Apexification of primary teeth: a treatment option

Marta Lua Pimentel Winz Almeida* / Licinia Maria Damasceno** / Laura Guimaraes Primo*** / Maristela Barbosa Portela****

This article reports a case of apexification in a child aged 20 months, with early childhood caries, using calcium hydroxide paste in two primary upper central incisors. This method is a feasible option for treating immature deciduous teeth showing pulpal necrosis.
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INTRODUCTION

Nursing bottle caries is usually associated to prolonged breastfeeding or artificial feeding and/or the use of sweetened pacifiers.[1] The term early childhood caries (ECC) was used because it best represents the complex etiological factors associated to this condition.[2] Among the risk factors are microbiological characteristics, demographic factors, such as race, ethnic origin, socioeconomic conditions, cultural background and cariogenic diet, in addition to knowledge and attitudes regarding oral health.[3]

The upper deciduous incisors are frequently the teeth most affected and in advanced cases, there may be complete coronary destruction of such teeth.[1] As they erupt around 7 1/2 to 9 months of age and the root is only complete at approximately 18 to 24 months,[4] pulp involvement may occur even before the end of this process, due to the fast evolution of ECC.

* Marta Lua Pimentel Winz Almeida, DDS, Postgraduate student in Pediatric Dentistry, Department of Pediatric Dentistry and Orthodontics, School of Dentistry, Federal University of Rio de Janeiro, Rio de Janeiro, Brazil.

** Licinia Maria Damasceno, DDS, Postgraduate student in Pediatric Dentistry, Department of Pediatric Dentistry and Orthodontics, School of Dentistry, Federal University of Rio de Janeiro, Rio de Janeiro, Brazil.

*** Laura Guimaraes Primo, DDS, MSD, PhD, Associate Professor, Department of Pediatric Dentistry and Orthodontics, School of Dentistry, Federal University of Rio de Janeiro, Rio de Janeiro, Brazil.

**** Maristela Barbosa Portela, DDS, Postgraduate student in Pediatric Dentistry, Department of Pediatric Dentistry and Orthodontics, School of Dentistry, Federal University of Rio de Janeiro, Rio de Janeiro, Brazil.

Send all correspondence to Dr. Marta Lua Pimentel Winz Almeida, Rua Oliveira Fausto, no 16B Botafogo, Rio de Janeiro, RJ, Brazil 22280-090.

Voice: 55 (21) 2541-9161
E-mail: martalua@hotmail.com

Apexification consists of inducement to form a calcified apical barrier in teeth that have pulpal necrosis, while apexogenesis consists of the continued formation of the root in teeth with vital root pulpal tissue remnants.[5]

Since the work of Frank,[6] the option for treating permanent pulpless teeth, with incomplete rhizogenesis, has been apexification using calcium hydroxide, a well-documented procedure.[7-10] This method also has been successful when treating permanent teeth submitted to periapical surgery,[8,11,12] mature and immature pulpless teeth with a history of luxation,[13] and roots that have resorption resulting from chronic inflammation.[14] However, in the literature studied, there are few reports on the use of the apexification method in deciduous dentition.[15,16]

The calcium hydroxide method enables the interrupted apical development process to retain its potentiality, allowing the root canal to be filled using routine endodontic procedures.[6] Therefore, the apical closure of immature deciduous teeth, through apexification, would allow the permanent filling material to be restricted to the root canal, thus avoiding dispersion to the periapex and consequently increasing the chances of success of the pulp therapy.

The purpose of this article is to report a case of apexification in immature, deciduous, upper central incisors, with pulp necrosis resulting from early childhood caries in a 20 month-old infant.

CASE REPORT

A male infant, 20 months old, was brought to the Pediatric Dental Clinic, with the main complaint of weak, brittle teeth. The medical history did not reveal any important information. Furthermore, his pediatrician had recommended prolonged breastfeeding to prevent malnutrition, due to his low socioeconomic level. At the first appointment, the child had a temperature and a dentoalveolar abscess in tooth 61. During the clinical examination, an edema on the upper lip was noted, in addition to early childhood caries in the four upper

Figure 1. Clinical view of upper incisors affected by early childhood caries and presence of purulent secretion drained through the gingival sulcus of tooth 61.

