



CASE REPORT

Jennifer Ribadeneira^{1,2}.
Eugenia Muñoz¹.

1. Facultad de Odontología, Universidad Andrés Bello. Chile.

2. Facultad de Odontología, Universidad Central del Ecuador. Ecuador.

Corresponding author: Jennifer Ribadeneira. Pedro de frutos N° 81-41 y Alonso de Jerez. Phone: +593993723472. E-mail: rjenn.ribmo@hotmail.com.

Receipt: 02/20/2015 **Revised:** 03/09/2015
Acceptance: 03/26/2015 **Online:** 03/26/2015

Vertical root fracture associated with prolonged use of calcium hydroxide during apexification. A case report

Abstract: Apexification is a procedure performed in young permanent teeth to promote apical closure and root elongation if Hertwig's epithelial sheath has not been irreversibly damaged. The objective of this article is to describe vertical root fracture as a complication during apexification when using calcium hydroxide for extended periods of time. The patient was a 9-year-old female student who went to the Faculty of Dentistry of the Universidad Andres Bello in Concepcion. She presented strong and spontaneous pain and pressure and swelling on the left cheek. Clinically, the vestibule of the lower left first molar (3.6) was edematous and had pus. Radiographically, lesions and open apices were seen in the apical zone. Diagnosis was pulp necrosis and acute apical abscess. The tooth was trephined to perform intracanal drainage and an oral antibiotic was prescribed. Afterwards, she was referred to the endodontic specialty office. The selected treatment was apexification with calcium hydroxide until achieving the formation of an apical barrier. When the apical formation was observed, a vertical root fracture was discovered as well, confirming that the use of calcium hydroxide should not be prolonged because dehydration processes lead to weakening of the walls and therefore of the tooth

Keywords: *Calcium hydroxide, apexification, non-vital tooth.*

DOI: 10.17126/joralres.2015.025.

Cite as: Ribadeneira J & Muñoz E. Vertical root fracture associated with prolonged use of calcium hydroxide during apexification. A case report. *J Oral Res* 2015; 4(2): 124-128.

INTRODUCTION.

The International Association of Dental Traumatology reports that one out of every two children will have a dental trauma, mainly between 8 and 12 years old. Many of these injuries in permanent dentition result in non-vital teeth lacking a complete apical formation (young permanent tooth). In consequence, adequate management of this type of teeth demands acute clinical knowledge to overcome the lack of apical stop and perform an endodontic treatment to keep the tooth in the mouth¹⁻⁴.

One of the objectives of the endodontic treatment in non-vital young permanent teeth is to generate a barrier or apical stop with root filling material. Many materials such as calcium hydroxide, zinc oxide, calcium phosphate and MTA

have been used to stimulate apical stop formation during apexification. For this purpose, multiple sessions are necessary for replacing the material but the outcome is usually favorable⁴⁻⁶.

The average time for the apical barrier formation is approximately 5 to 20 months¹. Several authors have pointed out that, in spite of having high success rates in treatment, these teeth may be altered and even suffer vertical root fracture due to weakened walls during or after treatment. Additionally, they affirm that, to a great extent, prognosis will depend on the state of root development in which the tooth was at the time of its pulp death⁷⁻⁹.

The objective of this article is to describe vertical root fracture as a complication during apexification when using cal-

cium hydroxide for extended periods of time.

CASE.

The patient was a 9-year-old female student. Her mother relates that she was diagnosed with asthma since birth and has used Salbutamol (AEROLIN LF Aerosol, GlaxoSmithKline, England) as medication. The girl attended the pediatric dentistry clinic at the Faculty of Dentistry in the Universidad Andres Bello in Concepcion presenting severe, pulsating and spontaneous pain, pressure and swelling on the left cheek. They thought it was linked to a lower molar with extensive decay. Clinically, a deep cavitation could be seen in the mandibular left first molar. The bottom of the vestibule was edematous with purulent content and there was slight mobility (3.6). Diagnosis was periapical pulp necrosis and acute apical abscess (Figure 1)

Because of the conditions the patient presented when coming to the Pedodontic clinic, it was decided to trephine the tooth to help evacuate the pus. Then, it was irrigated with abundant physiological saline and a small sterile cotton ball covered with glass ionomer was placed. Erythromycin (Eritromac, Delfarma, Peru) 15mg/kg body weight every 12 hours was prescribed because the patient had penicillin allergy. Then, she was referred to the endodontic specialty office to continue the treatment.

