# CALCIUM HYDROXIDE INDUCES MINERALIZED TISSUE NEOFORMATION: A CASE REPORT

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## ABSTRACT

Trauma in the anterior teeth is a relatively common occurrence during childhood, having as main consequence teeth with incomplete root development and open apices. Patient, male, leucoderma, 10 years old, attended the Dental Clinic of the Southern University of the State of Santa Catarina, reporting as main complaint fracture in the crown of element 11. After clinical and radiographic examination, it was possible to identify the incomplete apexogenesis of this tooth and the presence of necrotic pulp. Aiming to stimulate neoformation of mineralized tissue at the dental apex, the calcium hydroxide based dressing was used. He remained for eight months, always with radiographic control. Apexification was observed radiographically and proved through the use of an instrument introduced inside the canal. The use of calcium hydroxide as intracanal medication for eight months stimulated mineralized tissue neoformation in the apical region of element 11 and allowed endodontic treatment.

*KEYWORDS:* calcium hydroxide, tooth injuries, apexification

*http://dx.doi.org/10.19177/jrd.v5e62017121-125*

**INTRODUCTION**

Trauma to anterior teeth is a relatively common occurrence during childhood. Depending on its magnitude, it may produce concussion, dislocation, fracture, or avulsion of the teeth, which leads, in more severe cases, to pulpal necrosis [1]. This occurs most commonly in the permanent upper incisors leaving the teeth with incomplete root development and open apices [2].

Immature tooth has wide open apex making it difficult to achieve an ideal apical seal [3, 4]. In these cases, apexification seeks to induce the formation of a calcified barrier in a root with a flare apex [5, 6]. Dental trauma presents a challenge for clinicians worldwide [7, 8]. Consequently, correct diagnosis, treatment planning and follow-up are key to ensuring a favorable outcome [6].

Materials have been studied to induce the formation of an apical barrier in roots with open apex. Currently Mineral Trioxide Aggregate (MTA) has many characteristics that make it a suitable material for this purpose, including biocompatibility, sealing ability, low cytotoxicity and induction of a tissue response favorable to repair [6, 9, 10, 11]. However, MTA has some limitations such as lack of dentin adhesion and a higher cost [12, 13].

Another widely used material is calcium hydroxide paste ($Ca(OH)_2$), due to its biological performances [6, 8]. It can stimulate apexification due to its ability to induce mineral tissue formation and consequent, apical closure [3, 6, 14]. The use of $Ca(OH)_2$ in apexifications was first introduced by Kaiser and Frank in 1960 and has since been used with great success to induce the formation of an apical barrier in open apex teeth [15].

The disadvantage of this technique is that the time required for treatment is long. The time required for complete apex closure using $Ca(OH)_2$ has been reported as variable, 5 to 20 months or 12.9 months on average. For this reason, some authors prefer to perform apexification in only one session [15, 2] or root canal obturation with gutta-percha followed by apicectomy with retrograde obturation [17].

$Ca(OH)_2$ is a multipurpose compound due to both its antibacterial activity and the ability to induce calcified tissue formation [8, 18, 19, 20, 21, 22]. When $Ca(OH)_2$ releases hydroxyl ions ($OH^-$), local pH increases (12.5) in this tissues, causing damage to bacterial DNA and to the cytoplasmic membrane, resulting in cell death. At the same time, calcium ions ($Ca^{2+}$) are also released inducing cellular activity and promoting mineral tissue formation [8, 15, 19, 21, 22, 23].

Therefore, the aim of this study is to report a clinical case in which calcium hydroxide was used as an intracanal medication, and promoted mineralized tissue neoformation in the apex of a pulpless tooth with incomplete rhizogenesis.

## MATERIAL AND METHODS

This case report was submitted and accepted by the Ethics and Research Committee of the Southern University of Santa Catarina, numbered 1.517.338.

Patient, male, leucoderma, 10 years, attended the Dental Clinic of the Southern University of the State of Santa Catarina, Pedra Branca campus, presenting as main complain the fracture and darkening of the element 11 crown (Figure 1).

