



Case Report

Comparative Evaluation of Timing and Closure of Immature Anterior Teeth With Open Apex Using Two Different Regenerative Material: Case Report With 12 Months Follow-Up

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ABSTRACT

Regenerative endodontic Procedures provide an unconventional approach which relies on the principle of tissue engineering. Pulp necrosis of immature permanent teeth may impair root development and apical closure of root canals. Completion of root development takes around 3 years after eruption of permanent teeth. 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. Since debridement of pulp canal space is difficult, there is an increased possibility of root perforation and cervical root fracture, besides the presence of an open immature root apex jeopardize the apical seal of a root canal treatment resulting in subsequent failure. The purpose of this report is to present the case of a patient wherein apexification of an immature permanent maxillary left central incisor tooth was induced by the Biodentine (Calcium trisilicate cement) and Metapex paste (Calcium hydroxide and Iodoform).

Keywords: Apexification; Biodentine; Immature permanent tooth; Metapex; Open apex

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INTRODUCTION

Pulp degeneration and necrosis are a common sequelae of traumatic injuries to young permanent anterior teeth. The main challenge in cases with open apices is to overcome the lack of apical stop, against which endodontic fillers can be compacted.¹ The prevalence of Traumatic Dental Injuries in permanent anterior teeth in India varies from 7.3 to 8.79%. Anterior teeth are at the most susceptible position due to their projection. The apical closure of root in a tooth takes approximately 3 years after the eruption of crown in oral cavity.² When the young anterior teeth with open root apex gets involved in traumatic dental injuries, the ensuing pulpal necrosis often leads to arrest of normal process of root formation.³ Depending upon the vitality of pulp in young permanent teeth, two possible approaches available are Apexogenesis and Apexification.^{1,3} Apexogenesis is defined as 'a vital pulp therapy procedure performed to encourage continued physiological development and formation of the root end'. 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'.⁴ 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.⁵ The use of calcium hydroxide for the apexification in the pulpless tooth was first reported by Kaiser (1956) and it was popularized by the work of Frank. The calcium hydroxide can be used alone or it can be mixed with camphorated monochlorophenol (CMCP), metacresyl acetate, Cresanol, physiologic saline, Ringer's solution, distilled water and anaesthetic solution.⁶ Commercial product named Metapex (Meta BioMed Co., Ltd, Korea) and Biodentine (Septodont, 205-granite run drive suit 150- Lancaster PA, 17601) is been used as a root canal filling material in primary teeth. It contains iodoform (40.4 %), calcium hydroxide (30.3%), and silicone oil (22.4 %). The triple antibiotic paste (TAP) consisted primarily of a mixture of ciprofloxacin, metronidazole and minocycline which has been reported to be effective in bacterial elimination and canal disinfection. However, very few studies have reported on the efficacy of this material when used for apexification. The present article reports on the cases in which Metapex was used to promote root-end growth and apical closure (apexification) in an immature permanent tooth over a period of 6- 24 months, until apical closure is achieved.²

CASE REPORT 1

A 9-year-old female patient reported to the Department of Pedodontics and Preventive Dentistry with a chief complaint of pain, swelling and discoloured left upper anterior tooth (11). He gave a history of trauma to the upper anterior region 6 month back and history of pain on biting from the front tooth since last one months. The tooth was tender on percussion with no intraoral sinus tract. The tooth tested negative for the electric pulp test. On clinical examination, there was the presence of a uncomplicated crown fracture in 11 [Figure 1].

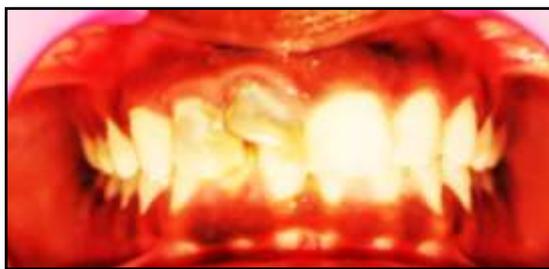


Figure 1: Preoperative intraoral frontal clinical photograph

Radiographically, the tooth exhibited incomplete root formation, characterized by blunderbuss canal and an associated periapical lesion with the same [Figure 2]



