Continued Root-End Growth & Apexification using a Calcium Hydroxide & Iodoform Paste (Metapex®) - A Case Report

Dr. Pema Tshering Lepcha[1], Dr. Abhay Agarwal[2], Dr. Neeraj Kant Panwar[3], Dr. Neeraj Solanki[4], Dr. Himanshu Tomar[5], Dr. R Archana Devi[6]

PG Student[1], HOD[2], Reader[3,4], Senior Lecturer[5], Private Practitioner[6], Department of Pedodontic & Preventive Dentistry, Kalka Dental College, Meerut

Abstract

Aim: The aim of these case reports is to present a treatment to promote root-end growth and apexification in nonvital immature permanent teeth in children.

Methods & Materials: The traumatic case were presented where the calcium hydroxide and iodoform paste Metapex® was placed in the root canals of immature permanent teeth using disposable plastic tips. The teeth involved were evaluated radiographically at regular intervals for the first 8 months after placement of the paste. At the end of 8 months the cases showed continued root growth and apical closure (apexification) with no evidence of periapical pathology. Conventional endodontic treatment was then performed.

Results: In this clinical cases presented, a combination of calcium hydroxide and iodoform paste (Metapex®) was used and showed promising results in inducing root-end growth and closure after 8th months

Conclusion: In this clinical case, the calcium hydroxide and iodoform paste Metapex® (Meta Biomed Co. Ltd., South Korea) was found to induce apical closure when assessed radiographically and clinically . Over a period of 8th months the cases showed continued root growth.

Clinical Significance: The calcium hydroxide and iodoform paste Metapex® promoted continued root-end growth with apexification in the nonvital immature permanent teeth treated.

Keywords: Apexification, apical closure, endodontics, Metapex®, calcium hydroxide

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Introduction

Dental trauma happens most frequently in young patients, who generally present with immature teeth (1). As the completion of root development and closure of the apex occur up to 3 years after eruption of tooth (2), trauma to these immature teeth affects the root development, making treatment consideration and result of the treatment , a big challenge.

The roots of these immature teeth are thin and fragile with divergent or parallel dentin walls, having an open apex with wide foramina diameter. This makes it impossible to perform conventional endodontic treatment. The main goal of the treatment should be to achieve the most physiological apical closure (3,4).

Hertwig's epithelial root sheath has a major role in development of root and also in determining its shape. It can survive periapical inflammation and continue root development when the inflammatory process is eliminated (5). Thus every effort should be made to maintain its viability. It is thought to provide a source of undifferentiated cells that could give rise to further hard tissue formation. It may also protect against the ingrowth of periodontal ligament into the root canal, which would result in intracanal bone formation and arrest of root development (6).

Complete destruction of Hertwig's epithelial root sheath results in cessation of normal root development. This does not however mean that there is an end to deposition of hard tissue in the region of root apex. Once the sheath has been destroyed there can be no further differentiation of odontoblasts. However hard tissue can be formed by cementoblasts that are normally present in the apical region and by fibroblast of dental follicle and periodontal ligament that undergo differentiation after the injury to become hard tissue producing cells (7).

A proper diagnosis of the pulp vitality should be done before deciding the treatment. In case of vital pulp, the induction of root formation celled Apexogenesis whereas in case of non vital, necrotic pulp process of root end closure called Apexification is the most reliable treatment option.

Apexification

Apexification is defined as "a method to induce a calcified barrier in a root with an open apex or the continued apical development of an incomplete root in teeth with necrotic pulp" (8). It is necessary to use a specific dressing material to neutralize the bacteria and their products to stimulate the Apexification process by forming a mineralized apical barrier so that the subsequent condensation of gutta-percha can be properly achieved (9).

In the past, techniques for management of open apex in non-vital teeth were confined to custom fitting the filling material (10, 11), paste fills (12), and apical surgery (13). The limited success enjoyed by these procedures resulted in significant interest in the phenomenon of continued apical development or establishment of an apical barrier, first proposed in 1960s (14, 15). Many techniques have been suggested for induction of apical closure in pulpless teeth to produce more favorable condition for conventional root canal filling (16). Some believe that instrumentation may in fact hamper root development and that preparation of these canals should be done cautiously, is at all (17).

