"One-Step Apexification with Biodentine: A Case Report"

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ABSTRACT:

The treatment of an immature tooth affected by pulpal necrosis and periapical pathology presents a major challenge in endodontics. In cases involving open apices, it is particularly challenging to retain the obturating material within the root canal without extending into the periapical region. To address this issue, the formation of an artificial apical barrier in a single step using biocompatible materials like Biodentine is now the preferred approach. This case report presents a large periapical lesion associated with traumatized maxillary central incisor. A 29-year-old male patient presented with the chief complaint of severe pain in relation to a fractured upper front tooth since 1 week. Intraoral examination showed a discolored tooth with Ellis Class IV fracture in relation to 21. Radiographic evaluation revealed an open apex which was diagnosed as an acute exacerbation of a chronic periapical lesion. Treatment Plane was Root canal therapy with biodentine single-step apexification. This case is highlighting successful apical closure using biodentine.

Key words: Apexification, Biodentine, Open apex, Periapical pathology.

INTRODUCTION:

Root development and closure of the apex typically continue for up to three years after the tooth erupts. However, if the tooth is affected by caries, trauma, or other pulpal pathologies during this period, dentin formation is disrupted, leading to arrested root development. [(1)] In immature teeth, the root canal is wide with thin, fragile walls, and the apex remains open. This anatomical condition complicates root canal instrumentation and makes achieving an appropriate apical stop difficult. Therefore, it becomes essential to create an artificial apical barrier with calcified tissue or to induce closure of the apical foramen, allowing proper condensation of the filling material and facilitating effective apical sealing. In such cases, apexification presents a feasible treatment option for managing premature permanent teeth with open apices.[(2)]

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 incompletely formed root in teeth with necrotic pulps'. [(3)]

Most commonly used different materials for apexification include calcium hydroxide, Mineral Trioxide Aggregate (MTA), Biodentine. Calcium hydroxide was widely used for root-end barrier formation, but it has drawbacks such as unpredictable apical barrier formation time, multiple visits, patient compliance issues, re-infection risks, and tooth fracture. Additionally, the barrier is porous and may contain soft tissue.[(4,5)] MTA is an alternative, offering strong sealing, biocompatibility, and antimicrobial properties, but has issues with setting time, handling, and discoloration of a tooth. Biodentine, a calcium silicate-based material, overcomes these drawbacks, offering faster setting time, better handling properties, and reduced infection risk, making it superior to MTA for various endodontic treatments, including apexification. However, Biodentine's low radiopacity is a downside.[(6-8)]

This case report highlights the successful healing of a large periapical lesion, with apex closure achieved using Biodentine in a pulpless permanent maxillary central incisor.

CASE REPORT:

A 29-year-old male patient presented to the Department of Conservative Dentistry and Endodontics with a chief complaint of severe pain in his upper front tooth since 1 week. There is no significant past medical as well as dental history.The patient had reported a history of trauma before 20 years. Clinical examination revealed a discolored tooth with an Ellis Class IV fracture on the left central incisor ,with tenderness on palpation and percussion was present. Pulp vitality testing yielded a negative response. Radiographic examination showed an open apex with PDL widening ,loss of lamina dura and periapical radiolucency around tooth 21.Based on clinical and radiographic examination it was diagnosed as an acute exacerbation of chronic lesion. Prognosis of lesion was good.

The treatment plan was to perform apexification using Biodentine as an apical plug, followed by obturation with bioceramic sealer and cold lateral compaction technique using gutta-percha in tooth 21. The procedure began with access opening under rubber dam isolation. The working length was determined, and gentle instrumentation was carried out using an #80 K-file. Root canal debridement was completed with alternate irrigation of 1% NaOCl and saline, followed by drying of the canal with absorbent paper points. An oil-based calcium hydroxide paste (Metapex) was then placed, and the access cavity was temporized with Cavit. The patient was recalled after six weeks for follow-up. Antibiotics, analgesics and anti-inflammatory were prescribed to the patient.

