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Apexification Treatment of an Immature Permanent Tooth with Biodentine: A Case Report

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Abstract: ***Apexification treatment of immature permanent teeth with pulp necrosis is an endodontic procedure to achieve apical closure. Calcium hydroxide has been most widely used in apexification of immature permanent teeth. However, some disadvantages also exist with the use of calcium hydroxide including, it require lot of time for dentine bridge formation multiple tunnel defects in the dentin bridges. Recently, mineral trioxide aggregate are used for such treatment. There are several disadvantages of MTA, as well i.e. it has shown high solubility rate, demonstrating 24% loss after 78 days of storage in water, prolonged setting time of approximately 2 hours and 45 minutes. This requires that apexification with MTA either can be done in a two-steps. Newer materials such as, Biodentine® (Septodont: Saint Maurdes Fosses France) with similar composition was introduced with shorter setting time (10 minutes), greater biocompatibility, bioactivity and biomineralization properties than MTA. Moreover, Biodentine shows improved antibacterial property and low cytotoxic effect as compared to MTA. The aim of this case report is to share a successful apexification of maxillary central incisor with a blunderbuss apex and periapical lesion by using Biodentine: radiographically, spontaneous hard tissue barrier has been established, and narrowing canal space and decreasing area of periapical shadow were documented without complications.***

Keywords: Apexification, bioactivity, Biodentine

1. Introduction

In recent decades, apexification has become a well-established choice of endodontic therapy for the treatment of nonvital, immature, permanent teeth. Treatment of these teeth involves special characteristics and challenges, such as the presence of wide open apices that might even be divergent and influence apical obturation and barrier formation. For many years, calcium hydroxide paste was used to induce a calcified barrier followed by root canal therapy until 1993 when mineral trioxide aggregate (MTA) became the chosen material to induce the formation of the apical barrier because of its sealing properties and biocompatibility. Several studies demonstrated its capacity to induce odontoblastic differentiation, good radiopacity, low solubility, high pH, expansion after setting, and antimicrobial activity[1,2].

There are several disadvantages with MTA, as well. It has shown high solubility, demonstrating 24% loss after 78 days of storage in water[3]. The presence of iron in the grey MTA formulation may darken the tooth. Significant downside to MTA is the prolonged setting time of approximately 2 hours and 45 minutes. Beside a long setting time the major drawbacks of MTA are its relatively low compression and flexural strength, which are lower than those of dentine[4,5].

In 2009 Biodentine (Septodont, St Maur des Fosses, France) was introduced as a tricalcium silicate cementum. Biodentine is supplied in individual powder capsules composed of tricalcium silicate, calcium carbonate, and zirconium oxide that are mixed with liquid containing water, calcium chloride to accelerate setting, and modified polycarboxylate as a plastifying agent. The powder is mixed with the liquid for 30 seconds with an amalgamator[1,6]. Biodentine possesses adequate handling characteristics because of its excellent viscosity and short setting time, which is about 12 minutes[7]. This material can be used for substitution of dentin in coronal restorations, pulp linings, pulpotomies, reparation of root perforations, internal and external resorptions, formation of apical barriers in apexification treatment, regenerative procedures, and as retrofilling material in endodontic surgery. Biodentine has improved sealing ability, higher compressive strengths, greater biocompatibility, bioactivity and biomineralization properties than MTA. Moreover, Biodentine shows improved antibacterial properties compared to MTA, as well as a low cytotoxic effect[3,8].

2. Case Report

A 14 year old systemically healthy, non-smoker male patient reported to the department of Pediatric and Preventive Dentistry with the chief complaint of continuous dull pain in upper left anterior tooth region from more than eight months. Patient gave the history of trauma that occurred 4 years back. Sensitivity tests (heat, cold, and electrical pulp testing) of the tooth gave no response. The tooth was tender to percussion, and mobility grade I was observed. A periapical radiograph (Fig-B) of the tooth showed that the coronal fracture appeared to reach the pulp chamber of tooth. Radiolucency was observed at the periapical area of the root. The root apex was not fully formed. The clinical diagnosis of tooth was Ellis# class 9radiograph (Fig-A). Aim of the treatment was eliminate the infection and close the blunderbuss apex for successful endodontic treatment.

Figure A: Ellis class 9#, **Figure B:** Periapical radiograph of the tooth showed that the coronal fracture appeared to reach the pulp chamber of tooth, blunderbuss apex, periapical radioleucency.

Treatment plan

Apexification with Biodentine after that canal obturation with gutta-percha point followed by, a ceramic veneer crown was chosen as the treatment plan. Patient was informed about the prognosis of the treatment. Written consent form was obtained from the parents.

