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**Case Report**

# Conventional Multivisit Calcium Hydroxide Apexification with Rare Apexogenesis Like Outcome and Novel Single Visit MTA Apexification Followed by Root Reinforcement with Fiber Post: Two Case Reports

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**Abstract:** Completion of root development takes around 3 years after eruption of permanent teeth. Any pulpal injury in this period can lead to necrosis of pulp. Pulp necrosis of immature permanent teeth may impair root development and apical closure of root canals. Management of immature non vital teeth is very challenging for a clinician because teeth may have wide open apex and thin root canal walls that may diverge towards the apex. Conventional cleaning and shaping of the canals and obturation may not be possible because of the lack of apical stop. This case report presents two cases of apexification. First case, managed using Calcium hydroxide and iodoform paste for multiple visit apexification which had a rare apexogenesis like outcome and second case using MTA for single visit apexification followed by root reinforcement with Glass fiber reinforced composite post.

**Keywords:** apexification, immature teeth, calcium hydroxide, mineral trioxide aggregate

## INTRODUCTION

Apexification is any method to induce a calcified apical barrier in a root with an open apex or continued development of apex of an incomplete root in teeth with non vital pulp”. Apexogenesis is the physiological process of root development. Apexogenesis is any vital pulp therapy procedure performed to promote continued physiological development and formation of the root apex [1]. Materials such as calcium hydroxide powder or mixed with different vehicles, collagen-calcium phosphate gel, osteogenic protein, bone growth factor, oxidized cellulose, tricalcium phosphate and MTA have been used for apexification. Kaiser obtained successful apexification with calcium hydroxide paste in 1956 and 1964.Frankand Heithersay also obtained similar results with calcium hydroxide. Calcium hydroxide or its combination with other materials has been the most commonly used material for apexification. Apexification with calcium hydroxide involves repeated stimulations with calcium hydroxide, over a period of 6-24 months, until apical closure is achieved. The calcium hydroxide powder mixed with Saline, distilled or sterile water, local anesthetic solution, CMCP (camphorated monochlorophenol), metacresyl acetate, mixture of CMCP & Metacresylacetate (Cresanol), methyl cellulose and Chlorhexidine have been used for apexification.

Single visit apexification is the non surgical condensation of a biocompatible material into the root apex of a tooth with open apex [2]. Materials that have been used for single visit apexification are tricalcium phosphate, calcium hydroxide, freeze dried bone, and freeze dried Dentin, dentinal shavings or chips, resorbable ceramic, collagen-calcium phosphate gel and Mineral trioxide aggregate(MTA)[3]. MTA was first introduced in 1993 and received FDA approval in 1998. MTA is a mixture of hydrophilic particles of tricalcium silicate, tricalcium oxide and silicate oxide in a fine powder form. MTA has low solubility and radiopacity greater than dentine. Good sealing ability and biocompatibility are also positive traits of MTA. After setting MTA has a pH of 12.5 similar to Calcium hydroxide. This high pH may impart some antibacterial properties to MTA. Whitherspoon and Ham asserts that MTA provides a scaffolding for hard tissue deposition and provides better seal [4]. Other advantages of MTA are low cytotoxicity, antimicrobial property, setting ability uninhibited by moisture, effect on the induction of odontoblasts and formation of a hard barrier. The most effective material for apexification among all these materials is calcium hydroxide or MTA [3].

This article presents two cases of apexification. In the first case report Calcium hydroxide and iodoform paste was used for multiple visit apexification which showed continued root-end growth with closure of root apex producing a rare apexogenesis like outcome and the second case was managed using MTA for single visit apexification followed by root reinforcement with Glass fiber reinforced composite post.

## CASE DESCRIPTION

### Case Report 1

A 16 year old boy reported to the department with pain in lower right posterior region. On clinical examination showed an amalgam restoration with secondary caries involving dentin in 46 and a deep caries lesion on 47.IOPA showed caries exposing pulp in 47 with open apex in both mesial and distal roots [Fig.1]. The tooth failed to respond to thermal and electric pulp tests. It was decided to attempt apexification using Calcium hydroxide and Iodoform paste in 47.Access opening followed by cleaning and shaping of root canals using Protaper (Dentsplymaillefer, Ballaigues, Switzerland) rotary files was performed till F2 in mesiobuccal and mesiolingual canals and F3 in distal canal of 47.Irrigation with alternate use of 3% Sodium hypochlorite and saline was done. Canals were dried using paper points. Metapex (Meta Biomed Co. Ltd, South Korea) was placed into the canals using the plastic needles supplied by the manufacturer. On three months recall radiographic examination showed significant calcific barrier formation at both mesial and distal root tips of 47 [Fig.2]. Another recall at 6 months showed well defined apical calcific barrier at both root tips of 47 as well as increase in root length of 47 [Fig.3]. The Metapex was removed from the root canals using H-file followed by irrigation with 1.25% sodium hypochlorite. Canals after drying with sterile paper points were obturated using Gutta Percha with cold lateral condensation technique [Fig4].