In the first session at the endodontic specialty office and under isolation protocols, glass ionomer and the small cotton ball were removed from the chamber. The tooth was irrigated with physiological saline and chlorhexidine (CHX) to eliminate the content from within the duct. When the apices are open, it is not possible to work with electronic apex locators (EALs); therefore, it was decided to work with tentative radiographic lengths of 11mm. Circumferential filing was done with a #40 K-file. It was irrigated abundantly with chlorhexidine (CHX), dried out and calcium hydroxide paste (pure chemical powder/propilenglycol) was placed and compacted inside the duct leaving dual chamber sealing for protection (white gutta-percha and glass ionomer), and an appointment was made 8 days later for a subsequent control. In this session, the patient stated not to experience dis-

Figure 1. Initial X-Ray.

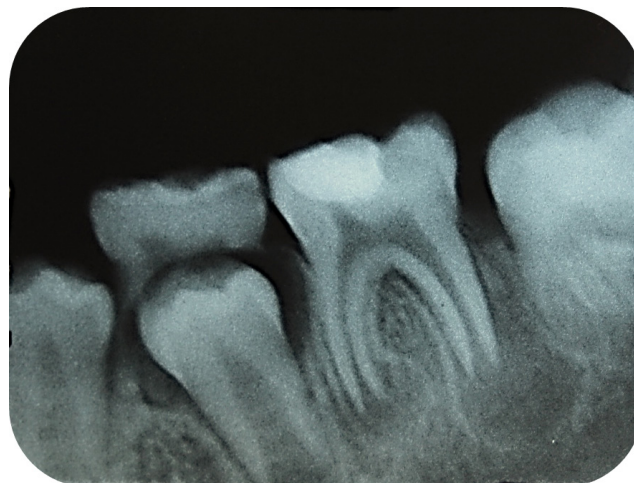


Figure 2. Replacement of Ca(OH)₂.



comfort and presented absence of symptoms: therefore, the next appointment was made within a month.

A month later, in the second monitoring appointment, the patient affirmed to have felt discomfort since the ninth day following the treatment. She was placed in absolute isolation and it was proceeded to irrigate with physiological saline and CHX to remove calcium hydroxide from within the ducts. Circumferential cleaning, drying, placement and compaction of the material within the ducts were repeated and an appointment was made within a month (Figure 2).

After a month, the patient went to her third appointment and it was decided to carry out a radiographic evaluation of the working lengths under isolation protocols. It showed an

Figure 3. X-ray 6 months later, new length of 14 mm. Apical formation can clearly be observed.

