ISSN Print: 2394-7489
ISSN Online: 2394-7497
IJADS 2022; 8(1): 293-295

www.oraljournal.com
Received: 07-11-2021
Accepted: 10-12-2021

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Apexification using biodentine: A case report

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DOI: https://doi.org/10.22271/oral.2022.v8.i1e.1440

Abstract
The dental professionals have a struggle to handle non-vital teeth with open apices. It is difficult to retain the obturating material inside the root canal in this clinical scenario without invading the periapical region. Such cases cannot be handled with traditional endodontic therapy and it might take longer for apical closure to treat such cases with calcium hydroxide. However, the same procedure can be completed in one visit with predictable results with this new material called biodentine. Therefore, this case study presents the use of Biodentine to create an open apex apical plug, followed by complete root canal sealing with thermoplastic gutta-percha.

Keywords: Apexification, apical plug, open apex, biodentine

1. Introduction
The root growth is a gradual phenomenon and a root apex closure takes place for up to three years after the tooth eruption. If some damage to the tooth occurs during this period, it will impede the root apex closure process. The root canal with thin and delicate walls is therefore wide and the apex is always open. This impairs the instrumentation of the root canal and prevents an appropriate apical stop. It is essential that an artificial apical barrier is created, or the apical foramen is closed with calcified tissue to permit the condensation of the filling material and to facilitate apical sealing in such cases. The apexification of premature permanent teeth with open apices may be a feasible alternative [1].

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.

Although several methods have been suggested using various material to induce the forming of root end barriers, calcium hydroxide has been accepted as widely as possible. While this strategy has many drawbacks, it is effective with predictable results. The disadvantages are the unpredictable time necessary to construct apical barrier, the need for multiple visits, patient conformity, re-infection as a result of temporary restoration and predisposition to tooth fracture. The nature of the barrier, which, while seemingly calcified, is still porous and often even containing tiny quantities of soft tissue is another downside of this strategy [2].

The development of an artificial apical barrier technique using MTA is an alternative to calcium hydroxide apexification [3]. Based on its sealing property and biocompatibility, the mineral trioxide aggregate (MTA) was the selected material for the apical barrier's formation. Various research showed that it is capable of causing odontoblastic separation, strong radiopacity, low solubility, high pH, expansion after setting and antimicrobial activity. The extended setting time, handling problems and potential coronal stains associated with MTA, however, contributed to the need for other alternative products.

Biodentine, the modern material dependent on calcium silicate, was designed to preserve without harmful characteristics, the properties and clinical uses of MTA. The consistently improved clinical usage ensures safer handling and protection, the drug does not need to be sealed in a two-step-obturation and the setting is faster; the chance of bacterium infection is reduced. Hence, Biodentine is superior than MTA. The substance can be used in dentine substitution in the field of coronal restoration, pulp lining, pulpotomy, root perforation repair, internal and external resorption, apical barriers in the treatment of apexification, regenerative operation and retro filling material in the field of endodontic surgery.

In comparison, its low radiopacity can be a downside for Biodentine [4-6].
Therefore, the purpose of this case report is to present the results of an open apex with periapical lesions that were accompanied by a filling with Biodentine and thermo-plasticized gutta-percha [6].

2. Case report

A 19-year-old male patient reported to the Department of Conservative Dentistry and Endodontics with a chief complaint of discolored tooth and want to get the buildup done w.r.t upper front tooth. Patient gave a history of trauma 10 years back.
On clinical examination, tooth was discolored with Ellis Class IV fracture w.r.t left central incisor. Vitality test was then performed, and tooth showed negative response to pulp vitality testing. Radiographic examination revealed an immature tooth with wide open apex and radiolucency in relation to 21. (FIGURE 1)
Then the treatment plan was decided to do apexification by using Biodentine as an apical plug followed by obturation with thermoplasticized gutta percha in 21.
Access opening was done under rubber dam isolation. Working length was determined and gentle instrumentation was done with #80 H-file in circumferential manner. (FIGURE 2) Root canal debridement was done using alternative irrigation with 1% NaOCl and saline. Then the canal was completely dried with multiple absorbent paper points and $Ca(OH)_2$ was placed in root canal and access was sealed with Cavit and patient was recalled after 1 week.
At subsequent appointment, $Ca(OH)_2$ dressing was removed, and saline irrigation was done. After drying the canal, Biodentine was manipulated and carried using Lumbar puncture needle (FIGURE 3) and condensed with hand plugger till the thickness of 5mm (FIGURE 4) and after that root canal was backfilled obturated and post-obturation radiograph was taken to confirm the completion of the endodontic therapy (FIGURE 5) and access was sealed with composite.
A 2 month follow up radiograph revealed decrease in apical radiolucency. Tooth was completely asymptomatic and has been called for future follow up.