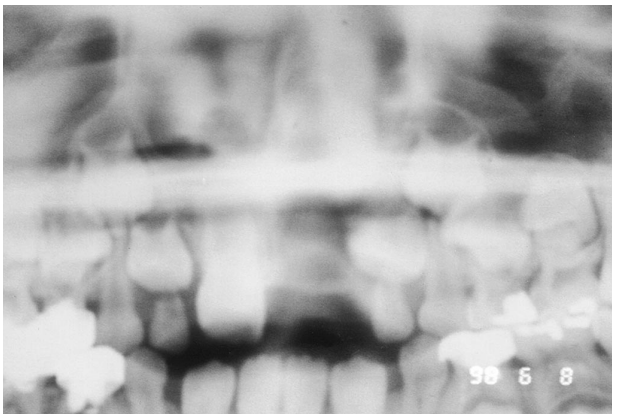

Figure 2. Initial radiograph at 1 year, 8 months. Note the incomplete root formation of the four incisors and confirmation of the diagnosis of the fusion of tooth 52.

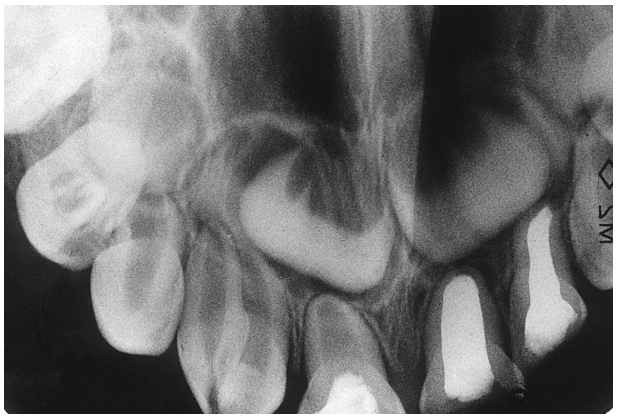

Figure 3. Radiographic view 4 months after the treatment began, in which the complete root formation of the central incisors and permanent obturation of the canal of teeth 61 and 62 are visible.

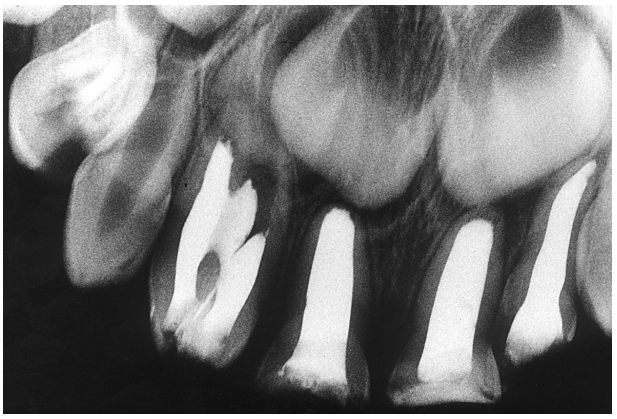

Figure 4. Follow-up 6 months after the start of treatment and final appearance of the endodontic therapy on the four upper incisors.

incisors (Figure 1). An orthogonal occlusal radiograph was taken of the upper anterior teeth (Figure 2), Amoxicillin 125 mg was prescribed during 7 days. Guidance was given on oral hygiene.