Figure 2: Working length determination in 11,12



Figure 3: Biomechanical preparation with Calcium hydroxide placement

On the basis of the clinical and radiographic findings, a final diagnosis of pulpal necrosis was made. The treatment plan was apexification with Metapex (calcium hydroxide and iodoform) for 11 followed by obturation with gutta-percha after closure of the root apex. An informed written consent was taken from the parents prior to the procedure. After isolation, access opening was done, and the necrotic pulp tissue was removed. Open dressing given and medicine was prescribed for 5 days i.e., Amoxycillin (250 mg) + Clavulanic Acid (125 mg) ^{Rx} Augmentin 375 (GSK, Pharmaceuticals Ltd) may be taken twice in 24 hrs and ibuprofen(400mg) + paracetamol (325mg) for children aged 7 to 12, ^{Rx} Ibugesic Plus and Metrogyl(200mg) ^{Rx} Metrogyl 200 (J B Chemicals and Pharmaceuticals Ltd) should be taken two times in 24 hours. After 3 days working length was determined slightly short (2-3 mm) of the radiographic apex [Figure 3]. The canal was enlarged till size 70 K-file. Copious irrigation was done with 1% sodium hypochlorite and normal saline solution. Intracanal dressing was given with TAP. Preparation of TAP were metronidazole tablets (400 mg) (Metrogyl 400, J B Chemicals and Pharmaceuticals Ltd), minocycline tablets (100 mg) (Minoz OD 100, Sun Pharmaceutical Industries), and ciprofloxacin tablets (250 mg) (Cipro 250, Torrent Pharmaceuticals Ltd). The enteric coating of the tablets was removed using a sterilized sharp blade, and the tablets were pulverized with a sterilized mortar and pestle. The powdered antibiotics were transferred into three sterile amber-coloured airtight glass containers and stored in refrigerators. The TAP was freshly prepared by a pharmacist before each scheduled treatment appointment. For its preparation, powdered antibiotics were proportioned in equal parts by volume (metronidazole, minocycline, and ciprofloxacin = 1:1:1), and then mixed with propylene glycol to get a paste-like consistency. Canal was then dried by sterile paper point and triple antibiotic paste (TAP) given for 15 days. After 15 days Ca (OH)₂ dressing given for 21 days and the canal was then dried by sterile paper points and calcium hydroxide and iodoform combination (Metapex, META Biomed Co. Ltd., Korea) was pushed into the canals till it reached the apex for 3 months. A radiograph was taken to check the same and then the access cavity was restored with glass ionomer cement (GC 2, GC Corporation, Japan) [Figure 4].



Figure 4: Post operative - IOPAR



Figure 5: 3 months follow-up - IOPAR

The patient was recalled after 1 week and the tooth was found to be completely asymptomatic. After 3 months, the radiolucency had reduced to half of its size as compared to the initial size. Follow-up radiograph at 6 months showed complete healing of the radiolucency and a calcific barrier was visible in the radiograph. IOPAR confirms that the root formation completed [Figure 5]. The apical closure was confirmed with the help of a size 30 K-file. The apical closure was confirmed by using a Gutta-percha (GP) point to check for the presence of a resistant “stop” and absence of haemorrhage, exudates or sensitivity. Metapex was removed from the canal and was obturated with gutta-percha and a full coverage crown was placed on the tooth later [Figure 6].



Figure 6: Obturation with gutta percha points



Figure 7: 12-months follow up

CASE REPORT 2

An 8 ½ -year-old girl was referred to the department of paediatric and preventive dentistry, KDDC, Mathura for the treatment of tooth #11. Three months prior the patient had suffered a dental trauma. The patient reported pain on mastication in the maxillary right central incisor. Clinical examination showed that tooth 11 had a complicated oblique fracture of the crown, and the probing depth was within normal limits [Figure 8]. Sensitivity tests (electrical pulp testing) of the tooth gave no response. The tooth was tender to percussion, and mobility grade I was observed.



Figure 8: Preoperative intraoral frontal clinical photograph

A periapical radiograph of the tooth showed that the coronal fracture appeared to reach the mesial pulp horn of tooth, and marked radiolucency was observed at the periapical area of the root. The root apex was not fully formed [Figure 9]. The revascularization treatment was explained to the patient's parents, and the decision of revascularization was made primarily because the diameter of the open apex was more than 2 mm [Figure 10].



Figure 9: Blunderbuss canal



Figure 10: BMP with large no. K file

Local anaesthesia with lignocaine (ICPA) was administered. The access cavity was prepared by using an Endo access bur and Endo-Z drill (Dentsply Millefleur, Ballaigues, Switzerland), and #15 K-file was introduced into the canal to ensure the patency of the canal. The canal was irrigated with copious amounts of 2.5% sodium hypochlorite ultrasound activated irrigation with negative apical pressure. A calcium hydroxide (CH) paste (Metapex; Meta Biomed, Chungju, Korea) was placed into the apical portion of canal with a lentulo-spiral as intracanal medication [Figure 11]. The access cavity was closed with a cotton pellet and temporary cement. The patient was scheduled for a second visit after 2 weeks.



