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"BIODENTINE" THE DENTINE IN A CAPSULE AS AN APICAL BARRIER IN TRAUMATIZED MAXILLARY CENTRAL INCISOR WITH TWO YEARS FOLLOW UP.

Dental Science

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ABSTRACT

Immature teeth are difficult to manage with conventional endodontic treatments and thus it becomes very challenging for clinicians. This case report describes an apexification with Biodentine in a maxillary left central incisor. The tooth became necrotic after the traumatic injury. According to the treatment procedure root canals were chemo-mechanically prepared, medicated with triple antibiotic paste followed by Biodentine plug to stimulate hard tissue apical barrier formation. Follow-up clinical and radiographic examinations were done after 1st quarter, 2nd quarter, 4th quarter and 2 years respectively. After two years follow-up the tooth was completely asymptomatic as well as resolution of periapical radiolucency was seen. Biodentine can be considered as basic, simple, biologically active, more limited setting time, improved mechanical properties and worthy cost. Therefore, it is a promising approach to other methods of an apexification.

KEYWORDS

Apexification; Apical barrier; Biodentine; Triple antibiotic paste

BACKGROUND

Traumatic injuries are common in young permanent teeth. These injuries mainly occur before the completion of root formation and could lead to pulpal inflammation, necrosis and crown discoloration. It takes 3 years for full formation of root and ceasing of the apical foramen. [1]Therefore, it has been seen that root canal treatment of such teeth or immature permanent teeth is very troublesome due to absence of apical stop, fragile dentinal walls, vulnerability of fracture of root as well as wide-open apex.[2]

Apexification can be defined as or apexification is , "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]

Various materials have been used for apexification and one of the oldest is calcium hydroxide. Although it has been widely used for apical barrier from past many years, there are many disadvantages seen with calcium hydroxide. For instance, longer time to form apical barrier, which is usually 6 to 18 months and the hard tissue that forms has many soft tissue inclusions often described as "swiss cheese-like" and this barrier may not be able to hold the filling material such as sealer or obturating material which may pass through the apex.[2] Moreover, in such cases patient's compliance is an important aspect because evaluation of development of apical barrier is required after every 3 months and it is crucial to check whether calcium hydroxide has been washed out or apical stop formation is enough to resist obturation material. Lastly, it weakens the resistance of dentine to fracture and may cause root fractures before the completion of apical barrier.[4]

Another material which has been used for apexification is Mineral Trioxide Aggregate (MTA). It has shown many promising properties like superior sealing ability, biocompatibility, regenerative capabilities and antibacterial properties. In spite of these favorable properties it also has shown certain disadvantages like long setting of about two hours and forty five minutes, difficult manipulation, inferior compressive strength, discoloration potential, uneconomical and existence of toxic chemical such as arsenic in its composition that propelled researchers to keep on exploring for its replacement.[5],[6]

As a result of rigorous research efforts for the new apexification material Biodentine has emerged as a novel and promising material. In the case study presented in this article, it shows favorable results both clinically as well as radiographically.

Case Description

A teenage female patient (19 years old) with chief complaint of stained permanent maxillary left central incisor (tooth #21) came to the Department of Conservative and Endodontics for consultation.

The patient told that she had suffered an injury while playing 7 years ago. No medical history was reported by the patient. The grayish discoloration of tooth #21 (Figure 1a) was noticed on intra oral clinical examination. In addition to this, sinus formation with respect to tooth #21 was evident. Tracing of the sinus tract with gutta percha confirmed the involvement of the maxillary left central incisor. The tooth did not demonstrate any abnormal mobility or sensitivity to percussion. The respective tooth gave no response to the sensitivity tests that is heat, cold, and electrical pulp testing. A radiographic analysis showed inadequate formation of root as well as wide-open apex for tooth #21 (Figure1b). On the basis of this information, the diagnosis of the concerned tooth was made as Ellis Class IV fracture with chronic apical abscess. After discussing different treatment options with the patient, it was decided to go for an apexification with Biodentine with a informed consent of patient.

