Traumatized Immature Teeth Treated with 2 Protocols of Pulp Revascularization

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Abstract

Introduction: Pulp revascularization may be considered a promising alternative for traumatized necrotic immature teeth. The aim of this study was to evaluate traumatized immature teeth treated with 2 protocols of pulp revascularization. **Methods:** Twenty-three teeth of young patients (7–17 years old) with necrotic upper incisors caused by dental trauma were divided into 2 groups; one group was treated with triple antibiotic paste (metronidazole, ciprofloxacin, and minocycline) (TAP) (n = 12), and the other was medicated with combination of calcium hydroxide and 2% chlorhexidine gel (CHP) (n = 11). Patients were treated and followed up for a period from 9–19 months in 2 dental institutions for evaluation of clinical and radiographic data. **Results:** Most of the teeth were affected by lateral luxation (47.8%). Clinical evaluation in group TAP showed significant reduction in spontaneous pain (P = .01), pain on horizontal percussion (P = .007), and pain on palpation (P = .03), whereas group CHP showed significant reduction in pain on vertical percussion (P = .03). Crown discoloration was observed significantly more in teeth of group TAP (83.3%) (P < .002). On radiographic exam, periapical repair was found in all TAP-treated teeth (P = .03). Similarly, the same findings were found for all teeth treated with CHP with exception of 1 tooth (P = .21). Apical closure was significantly observed in both groups (P < .05). Increase in root length was demonstrated in 5 teeth (41.7%) and 3 teeth (27.3%) of groups TAP and CHP, respectively. Thickening of lateral dentinal walls was observed in 5 teeth of each group. **Conclusions:** Revascularization outcomes for traumatized patients treated with the tested protocols presented similar clinical and radiographic data. However, TAP caused esthetic problem leading to tooth discoloration, which can be considered a disadvantage when compared with CHP. *(J Endod 2014;40:606–612)*

Key Words

Calcium hydroxide, intracanal medication, pulp revascularization, triple antibiotic paste

Most of the dental traumas are associated with luxation injuries, which may damage the periodontal ligament attachment as well as the apical neurovascular bundle. Depending on the severity, the tissue may be compressed or disrupted, and both the cells and intercellular structures may be damaged (1). In traumatized immature teeth, this damage to periapical region may also affect apical papilla cells and periodontal ligament cells, and any disruption of these structures may impede further root development (2). In this context, healing after a luxation injury involves reorganization and reestablishment of the continuity of the periodontal ligament fibers, including pulpal revascularization and reinnervation. When reinnervation does not occur, pulp tissue becomes necrotic (3). Pulp necrosis is the most frequent posttraumatic complication in all types of dental traumas; it is more frequent in mature than in immature teeth (4). The most traditional endodontic treatment for immature teeth is apexification through periodic changes of intracanal medication or using an apical plug of mineral trioxide aggregate (MTA) (5–8).

Recently, pulp revascularization has been studied as an alternative therapy for immature necrotic teeth, with the advantage of inducing root-end development (9, 10). Most of the pulp revascularization studies refer to case reports that use passive decontamination and antibiotic paste composed of metronidazole, ciprofloxacin, and minocycline as intracanal medication (11–13). Calcium hydroxide also has been used as intracanal dressing, although there still is controversy in the literature concerning its beneficial properties when used in contact with undifferentiated cells and dentin root walls (14–18). A recent case report demonstrated success in pulp revascularization performed with the combination of calcium hydroxide and 2% chlorhexidine gel, showing thickness in dentin walls and increase in root length and apical closure (19).

Case reports on pulp revascularization have mostly been evaluated in terms of apical periodontitis and dentoalveolar abscesses (20, 21). However, pulp necrosis in immature teeth may also occur in traumatized teeth, which present different mechanisms of complications and physical compromise of the periodontal ligament cells and apical papilla when compared with pulp necrosis caused by infection. Considering the importance of the integrity of periodontal ligament cells for revascularization repair, the clinical success of such protocols should be evaluated. In addition, dental trauma may play a different role in the apical repair of immature teeth, considering the possibility of physical destruction of stem cells. This study

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aimed to conduct a prospective clinical evaluation to compare triple antibiotic paste (TAP) and the combination of calcium hydroxide and 2% chlorhexidine gel (CHP) as intracanal medications for pulp revascularization in traumatized teeth.

Materials and Methods

Samples

Twenty-three teeth of patients (7–17 years old) with immature and nonvital maxillary anterior teeth were used in the study. Patients who presented pulp necrosis caused by hard tissue trauma and/or some severe luxation (extrusive luxation, lateral luxation, intrusive luxation, and avulsion) with or without periapical pathology were included in this research. Clinical examination included presence of spontaneous pain, sinus tract, swelling, tenderness, sensibility to palpation, and cold and electric pulp tests. All examinations were performed in both affected and control (contralateral but unaffected) teeth. Intraoral periapical radiographs revealed immature apices, either blunderbuss canals or wide canals with parallel walls and a slight flaring in the apical end. In a few cases, moderately developed root with an open apex was observed. In addition, the presence of periapical lesions was recorded.

The time period data between the trauma and revascularization treatment were defined according to the dental clinical condition observed in the first visit. When the patient delayed to seek treatment after trauma and pulp necrosis was diagnosed, revascularization was immediately performed. On the other hand, when the patient sought treatment soon after trauma, a time period varying from 2–3 months was required for definitive diagnosis.