Cooke and Robotham (18) hypothesize that the remnants of Hertwig's epithelial root sheath, under favorable conditions, may organize the apical mesoderm tissue into root components. They advised avoidance of trauma to the tissue around the apex. This theory was supported by Vojinovic (19) and Dylewski (20). An apical barrier is formed as a result of Apexification.

The apical barrier varies in composition. Most often a cementum-like tissue is recognized. Other times the tissue is so irregular that all that can be said about it is that it is a mineralized tissue which is often contains inclusions of soft tissue (21). Dentine and bone can also form (22), but most common result is a combination of dentine, cementum and bone (23, 24), with connective tissue and calcium hydroxide occasionally mixed in with them (25). Therefore such an apical hard tissue bridge does not seal the root canal. It only renders a barrier against which a bacteria- tight seal of the canal may be achieved by means of root filling material (21).

Many kinds of material have been used to induce Apexification in teeth with immature apices: anti-septic pastes, antibiotic pastes (17), ceramic tricalcium phosphate, the osteogenic protein-I, mineral trioxide aggregate (MTA) (22,23), calcium hydroxide mixed with different substances in solution (24, 25), calcium hydroxide and idoform paste (Metapex) (26,27), etc.

Calcium Hydroxide & Iodoform Paste (metapex)

Metapex, a silicone oil-based calcium hydroxide paste containing 38% iodoform is very popular (28) and has been used as a root canal filling material in primary teeth. Use of it in Apexification has also been reported (29). Several studies have been conducted mainly in Japan (30, 31), the United States (32) and South America (33), that demonstrated good clinical and radiographic success.

The mechanism of action of calcium hydroxide on microorganisms can be explained by the influence of pH on growth, metabolism and bacterial cell division. It is believed that the hydroxyl ions from calcium hydroxide develop their mechanism of action in the cytoplasmic membrane, because enzymatic sites are located in the cytoplasmic membrane. This membrane is responsible for essential functions such as metabolism, cellular division and growth and it takes part in the final stages of cellular wall formation, biosynthesis of lipids, transport of electrons and oxidative phosphorylation (34,35). The pH gradient of the cytoplasmic membrane is altered by the high concentration of hydroxyl ions of calcium hydroxide acting on the proteins of the membrane (proteic denaturation) (36). The effect of the high pH of calcium hydroxide alters the integrity of the cytoplasmic membrane by means of chemical injury to organic components and transport of nutrients, or by means of the destruction of phospholipids or unsaturated fatty acids of the cytoplasmic membrane, observed in the peroxidation process, which is a saponification reaction (34). The superior antimicrobial effects of Metapex may be due to the combination with iodoform and to the viscous and oily vehicle, which may prolong the action of the medicament. Accordingly, Gomes et al showed that oily vehicles increase the antimicrobial

effects of calcium hydroxide against E. faecalis and other bacteria (37). Iodine is bactericidal as well as fungicidal (38).

In a study conducted to determine the anti bacterial efficacy of Metapex, it was showed that Metapex has potent antimicrobial ability, a decreased concentrations of it resulted in significantly decreased antimicrobial effects (39). It is demonstrated by Sridhar and Shobha Tandon (26) that both clinical and radiographic follow up of the teeth treated with Metapex showed the absence of clinical symptom and continued hard tissue formation at the apex. However very few studies have reported on the efficacy of this material when it is used for Apexification (29,40).

Case Report

A 8 years old male patients reported to the Department of Pedodontic and Preventive Dentistry ,K.D.C .Meerut. with the chief complaint of swelling and pain on upper front tooth region and bellow the eyes region from past 2 days. On going through with her chief complaint, general examination , clinical examination and investigation the case was diagnosis as Ellis class IV Fracture with incomplete root closer.