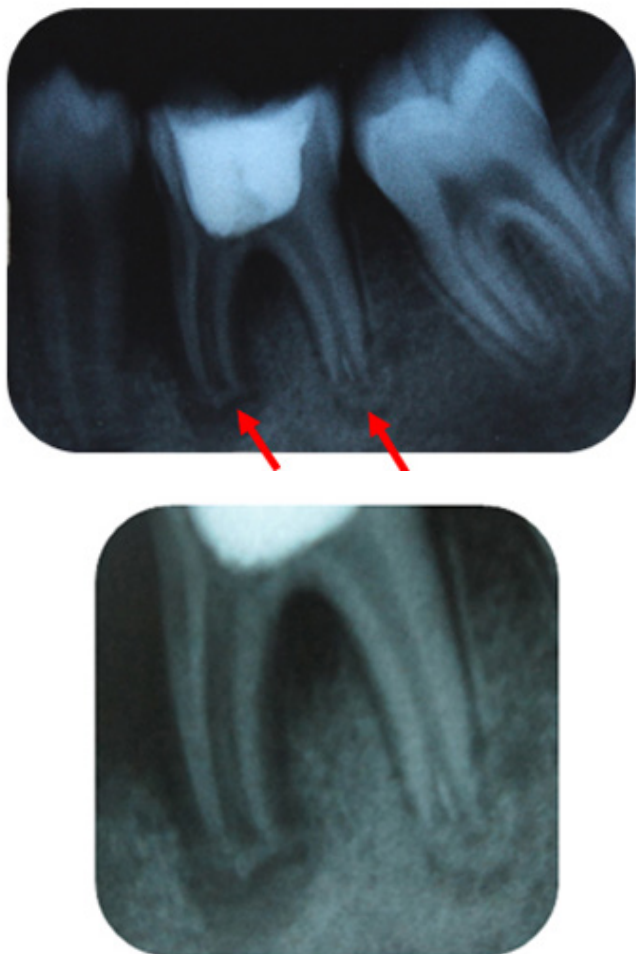
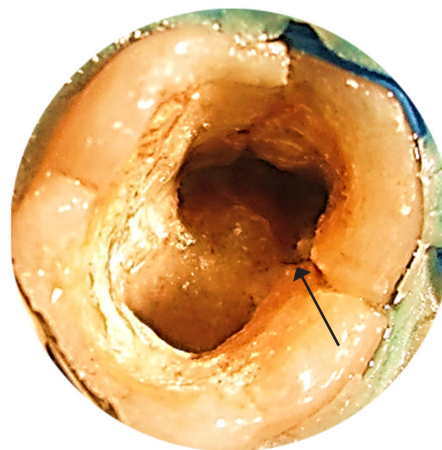
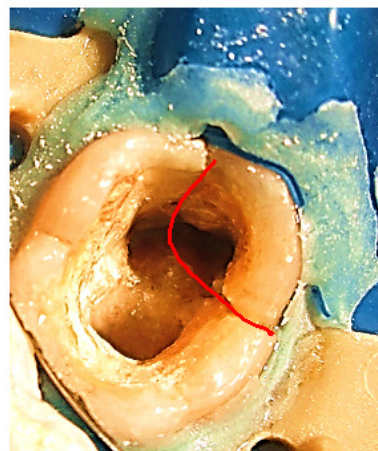


Figure 4. Observation of the fracture and its extension under the microscope.



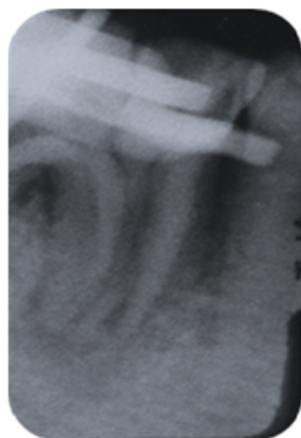
increase (11mm to 12mm) compared to the previous appointment after placement and compaction of calcium hydroxide. The next appointment is made within three months but all the relevant information and care are provided.

Three months later, the patient attended for checkup and replacement of material. A new x-ray is taken it is proceeded to perform absolute isolation. After extensive irrigation with saline solution, the little residue of existing material within the duct was removed. In this session, it was chosen to work with 2.25% NaClO because, radiographically, it was possible to observe a stop in the apical area and a zone of resistance could be felt with the file. After seeing this progress, a #40 K-file was introduced so that, aided by EALs, it could directly measure root length to be compared with the length obtained in the X-ray. EALs confirmed

what had been seen radiographically: a new increase in root length (14mm). Cleaning and shaping based on the new working length was performed. Calcium hydroxide was placed and compacted and a double seal (white gutta-percha and glass ionomer) was used to avoid filtration. Again, an appointment was made within three months (Figure 3).

