of the previous resorption [Andreasen, 2007]. Regenerative endodontic procedures (REPs) are defined as biologically based procedures designed to physiologically replace damaged tooth structures, including dentin and root structures, as well as cells of the pulp-dentin complex (Regenerative endodontics AAE position statement, 2013). REPs have been successfully applied to the conservative treatment of necrotic immature teeth [Harlamb, 2016, Milia et al., 2020], and recently they have been suggested as an alternative treatment for primary teeth [Snigdha et al., 2024] and in the management of traumatized immature teeth affected by EILR [Lin et al., 2022]. Based on a recent review [Lin et al., 2022], the most important advantages of using REP to treat EILR are the reduction of the number of appointments and their efficacy in both arresting the resorption and promoting the development or repair of the immature root. In the case of an immature tooth with apical periodontitis and detectable EILR, REP should be initiated following AAE indications [AAE, 2021]. The aim of the present article is to report a case in which a traumatized tooth affected by EILR was treated using a regenerative endodontic approach.

Case report

A 9 years-old girl fell off her the bicycle and experienced a minimal extrusive luxation of tooth #11, and the concussion,

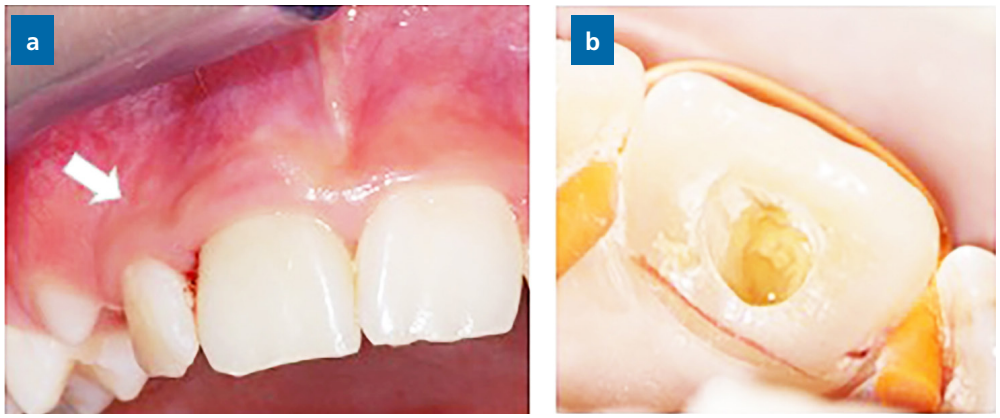

FIG.2. Second appointment. Healing of sinus tract, arrowed (b). Access cavity on tooth # 11 (b).

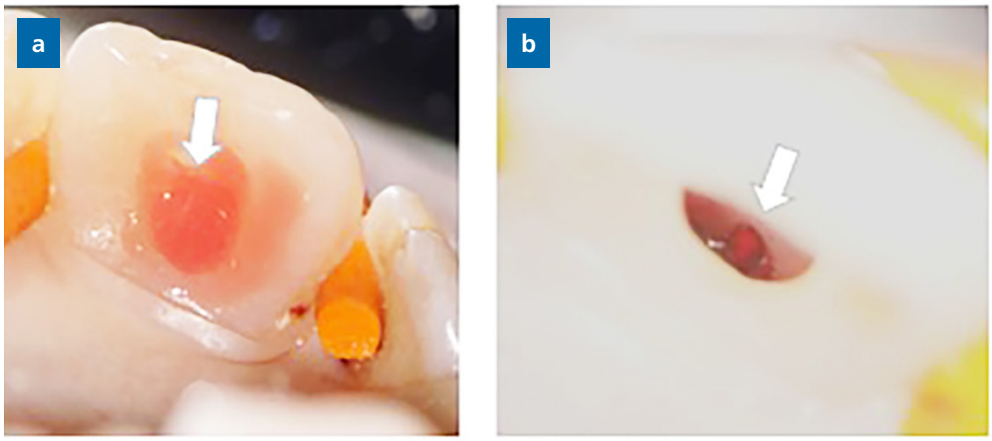

FIG. 3. Bleeding induced at the apex of the tooth, arrowed (a); Microphotograph (20x) showing the induced coagulum within the tooth and at the resorption site, arrowed (b).

with a fracture of the incisal margin of tooth #21.