It was decided to induce root completion by using the calcium hydroxide and iodoform paste Metapex®. At the initial appointment , access to the canal was established and a thin purulent discharge from the canal was noticed.the canal was irrigated with normal saline a cotton pellet was placed within the pulp chamber, the cavity kept open and the patients was discharged with the advice of warm saline gurgling frequently over the next 48 hours and patients was prescribed with antibiotic drugs for 7 days to aid in pariradicular microbiological central. On the next visit after 5 days walking length was determined 23mm , 2mm short from the radiograph apex

The canal was then instrumented with k –file 40 followed by copious irrigation with normal saline.after drying with paper point the canal was inserted with metapex in order to place the metapex ,the syringe was inserted into the canal, and paste was pressed down into the pulp space.when the paste flowed back from the root canal into the access cavity the syringe was slowly withdrawn. The occlusal surface was sealed with a provisional materials (cavit,TM 3 M ESPN,ST Paul,MN, USA). An immediate postoperative radiograph was taken to access the extent and placement of the materials in the root canal.after taking a periapical radiograph , it was found that , due to open apex, a part of metapex was extruded from root canal space.

The patients was called after one month but unfortunately patients reported after 3 months , the periapical radiograph showed no changes, so that tooth was re-entired and checked with number size 30 paper point for presence of resistance,'stop' but no sign of it . the canal was re inserted with metapex and patients was appointed again after 2 month.

5 month after the post appointment , at the 4th visit patients no symptom and a new periapical view showed dissolution of the calcium hydroxide from the apical 2-3mm with no sign of apical closure.

The tooth was re entered and the NO 30 paper point was gently inserted and no barrier was formed. The metapex was packed again with the canal and the cavity seated.

The patients again visited after 3 month by missing his scheduled visit. A follow up periapical view was then taken and the patients was clinically examined. This time a faint sensation of resistance was felt with the no 30 paper point and the radiograph also conformed the presence of a horizontal bridge and the increase of the apical rooth length.

The canal was then prepared to an apical size of 45 k file and Obturation done with guttapercha cone and restored with cavition.

After a week follow up clinical examination done to see if there was any pot Obturation complication.As there was no complain , the patients was ask to visit after one month for composite crown build up.

As the clinical and radiograph review of the tooth after 1 month later was satisfactory, the composite crown build up done using the light cure composite resin restoration material and finally with the composite finishing kid the review of tooth was carried out 12 month later which show no abnormally in the periapical tissue.

Fig 1. Extra oral swelling on right cheek and infra orbital region

Fig 2. Open apex with apical lesion

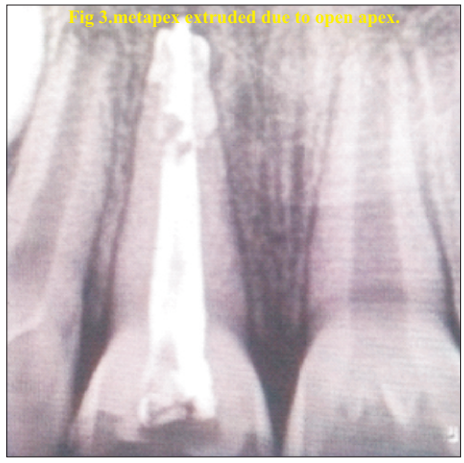

Fig 3.metapex extruded due to open apex.

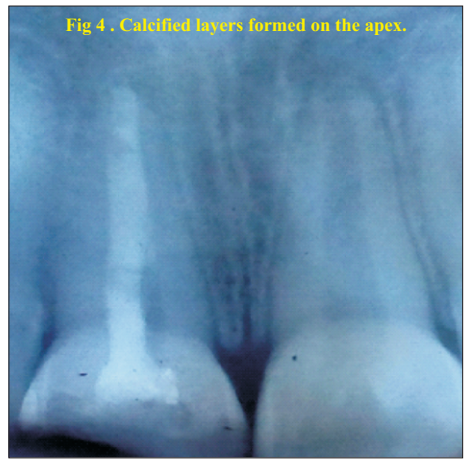

Fig 4 . Calcified layers formed on the apex.

Fig 5.obturation done with gutta percha

Fig 6. Composite restoration done in 11

Discussion

The completion of root development was achieved through Apexification procedure by placement of certain biocompatible materials in the root canals to the apical region.

Calcium hydroxide was introduced by Hermann(1920) for pulp capping ,was later used as temporary root filling materials and in the treatment of periapical lesion.[a]

The choice of the calcium hydroxide Apexification technique is based essentially on the biological properties of this material. its anti-inflammatory effect added to its alkalinity by the diffusion of hydroxyl ions opposes acidosis and thus inhibits any inflammatory resorption. Its antibacterial action promotes healing and repairs the injured tissues. Calcium

hydroxide also acts by releasing Ca2+ which may stimulate the biological repair processes and the mineralized tissue formation.