**Fig-1: preoperative radiograph (Case 1)**

**Fig-2: three months recall**

**Fig-3: six months recall**

**Fig-4: Postoperative radiograph**

### Case Report 2

An 18year old boy reported to department with complaint of fractured anterior tooth. He had a history of trauma 10 year backs and had not undergone any treatment. On examination Upper Right Central Incisor (11) had Ellis Class III fracture and pulp chamber was open with caries on the walls of the pulp chamber.11showed no response to thermal & electric pulp testing whereas 21and12 showed normal response. IOPA radiograph showed a very wide root canal with thin root walls with blunderbuss root apex in 11 with a periapical lesion measuring 1x1cm [Fig.5]. It was planned to perform a single visit apexification using MTA and reinforcing the root with fiber post followed by full crown in 11.

**Fig-5: Preoperative radiograph (Case 2)**

Isolation with rubber dam from canine to canine was done. No local anesthesia was needed since the tooth was non vital. Caries was excavated from 11 followed by modification of access cavity. Canal was cleaned by circumferential filing to 80 size file at the established working length of 21mm. Copious irrigation with alternate use of 3% Sodium hypochlorite and normal saline was done. MTA (ProRoot, Dentsply, Maillefer) was mixed as per the manufacturer's instruction and was introduced into the canal using a messing gun. A plugger of 80 size was used to push the MTA into the apical third of the root [Fig.6]. A moist Cotton pellet was placed in the canal and access cavity was sealed with Cavit G (3M ESPE, Germany). Patient was recalled after 1 day and canal was opened to remove the cotton pellet. Apical plug of MTA on evaluation with a DG 16 explorer felt hard. A large sizeglass fiber reinforced composite post(FRC postec plus)size 3(Ivoclar Vivadent,)was selected and was cemented into the root canal using resin cement Rely X U 200(3M, Germany) [Fig 7, Fig8]. Access cavity was sealed with compositeres in Z350 (3M ESPE, Germany) and a ceramic crown was placed. A six month recall of the patient showed reduction in size of the lesion and evidence of new bone formation in the lesion [Fig.9].

**Fig-6: Apical plug of MTA placed**

**Fig-7: Fiber post selected**

**Fig-8: Post cemented in canal**

**Fig-9: Six months follow up**

## DISCUSSION

Apexification aims to achieve root end closure in non vital teeth with incomplete root formation. In 1966 Frank classified the outcome of apexification into 4 types: Type 1:Normal apexogenesis which is rare, Type 2: Dome shaped apical closure with blunderbuss appearance remaining, Type 3: No apparent radiographic change but positive stop at apex and Type

4: Hard tissue barrier short of apex leaving thin dentinal walls subject to further trauma [3].

Calcium hydroxide and Iodoform paste for root end closure has been reported by Sridhar N and S Tandon [5]. They concluded that Calcium hydroxide and Iodoform paste (Metapex) may be used as medicament to promote root growth and apexification. Ghose *et al* has described the apical barrier formed as a cap, bridge or an ingrown wedge made up of cementum, dentine, bone or osteodentine [6]. Osteodentine is supposed to be formed from connective tissue at root apices when Hertwig's epithelial root sheath (HERS) are not present. Steiner and Van Hassel reported that histological study of the apical calcific barrier proved it to be cementum [5]. The antibacterial efficacy of three Ca(OH)2 formulations were determined by Cwikla et al and found Ca(OH)2 mixed with iodoform and silicon oil (Metapex) to be the most effective dentinal tubule disinfectant [7].

Calcium hydroxide placed inside the root canals dissociates into calcium and hydroxyl ions. The hydroxyl ions destroy the lipids resulting in structural damage of bacterial proteins and nucleic acids. The high alkaline pH of Calcium hydroxide activates alkaline phosphatase enzyme which releases inorganic phosphate ions. The inorganic phosphate ions produced reacts with calcium ions in blood stream forming calcium phosphate. Calcium phosphate, the molecular unit of hydroxyapatite, produces mineralization [5].

