Case Report

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Apexification: A Conventional and a Contemporary Approach

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ABSTRACT

Background: The completion of root development and closure of the apex occurs up to 3 years after eruption of the tooth. Management of pulpal injury during this period is quite a challenge for dentists. Depending on the vitality of the affected tooth, two approaches are possible – apexogenesis and apexification. Apexogenesis is a vital pulp therapy procedure performed to encourage continued root development. Apexification is defined as a method to induce a calcified barrier in a immature tooth with necrotic pulp. The most commonly advocated medicament is calcium hydroxide, although recently considerable interest has been expressed in the use of mineral trioxide aggregate as it overcomes many of the drawbacks of calcium hydroxide and suitable for one visit apexification. This paper includes clinical cases of apexification with mineral trioxide aggregate and calcium hydroxide both.

Keywords: Apexification, calcium hydroxide, mineral trioxide aggregate.

INTRODUCTION

Management of young permanent tooth, either due to trauma or caries, having immature roots pose a significant challenge for the dentist. From the effect of dental trauma, a permanent young tooth can lose pulpal vitality, halting radicular growth and causing tooth formation to be incomplete. The necrotic pulp acts as an irritant to the periapical tissues. The apical foramen remains open in a tubular or blunted form. Stimulating radicular development may close the apex and provide for suitable radicular canal obturation. The treatment of choice for such tooth with nonvital pulp is apexification. Apexification is a procedure to promote the formation of an apical barrier to close the open apex of an immature tooth with a nonvital pulp such that the filling materials can be contained within the root canal space [1].

Immature teeth undergoing apexification are usually disinfected with irrigants including NaOCl, chlorhexidine, EDTA and iodine–potassium iodide [1]. The canal is then filled with $Ca(OH)_2$ paste for the purpose of further disinfection and induction of an apical calcific barrier. $Ca(OH)_2$ is antimicrobial because of its release of hydroxyl ions which can cause damage to the bacterial cellular components. The best example is the demonstration of its effect on lipopolysaccharide (LPS). $Ca(OH)_2$ chemically alters LPS which affects its various biological properties[2].

Filling the root canal is undertaken normally when the apical calcific barrier is formed. Without the barrier, there is nothing against which the traditional gutta-percha filling material can be condensed. Besides the fact that $Ca(OH)_2$ functions as a potent disinfectant, early evidence has suggested osteo-inductive properties[3], although it has been difficult to demonstrate this effect in vitro[4]. It was considered that the high pH may be a contributing factor for the induction of hard tissue formation[5]. The time required for apical barrier formation in apexification using $Ca(OH)_2$ may be considerable, often as long as 20 months and other conditions such as age and presence of symptoms or periradicular radiolucencies may affect the time needed to form an apical barrier. Refreshing the

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$Ca(OH)_2$ paste usually takes place every 3 months[1]. A number of shortcomings can be summarized for $Ca(OH)_2$ apexification: (i) long time-span of the entire treatment; (ii) multiple visits with heavy demands on patients and carers and inevitable clinical costs; (iii) increased risk of tooth fracture using $Ca(OH)_2$ as a long-term root canal dressing[7]. Though apexification with $Ca(OH)_2$ has been proven to be a reliable and most welcome addition to the therapeutic armamentarium[6] since Frank described it in 1966, its drawbacks led to the use of mineral trioxide aggregate (MTA) to fill the apical end without the need for calcific barrier formation. In comparison to $Ca(OH)_2$, some data suggest that MTA appears to be more predictable with consistent hard-tissue formation based on in vivo studies in dogs[8]. Using MTA for apexification may shorten the treatment period with more favourable results and improved patient compliance [9]. Many authors and clinicians propose a one-visit apexification protocol with MTA, which presents a major advantages over traditional $Ca(OH)_2$ methods[10] . This expedient cleaning and shaping of the root canal system followed by its apical seal with MTA makes the rapid placement of a bonded restoration the root canal possible, which may prevent potential fractures of immature teeth.

CASE REPORT

CASE 1:

A 12-yr-old male reported with pain in the upper right central incisor. He had a history of trauma to the same tooth four years back. There was swelling and tooth mobility (tooth #21). Thermal and electric pulp tests confirmed that tooth #21 was nonvital, whereas all adjacent teeth contained vital pulps. The radiograph showed that tooth #21 had an incompletely formed root with a "blunderbuss" apex. With the parent's consent nonsurgical root canal therapy with $Ca(OH)_2$ apexification was initiated. After one month patient came back, the swelling was subsided and tender on percussion was negative. $Ca(OH)_2$ paste was changed and patient was recalled after three months. Attempts to schedule treatments at 3-month intervals were unsuccessful because of patient lack of cooperation. Nevertheless when reexamined 1 yr after the start of treatment the radiograph showed advanced apexification with calcific deposition within the apical root canal and regeneration of the periradicular tissues, including a normal thickness ligament space and lamina dura, and a fully formed apex. In addition the tooth was free of any symptoms. Obturation was accomplished with soft gutta-percha and sealer and the tooth was restored.

