Pulp Revascularization after Root Canal Decontamination with Calcium Hydroxide and 2% Chlorhexidine Gel

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Abstract

Introduction: Pulp revascularization may be considered a promising alternative for necrotic immature teeth. Many studies have accomplished passive decontamination associated with an antibiotic paste. To date, there is no report evaluating calcium hydroxide associated with 2% chlorhexidine gel for revascularization therapy. The aim of this case report was to describe a new proposal for pulp revascularization with mechanical decontamination and intracanal medication composed of calcium hydroxide and 2% chlorhexidine gel. Methods: The patient, a 9-year-old girl, suffered an intrusion associated with pulp exposure caused by an enamel-dentin fracture in her maxillary left central incisor. After diagnosis, treatment consisted of revascularization therapy with gentle manual instrumentation of the cervical and medium thirds of the root in addition to intracanal medication with calcium hydroxide and 2% chlorhexidine gel for 21 days. In the second session, a blood clot was stimulated up to the cervical third of the root canal. Mineral trioxide aggregate (MTA; Angelus, Londrina, Paraná, Brazil) was used for cervical sealing of the canal. Coronal sealing was performed with temporary filling material and composite resin. Results: During the follow-up period, the root canal space showed a progressive decrease in width, mineralized tissue deposition on root canal walls, and apical closure. A cone-beam computed tomography scan taken at the 2-year follow-up confirmed these findings and did not show complete root canal calcification. Conclusions: This new proposal for revascularization therapy with 2% chlorhexidine gel may be used for the treatment of necrotic immature root canals. (J Endod 2013;39:417–420)

Case Report

The patient, a 9-year-old girl, was referred to the Dental Trauma Service of the Piracicaba Dental School, State University of Campinas, Piracicaba, São Paulo, Brazil,
after falling off a bicycle the previous day. A clinical examination revealed enamel-dentin-pulp fracture in the maxillary left central incisor associated with intrusive luxation that could be diagnosed because of slight clinical infraocclusion and a history of gingival bleeding. The other maxillary central incisor suffered subluxation. There was no mobility, root fracture, or bone fractures. A radiographic examination showed incomplete root formation of the affected teeth, and the periodontal ligament space was apparently intact (Fig. 1A). During the first visit, the cold pulp test (Endo-Frost; Roeko, Langenau, Germany) and the electric test (Pulp Tester; Analytic Technology, Redmond, WA) were performed in all traumatized teeth, which presented questionable responses. There was a bleeding point of pulp exposure in the left incisor that was sealed with calcium hydroxide and temporarily restored with glass ionomer cement (SS White Dental Materials, Rio de Janeiro, Brazil). No endodontic procedure was performed because of the recent occurrence of trauma, the questionable pulp tests, and the open apexes. After 3 weeks, the sensitivity to cold (Endo-Frost) and the electric pulp tests (Pulp Tester) were repeated. The left central incisor showed a negative response, and the right central incisor showed a positive response. In addition, only the left central incisor showed positive sensitivity to the percussion test; however, there was no pain on palpation. The right central incisor prognosis was favorable; therefore, the authors decided to follow up with the case. However, because the left central incisor was diagnosed with pulp necrosis, we decided to perform endodontic treatment. After complete explanation of the treatment procedure, risks, and benefits, informed consent was obtained from the patient’s legal guardians, and the treatment of choice was to implement a new proposal for pulp revascularization in 2 sessions. The tooth was anesthetized and isolated with a rubber dam. The access cavity was prepared using a diamond bur (KG Sorensen, Barueri, Brazil) and a high-speed handpiece with copious sterile physiologic solution. No bleeding from the pulp tissue was observed. The working length was determined with a periapical radiograph with the use of a #35 Kerr file (Dentsply-Maillefer, Petrópolis, Rio de Janeiro, Brazil) in the canal, and some bleeding around the apex was observed during this procedure. Manual endodontic K-files sizes #55, 50, and 45 (Dentsply Maillefer, Tulsa, OK) and Gates Glidden drills sizes #5, 4, 3, and 2 (Dentsply Maillefer) were used in the presence of 2% chlorhexidine gel (Endogel, Itapetininga, Brazil). Irrigation with sterile physiologic solution removed pulp and necrotic tissue from the cervical and middle thirds. The apical third received no treatment for the preservation of stem cells that might be present. After cleaning, a dressing prepared in the proportion of 1:1 of calcium hydroxide (Biodinâmica, Ibiporã, Brazil) and 2% chlorhexidine gel in a creamy consistency (Endogel) was inserted into the cervical and middle thirds of the root canal with a lentulo spiral (Dentsply Maillefer). The tooth was sealed with Coltosol (Coltene Whaledent, Mahwah, NJ) and composite resin (Z250 Filtek; 3M ESPE, São Paulo, Brazil). The dressing was left in the root canal for 21 days. During the second visit, the tooth was anesthetized, accessed, and irrigated with physiologic solution. Manual K-files (Dentsply-Maillefer, Ballaigues, Switzerland) were used under irrigation with physiologic solution to remove the intracanal dressing. After this, irrigation with 3 mL 17% EDTA solution (Fórmula e Ação, São Paulo, Brazil) for 3 minutes was followed by sterile saline solution irrigation because of the known beneficial properties of EDTA on conditioning the dentin for stem cell differentiation (25). After this, the root canal space was properly dried, and manual K-files (Dentsply-Maillefer) were used to stimulate bleeding for clot formation. Next, mineral trioxide aggregate (MTA; Angelus, Londrina, Paraná, Brazil) with condensers (Konne, Belo Horizonte, Brazil) was used to seal the cervical third of the root canal, and Coltosol and composite resin (Filtek) were used for coronal sealing of the tooth.