This research was approved by the research ethics committee (CEP) of Piracicaba Dental School, UNICAMP, and Faculty of São Leopoldo Mandic because it was performed in these 2 dental institutions. Teeth were randomly divided into 2 groups according to the intracanal medication used in the revascularization therapy; one group was treated with TAP (n = 12), and the other was treated with CHP (n = 11).

Revascularization Procedures

Teeth were anesthetized with 2% lidocaine with vasoconstrictor (Alphacaine; DFL, Rio de Janeiro, Brazil) and isolated with a rubber dam. The access cavity was prepared by using a diamond bur (KG Sorensen, Barueri, Brazil) and a high-speed handpiece under refrigeration with copious sterile saline solution. Root canal systems were slowly and carefully irrigated with 20 mL 6% sodium hypochlorite, which was inactivated with 5 mL sterile 5% sodium thiosulfate for 1 minute, followed by 10 mL physiological solution and 10 mL 2% chlorhexidine, being 3 mm shorter than the apparent working length. The action of chlorhexidine was neutralized by 5% Tween 80 and 0.07% soy lecithin to reduce the carryover effect of chlorhexidine and consequently prevent its possible cytotoxicity effects against stem cells (22). The apical third received no treatment to preserve stem cells that might be present. For the teeth of group TAP, the canal was dried with sterile paper points, and then a mixture of ciprofloxacin 250 mg, metronidazole 400 mg, and minocycline 50 mg in the proportion of 1:1:1 was prepared as described by Hoshino et al (23). The paste was placed into the root canal at 3 mm from the working length and left for 21 days. The access cavity was double-sealed with coltosol (Coltene-Whaledent, Langenau, Germany) and composite resin (Z250 Filtek; 3M ESPE, Sumaré, São Paulo, Brazil). For the teeth of group CHP, the canal was dried with sterile paper points, and then a creamy dressing prepared with calcium hydroxide (Biodinâmica, Ibiporã, Brazil) and 2% chlorhexidine gel (Endogel; Itapetininga, São Paulo, Brazil) in a proportion of 1:1 was placed into the root canal at 3 mm from the working length and left for 21 days. The access cavity was also double-sealed with coltosol and composite resin (Z250 Filtek). In the following visit, the teeth of both groups were anesthetized with 2% lidocaine with vasoconstrictor (Alphacaine), accessed, and irrigated with saline solution for intracanal medication removal. Next, a final irrigation with 3 mL 17% EDTA solution (Fórmula e Ação, São Paulo, Brazil) for 3 minutes was followed by saline solution irrigation because of the well-known conditioning properties of EDTA on the dentin for stem cell differentiation (24). Then, a manual K-file (Dentsply Maillefer, Baillaigues, Switzerland) was introduced into the root canal and placed at 2 mm beyond the working length to induce bleeding into the canal. The bleeding was allowed to reach 3 mm below the cementoenamel junction, and teeth were left for 5 minutes so that a blood clot was formed. CollaCote (Zimmer Dental, Carlsbad, CA) fibers were placed on the blood clot, and then a 3-mm white MTA (Angelus, Londrina, Brazil) barrier was placed. The access opening was double-sealed with coltosol and with composite resin (Z250 Filtek).

Clinical and Radiographic Evaluation

Patients of both groups were recalled in the periods of 1, 3, 6, 9, 12, 15, and 19 months, and the follow-up period varied from 9–19 months (mean follow-up period, 15 months). Initial exams were compared with the data collected during the follow-up period. Clinical and radiographic findings were recorded. The clinical findings were assessed according to the presence of pulp sensitivity, spontaneous pain, tenderness, pain on palpation, sinus tract, swelling, and crown discoloration. Pulp sensitivity was assessed by the cold thermal test by using carbon dioxide negative test (−50°C) (EndoFrost; Roeko, Langenau, Germany) and by electric pulp test (Pulp Tester; Analytic Technology, Redmond, WA). The radiographic examination evaluated the following criteria: periapical lesion, root resorption, apical closure, root length, and root thickness. Radiographic analyses were subjectively performed by 2 trained endodontic specialists, blinded to the results, who used a negatoscope (Lumatron; Encor Indústria Fotográfica Ltda, Rio Claro, São Paulo, Brazil) coupled to a ×4 magnifying glass. The examiners compared the initial and the follow-up radiographs according to the presence or absence of pre-established criteria. Radiographic repair was considered in the absence of periapical radiolucent image associated or not to the deposition of radiopaque tissue in the apical foramen and in the inner walls of root and increase in the root length when compared with the initial radiograph. All radiographs were taken with periapical films (Kodak, São José dos Campos, São Paulo, Brazil) combined with condensation silicone impression material and an intraoral positioner (Indusbello Indústria de Instrumentos Odontológicos Ltda, Londrina, Paraná, Brazil) to ensure quality and standardization of the images.

The results were evaluated in the BioEstat 5.0 program at a level of significance of 5%. The McNemar test was used to analyze clinical and radiographic parameters before and after pulp revascularization therapy, and the Fisher exact test evaluated the difference between the group TAP and group CHP.

Results

Patients in this study had experienced lateral luxation (11/47.8%), extrusive luxation (9/39.1%), intrusive luxation (1/4.3%), or avulsion (2/8.7%). The follow-up period of the cases ranged between 9 and 19 months. In the clinical evaluation it was observed that in both groups (TAP and CHP) there was reduction in spontaneous pain, pain on percussion and palpation, sinus tract, and swelling after revascularization therapy. Group TAP showed significant reduction in spontaneous pain (P = .01), pain on horizontal percussion (P = .007), and pain on