Hence, in the present Case report 1 we planned multi visit apexification using a calcium hydroxide formulation with iodoform (Metapex). Six months radiographic follow up showed that there was continued root formation as well as apical closure with a definite apical stop thereby showing Frank's Type 1 apexification which is rare specially considering the fact that tooth was non vital.

Clinical studies have already reported conservative treatment resulting in increase of root length and thickness in immature teeth with periapical lesions and extensive boneresorption [8, 9]. This could be due to an inaccurate clinical diagnosis of pulp status in teeth that may have vital tissues in apical region. Continued root development may also result from the presence of viable HERS and apical papilla [10]. Even in cases with non vital pulp, HERS and apical papilla completely lost, root walls may increase in thickness from ingrowth of cementum from periapical areas into internal root dentine walls [11]. The normal root end closure obtained in Case report 1 facilitated conventional root canal treatment.

There are many disadvantages for calcium hydroxide apexification.

i. Calcium hydroxide apexification requires repeated changing of the medication over a 5-20 months course. This unpredictable and lengthy course of treatment with a temporary coronal restoration that may fail in between treatment increases the chances for re-infection [12].

ii. It is not possible to give a permanent restoration till completion of apexification.

iii. Cervical root fractures were common in teeth following calcium hydroxide apexification due to thin dentinal walls as well as weakened tooth structure induced by calcium hydroxide [13].

iv. This treatment requires a high level of patient compliance.

Because of these reasons a single visit apexification with MTA has been suggested. In a study, that compared the effectiveness of MTA and $Ca(OH)_2$ for apexification of young permanent incisors with open apices, reduced treatment time, good sealing ability, good biocompatibility makes MTA an effective material for producing an apical barrier for immediate obturation [14]. Shababhang *et al* compared the efficacy of osteogenic protein-1, Calcium hydroxide and MTA concluded that amount of hard tissue formed was similar but apical barrier produced by MTA has greater consistency [3]. Superior biocompatibility of MTA and presence of calcium and phosphate ions result in attraction of blastic cells and promotes a favourable environment for calcium deposition [15, 16]. Felippe *et al* studied the effect of Calcium hydroxide on dog's teeth with open apices treated with MTA. They proved that the groups treated with and without Ca $(OH)_2$ prior to MTA placement shoved no difference in the apical closure, bone resorption and root resorption. They also proved that placing MTA without pretreating the canals with $Ca(OH)_2$ results in more complete apical barrier formation in comparison with those treated with Ca(OH)2 before placing MTA [17].

Hand method of placement and condensation of MTA was proven radiograpically and microscopically to produce better adaptation with fewer voids than ultrasonic method by Aminosharie *et al* [18]. So in the present case reports MTA placement and condensation was done manually with pluggers and no pretreatment of canals with $Ca(OH)_2$ was done. However, MTA is much expensive and its sandy consistency when hydrated makes manipulation difficult [19].

In the present case report2 the weak root with wide root canal with thin root canal walls was a challenge to the clinician because of propensity for root fracture following a conventional root canal treatment and obturation. To reduce the chances of root fracture it was decided to reinforce the tooth with placement of post inside the root canal after achieving apical closure with MTA. Fiber post was selected in this case because available literature shows that tooth with fiber posts showed failure at a higher load compared to custom fabricated metal posts. Mode of failure of fiber posts were also more favorable because the teeth with fiber post fractures more at core level with minimum damage to tooth structure, whereas custom metal posts cause exhibits root fracture resulting in teeth that are non restorable [20].

Newer materials like Biodentine and Calcium enriched mixture cement (CEM) have also been tried as root end materials. Root end Biodentine restorations done after ultrasonic preparation of root end has shown better results on comparison with MTA in micro leakage studies [21].

CEM also has shown superior sealing ability compared to MTA [22]. CEM has better handling characteristics, adheres better to root dentinal walls, penetrates well into dentinal tubules and expands on setting increasing adaptation [22]. In aqueous environment CEM produces hydroxyl, calcium and phosphate ions leading to hydoxyapatite that improves seal [22].

Clinical and radiographic follow up showed that teeth treated with MTA as well as Calcium hydroxide showed absence of symptoms and satisfactory seal of root apex facilitating successful outcome in root canal treatment. However, newer materials like Biodentine and CEM also should be considered before selecting materials for root end closure.

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