Figure 1. (A) The initial radiograph showing the open apex of the left central incisor. (B) Pulp revascularization sealed with MTA, coltosol, and composite resin. (C) The 3-month follow-up. (D) The 9-month follow-up. (E) The 12-month follow-up. (F) The 24-month follow-up.
In all the follow-up visits (at intervals of 1, 3, 6, 9, 12, 15, and 24 months), the patient showed no signs and symptoms, and the radiographic examinations showed good conditions of periodontal tissues with the continuation of root formation and apical closure (Fig. 1C–F). Cold sensitivity, electric pulp, percussion, and palpation tests were performed in all visits, and the left central incisor always responded negatively. A cone-beam computed tomography scan using classic iCAT tomography (Imaging Sciences International Inc, Hatfield, PA) was taken at the 24-month follow-up. The images showed no peri-apical lesion, continuing root development, apical closure, and thickness of the root canal space without complete calcification (Fig. 2–D).

**Discussion**

In this case report, the patient suffered intrusive luxation, which is considered one of the most uncommon and severe injuries. It corresponds to 0.9% to 1.3% of traumatic lesions (26). Its severity could be attributed to the crushing of periodontal fibers, the neurovascular bundle, and alveolar bone (27). Therefore, pulp necrosis is one of the most frequent posttraumatic complications in this type of trauma, corresponding to 73.3% of the sequelae (28). Combined with intrusion luxation, there was an enamel-dentin fracture with pulp exposure that also contributed to pulp tissue contamination.

In the classic revascularization protocol in the majority of studies, passive decontamination is performed with sodium hypochlorite without conventional mechanical instrumentation for the prevention of cell destruction, particularly those responsible for mineralized tissue deposition on the internal root walls (4, 6). Contrary to most of the published research, in the present case, mechanical instrumentation of the cervical and middle thirds of the canal was performed with manual K-files to remove necrotic pulp and facilitate the insertion of intracanal medication and sealing material, which did not interfere in the revascularization process. Another modification was the use of 2% chlorhexidine gel as the irritant instead of sodium hypochlorite. This choice was made because some studies showed the low cytotoxicity of this substance in contact with periapical tissues (23, 24) and other articles showed successful revascularization (5, 7, 14). In addition to irrigation, the literature reports that the use of intracanal dressing materials, mainly those composed of the antibiotics metronidazole, ciprofloxacin, and minocycline, contributes to decontamination (7, 12). These antibiotics have shown antimicrobial action against endodontic pathogens in addition to satisfactory results with root development in pulp revascularization (2, 5). Nevertheless, this paste may promote some side effects such as coronal discoloration, bacterial resistance, and allergic reactions (12). In the present study, calcium hydroxide intracanal medication with 2% chlorhexidine gel was used in the cervical and middle thirds of the root canal for 21 days, which did not promote coronal discoloration, thereby preventing esthetic disharmony. The antimicrobial potential of calcium hydroxide and the distance action of the vehicle chlorhexidine, particularly in dentinal tubules, are well known (29–31). Considering disinfection with chlorhexidine, studies have evaluated the cytotoxicity of some irritants in contact with stem cells of the apical papilla (32). In this article, it was observed that 2% chlorhexidine affected the viability of stem cells of the apical papilla leading to no viable cells. In addition, some authors have related the harmful action of calcium hydroxide in pulp revascularization (5). It has been suggested that because of its high pH, calcium hydroxide will necrose tissue immediately upon contact with it, thereby destroying tissues with the potential to differentiate into new pulp (5). Another disadvantage is related to the increased risk of root fracture in immature teeth with calcium hydroxide dressing, which is caused by its reaction with dentin (33). On the other hand, some recent case reports have shown favorable results when using calcium hydroxide in the cervical third of the root canal (8, 19, 20), and others effectively used irrigation protocols with chlorhexidine (7, 14). Moreover, 2% gel chlorhexidine has antimicrobial properties and low cytotoxicity (24). In the present report, an increase in the thickness of the root wall and apical closure were observed with the use of this medication, which is already routinely used in endodontic treatment and does not have cytotoxic effects that would facilitate the clinical applicability of this therapy.

During the entire follow-up period, apical closure and increasing radicular thickness were noted at the 9-month follow-up, and they were quite remarkable in the subsequent follow-ups, which agreed with previous reports (5, 14, 19). In previous reports (4, 7, 8, 19), longer periods of follow-up showed partial canal obliteration, which is also a finding of this study. During the follow-up period, the tooth showed no response to the sensitivity cold and electric tests. The absence of a positive response may be because the tissue that invaginated into the canal space was probably not innervated or more likely because of the presence of MTA sealing and partial obliteration of the root canal space. A cone-beam computed tomography scan was performed only at the last follow-up (24 months) to confirm the success of the therapy and to better evaluate continuing root development and the presence of root canal space. Total calcification (obliteration) was not present, and periapical region healing was confirmed by tomography scanning, which was also used in a recent study (34). It is also remarkable that the calcification process in revascularized teeth is more accelerated when compared with the natural development of the root, which can be compared with the adjacent teeth.

Further studies characterizing the developed tissue are necessary in order to understand the mechanism of pulp revascularization and for the clinical application of this promising therapy. In addition, comparative studies with different protocols for pulp revascularization...
and more clinically controlled studies would contribute to the best form of action in the use of this therapy. This report of pulp revascularization shows that mechanical instrumentation of the cervical and middle thirds of the root canal in association with intracanal dressing composed of calcium hydroxide and 2% chlorhexidine gel leads to satisfactory root development in necrotic immature teeth.

Acknowledgments

The authors deny any conflicts of interest related to this study.

References