ENDODONTIC TREATMENT OF AN IMMATURE PERMANENT TOOTH WITH PULP REVASCULARIZATION TECHNIQUE: A 3-YEAR FOLLOW-UP

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ABSTRACT

Aims: To report a clinical case where a pulp revascularization procedure was performed in an immature permanent tooth with necrosis and periapical lesion.

Case report: A 7-year-old girl with a history of trauma seven months before presented pulp necrosis in the upper left central incisor (9) with incomplete root formation. After clinical and radiographic examinations, the diagnosis was a chronic periapical abscess—the proposed treatment of pulpal revascularization. Two appointments were performed according to the protocol proposed by the American Association of Endodontics (AAE). In the first consultation, access surgery was performed, and presentation protocol with sodium hypochlorite (NaOCl) 1% and EDTA 17%. Calcium hydroxide was used as root canal dressing for 15 days. The intracanal medication was removed in the second appointment; a new disinfection protocol was performed, bleeding was induced with a #35 K-file and clot formation, buffer with mineral trioxide aggregate, and definitive restoration was performed. The follow-up of the case was carried out over periods of 30 days and later three years.

Results: In the 3-year follow-up, the patient has no signs and symptoms of infection. In addition, a radiographic image demonstrates the healing of apical periodontitis with a formation of a mineralized barrier at the apical level.

Conclusion: It is possible to consider the case successful. New consultations are necessary to observe the completion of the root formation process and the thickening of the root canal walls.

KEYWORDS: Dental trauma. Immature permanent tooth. Pulp necrosis. Pulp revascularization.
https://doi.org/ 10.59306/jrd.v11e3202316-21

INTRODUCTION

Regenerative endodontics is a biologically based procedure designed to replace dental structures, including cells of the dentin-pulp complex[1]. This technique is based on the attempt to regenerate the pulp tissue, with a high success rate of 75-80%[2-5].

Pulp revascularization aims, from the remnants of stem cells present in the apical papilla, to complement the root formation in terms of length and thickness of the root walls[6]. Additionally, pulp revascularization aims to promote the closure of the apical foramen and the healing of the periapical tissues. In this sense, it promotes the strengthening of the dental structure, improving the prognosis and the survival rate of immature teeth[4].

Figure 1. A periapical radiograph showed the incomplete formation of the dental apex of the left maxillary central incisor.

Figure 2. Odontometric radiography

Figure 3. Calcium hydroxide paste as intracanal medication.

The American Association of Endodontists recommends the disinfection of the root canal system through irrigating solutions, usually 1% NaOCl and 17% EDTA. Subsequently, an intracanal medication based on calcium hydroxide or a combination of antibiotics (ciprofloxacin, minocycline, and metronidazole) must be used[7]. After two to three weeks, a mechanical induction of bleeding is performed using stainless steel files over the formed apex and the canal is filled with blood. This blood-clot will contain mesenchymal stem cells in the pulp space that will induce the formation of root and a pulp-like tissue[8,9]. Mineral trioxide aggregate (MTA) is the material of choice due to its excellent sealing ability and biocompatibility. It is recommended to place 3 mm of MTA over the blood clot as a capping material, followed by a bonded restorative material to avoid infiltration[4,10].

Several case reports and series of cases have described good results with pulpal revascularization of immature teeth with radiographic signs of tooth maturation and elimination of signs and symptoms[5,11]. As well, randomized clinical trials also show good results for regenerative endodontic therapy, demonstrating that, likewise, when apexification is detected, it brings a significant increase in root length and thickness, with 100% survival and about 90% of cases showing clinical e radiographic success within 12 months[12]. This case report aims to describe the endodontic treatment of an immature maxillary incisor with apical periodontitis using the pulp revascularization technique.

CASE REPORT

The study was submitted and approved by the Research Committee of the Federal University of Rio Grande do Sul. This case report was written following the 2020 Preferred Reporting Items for Case Reports in Endodontics (PRICE) guidelines[13].