Fig 1: Pre operative photograph.

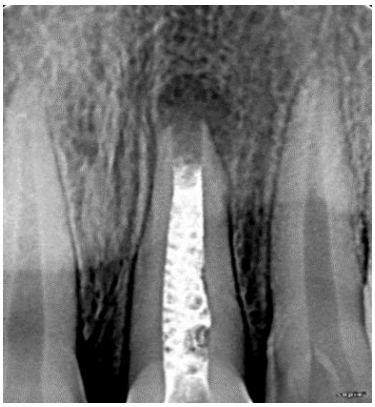

Fig 2: Calcium hydroxide applied to the weeping canal.

Fig 3: Obturation done after 1 year.

Fig 4: Post-operative photograph.

CASE 2:

An 11-yr-old boy presented with pain in his upper left central incisor. He had a history of a traumatic incident 3 years back to the same tooth. On examination a fluctuant swelling was present over the tooth. It was acutely tender to percussion.

Fig 5: Preoperative photograph.

Fig 6: Blunderbuss Canal.

Fig 7: Apexification done with MTA.

Fig 8: 3 Month post operative.

A radiograph was taken which revealed diffuse periapical radiolucency and the root canals of this tooth was wide and the apex was incompletely formed. After giving local anesthesia drainage was established by lingual access in the pulp chamber and necrotic pulp was extripated completely. The root canal was irrigated with NaOCl in a controlled way. Fresh paste of $Ca(OH)_2$ was place and the access was sealed with cavit. Patient reported after three weeks with symptom free and subsided swelling over the tooth. Cavit was removed and canal was irrigated again and after removal of

remaining $Ca(OH)_2$ paste but we could not dry it completely with the paper points. Then apical plug of MTA was placed inside the canals with the help of MTA carrier. Obturation and restoration of the tooth was completed. After three months recall the tissue were clinically normal and healthy. A radiograph of upper right central incisor showed a thin layer of calcified tissue covering the apex.

DISCUSSION

Apexification treatment allows Hertwig's epithelial root sheath to continue its function of root development and that occurs through the continuous deposition of dentine and cementum by stimulation and differentiation of Hertwig's epithelial root sheath (HERS) and surrounding undifferentiated progenitor cells. Root formation, in the presence of HERS, can continue even with pulpal inflammation or necrosis thus the effort should be made to preserve HERS as it is. HERS Provide a source of undifferentianed mesenchymal cells which give rise to further hard tissue formation and it also prevents the in growth of periodontal ligament cells into the root canal, which otherwise can lead to intracanal bone formation and arrest of root development. Since very long Ca(OH)2 has been recommended as the material of choice for apexification but due to its unpredictability MTA has taken its place in contemprory dentistry.

In the 1st case the formation of a mature apex with Ca(OH)2 served to demonstrate its possibility, but not its predictability. In addition successful treatment occurred in 12 months with only two applications of Ca(OH)2 paste spaced one month apart, whereas the widely accepted protocol recommended changing the paste every 3 to 6 months hence the most efficacious frequency of Ca(OH)2 treatments is still controversial. Furthermore the time required to effectively close the open apex is hard to predict lengthy procedure and temporary coronal restoration during inter-appiontment dressings may cause contamination and finally resulting in re-infection. This conventional approach also requires a high level of patient's acceptance as most of them will be unwilling for such a lengthy procedure hence one visit apexification developed.

In the 2nd case compared with $Ca(OH)_2$ apexification, M.T.A apexification reduced the treatment time, the number of radiographs with much more acceptance from the patient side. MTA provides scaffolding for the formation of hard tissue and has the potential of a better biologic seal. It is a hydrophilic material that has three hour setting time in the presence of moisture. From the practical point of view the cases have shown the use of MTA in root canals containing moisture. This property is important in nonvital teeh with necrotic pulps and inflamed periapical lesions. The cases treated using MTA exhibited apical closure and healing during subsequent follow up. MTA induces apical hard tissue formation with less inflammation than other test materials.

CONCLUSION

The Radiographic follow-ups in both the cases showed new hard tissue formation and healing taking place in the apical area of affected teeth. Though Ca(OH)2 induced apexification can give optimum result but MTA appeared to be a reliable and predictable option for single step apexification overcoming the drawbacks of CA(OH)2 .

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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