Suggesting a new therapeutic protocol for permanent teeth with incomplete root apex and lateral luxation: A case report

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doi: http://dx.doi.org/10.1590/2178-3713.4.2.056-061.oar

ABSTRACT

The present study reports the case of a permanent tooth with incomplete root formation and lateral luxation endodontically treated with a therapeutic protocol associating calcium hydroxide, 2% chlorhexidine gel and zinc oxide (2:1:2 ratio) used as intracanal dressing with no need of replacement. In conventional apexification treatment, intracanal dressing normally includes calcium hydroxide paste associated with aqueous, viscous or oily vehicle periodically changed. The intracanal dressing used in this article, however, did not need to be replaced. The authors concluded that the protocol proved effective in treating a permanent tooth with open apex, as the tooth remained in the oral cavity fulfilling its esthetic and masticatory functions. Treatment cost and time were decreased.

Keywords: Lateral luxation. Endodontics. Chlorhexidine. Calcium hydroxide.

Submitted: April 16, 2014. Revised and accepted: April 22, 2014.

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How to cite this article: Marion JJC, Felippe LS, Vilela CB, Nagata JY, Lima TFR, Soares AJ. Suggesting a new therapeutic protocol for permanent teeth with incomplete root apex and lateral luxation: A case report. Dental Press Endod. 2014 May-Aug;4(2):56-61. DOI: http://dx.doi.org/10.1590/2178-3713.4.2.056-061.oar

» The authors report no commercial, proprietary or financial interest in the products or companies described in this article.

» Patients displayed in this article previously approved the use of their facial and intraoral photographs.

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Introduction

Teeth subjected to trauma require a multidisciplinary approach and are considered cases of dental emergency. Endodontics is the specialty mostly engaged in studying the theme, since severe damage is caused to pulp and periapical tissues.[1,2] Patients at different ages might be subject to lesion caused by trauma, however, it is highly prevalent in children aged between 8 and 15 years old.[3,4]

Several sequelae can be diagnosed after trauma. The most common are: calcification (24%),[5] pulp necrosis (9 to 63%)[6,7] and resorption (7 to 36%),[8] with the latter having the worst prognosis.[9,10] Teeth subjected to luxation and avulsion are more likely to develop these sequelae.[6,11]

Teeth with incomplete root formation, subjected to trauma and requiring apexification treatment do not have favorable conditions to undergo conventional endodontic therapy. Their foramen is under formation and the root canal walls are not yet parallel (increased diameter), thereby disagreeing with the apex and hindering preparation of the filling material normally used for sealing. The material most commonly used for apexification treatment are zinc oxide paste with cresol, iodoform and timol;[12] polyantibiotic paste with ciprofloxacin, metronidazole and calcium hydroxide;[13] mineral trioxide aggregate (MTA);[14-17] and calcium hydroxide paste associated with different vehicles.[18-26]

Soares[27] recently proposed associating calcium hydroxide, 2% chlorhexidine gel and zinc oxide to treat apexification. Periodic changes were unnecessary. This paste allowed root canal filling for a long period of time, thereby decreasing chair time and treatment cost. Patient's tooth and supporting structures were maintained.

This paper aims at reporting the case of a traumatized tooth with incomplete root formation and lateral luxation endodontically treated with a therapeutic protocol associating calcium hydroxide, 2% chlorhexidine gel and zinc oxide (2:1:2 ratio) used as intracanal dressing with no need of replacement.

Case report

A 6-year-old, male patient attended the Service of Dental Trauma at the School of Dentistry — State University of Campinas/Piracicaba (FOP-UNICAMP). He had suffered a bicycle accident 10 days before. As reported by the patient's guardian, emergency assistance was provided on the day of trauma in a hospital near their home. A removable retainer was installed, since tooth #11 presented significant mobility. During the first visit at FOP-UNICAMP, clinical examination revealed that teeth #21, 22 and 63 had undergone avulsion and were not reimplanted. As for tooth #11, it revealed enamel and dentin fracture associated with lateral luxation.

Radiographic examination revealed #11 with incomplete root formation and periapical lesion. Diagnosis of pulp necrosis was confirmed by pulp vitality cold tests with no response. Multidisciplinary treatment plan consisted of anterior esthetic restoration of #11 and installation of a space maintainer in the region of avulsed teeth. Additionally, due to being a case of incomplete root formation and pulp necrosis, treatment included apexification with a paste associating calcium hydroxide, 2% chlorhexidine gel and zinc oxide. The retainer remained in place for seven other days and the patient was advised to return in the following week for endodontic treatment onset.