A seven years-old female patient with no reports of systemic diseases or allergies, was referred to the endodontic care service of the Federal University of Rio Grande do Sul (UFRGS) for endodontic treatment of tooth 9. In the first appointment, the responsible person for the child reported that the patient had suffered a trauma in the anterior region of the maxilla with a coronary fracture of the left maxillary central incisor around seven months ago but did not seek by dental care. After the period, the presence of a sinus tract associated with this tooth was observed, which led to the search for a dental surgeon from the primary health care unit, who initiated the emergency treatment of this case, proceeding endodontic access and placement of an intracanal sterilized cotton pellet, and the patient was referred to UFRGS endodontic service. A periapical radiograph was performed and showed the incomplete formation of the dental apex of the left maxillary central incisor (**Figure 1**). Clinical examination revealed positive results of pain for apical digitation and vertical percussion. Cooling test was negative, and the sinus tract was absent at this appointment. Therefore, an apical periodontitis associated to the left maxillary central incisor was diagnosed.

After assignment of the informed consent, the clinical procedures were performed. First, an anterior superior alveolar and nasopalatine nerve anesthesia was performed, with 2% lidocaine with 1:100.000. After rubber dam isolation, the coronary access was performed by the palatal aspect. The disinfection procedure was performed as described

Figure 4. A 3mm MTA-plug

Figure 5. Follow-up one month later appointment, radiographically, the periapical lesion was slightly reduced.

Figure 6. In the three-year follow-up, complete repair of the periapical region is observed, and it was observed a mineralized barrier at the apical level of the root, but there was no thickening of the canal walls.

by AAE with a size #40 K-type stainless steel file (Dentsply Meillefer, Ballaigues, Switzerland) until 4 mm of the terminus of the formed root. Irrigation with 5mL of 1% sodium hypochlorite (NaOCl) (Farmácia Marcela, Porto Alegre, RS, Brazil) was used to irrigate the root canal. The working length (WL) was stablished in 20mm from the incisal point of the crown based on the work length radiography (**Figure 2**). Next, an irrigation with 5mL of 1% NaOCl was performed for 5 min using NaviTip needles (Ultradent) and a dispensable 10mL syringe.

The canal preparation was gently performed with a size #80 stainless steel file using translational movements to touch the maximum area of the root canal walls. Irrigation was performed with 20 mL of 1% sodium hypochlorite. Calcium hydroxide paste (Ultracal; UltraDent Product, Inc. South Jordan, USA) was used as intracanal medication for 15 days. The coronal sealing was performed with a sterilized cotton pellet, temporary material (Cavit, 3M ESPE, Seefeld, Germany) and Maxxion R® glass ionomer cement (FGM, Joinville, Santa Catarina, Brazil) (**Figure 3**).

After 15 days, the patient returned for the second appointment. No clinical signs or symptoms of infection were observed after clinical examination. First, an anterior superior alveolar and nasopalatine nerve anesthesia was performed, with 2% lidocaine with 1:100.000, rubber dam isolation, and removal of temporary restoration were performed. The intracanal medication was removed under irrigation with 20 mL of 1% sodium hypochlorite for 10 minutes followed by 20 mL of 17% EDTA for 5 minutes. An over-instrumentation was performed with a size #35 K file (2 mm beyond the WL) to stimulate the bleeding. Next, a sterilized cotton pellet embedded with saline was positioned 3mm under the cementoenamel junction for 5 minutes to contain the bleeding and to form the blod-clot. A 3mm MTA-plug (MTA; Angelus Londrina, Brazil) was positioned in contact to the blod-clot 3mm above the cementoenamel junction. The restoration was performed with Maxxion R® glass ionomer (FGM, Joinville, Santa Catarina, Brazil) and composite resin (Magicfill, Vigodent, São Paulo, SP, Brazil) (**Figure 4**).

Patient returned one month later for the first follow-up appointment with absence of postoperative pain and any symptoms related to this tooth. Clinically, the region at the bottom of the sulcus had a healthy appearance with no sinus tract anymore. Radiographically, the periapical lesion was slightly reduced (**Figure 5**). In the three-year follow-up, complete repair of the periapical region is observed, and it was observed a mineralized barrier at the apical level of the root, but there was no thickening of the canal walls (**Figure 6**). Patient did not present any signal or symptoms of infection.

DISCUSSION

The case report describes a pulp revascularization in the maxillary left central incisor with incomplete apex of a 7-year-old patient. The dental trauma resulted in an apical periodontitis. These data corroborate those found in the literature, dental trauma being the main cause of pulp necrosis in immature permanent teeth and upper central incisors[14].