Figure 1. Crown of element 11.

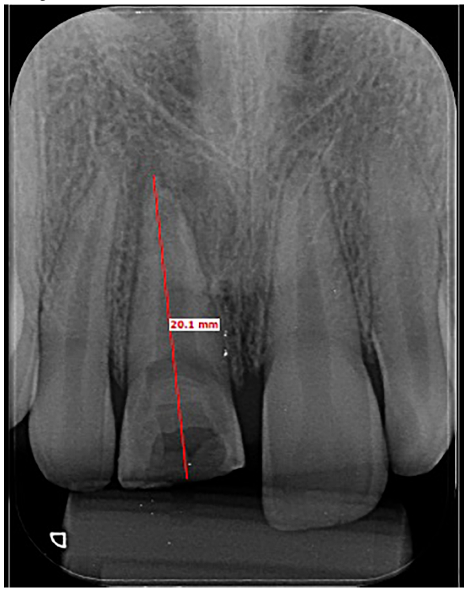
Anamnesis and clinical examination were made, pointing in addition to the fracture of element 11 crown, carious lesion on occlusal surface of element 36 and in distal and lingual surfaces of element 46. The teeth were correctly treated, removing all carious tissue with low rotation multilaminate drills and dentin curettes, and restored with glass ionomer (VITREBOND, 3M Espe, USA).

Patient returned to the Dental Clinic for periapical radiographic examination of element 11, where it was possible to observe the incomplete root apexogenesis (Figure 2). A pulp vitality test was performed, turning out negative. At this moment it was explained to the patient and his caretaker that tooth 11 would require a special endodontic treatment due to its incomplete rhizogenesis and absence of pulp vitality. The necessary documents were duly filled out and signed by the main investigator and the patient's mother.

To begin the treatment, anesthesia was performed using Mepiadre 2%, mepivacaine hydrochloride with epinephrine (NOVA DFL, Indústria e Comércio, Brazil), under the supraperiosteal and ischemic anesthetic technique in the tooth region 11. Followed by absolute isolation and canal access with high rotation drill. Apparent length of tooth 11 was 20 mm (Figure 3).

Figure 2. Initial radiography. Presence of incomplete rhizogenesis in element 11.

Figure 3. Radiograph to establish the apparent length of the tooth.




Exploration was carried out with file #15 (DENTSPLY, Maillefer, USA), adjusted at a length of 19 mm after abundant irrigation with 1% sodium hypochlorite solution (ASFER, Indústria Química, Brazil). The solution was introduced through a glass syringe with the irrigation needle calibrated at 16 mm. In sequence, working length was established (tooth length is 20 mm) and root canal was slightly instrumented and disinfected by K-file #40, #60 and #80 (DENTSPLY, Maillefer, USA) (Figure 4).

Aiming to stimulate mineralized tissue neoformation at the apex of this tooth, the root canal was dried with #80 absorbent paper tips (TANARI, Tanariman, Brazil), and filled with calcium hydroxide base dressing. This was manipulated in a glass plate with calcium hydroxide powder P.A. (HIDROXIDE, Iodontosul, Brazil), and propylene glycol (Equilibrium Manipulation Pharmacy). Root canal was filled up with the aid of a lentulo spiral (MANI, Wilcos, Brazil), until the paste reflow was observed. The access cavity was restored with restorative glass ionomer (VITREMER, 3M Espe, USA). A periapical radiograph of the tooth was made to evaluate the filling of the calcium hydroxide throughout the canal.

Patient returned to the clinic to perform monthly X-rays to monitor element 11. After comparisons with the first radiograph, neoformation of mineralized tissue at the apex of the root was observed.

After 8 months of treatment with calcium hydroxide in the elemental canal 11, patient came to us because he would change his city and he would have to stop the treatment. For this reason, a new radiograph of the tooth was made to evaluate the possibility of obturation. The formation of sufficient mineralized tissue was observed to allow its filling (Figure 5).

However, preferably this tooth would remain even longer with intracanal medication.