When she was seen by her dentist one day after the trauma, all four upper incisors were asymptomatic and responsive to cold and EPT, with percussion and palpation tests within normal limits. It was decided to monitor her with monthly follow-ups [Bourguignon et al., 2020; Fouad et al., 2020]. Three months later, she was referred for consultation to the Department of Endodontics of the Dental School, because tooth #11 showed a radiolucency in the lateral wall of the root. At first visit, tooth #11 exhibited no response to cold and EPT, tenderness to palpation and signs of a non-active sinus tract on the distal-buccal (Fig 1c, arrowed). The radiographic examination showed a stage -3 root development [Cvek, 1992] and signs of lateral resorption in the distal-cervical portion of the root (Fig 1b, arrowed). The diagnosis was pulp necrosis, symptomatic apical periodontitis, and external inflammatory lateral resorption. Treatment options included traditional dressing with calcium hydroxide followed by apexification, or regenerative endodontic procedure. REP was chosen and performed following AAE protocol [AAE, 2021].

At the first appointment, following local anesthesia (mepivacaine with adrenaline 1:100.000) and isolation, the access cavity was opened, and the coronal and middle third of the canal were mildly instrumented using a small excavator and large hand K files (Maillefer, Dentspy Sirona S.r.l., RM, Italy). Irrigation was done with 20 mL of NaOCl diluited at 1,5% (Niclor 5, Giovanni Ogna & Figli S.r.l., Muggiò, MB, Italy), followed by a final rinse with 20 mL of sterile saline solution (Sodio Cloruro 0.9%, GIOVANNI OGNA & Figli S.r.l., Muggiò, MB, Italy). The instrumented canal portion was then dried with large paper points and filled with Ca(OH)2 (Caliform, Ogna S.r.l., Muggiò, MB, Italy). The access was temporized with a cotton pellet and temporary cement (Cavit, 3M Italia srl, Pioltello, MI, Italy). Twenty days later, the patient was asymptomatic, and the sinus tract sign had disappeared from the alveolar mucosa (Fig 2a, arrowed). At the second appointment, local anaesthesia (mepivacaine without adrenaline) and isolation were applied. Calcium hydroxide paste (Caliform, Ogna S.r.l., Muggiò, MB, Italy) was gently removed and the canal was rinsed with 17% EDTA (E.D.T.A. 17% Giovanni Ogna & Figli S.r.l., Muggiò, MB, Italy) and dried. Bleeding was then induced within the root canal using a hand file #15 (Maillefer, Dentspy Sirona S.r.l., RM, Italy) beyond the apex, leading to the formation of a coagulum (Fig 3a, arrowed). A calcium silicate cement (Pro-Root MTA, Dentsply Tulsa Dental, Tulsa, OK, USA) was then gently placed against the coagulum [Olczak and Pawlicka, 2014; Kasimoglu et al, 2024]. Using the operating microscope it was possible to observe the coagulum in the center and mesial portion of the root (Fig 3b, arrowed). The access cavity was temporized with a cotton-pellet and Cavit (3M Italia Srl, Pioltello, MI, Italy).

The access was then restored with composite resin (Tetric PowerFill, Ivoclar Vivadent AG, Schaan, Liechtenstein) and dental adhesive (Adhese universal, Ivoclar Vivadent AG, Schaan, Liechtenstein) on the third appointment after verifying the complete setting of the MTA.

Follow-up was scheduled every 6 months for the first two years, then once a year for 5 years [Galler et al., 2016].

At the two years follow-up the patients is symptoms free, with no visible signs in the soft tissues. The radiograph shows the arrest of the EILR and the autologus repair of the root. The root appears longer and thicker (Fig. 4b, arrowed), the first two goals of REP were thus achieved [AAE, 2021], while no response to sensitivity tests were obtained. Patient will be followed-up every year.