Figure 11: Metapex ICM dressing



Figure 12: Periapical lesion regression

The tooth was asymptomatic during the entire postoperative period, and the temporary filling was intact. Local anesthesia was accomplished with Lignocaine (ICPA). The glass ionomer and cotton pellet were removed from the access cavity. A copious amount of 2.5% sodium hypochlorite ultrasound activated irrigation with negative apical pressure was used to remove the CH paste from the canal. A final rinse of 17% EDTA for 1 minute was performed [Figure 12]. Same day Platelet Rich Fibrinogen (PRF) was prepared in department by drawing blood from the cubital fossa. And the drawn blood is centrifuged with 2000-3000 RPM to prepare PRF [Figure 13]. The canal was dried with paper point, and a small piece of PRF was placed at the apical portion of the canal using sterile plugger. The membrane was introduced through the root canal and gently compacted by using pre-fitted hand pluggers slightly beyond the apex to achieve a matrix [Figure 14].



Figure 13: Platelet Rich Fibrinogen



Figure 14: PRF Placement



Figure 15: Armamentarium

Biodentine was prepared according to the manufacturer's instructions. It was carried into the canal with an amalgam carrier and condensed with hand pluggers to form apical plug of 5 mm in thickness [Figure 16], [Figure 17]. The excess material from the walls was removed with paper points, and after 12 minutes, the rest of the canal was obturated with gutta-percha and seal apex sealer is original non-eugenol, calcium hydroxide polymeric root canal sealer (Kerr, Balz, Italy). The access cavity was closed temporarily with glass ionomer [Figure 18]. After 1 week, the glass ionomer was replaced by a bonded resin restoration (Filtek Z350XT; 3M ESPE Dental Products, St Paul, MN).



Figure 16: Biodentine Placement



Figure 17: Post operative- IOPAR

At follow-ups performed at 3, 6, and 18 months (Fig. 3) after treatment the tooth was asymptomatic, and the colour of the crown did not change. The continuity in the periodontal ligament space with absence of periapical radiolucency was observed at 3-month, 6-month, and 12-month radiographs



Figure 18: 3- , 6- and 12-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.⁴

Physiological completion of root apex depends on the maintenance of vitality of the tissues that form root dentine and apical periodontal ligament. Hertwig's epithelial root sheath's (HERS) inductive action leads to the differentiation of cells of the dental papilla into odontoblasts, which progressively form the root dentine. With the onset of root formation, the initially formed dentine induces fragmentation of the HERS, which then becomes discontinuous and is permeated by cells of the dental follicle which undergo differentiation into cementoblasts close to the newly formed dentine.⁷

Numerous treatment variants have been tried in the past for immature permanent tooth injuries. It's a tangible challenge to treat the immature teeth because of following reasons: 1: Thin dentin wall: The pulp canal wall is thin, and root fractures easily occur during mechanical debridement; 2: Wide open apex: The apical foramen is not converged, and attaining a favourable apical closure with traditional endodontic treatment is difficult; 3: Challenging behaviour: Patients are relatively young when these dental problems occur, and they are nervous, frightened, and impatient during treatment.⁸

Calcium hydroxide and Iodoform paste for root end closure has been reported by Sridhar N and S Tandon.⁷ 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.⁹ The antibacterial efficacy of three Calcium hydroxide formulations were determined by previous researchers and found Calcium hydroxide mixed with iodoform and silicon oil (Metapex) to be the most effective dentinal tubule disinfectant.¹⁰ 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.¹¹ A study over a period of 30 month in 64 younger permanent teeth were observed for three years, wherein 24 teeth (37.5percent) successfully achieved apexification, 37 teeth (57.81 percent) were in the process of root end closure, and only 3 teeth (4.69 percent) failed to achieve apexification.¹²

Biodentine is a new bioactive dentin substitute cement, which is composed of powder that consists of tricalcium silicate, dicalcium silicate, calcium carbonate, calcium oxide, zirconium oxide, and CH. The liquid for mixing with the cement powder consists of a water-soluble polymer and calcium chloride, which accelerates the setting reaction.¹³ Biodentine is considered a suitable pulp-capping material. It has been suggested that Biodentine is bioactive because it induces differentiation of odontoblast-like cells and increases murine pulp cell proliferation and biomineralization.⁸