Local anesthesia with 3% mepivacaine (Scandonest; Septodont) was administered. The endodontic access cavity was made with Endo Access Bur and Endo Z followed by radiographically determined working length in tooth #21 after proper isolation with rubber dam. Root canal was chemo-mechanically debrided with circumferential filing using 80 K-file in conjunction with copious amount of irrigation with 2.5% sodium hypochlorite solution. A volume of 3 ml of 17% ethylenediaminetetraacetic acid (EDTA) solution was used for smear layer removal for 1 minute.

Paper points were used for drying the root canal followed by an intracanal dressing of triple antibiotic paste containing minocycline, ciprofloxacin, and metronidazole was packed up to working length using lentiospiral. The access cavity was closed with a cotton pellet followed by 4 mm Cavit G. After 1 week the patient was called back for second session.

A week later, it was noticed that the patient did not exhibit any kind of discomfort and symptoms related to tooth #21. Local anesthesia was attained with 3% mepivacaine followed by rubber dam application. The temporary filling and cotton pellet was taken out from the tooth. The irrigation was done by ample amount of 2.5% sodium hypochlorite followed by sterile saline and then desiccated with absorbent paper points.

The manufacturer's specification was followed for preparing the biodentine paste. The powder had been incorporated with 5 drops of liquid subsequently activated in a triturator for 30 seconds. Amalgam carrier was used to carry it to place into the canal, after which it condensed with finger and hand pluggers to make an apical plug of 5 mm thick. The surplus material with absorbent paper points was removed from walls. After waiting for 12 minutes and confirming that the material had set, glass inomer cement followed by composite resin was used to seal the access cavity. A radiograph was taken to confirm

the accomplishment of endodontic treatment.

The patient was reexamined after 13 weeks, 26 weeks and 104 weeks and it was noticed that the tooth was asymptomatic as well as sinus tract was healed. Finally, the tooth was restored with full ceramic crown due to aesthetic concern. A resolution of periapical radiolucency and constancy in the periodontal ligament space was noted (Figure2 a and b).

DISCUSSION:

The goal of endodontic treatment of tooth with an open apex is to achieve an apical stop subsequently preventing entry of toxic substances and microorganisms in the periapical tissue. Besides this, necrotic teeth having open apices require a thorough debridement as well as disinfection of the root canals.

The combined use of antibiotics can more effectively disinfect the root canal and lower the possibility of antibiotic resistance. Both aerobic and anaerobic bacteria are responsible for infection of the root canals of permanent teeth having open apices. Thus, we need amalgamation of antibiotics to successfully disinfect the canal walls, which we have done in our case by using triple antibiotic paste (TAP) or 3mix.[7]

Triple antibiotic paste (TAP) consists of a mixture of ciprofloxacin, metronidazole and minocycline. Metronidazole is effective against protozoal infections and anaerobic bacteria. Whereas, minocycline acts as a bacteriostatic against gram-positive as well as gram-negative bacteria. Ciprofloxacin is a second-generation fluoroquinolone antibiotic and exhibits high antimicrobial activity against gram-negative bacteria.[8] It is recommended to use ciprofloxacin, metronidazole and minocycline in the ratio of 1:1:1 [9],[10] to obtain an intensity of 0.1–1.0 mg/mL .[11]

The study done by Rehani MF et al[12]suggested that if concentration of triple antibiotic paste is minimum, then there are high chances that it can reduce staining of the tooth as well as can minimize the undesirable effects on the stem cells and simultaneously promotes regeneration potential. The use of this medication after a week may be able to obliterate bacterial substrates present in the canal space.

Another important aspect in the apexification procedures is an apical plug formation to prevent any entry of toxins and microorganisms periapically. Various materials such as mineral trioxide aggregate have been commonly used for apical plug formation but due to its aforementioned disadvantages, new material (Biodentine) was considered.