In the following week, the retainer was removed and a new periapical radiograph was taken (Fig 1). After crown opening, the septic-toxic content was neutralized and crown-apex biomechanical preparation was carried out with Gates Gliden bur #5, 4, 3 (Dentsply/Maillefer®, Ballaigues, Switzerland) with a view to decontaminating the cervical and middle thirds. Odontometry was carried out with a #45 file (Dentsply Maillefer®, Ballaigues, Switzerland) freely entering the entire root canal extent. Working length was determined with an apex locator (Novapex, Fórum Technologies, Richion, Lê-Zion, Israel) and further confirmed by periapical radiograph. Root canal underwent manual instrumentation up to file #70. During the instrumentation procedure, 2% chlorhexidine gel (Endogel, EssencialPharma, Itapetininga/MG, Brazil) was inserted into the root canal at each change of instrument, followed by abundant irrigation with 5 ml of saline solution.

The smear layer was removed by irrigation with 3 ml of 17% EDTA for 3 minutes followed by irrigation with saline solution. Root canals were dried with absorbent paper points (KonneIndústria e Comércio de Materiais Odontológicos Ltda., Belo Horizonte/MG, Brazil) and subsequently filled with a paste associating calcium hydroxide (Konne Indústria e Comércio de Materiais Odontológicos Ltda., Belo Horizonte-MG, Brazil), 2% chlorhexidine gel and zinc oxide (S.S. White ArtigosDentários, Ltda. Rio de Janeiro – RJ, Brazil). The paste was putty-consistent and prepared in a 2:1:2 ratio. It was inserted by increments with medium and fine medium vertical condenser (Kon-neIndústria e Comércio de Materiais Odontológicos Ltda. Belo Horizonte – MG, Brazil) throughout the entire root canal. Root canals were then sealed with coltosol (Vigodent S/A Indústria e Comércio, Rio de Janeiro/RJ, Brazil) and composite resin (Filtek Z350, 3M Dental Products, Saint Paul, USA) (Fig 2).

The patient returned for clinical follow-up every three months, since radiographic examination revealed the presence of intracanal dressing completely filling the root canal. After nine months of treatment, there was an apical barrier on tooth #11 and partial periapical lesion remission (Fig 3A). After two years, the intracanal dressing remained filling the root canal with no need of replacement. Apical barrier and periapical lesion remission were then identified (Fig 3B).

Figure 1. Initial radiograph after retainer removal.

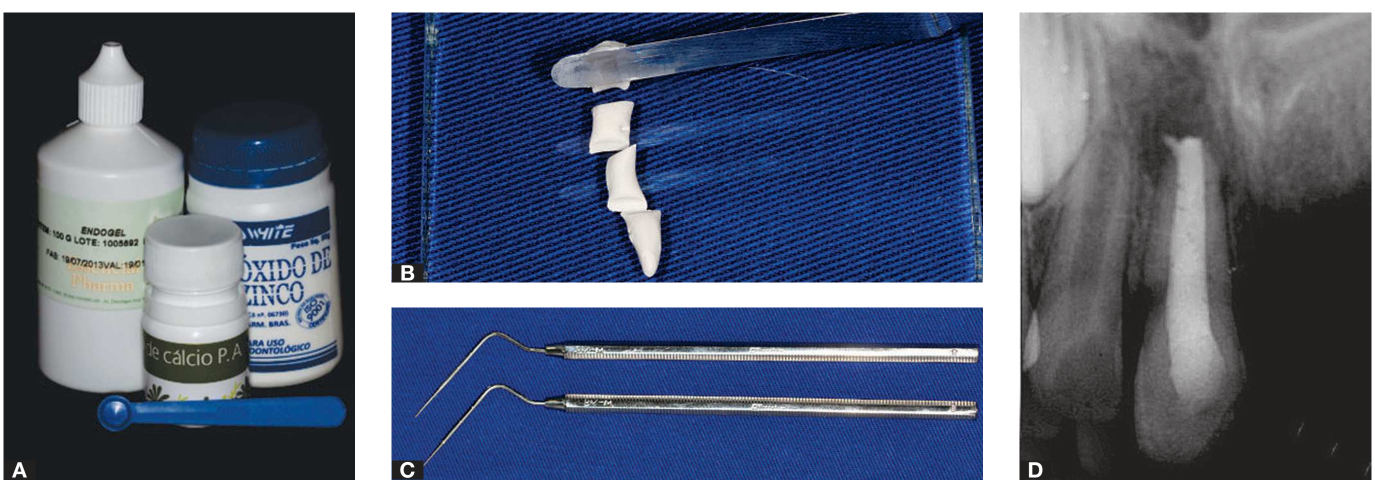

Figure 2. A) Calcium hydroxide P.A., 2% chlorhexidine gel (Endogel) and zinc oxide used as intracanal dressing; **B**) Paste final consistency; **C**) Vertical condenser used to insert the intracanal dressing; **D**) Final radiograph evincing the quality of intracanal dressing insertion.