Dental treatment was begun after 12 days, in a clinic and under local anesthesia, using absolute isolation and physical restraint by the personal responsible for the child. During that session, the pulp in the central incisors showing purulent exudate was accessed. The pulp contents were removed, followed by irrigation with 5.25% sodium hypochlorite, an intracanal dressing with camphorated paramonochlorophenol and sealing with zinc oxide cement and eugenol. The child returned 2 months later, when instrumentation was done and a temporary obturation of the canals using paste made of calcium hydroxide powder and normal saline, to induce apical closure. Due to his frequent failures to return, another 2 months went by when, clinically, it was noted that the dressing in tooth 61 had dropped out and, after a radiograph, the presence of a mineralized apical stop was noted on the upper central incisors. Tooth 61 was then submitted to light instrumentation and irrigation with 5.25% sodium hypochlorite, followed by permanent filling of the canals with iodoform paste and sealing with gutta-percha and glass ionomer. During the same session, carious tissue was removed from tooth 62, where there was pulp exposure and immediate pulpectomy was done, also using iodoform paste (Figure 3). The patient returned 1 month later, when the pulp was accessed in tooth 52 and teeth 51 and 52 were permanently filled with iodoform paste (Figure 4).

Restorations were done with celluloid crowns, and pins made with 0.7 mm orthodontic wire in teeth 51, 61 and 52, which had been extensively destroyed and then tooth 62 was restored with composite (Figures 5, 6). At present, the oral hygiene is good and breastfeeding is discontinued. Now, two months after the treatment was concluded, he is being followed up monthly for guid-

Figure 5. Clinical view of the upper incisors after rehabilitation.

Figure 6. Radiograph 2 months after the endodontic treatment ended.

ance on diet and oral hygiene and quarterly clinical and radiographic control of the endodontically treated teeth.

DISCUSSION

Among the materials used as a medium for the calcium hydroxide is camphorated paramonochlorophenol (CPMC),[6] distilled water,[16] metacresol acetate, cresanol (CPMC + metacresol acetate), normal saline solution, Ringer's solution and anesthetic solution.[17] Rivera and Williams[18] found that glycerin provided better fluidity for the calcium hydroxide paste than distilled water. In this report, the medium used was normal saline solution.

Harbert[19] suggests the use of tricalcium phosphate (TCP) instead of calcium hydroxide, because as an apical plug it can be placed in a single session, reducing the treatment time, the number of appointments and radiographs and, consequently, treatment problems.

The occurrence of apexification in permanent teeth only with the removal of the necrotic pulp tissue and without using filling material, has been described in the literature.[20,21] The most important factors for favoring this phenomenon seem to be the removal of all the necrotic pulp tissue from the root canal and sealing the tooth to prevent the entry of bacteria and substrate.[17] In this report, after removing the infected pulp contents, the camphorated paramonochlorophenol dressing was left there for 2 months, before using the calcium hydroxide paste, without interfering in the success of the apexification. However, a case has been reported of apical closure in a permanent necrotized tooth, with a history of trauma 10 months ago, when there was no endodontic intervention.[22]

Heithersay[7] noted that the process of apical repair, using calcium hydroxide paste, was similar among cases that initially showed acute inflammation and those that had an associated chronic periapical lesion. In the study done by Binnie and Rowe,[23] with dogs' teeth, there was no difference in the periapical tissue response with the use of calcium hydroxide paste and distilled water between teeth that had been filled immediately after the pulp removal and those that had been contaminated, staying open for one week, and that the success of the calcium hydroxide was not reduced by the presence of infection. Cvek[13] did not find significant differences between teeth filled immediately with calcium hydroxide and those previously dressed with an antibacterial substance. However, Camp[17] recommended that cleaning and obturation be done in separate sessions and that ideally all signs and symptoms of infection and inflammation should have gone before placement of the calcium hydroxide paste. In the case described here, it was decided to insert the calcium hydroxide paste after controlling the acute infection phase, although the lack of assiduity delayed the second appointment by 2 months, and during that period the teeth only had the CPMC dressing.

Some authors[12] have reported cases of apexification in permanent teeth, with placement only of calcium hydroxide paste. The same occurred in this report, when the paste stayed there for 2 and 3 months, in teeth 61 and 51 respectively. Gomes *et al.*,[24] in an *in vitro* study of human teeth, found that the diffusion of calcium ions from the calcium hydroxide intracanal paste and saline solution, tends to stabilize after 16 days, and that the replacement of the paste produces a new state of equilibrium between the aqueous external medium and the root canal.