In 2009, an "Active Bio Silicate Technology" based material was introduced known as Biodentine a tricalcium silicate cementum that comprises constituents like capsule containing a power an ampule with liquid. The powder consists of tricalcium silicate($3CaO.SiO_2$) as the primary core material, dicalcium silicate ($2CaO.SiO_2$) as the secondary core material, zirconium oxide (ZrO_2) radiopacifier and iron oxide plays a role of a coloring agent. Liquid comes in pipette and is made up of calcium chloride ($CaCl_2.2H_2O$) which works as an accelerator. Hydro soluble polymer functions as water reducing agent.[13],[14] Five drops of liquid are mixed with powder in a capsule followed by a trituration for 30 seconds. It has total handling time of 12 minutes which includes mixing and placement time of 6 minutes and setting time of 6 minutes. This is due to it increase in particle size, the presence of calcium chloride(setting accelerator) and water (reducing agent). It has much shorter setting time as compared to MTA. This reduced setting time eradicates the demand of obturation done in two steps as it is done in MTA and in addition to this chances of bacterial contamination gets minimized.

After mixing powder and liquid, calcium silicate gel in hydrated form is formed due to hydration of tricalcium silicate while nucleation of calcium hydroxide takes place. Solid network is formed due to polymerization of calcium silicate gel and calcium hydroxide ions get released enhancing the alkalinity of adjoining medium.

Biodentine has physical and mechanical properties similar to dentin such as elastic modulus of 22 Gpa, compressive strength of 213.7 Mpa and microhardness of 60.9 HVN (Vickers microhardness) whereas dentin has values 18.5 Gpa, 297Mpa and 60HVN respectively.[15] Biodentine has the property to create an interfacial layer which is mineral rich and a structure that is tag like which extends from interfacial layer to dentinal tubules due to release of larger amounts of calcium compared to MTA. Thus, it forms a better micromechanical anchorage with dentine interface.[16] An in vitro study done by Kokate SR et al [17]showed least microleakage with Biodentine when used as a retrograde filling material as compared to MTA and glass inomer cement.

Biodentine is an innovative bioactive material. Bioactivity largely refers to stimulation of firm tissue formation that is provoked by a material. Early mineralization is induced by it due to increase in secretion of transfer growth factor beta-1 (TGF-β1) from pulpal cells after its application.[18] A study done by Zanini et al [19] that Biodentine showed bioactive properties as it enhanced the production of cells similar to odontoblasts and increased biomineralization. Therefore, it can be recognized as an appropriate material for regeneration of dentin-pulp complex. There are several other useful properties of Biodentine which make this material useful for various applications in dentistry like pulpotomy, perforation repair, apical surgery, internal and external resorption. These are biocompatibility, anti-bacterial activity (pH 12.5), low cytotoxicity and low genotoxicity.

A study done by Laurent et al [20] concluded that Biodentine is biocompatible and this material has no effect on the specific functions of target cells. In one of our previous case report with two year follow up, showed satisfying results with Biodentine in the treatment of iatrogenic furcation perforation repair in mandibular first molar. [21] Numerous studies have been published on the successful apexification cases with Biodentine. Khetarpal A et al [22] used Biodentine matrix in the treatment of symptomatic teeth having open apices including large periapical radiolucency. The 18th month clinical and radiographic follow-up showed the absence of clinical symptoms with no evidence sinus tract formation, complete healing of periapical radiolucency and regeneration of the periradicular tissues.

Biodentine has contrasting edge over its closet alternatives like MTA and calcium hydroxide for use in apexification cases. Single visit apexification with it is a bonanza in open apex cases.

CONCLUSION:

Many favorable characteristics are shown by Biodentine such as anti-microbial activity, cost-effectiveness, no staining, easy to use, shorter setting time, biocompatibility and biologically active. Besides this it has mechanical properties similar to dentine that's why a name is given to it as "dentine in a capsule." Therefore, this makes it interesting, distinctive, suitable and favorable material which can be used for various applications in the field of endodontics as well as restorative dentistry. In the present case, the favorable clinical results encourage the application of Biodentine in teeth with open apices and necrotic pulps successfully.

Conflict Of Interest:

"No potential conflict of interest relevant to this article was reported".

Figures

Figure 1. (a) Preclinical photograph of maxillary left central incisor (tooth # 21); (b) Preoperative intra oral periapical radiograph of maxillary central incisor (tooth # 21).

Figure 2. (c) Postoperative clinical photograph with all ceramic crown of maxillary left central incisor (tooth # 21); (d) Postoperative intra

oral periapical radiograph of maxillary left central incisor showing periapical healing (#21).

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