The patient attended the clinical and radiographic follow-up three months after the last appointment. As she did not show symptoms and a clear apical formation could be seen radiographically, it was decided to fill the treated tooth. Prior to isolation, the crown was evaluated clinically and it was possible to feel a retentive area in the mesial lingual cusp with the curve probe. Under insulation and with aided by a microscope, it was possible to observe the presence of a vertical root fracture even involving the mesial

Figure 5. X-ray showing fracture extension.



lingual cusp. (Figure 4) Radiographically, a new increase in root length (16mm) and, most importantly, the presence of the apical barrier could be seen. Afterwards, the parents and the patient were informed on this condition occurred after 10 months of treatment and interconsultation with pediatric dentistry was requested. They suggested removing the tooth and placing a space-maintainer until the patient was old enough to place a dental implant (Figure 5).

DISCUSSION.

Concerning the length of time to use calcium hydroxide as recommended medication during apexification, authors show that teeth with open apices in older children, 9 to 11 years, will need shorter treatments. In contrast, younger children whose ages vary from 6 to 8 will require longer treatment with this material and can be exposed to future complications¹⁻³.

Regarding the relationship between presence or absence of pathologies during apexification and their resolution time, it is noted that, contrary to what was always thought, they will not influence the time needed for apexification⁴.

There are studies showing that the time required for the formation of the apical barrier using calcium hydroxide can be long, up to about 20 months, and it is necessary to consider other factors such as age, the presence of symptoms, which can affect the time taken for apical

barrier formation even extending it⁵⁻⁶.

Authors agree that the use of this paste has a greater purpose than simple duct disinfection. It also induces apical barrier formation by coming into direct contact with the affected area stimulating the production of hard tissue⁷⁻⁹. However, this medication cannot fulfill its mission without good irrigation prior. Sodium hypochlorite ranks first par excellence, followed by CHX, ethylene-diaminetetraacetic acid and potassium iodide which have been reported to be used for this type of treatments¹⁰.

Regarding proper time for replacing calcium hydroxide, it is concluded that several authors prefer to wait three months proving it is the ideal time, while others prefer to wait for important radiographic changes to indicate replacement¹¹⁻¹³.

There are studies conducted in recent years which demonstrate that even filled teeth presented a coronal or root fracture clinically and radiographically even 6 months after completion of treatment. They explain that the possible cause is the use of calcium hydroxide, *i.e.* in order for the effect of calcium hydroxide to last, it dehydrates dentin making it weak and causing an inevitable fracture due to biting forces¹⁴⁻¹⁶.

Vertical root fracture represents approximately 2% to 5% of dental fractures in adult teeth that have undergone endodontic treatments, but there is a similar rate in young teeth undergoing treatments such as apexification. Also, it is reported that both young and adult teeth presented fractures involving the mesial lingual cusp, as presented in this case¹⁷.

Currently, it has been shown that the best method to detect a vertical root fracture is CBCT (Cone Beam Computerized Tomography) because it provides a dimensional vision of the tooth in study, and represents an advantage over x-ray¹⁸.

CONCLUSION.

Calcium hydroxide continues to be a suitable material to perform apexification, although its long-term use can carry complications.

Fractura radicular vertical asociada al uso prolongado de hidróxido de calcio durante una apexificación. Reporte de caso.

Resumen: La apexificación es un procedimiento realizado en dientes permanentes jóvenes que busca un cierre apical y elongación radicular, cuando la vaina epitelial de Hertwig no se encuentre irreversiblemente afectada. El objetivo de este artículo es relacionar a la fractura vertical radicular como una complicación durante una apexificación al trabajar por tiempo prolongado con hidróxido de calcio. Paciente de sexo femenino, estudiante, 9 años, acudió a la Facultad de Odontología de la Universidad Andrés Bello Sede Concepción, presentó dolor fuerte y espontaneo, presión e hinchazón de la mejilla izquierda. Clínicamente el fondo de vestíbulo del primer molar inferior izquierdo (3.6) edematoso y con con-

tenido purulento. Radiográficamente se observó en la zona apical la presencia de lesiones y ápices abiertos. El diagnóstico fue Necrosis pulpar y Absceso Apical Agudo, se trepanó para realizar drenaje intraconducto y se prescribió medicación antibiótica oral, para luego ser remitida a la especialidad de endodoncia, donde el tratamiento seleccionado fue Apexificación con hidróxido de calcio hasta observar la formación de barrera apical. Al cumplirse el objetivo de formación apical se descubrió una fractura radicular vertical. La presencia de la fractura radicular vertical fue asociada al tiempo de uso del hidróxido de calcio, confirmando que este no debe ser prolongado ya que por procesos de deshidratación lleva al debilitamiento de las paredes y por ende de la pieza dental.