According to Frank[6] there are four clinical possibilities in apexification. There can be definite apical closure, accompanied by minimal recession of the root canal. Also, there may be no reduction of the space of the root canal, and the canal may be shaped like a blunderbuss. There may be no radiographic evidence of any development in the periapex or in the root canal. Although it is possible to note the presence of a barrier when an instru-

ment is inserted in the root canal or a radiographic picture can be seen of a calcified barrier located coronally to the root apex. According to McDonald and Avery,[5] apexification in permanent teeth usually occurs at 6 months, although the younger the patient the faster it occurs.[10] In the report of Trairatvorakul,[16] apexification in a deciduous tooth of a 14-month old infant occurred after 6 months, when probing into the root canal detected the presence of an apical stop, which usually is detected clinically 30 to 45 days before the presence of a radiographic picture.[21] In the present case, apical closure was confirmed radiographically after 4 months, along with the presence of a well-defined apex. This may be because rhyzogenesis in this infant was at a more advanced stage of development, thereby resulting in a shorter apexification time. In the report of O'Riordan,[16] it took 3 months in a 2 year-old child.

Heithersay[7] observed that 21 immature permanent teeth treated with sodium hydroxide paste, 19 showed continuation of root development, while in 5 of these the apical formation was partial and in 14 it was complete. In the latter, the presence of a defined root canal was visible. This apical barrier was described as being composed of cement, dentin, bone or of a combination of these three tissues.[25-27] The histological findings of Heithersay[7] show the formation of pulpal tissue, cement and dentin, and a dentin deposit inside and on the surface of the root canal. The closure of the apex may be partial or complete, although there are minuscule communications with the periapical tissues. Accordingly, apexification always should be followed by permanent filling of the canal.[17] In this report, formation of the apical stop was followed by permanent filling of the canal with iodoformed paste.

The fact that the root formation could be resumed after a period of inactivity caused by the infection, leads to the hypothesis that the epithelial sheath of Hertwig continues intact and ready to resume function after removal of the source of infection.[6,7] However, success was reported in the apexification of teeth submitted to apicocurettage, where there was probable removal of the remnants of this sheath.[8,11,12] This success could be related to the presence of inactive Malassez epithelial rests in the periodontal ligament, when the production of a barrier of hard tissue in the apexification would be the consequence of stimulating those cells.[12]

Frank[6] stressed the importance of the integrity of the dressing, with the paste being replaced at the next appointment, if the apical closure is not sufficient. However, Heithersay[7] reported that the dressing broke in a permanent tooth 10 months after placement of the calcium hydroxide paste, resulting in bacterial contamination. The canal was treated again and in the 18th month of follow-up, there was evidence of partial periapical repair. In this report, the loss of the dressing in tooth 61 did not jeopardize the success of the apexification. This technique has some drawbacks such as the long treatment time. Also, the assiduity of the parents/patient is decisive for the success of this therapy,[14] which although it did not happen in this report, where the patient often did not turn up, it did not affect the finalization of the apical closure.

Binnie and Rowe,[23] in a histological study of dogs' teeth, noted the absence of adverse periapical reaction to calcium hydroxide. Cvek[13] obtained 95% success in periapical repair after calcium hydroxide therapy, and this percentage was 91%, 4 years after the final root filling. Trairatvorakul,[16] after 6 years of clinical and radiographic follow-up of a deciduous tooth submitted to apexification, using the same technique, did not note alterations in the formation and eruption of the permanent successor. The case described was followed up during 2 months, without any painful symptoms, presence of a fistula or mobility being noted.

Consequently, apexification with calcium hydroxide in immature deciduous teeth is a viable treatment option when there is pulpal necrosis, although further studies are necessary of the longitudinal follow-up of those teeth until the successors erupt.