At the subsequent appointment, the $Ca(OH)_2$ dressing , metapex was removed with H files , and the canal was irrigated with normal saline and 1% sodium hypochlorite , final rinse was done using saline. After drying, Biodentine was mixed according to manufacturer's instruction and delivered using an amalgam carrier, then condensed with a hand plugger to a thickness of 5 mm. The root canal was obturated using gutta-percha cone ,bioceramic sealer and cold lateral compaction technique, the post endodontic restoration was done with composite resin. The tooth was asymptomatic, and the patient was scheduled for further follow-up.

DISCUSSION:

The management of an open apex offers several options, including apexification, apexogenesis, and the revascularization technique. Apexogenesis aims to preserve vital pulp tissue in the apical portion of the root canal to complete root apex formation. This approach, however, is only feasible when some vital pulp remains, which was not possible in case of necrotic pulp in our patient. The revascularization technique, on the other hand, promotes the formation of the pulp-dentin complex and supports the pulp's defence mechanisms. However, it comes with the disadvantage of requiring long-term follow-up and the uncertainty of results.[9]

The challenges arise in endodontic procedures for immature permanent teeth are not only due to the wide-open root apex but also the fragile and weak dentin walls.[10] The goal of apexification is to create an apical barrier that prevents the passage of toxins and bacteria from the root canal into the periapical tissues. This barrier is essential for ensuring the proper compaction of the root canal filling material.[11]

While calcium hydroxide has demonstrated a higher success rate in apical barrier formation, long-term monitoring remains crucial. Previous studies have highlighted the drawbacks of apexification with calcium hydroxide, including its inability to prevent infection, the risk of infection recurrence, and cervical fractures.[12,13]

With the discovery of MTA by Torabinejad et al.[14], it has become the material of choice for apexification. Single-visit apexification has emerged as a viable approach for treating immature apices. The main components of MTA include Calcium Silicate ($CaSiO_4$), Bismuth Oxide (Bi_2O_3), Calcium Carbonate ($CaCO_3$), Calcium Sulfate ($CaSO_4$), and Calcium Aluminate ($CaAl_2O_4$). The hydrophilic powder in MTA reacts with water to produce a calcium hydroxide ($Ca(OH)_2$) and Calcium Silicate ($CaSiO_4$) hydrated gel. Holland et al. suggested that the tricalcium oxide in MTA interacts with tissue fluids to form calcium hydroxide, which then results in the formation of an apical barrier.[15] However, MTA's long setting time of 2 hours 45 minutes, poor handling characteristics, potential for discoloration (Gray MTA), low washout resistance, and high material cost remain significant drawbacks.[16]

Biodentine is a bioactive dentine substitute developed using 'Active Biosilicate Technology' and was launched by Septodont in September 2010. It is also termed as 'Man made Dentine' or 'Dentine in capsule' It comes in a powder form within a capsule and a liquid in a pipette. The powder is composed of Tricalcium Silicate (Ca_3SiO_5), Dicalcium Silicate (Ca_2SiO_4), Calcium Carbonate ($CaCO_3$), Calcium Oxide (CaO), Zirconium Oxide (ZrO_2), and Calcium Hydroxide ($Ca(OH)_2$ or CH). The liquid, used for mixing with the powder, contains a water-soluble polymer and calcium chloride ($CaCl_2$), which accelerates the setting reaction.[17] Its compressive strength,

elasticity, and micro stiffness are comparable to those of natural dentine. It forms a tag-like crystalline structure within the dentinal tubules, which helps micromechanically bond the dentine with the new calcium silicate material. Additionally, due to its shorter setting time of 9-12 minutes, the procedure can be completed on the same day.[18]

CONCLUSION:

A one-step technique using biocompatible materials such as Biodentine can serve as an effective treatment for open apices. With its excellent performance, Biodentine addresses many of the drawbacks associated with calcium hydroxide and MTA. The material shows great potential in managing open apices, particularly due to its ability to support biomimetic mineralization. It is both predictable and requires less time for implementation compared to other methods.