Use of calcium hydroxide and iodoform in apexification also has been reported.[41,42] Lu & Qin [43]compared an antibiotic paste and Vitapex® paste (calcium hydroxide and iodoform) for their use in apexification. Over a follow-up period of 30 months, they concluded that both materials showed the same level of radiographic success. But in those cases where periapical inflammation was present, the antibiotic paste produced superior results.

In another study, Weng [41]evaluated 64 younger permanent teeth with underdeveloped root apices and necrotic pulps. After the root canals were prepared and sterilized, Vitapex® paste was placed in an attempt to achieve apexification. All the teeth were observed for three years, and 24 teeth (37.5 percent) successfully achieved apexification, 37 teeth (57.81 percent) were in the process of rootend closure, and only 3 teeth (4.69 percent) failed to achieve apexification. Altogether the treatment was successful for 61 teeth, for an effective rate of 95.3 percent.

Weng[41] concluded that Vitapex® paste was an effective material for achieving Apexification for younger permanent teeth.

The cases presented included clinical and radiographic evidence of success in achieving apexification. Unlike with barrier formation, continued root growth was observed for the treated teeth. A similar finding for Vitapex paste was reported by Gu et al.,[42] where there was complete root development and apical closure involving seven teeth. Ghose et al.[44] described the barrier as a cap, bridge, or ingrown wedge that may be composed of cementum, dentin, bone, or osteodentin.

This osteodentin, when present, appears to be formed by connective tissue at the apices where Hertwig's epithelial sheath is not seen. Torneck et al.[45] reported that a bonelike material was deposited on inner walls of the canal, while Steiner and Van Hassel[46] demonstrated apical closure by formation of a calcific barrier that satisfied the usual histological criteria for identification as cementum.

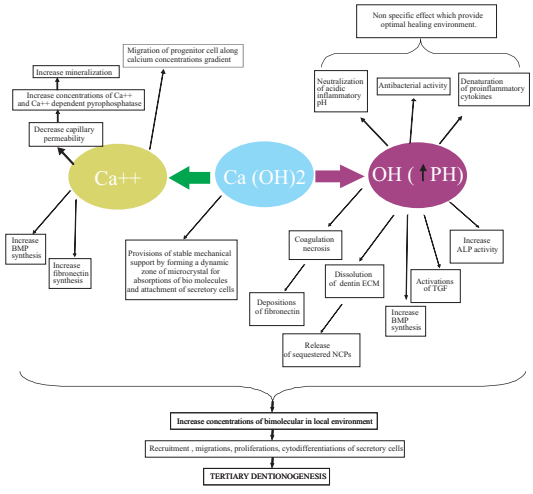

Fig 1.Hypothetical model of mechanisms by which Ca(OH)2 induces tertiary dentine formation. Release of bioactive molecules, either through direct stimulation of cells or by solubilization of dentine extracellular matrix, is vital for biological effects of Ca (OH) 2 . Calcium as well as hydroxyl ions released from the material regulate the events leading to tertiary dentinogenesis. Ca(OH)2 containing cement , together with microcrystals deposited on its surface, provides a biologically active substrate for adsorption of biomolecules and adhesion of odontoblasts. In addition ,non-specific, antimicrobial and anti-inflammatory effects of Ca(OH)2 on dental pulp may succour the process of mineralization.

Study of several sections gave the impression that cementum formation proceeds from the periphery of the original apex towards the center of the root in decreasing concentric circles. In these clinical cases it is believed that continued root formation took place because of the activity of Hertwig's epithelial sheath present at the apex. Both clinical and radiographic follow-up of the teeth treated with Metapex® showed the absence of clinical symptoms and continued hard-tissue formation at the apex. Even though there are no other reports of such findings, these observations are consistent with the results reported by Weng.[41]

Conclusion

Based on these clinical observations, the following conclusions were made:

- The cases treated with Metapex® showed good clinical and radiographic evidence of success in promoting continued root growth and inducing root-end closure in immature young permanent teeth.
- Barrier formation was not evident in this cases presented.
- Metapex® can be used as a medicament to promote root growth and apexification.

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