The treatment of a pulp necrosis is through an endodontic procedure to prevent bacterial dissemination and worsening of the infectious condition. Furthermore, other adverse events may occur in cases of dental trauma, such as obliteration of the canal lumen and internal or external dentine resorption[15,16]. After coronal opening, a gently canal preparation was performed aiming to disorganize the bacterial biofilm but not to wear the canal walls[11, 17]. Most of the root canal disinfection is achieved by the chemical and mechanical effects of the irrigant, rather than the mechanical action of the endodontic instruments on the canal walls[18-20]. NaOCl is the solution of choice for these cases[18, 19]. Higher concentrations exhibit cytotoxicity to the undifferentiated mesenchymal cells of the dental papilla and can impair their differentiation into cells similar to those of the tooth-pulp complex[20].

The literature shows the possibility of using basically two intracanal medications: a calcium hydroxide-based paste or a combination of antibiotics. The use of antibiotics, such as the triantibiotic paste (TAP), combine minocycline, ciprofloxacin, and metronidazole. Calcium hydroxide appears as an alternative to TAP since the combination of antibiotics has disadvantages, such as the microbial resistance, allergic reactions, and color changing of the dental crown caused by minocycline[11,21]. Dental staining has been reported as the main complication found in pulpal revascularization cases[4,11]. On the other hand, the calcium hydroxide paste has antimicrobial properties, osteoconductive properties, less cytotoxicity, and does not cause tooth staining[20]. Data regarding the effectiveness of calcium hydroxide for use as a delay dressing are evidenced in the literature[17,18,22]. The antimicrobial properties of calcium hydroxide derive from its high pH, which makes the environment unfavorable for the survival of most microorganisms[23]. Furthermore, it can cause the hydrolysis of lipopolysaccharide (LPS) present in the cell wall of gram-negative cells[23]. LPS is responsible for inflammatory events such as stimulating the release of chemical mediators of inflammation and reabsorption of hard tissues[24]. Furthermore, the bacterial resistance to antibiotics when multi-antibiotics are used for a short period is documented and argues against triple antibiotic paste[21,24]. In this sense, in the present case, the calcium hydroxide paste was used as the root canal dressing.

In the second session, after the final irrigation with NaOCl, 20 mL of 17% EDTA was also performed for 5 minutes. The combination of NaOCl and 17% EDTA is crucial because of their ability to dissolve organic matter and eliminate bacteria and remove the smear layer, respectively[25]. EDTA also acts activating the releasing of dentin growth factors, promoting the differentiation of papilla cells[20,22,26]. Histological studies have shown that most of the tissues formed in the pulp revascularization technique are not histologically identical to pulp and dentin but rather cementoid and osteoid-like[17,22,27]. According to histological analyses, there are distinct tissues that form within the canal space: intracanal cementum, which provides an increase in the thickness of the dentin walls tissue similar to bone tissue, and fibrous periodontal tissue that develops around the cementoid or osteoid-like[22]. The formation of these tissues may be like the pulp due to the permanence of the apical papilla[28].

The initial goal of the pulp revascularization is to control the inflammatory process related to the infection installed into the canal. In addition, it aims to stimulate the root formation in length and width. To induce the root development, the cells of Hertwig's epithelial sheath must be viable even after the installation of apical periodontitis or apical abscess[16]. However, success in cases of revascularization goes beyond just completing root formation. The absence of clinical signs such as sinus tract, edema, mobility, painful symptomatology, and radiographic images demonstrating the reduction or repair of the periapical lesion must also be considered[29]. One study followed up to 26 months of 20 cases of immature permanent teeth with apical periodontitis and incomplete root formation, treated with the pulp revascularization protocol. Seventy-five per cent of the cases showed radiographic evidence of increased root wall thickness. In 5 cases, there was no significant continuation of the root development, but with the formation of an apical barrier. Basically, five different outcomes related to root development can occur after pulp revascularization in immature permanent teeth: an increase in the thickness of the dentin walls and continuation of root formation; non-significant continuation in root formation with the formation of an apical stop; a continuation of root formation but no closure of the apex; calcification of the canal space, and formation of a hard tissue barrier between the MTA plug and the clot[16].

CONCLUSION

In this case report, the pulp revascularization controlled the canal infection and the periapical inflammation healed. The patient remains asymptomatic, and the tooth demonstrates complete repair of the apical periodontitis with a formation of a mineralized barrier at the apical level after three years follow-up. A long term follow up is still necessary to verify if an increase in the thickness of the canal walls or the root length will occur.

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