REFERENCES

1. Ripa, L. W. Nursing habits and dental decay in infants: "nursing bottle caries". J Dent Child 45: 274-275, 1978.
2. Kaste ML. Gift HC. Inappropriate infant bottle feeding. Status of healthy people 2000 objective. Arch Pediatr Adolesc Med 149: 786-791, 1995.
3. Reisine S. Douglass JM. Psychosocial and behavioral issues in early childhood caries. Community Dent Oral Epidemiol 26: 32-44, 1998.
4. De Kronfeld R. Bur 35:18-25, 1935. found in McDonald RE. Avery DR. Eruption of the teeth: local, systemic, and congenital factors that influence the process. In: Dentistry for the child and adolescent. 7th ed. St. Louis, Mosby, pp180-208. Chapter 9, 2000.
5. McDonald RE. Avery DR. Management of trauma to the teeth and supporting tissues. In: Dentistry for the child and adolescent. 7th ed. St. Louis: Mosby; pp485-542. Chapter 21, 2000.
6. Frank AL. Therapy for the divergent pulpless tooth by continued apical formation. J A D A 72: 87-93, 1966.
7. Heithersay GS. Stimulation of root formation in incompletely developed pulpless teeth. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 29: 620-630, 1970.
8. Ohara PK. Torabinejad M. Apical closure of an immature root subsequent to apical curettage. Endod Dent Traumatol 8: 134-137, 1992.
9. Gupta S. Sharma A. Unmonitored apexification of wide open apex in nonvital, immature incisor: a case report. J Clin Pediatr Dent 20: 145-147, 1996.
10. Morabito A. Defabianis P. Apexification in the endodontic treatment of pulpless immature teeth: indications and requirements. J Clin Pediatr Dent 20: 197-204, 1996.
11. Harbert HL. Periapical healing after apicocurettage during apexification. J Dent Child 52: 303-305, 1985.
12. Parashos, P. Apexification: Case report. Aust Dent J 42: 43-46, 1997.
13. Cvek M. Prognosis of luxated non-vital maxillary incisors treated with calcium hydroxide and filled with gutta-percha. Endod Dent Traumatol 8: 45-55, 1992.
14. Rotstein I. Friedman S. Katz J. Apical closure of mature molar roots with the use of calcium hydroxide. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 70: 656-660, 1990.

15. O'Riordan M. Apexification of deciduous incisor. J Endod 6: 607-609, 1980.
16. Trairatvorakul C. Apexification of a primary central incisor: 6-year follow-up. Pediatr Dent 20: 425-427, 1998.
17. Camp JH. Pediatric endodontic treatment. In: Cohen S. Burns RC. Pathways of the pulp. 7th ed. St Louis: Mosby; pp718-758. Chapter 22, 1998.
18. Rivera EM. Williams K. Placement of calcium hydroxide in simulated canals: comparison of glycerin versus water. J Endod 20: 445-448, 1994.
19. Harbert H. One-step apexification without calcium hydroxide. J Endod 22: 690-692, 1996.
20. Englan MC. Best E. Non-induced apical closure in immature roots of dogs' teeth. J Endod 3 :411-417, 1977.
21. Chawla HS. Tewari A. Ramakrishnan E. A study of apexification without a catalyst paste. J Dent Child 47: 431-434, 1980.
22. Whittle M. Apexification of an infected untreated immature tooth. J Endod 26: 245-247, 2000.
23. Binnie WH. Rowe AHR. A histological study of the periapical tissues of incompletely formed pulpless teeth filled with calcium hydroxide. J Dent Res 52: 1110-1116, 1973.
24. Gomes IC. Chevitarese O. Almeida NS. Salles MR. Gomes GC. Diffusion of calcium through dentin. J Endod 22: 590-595, 1996.
25. Torneck CD. Smith J. Biologic effects of endodontic procedures on developing incisor teeth. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 30: 258-266, 1970.
26. Steiner JC. Van Hassel HJ. Experimental root apexification in primates. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 31: 409-415, 1971.
27. Dylewski JJ. Apical closure of nonvital teeth. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 32: 82-89, 1971.