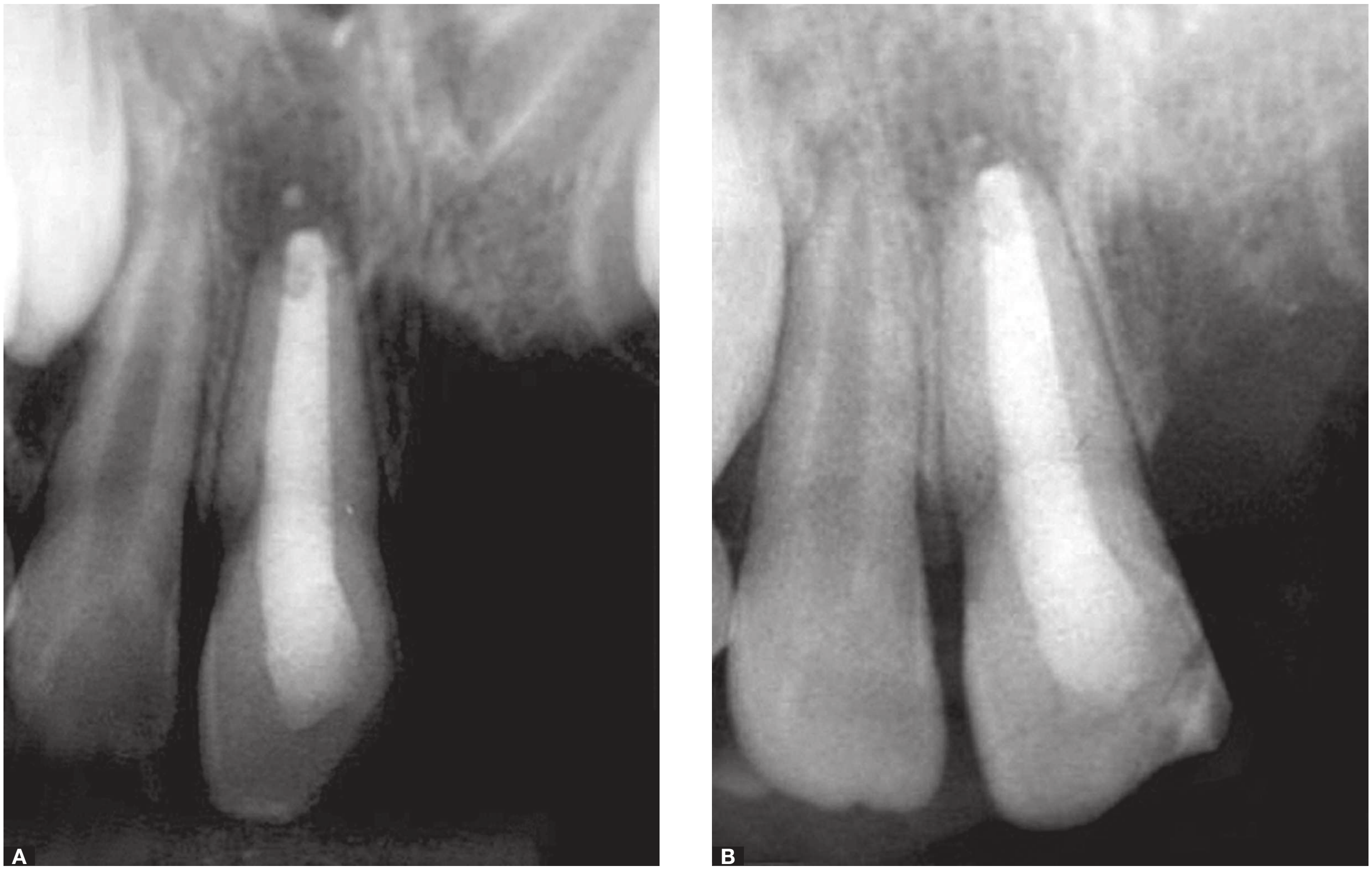

Figure 3. A) Third follow-up radiograph (9 months); **B**) Eighth follow-up radiograph (2 years).

Discussion

The literature does not reach a consensus regarding treatment of traumatized teeth with incomplete root formation, particularly with regard to periodic changes and frequency of renewal and/or maintenance of intracanal dressing.[19,28-31] Periodic changes every 1 to 3 months are widely recommended.[21,24,25,32] However, Yates,[21] Chawla[33] and Webber[34] recommend intracanal dressing change every time a radiographic examination reveals incomplete filling. Furthermore, according to Sidley,[35] periodic changes every 4 to 6 months during 18 months yield satisfactory treatment outcomes for severely traumatized teeth. Due to wide apical foramen diameter and the presence of exudate in the periapical region, dressing dissolution rate increases, thereby creating the need for change.[21,22]

The present study agrees with the following authors when suggesting to keep intracanal dressing inside the root canal for much longer periods without periodic changes: Chosack et al,[23] Felippe et al,[28] Steiner et al,[29] Chawla et al[33] and Túrkún.[36] The study conducted by Chawla[33] found mineralized tissue formation after intracanal dressing remained in the root canal for 6 to 12 months without periodic changes. Furthermore, in the study conducted by Sidley[35] and Trope et al,[37] calcium hydroxide intracanal dressing was inserted into the root canal in cases of apexification. A single insertion procedure proved satisfactory to promote apical formation onset without further need of periodic changes.