The response of dental pulp after direct capping with Biodentine revealed a complete dentinal bridge formation and a layer of odontoblast-like cells under the osteodentine. Biodentine has been shown to lack cytotoxicity, and it is able to stimulate collagen fiber and fibroblast formation. The alkaline caustic effect of CH degrades the collagenous component of the interfacial dentin, leading to the formation of a porous structure that facilitates the permeation of high concentrations of Ca (2+), OH (), and CO (3) (2) ions. The tag-like structures alongside an interfacial layer called the mineral infiltration zone increase mineralization in this region.¹⁰

Hence, in the present case report, we planned multi visit apexification using a calcium hydroxide formulation with iodoform (Metapex) and Biodentine. Twelve 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 2 apexification which is rare especially considering the fact that tooth was non vital. The present case indicates good results with biodentine as an apexification agent taking into consideration the cost factors, ease of placement and radiographic interpretation and timing.

CONCLUSION

Apical closure in non-vital permanent teeth can be achieved at the earliest with placement of Biodentine with an effective coronal restoration. The effectiveness of trisilicate cement might be attributed to its antibacterial activity and its high pH which has its direct effect on the apical and periapical soft tissues.

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REFERENCES

1. Ahuja V, Ahuja A, Verma J. Apexification with apical growth and closure using Metapex in a Necrotic Immature Permanent Tooth with Periapical abscess: A Case Report with 16 months follow-up. *University Journal Of Dental Sciences*. 2021; 7(1):30.
2. Mathew J, Syriac G, Nair M, Rahul J. Conventional Multi visit Calcium Hydroxide Apexification with Rare Apexogenesis Like Outcome and Novel Single Visit MTA Apexification Followed by Root Reinforcement with Fiber Post: Two Case Reports. *Saudi J Oral Dent Res*. 2017; 2(2):43-8.
3. Soni HK. Management of Non-Vital Permanent Central Incisor using Single Calcium Hydroxide Medication. *Journal of International Oral Health*. 2015; 7(11):20.
4. American Association of Endodontists. Glossary of endodontic terms, 7th edn. Chicago: American Association of Endodontists; 2003.
5. Sridhar, N., & Tandon, S. Continued root end growth and apexification using a calcium hydroxide and iodoformpaste(Metapex): three case Reports. *J Contemp Dent Pract*. 2010; 11(5):63-70.
6. Ghose, L. J., Baghdady, V. S., & Hikmat, B. Y. Apexification of immature apices of pulpless permanent anterior teeth with calcium hydroxide. *Journal of Endodontics*. 1987; 13(6), 285-290.
7. Cwikla, S. J., Bélanger, M., Giguère, S., Progulske- Fox, A., & Vertucci, F. J. Dentinal tubule disinfection using three calcium hydroxide formulations. *Journal of endodontics*. 2005; 31(1), 50-52.
8. Lu YM, Qin JN. A comparison of the effect between Vitapex paste and antibiotic paste in apexification. *Shanghai Kou Qiang Yi Xue*. 2004;13(5):449-451.
9. Vidal, K., Martin, G., Lozano, O., Salas, M., Trigueros, J., & Aguilar, G. (2016). Apical Closure in Apexification: A Review and Case Report of Apexification Treatment of an Immature Permanent Tooth with Biodentine. *Journal of Endodontics*. 2016; 42(5):730–734.
10. Pace R, Giuliani V, Nieri M, Di Nasso L, Pagavino G. Mineral trioxide aggregate as apical plug in teeth with necrotic pulp and immature apices: a 10-year case series. *Journal of endodontics*. 2014; 40(8):1250-4.
11. Chen MH, Chen KL, Chen CA, Tayebaty F, Rosenberg PA, Lin LM. Responses of immature permanent teeth with infected necrotic pulp tissue and apical periodontitis/abscess to revascularization procedures. *International endodontic journal*. 2012; 45(3):294-305.
12. Annamalai S, Mungara J. Efficacy of mineral trioxide aggregate as an apical plug in non-vital young permanent teeth: preliminary results. *Journal of Clinical Pediatric Dentistry*. 2010; 35(2):149-55.
13. Moore A, Howley MF, O'Connell AC. Treatment of open apex teeth using two types of white mineral trioxide aggregate after initial dressing with calcium hydroxide in children. *Dental Traumatology*. 2011; 27(3):166-73.



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