Discussion

Post traumatic EILR needs to be prevented, or managed and arrested as soon as possible. The IADT guidelines suggest different approaches, depending on the stage of apex maturation [Bourguignon et al, 2020; Fouad et al., 2020]. In mature teeth, two weeks after trauma or when the tooth position allows it, a long term (4-6 weeks) intracanal medication

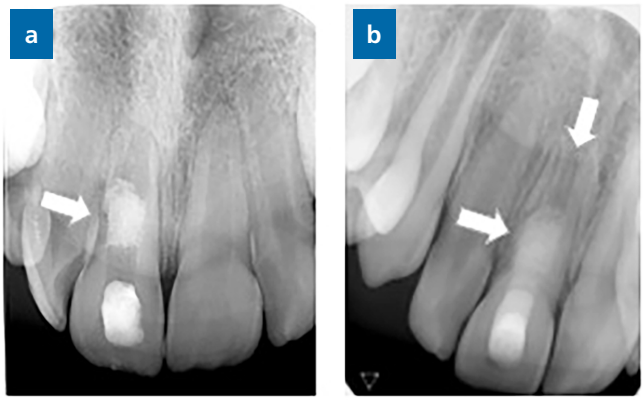

FIG. 4. Case completed, MTA obturation in the REP site, arrowed (a). 2 years follow up showing the arrest of the resorption, the healing of the lateral lesion (small arrow) and the filling of the root canal by autologous tissue (big arrow) (b).

with calcium hydroxide (or CS-AB paste), followed by canal obturation is recommended. In immature teeth a watchful waiting approach is suggested, as the immature pulp could heal or be revascularized [Bourguignon et al., 2020; Fouad et al., 2020]. If pulp necrosis occurs root canal treatment is mandatory, following the proper procedures for treating immature teeth. Since pulp necrosis is likely to occur, other authors suggest a preventive endodontic treatment even in immature teeth [Abbott, 2016]. In recent years, however, using REP has been proposed as an alternative to manage immature teeth affected by post traumatic EILR [Lin et al., 2022]. According to the clinical indications of American Association of Endodontists [AAE, 2021], REP should be performed to eliminate the patient's symptoms, achieve bone healing, increase the thickness and length of the root, and obtain a positive response to vitality test. Although these goals may not always be fully achieved, clinical reports have shown that this approach is effective in arresting EILR, being at the same time less invasive, reducing the number of treatment appointments, and supporting the strengthening and continuous development of the root [Lin et al., 2022; Galler et al., 2016; AAE, 2021]. While some studies on survival and success of REP have shown high success rates (97,8% and 91,3%, respectively), and not significantly different from apexification, [Torabinejad et al., 2017], others have demonstrated better long-term outcomes in traumatized upper incisors treated with apexification [Van Gorp et al., 2023]. Disagreements on the results can be explained by emphasizing that the treatment approach should depend on the stage of root development, which also affects REP prognosis [Van Gorp et al., 2023], as teeth at early stages of root development seem to exhibit better clinical and radiographic outcomes, with increased radiographic root area [Van Gorp et al., 2023, Erdogan et al. 2024]. Histological evaluation on REP cases have revealed that the newly formed tissue is not pulpal tissue, but rather an ectopic, cementoid-like tissue, fibrous tissue or bone-like tissue [Becerra et al., 2014, Meschi et al., 2015; Zhou et al., 2017]. For this reason, some authors refer to it as repair rather than regeneration [Galler et al., 2016]. The important aspect of REP is that autologous tissue can be obtained, achieving periodontal healing without weakening the immature tooth.

Conclusions

External inflammatory lateral resorption is a serious post-traumatic complication. To date, a definitive protocol for arresting EILR does not exist. However, regenerative endodontic procedure can be a valid therapeutic alternative to decrease the invasiveness on the involved tooth while obtaining a biological repair with the ingrowth of autologous tissues. Further clinical studies are mandatory to define an effective and definitive operative protocol.

Statement of the authors

The authors declare that the manuscript is original, is not currently under consideration for publication in another journal, has not been published elsewhere, and does not violate third-party copyright laws.

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