Palabras clave: *Hidróxido de calcio, Apexificación, Diente no vital.*

REFERENCES.

1. Ghosh S, Mazumdar D, Ray P, Bhattacharya B. Comparative evaluation of different forms of calcium hydroxide in apexification. *Contemp Clin Dent.* 2014; 5(1): 6-12.
2. Huang G. Apexification: the beginning of its end. *Int Endod J.* 2009; 42(10): 855-866.
3. Bodrumlu E, Cicek E, Guler B. Apexification of immature teeth with calcium oxide: three case reports. *Int J Clin Dent.* 2013; 6(2): 121-129.
4. Shabahang S. Treatment Options: Apexogenesis and Apexification. *Pediatric Dent.* 2013; 35(2): 125-128.
5. Razavian H, Haerian A, Mosleh H. Novel Apexification Method In a Non-Vital Tooth With an Open Apex: A Case Report. *J Dent (Tehran).* 2014; 11(3): 371-378.
6. Strom T, Arora A, Osborn B, Karim N, Komabayashi T, Liu X. Endodontic Release System for Apexification with Calcium Hydroxide Microspheres. *J Dent Res.* 2012; 91(11): 1055-1059.
7. Jyothi M. Management of immature teeth - a paradigm shift from apexification to apexogenesis. *Ann Essences Dent.* 2012; 4(3): 34-38.
8. Aggarwal V, Miglani S, Singla M. Conventional apexification and revascularization induced maturogenesis of two non-vital, immature teeth in same patient: 24 months follow up of a case. *J Cons Dent.* 2012; 15(1): 68-72.
9. Friedlander L, Cullinan M, Love R. Dental stem cells and their potential role in apexogenesis and apexification. *Int Endod J.* 2009; 42(11): 955-962.
10. Coaguila H, Denegri A. Uso de barreras apicales y apexificación en endodoncia. *Rev Estomatol Hered.* 2014; 24(2): 120-6.
11. Perez MA. Odontopediatría: ¿Cuál es su criterio para establecer el diagnóstico y el tratamiento de la necrosis pulpar en diente permanente joven? *Rev Canal Abierto* 2012; 25: 10-12.
12. Morales D, Covo E, Díaz A. Efectos adversos en el periápice relacionados con el uso del mineral trióxido agregado en apexificación. Revisión sistemática. *Av Odontostomatol.* 2014; 30(2):95-97.
13. Silva R, Silveira F, Nunes E. Apexification in Non-Vital Teeth with Immature Roots: Report of Two Cases. *Iran Endod J.* 2015; 10(1): 79-81.
14. Jeeruphan T, Jantarat J, Yanpiset K, Suwannapan L, Khewsawai P, Hargreaves K. Mahidol study 1: Comparison of radiographic and survival outcomes of immature teeth treated with either regenerative endodontic or apexification methods: A retrospective study. *J Endod* 2012; 38(10):1330-1336.
15. Bodrumlu E, Cicek E, Guler B. Apexification of immature teeth with calcium oxide: three case reports. *Int J Clin Dent* 2013; 6(2): 121-129.
16. Gomes-Filho J, Mendes C, Watanaabe S, Lodi C, Danelon M, Cintra L. Late treatment of dental trauma using apexification technique. *Dent Press Endod.* 2013; 3(1): 78-83.
17. de Carvalho Marion J, Manhães F, Duque T, Achitti S. The use of calcium hydroxide as an intracanal medication for the apexification of immature permanent teeth. *Dent Press Endod.* 2012; 2(3): 67-73.
18. Haueisen H, Gärtner K, Kaiser L, Trohorsch D, Heidemann D. Vertical root fracture: Prevalence, etiology, and diagnosis. *Quintessence Int.* 2013; 44(7): 467-474.