The same anesthetic procedure and absolute isolation were performed, and the glass ionomer was removed with high rotation drills. The calcium hydroxide from within the canal was removed with 1% sodium hypochlorite and the root canal was smoothly instrumented using the K-file #80 (Figure 6).

Figure 4. Odontometry radiography.

Figure 5. Radiography of the tooth filled with calcium hydroxide where the formation of mineralized tissue was observed.

A gutta percha point compatible with the canal diameter was made from the union of two points size #80 and a radiography was made to verify the point in the apical region. Also, the digital blue spacer (DENTSPLY, Maillefer, USA) was chosen, followed by the compatible gutta percha accessory points (TANARI, Tanariman, Brazil). The zinc oxide (Equilibrium Handling Pharmacy) and Eugenol (ASFER, Indústria Química, Brasil) sealer was manipulated, the points were coated with the sealer and taken into the canal, performing a lateral condensation filling. A new X-ray of tooth 11 was made to confirm the canal obturation (Figure 7). At this point, vertical compaction and correct cut was proceed to finish the obturation. Tooth was temporarily restored with restorative glass ionomer (Figure 8).

Figure 6. X-ray evidence of mineralized tissue neoformation in the apical region.

Figure 7. Pre-final X-ray.

One week after, the restorative glass ionomer was removed with high speed drills. Glass ionomer base lining (VITREBOND, 3M Espe, USA) was performed. Dental remnant conditioning was done with phosphoric acid (CONDAC 37, FGM, Brazil) and adhesive system (SINGLE BOND, 3M Espe, USA). Flow resin (FILTEK BULK FILL, 3M Espe, USA) was used to fill the most cervical portion of the canal. Followed by the use of EB2, DB2 and OP resins (OPALLIS, FGM, Brazil) for the dental structure.

Polishing was done with a flexible felt disc (DIAMOND FLEX, FGM, Brazil) and sequential rubbers for composite resin (Microdont, Brazil) (Figure 9).

Figure 8. Radiography for cervical cut-off.

Figure 9. Final photo.

Patient was discharged from treatment.

**DISCUSSION**

After traumatic lesions, pulps of young permanent teeth often necrosate, leaving incomplete root development with open apices [24]. In these cases, apexification is the indicated method to stimulate the formation of a calcified tissue barrier in a root with an open apex [5].

Currently, Mineral Trioxide Aggregate (MTA) has been widely used for the inoculation procedures [6, 11]. However, due to its high cost [13] and the treatment being performed in a school clinic, the use of MTA was not possible.

Calcium hydroxide is the most commonly used canal dressing in endodontics [18, 25] and its use in apexifications was first introduced by Kaiser and Frank in 1960 [26]. It presents good tolerance for the periapical tissues and its capacity to induce mineralized tissue formation is already a consolidated feature in the literature[6,8,15,18,22,25]. Calcium ions ($Ca^{2+}$) that are released induce cellular activity and promote the calcified tissue formation [8, 18, 21].

Another important characteristic of calcium hydroxide is its antibacterial properties [8, 12, 18, 19], since it has been demonstrated that the formation of apical barrier is more successful in the absence of microorganisms [27]. Therefore, it was the chosen material for the treatment.

The main disadvantage of using the calcium hydroxide dressing is time. The time required for formation of an apical barrier is variable, averaging 12.9 months [2, 16.]. In our study, the calcium hydroxide paste remained 8 months as intracanal medication. Radiographs were performed, in which it was possible to observe the neoformation of mineralized tissue at the apex of the dental element, besides the conference with an appropriate instrument.

Studies have shown that a single application of calcium hydroxide paste is sufficient to induce apical closure in 92.3% of the treated teeth [28]. Their exchange is not indicated since the replacement of the calcium hydroxide paste significantly reduces the intensity of the inflammatory process, leading to a reduction in the occurrence of apexification [29]. During these 8 months, calcium hydroxide dressing was only changed for sealing purposes.

**CONCLUSIONS**

The use of calcium hydroxide as intracanal medication for eight months stimulated mineralized tissue neoformation in the apical region of element 11, allowed endodontic treatment and subsequent restorative procedure.

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