Felippe et al[28] reported infeasible carrying out several changes of calcium hydroxide paste in teeth with incomplete root formation and infected root canal system. The present study corroborates the authors while disagreeing with Holland et al,[38] Holland et al,[39] Hulsmann,[40] Holland et al[41] and Nedley and Powers[42] who believe that root canal disinfection as well as mineral tissue deposition stimulating root apex closure rely on the alternate use of calcium hydroxide paste.

Effective intracanal dressing needs to remain active within the period between dental sessions. The amount of dressing, its concentration, the presence or not of infection, periapical tissue conditions, foramen width, and the choice of material used for coronal sealing have direct influence on intracanal dressing effects.[43]

Although calcium hydroxide is frequently used as intracanal dressing to treat teeth with developing apex, it should not be considered as universal; particularly because it is not equally effective for all microorganisms found in all root canal systems.[44] For this reason, associating chlorhexidine and calcium hydroxide proves fruitful due to the antimicrobial characteristics of the former, which increases the bactericidal power of the dressing without interfering in the biological/mechanical properties of calcium hydroxide.[45] According to Soares et al,[10] intracanal dressing associating calcium hydroxide and chlorhexidine is a promising alternative used to treat periapical lesions.

Soares[27] conducted studies associating calcium hydroxide, 2% chlorhexidine gel and zinc oxide. The paste was putty-consistent, prepared in a 2:1:2 ratio and used to fill the root canal. Control was performed every three months. Radiographic examination revealed that the intracanal dressing remained inside the root canal until definite filling was carried out. Frank[18] had previously advocated the use of putty-consistent paste for the same purposes, i.e., for treatment of teeth with incomplete apex formation. Additionally, for Soares,[27] putty-consistent paste favors treatment of teeth with the same clinical conditions. The present study corroborates the findings of the aforementioned authors.

Zinc oxide, one of the components used to produce the paste recommended in the present study, not only provides it with a better consistency, but also aids complete root canal filling due to its radiopacifier property.[46] However, Moorer and Genet[46] suggest that additional studies be carried out so as to better understand the biological properties of zinc oxide, since the authors do not consider it as an inert component. On the other hand, Leonardo et al[43] reported that zinc oxide associated with distilled water was effective in inhibiting *Enterococcus Faecallis* growth within 24 hours. Almeida et al[44] proved that zinc oxide associated with calcium hydroxide was similar to calcium hydroxide associated with saline solution, as both solutions inhibited microorganisms growth and did not interfere in the antimicrobial effect produced by calcium hydroxide.

The present study corroborates Almeida et al[44] who analyzed intracanal dressings associating calcium hydroxide, chlorhexidine gel and zinc oxide at various rates against microorganisms normally found in the root canal. The authors did not find any pH changes, however, when compared to control, they found greater inhibition of microbial growth in intracanal dressings with increased concentrations of calcium hydroxide and 2% chlorhexidine gel. Zinc oxide in greater concentrations decreased inhibition of microbial growth. Additionally, Almeida et al[44] and Montagner et al[45] agree on the fact that the greater the amount of calcium hydroxide or zinc oxide, the lower the effectiveness of 2% chlorhexidine gel as an antimicrobial agent.

The therapeutic protocol used in the present study has also been established on the basis of Montagner et al[45] who demonstrated that calcium hydroxide associated *in vitro* with 2% chlorhexidine gel and zinc oxide has the ability of diffusion in root dentin, thereby inhibiting bacterial growth. It is also based on Soares[27] who suggested that intracanal dressing could remain inside the root canal for long periods of time without periodic changes, keeping its antimicrobial properties by diffusion through dentin tubules. This would also be an option for teeth with incomplete root formation, subjected to trauma and in need of endodontic treatment.

Conclusion

Based on the literature and on the results of this study it is reasonable to conclude that filling paste consisting of calcium hydroxide, 2% chlorhexidine gel and zinc oxide (2:1:2 ratio) is effective in treating permanent teeth with incomplete root formation subjected to lateral luxation. Additionally, it only needs to be applied once and remains inside the root canal during treatment without periodic changes, which is advantageous for the patient as it decreases treatment costs and chair time.

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