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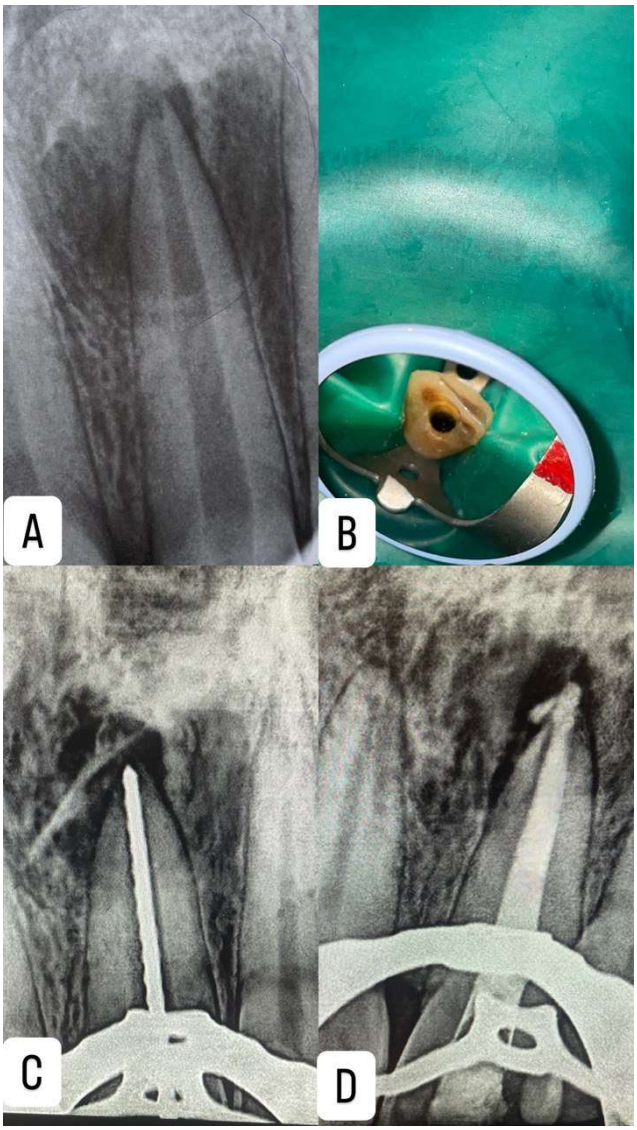
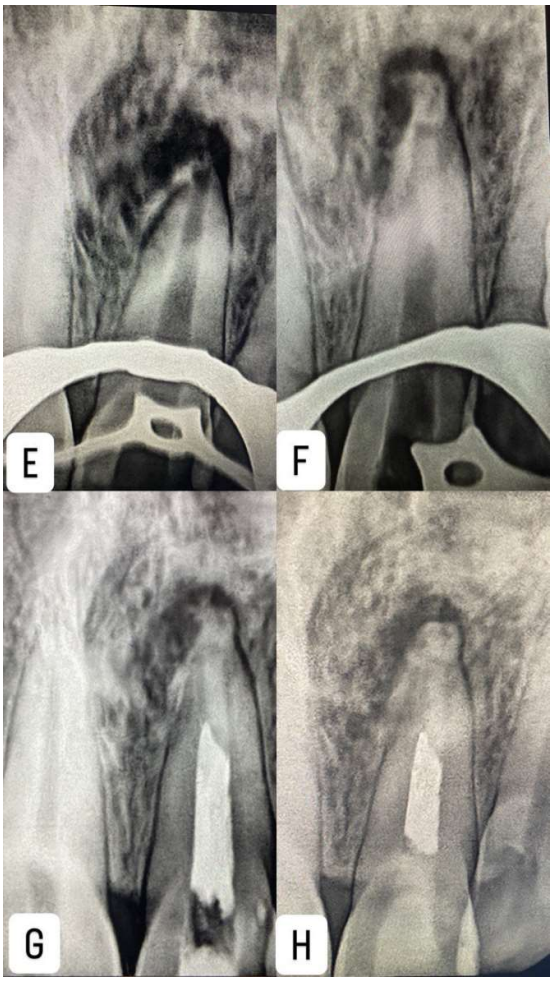


A.Preoperative IOPA

B.Access Cavity Prepration

C. Working Length IOPA

D. ICM Metapex IOPA



E.Removal of Metapex IOPA

F. Biodentine Apical Plug IOPA

G. Obturation IOPA

H.Post Operative IOPA