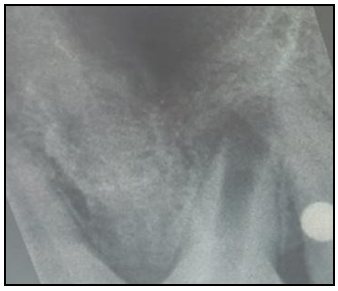

Fig 1: Preoperative radiograph showing tooth 21 with open apices and periapical radiolucency

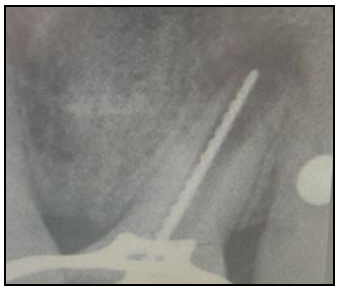

Fig 2: Working length Radiograph

Fig 3: Lumbar puncture needle

Fig 4: Radiograph confirming the placement of Biodentine apical plug

Fig 5: Backfill performed using thermoplasticized gutta-percha

3. Discussion

In endodontic procedures, not only the wide-open apex of root posed by premature permanent teeth, but also the delicate thin dental walls raise special difficulty. Calcium hydroxide traditional apexification procedure takes at least three to four months and demands several appointments. This prolonged care regimen could be poorly complied with and many will not return to scheduled treatments. The therapy discussed in this study aims to build an apical barrier in one appointment, which would prevent penetration of toxins and bacteria from root canal into periapical tissues. This barrier is technically also needed to enable the root filling material to be compacted. Although the use of calcium hydroxide has shown a higher rate of success in apical barrier development, long-term monitoring is important. Earlier studies have identified the drawbacks of apexification with calcium hydroxide including inability to prevent infection, infection recurrence

and cervical fractures.

An alternative treatment solution for immature pulpless teeth is provided by apexification using MTA. In addition to poor handling properties, discoloration (Gray MTA), low washing resistance and high material costs, the long setting time of the ProRoot MTA is an important issue in material [8, 9].

Biodentine is a bioactive replacement dentine based on 'Active Biosilicate Technology,' launched by Septodont in September 2010. (10) Biodentine consists of powder in a capsule and liquid in a pipette. The composition of the powder and liquid is shown in the Table 1 [3].

Its compressive strength, elasticity and micro stiffness is similar to that of natural dentine. It can produce a tag-like crystalline structure in the dentinal tubules that can help to micromechanically bind the dentine with new calcium silicate substances. Furthermore, as the time limit is lower, it is possible to complete the procedure on the same day unlike MTA, where a two-stage technique is necessary [10]. Biodentine has a shorter setting time of 12 min as compared to MTA which is 2 hours and 45 min. This is due to the high specific particle surface size, by applying calcium chloride to the fluid process and by decreasing the quality of the fluid. Short setting time would remove the two-stage obturation as in MTA during the apexification process and reduce the chance of bacterial contaminations [3].

A research to compare the impact of these biomaterials' thickness on their sealing capacity showed that Biodentine apical sealing capacity is comparable to that of MTA at any apical plug thickness and that Biodentine and MTA 1- or 2-mm apical plugs could be ineffective with apical leakage. Hence, in this case, a 4–5 mm barrier was created [10].

Biodentine will continue to improve intensity for several days until after a month it reaches 300 MPa. This mechanism of maturation can be associated with decreasing porosity over time. Research on Biodentine's biological effects on immortalized murine pulp cells concluded that Biodentine showed apatite formation, which indicated its bioactivity, after immersion in a phosphate solution. Deposition of apatite structures may improve the material's marginal sealing [5, 7]

Table 1: Composition of Biodentine

Constituent	Function
Powder	
Tricalcium Silicate	Main component
Calcium carbonate	Filler material
Zirconium oxide	Radioopacifier
Dicalcium silicate	Traces
Calcium oxide	Traces
Iron oxide	Traces
Liquid	
Hydro soluble polymer	Water reducing agent
Calcium chloride	Decreases the setting time

In the case presented, a two-visit one-step apexification with the use of Biodentine indicates the effective treatment of an immature permanent tooth with a periapical lesion. Biodentine also poses a promising choice of substance as an apical barrier for apexification procedures due to its outstanding physical, mechanical and biochemical properties along with superior clinical handler capabilities [10].

4. Conclusion

A single visit with biocompatible materials such as Biodentine may be seen as an efficient treatment choice for open apices. Biodentine, which is followed by excellent performance, has solved much of the disadvantages of reliance on calcium hydroxide and MTA. The material has great potential for managing an open apex of a tooth, particularly in its capacity for biomimetic mineralization. It is predictable and takes less time to implement this creative process.

Financial support and sponsorship
NIL

Conflicts of interest
There are no conflicts of interest.

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