3. Procedure

Without anesthesia, the tooth was accessed. Accompanied by a copious haemorrhage, the patient experienced mild pain upon reaching the apex area with a barbed broach. The pulp chamber was abundantly irrigated with 3% hydrogen peroxide and 0.9% saline until no significant haemorrhagic secretion was noticed. The root canal length was measured with X-ray (IOPAR) by placing a #40 gutta-percha in the canal and measuring the length of the gutta-percha. The canal was carefully dried, and a little cotton pellet was put into the canal for drainage. One week later, the patient reported no symptoms since the first appointment. There was no hemorrhage upon reentry. After isolation, the cotton pellet was removed from the access cavity. A copious amount of 2.5% sodium hypochlorite was used to remove the calcium hydroxide paste paste from the canal. A final rinse of 0.9% saline for 1 minute was performed. The canal was dried with absorbent paper point. Biodentine was prepared according to the manufacturer's instructions. It was carried into the canal with MTA carrier and condensed with hand pluggers to form apical plug of 5 mm in thickness (Fig-C). The excess material from the walls was removed with paper points, and after 12 minutes, the rest of the canal was obturated with thermoplasticized gutta-percha (Dentsply De Trey, Konstanz, Germany) by using the lateral compaction technique. The access cavity was closed temporarily with glass ionomer(Fig-D). After 1 week, the glass ionomer was replaced by a bonded resin restoration (Filtek Z350XT; 3M ESPE Dental Products, St Paul, MN).

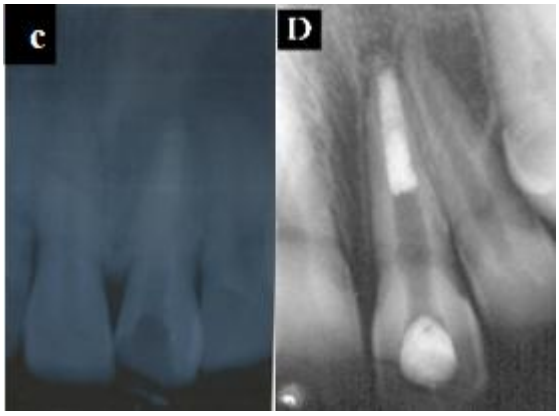

Figure C: Immediate IOPAR of apical plug, **Figure D:**

Follow-up: At follow-up performed at 3, 6, and 18 months after treatment the tooth was asymptomatic, and the color 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 18-month radiographs.

4. Discussion

Apexification is defined as a method of inducing a calcified apical barrier or continued apical development of an incompletely formed root in teeth with necrotic pulp[4,9]. Traditionally, the apexification method involves application of calcium hydroxide for completion of root-end closure. However, the disadvantages of this long-term technique include delayed treatment, difficulty in following up with patients, unpredictability of an apical seal, and the risk of root fractures because of the presence of thin walls[10]. Studies shows that calcium hyroxide dressing for extended periods may weaken tooth structure. In most apexification of immature permanent teeth with apical periodontitis, the placement of an apical plug is crucial for sealing and preventing bacterial leakage[11].

Mineral trioxide aggregate (MTA) is a bioactive endodontic cement mainly comprised of calcium and silicate elements. The cement was introduced by Torabinejad in the 1990s and has been approved by the Food and Drug Administration to be used in the United States in 1997[10]. The main constituents are tricalcium silicate, bismuth oxide, dicalcium silicate, tricalcium aluminate, calcium sulfate dehydrate or gypsum. It contain a hydrophilic powder that react with water and produce a calcium hydroxide and $CaSiO_4$ hydrate gel.MTA was originally formulated to provide the physical properties, setting requirements and characteristics necessary for an ideal repair and medicament material[12]. The lower microleakage values of MTA may be attributed to its superior marginal sealing ability resulting from its hydrophilic properties and formations of an interfacial layer between the material and dentin. The interfacial layer reduces the risk of marginal percolation and gives promising long-term clinical success. The cause of discoloration is still debatable, however, the interaction of bismuth oxide with collagen present in tooth tissue and sodium hypochlorite, which is routinely used during root canal therapy has been indicated as the main causative factor. Materials based on tricalcium silicate with alternative radiopacifiers are available clinically. Such formulations include Biodentine, which do not include bismuth oxide in their

formulation[10,11,13].Beside a long setting time and discoloration of tooth the major drawbacks of MTA are its relatively low compression and flexural strength, which are lower than those of dentine. These factors are limiting the field of application to low stress-bearing areas.[9]In recent years, various material like Biodentine, MTA plus have been introduced with the aim of overcoming some of the disadvantage of the MTA[11].

Biodentine the new high purity, calcium silicate-based dental cement, was designed as a dentin substitute for resin composite restorations, pulp capping, and endodontic repair material. Biodentin contains tricalcium silicate, calcium carbonate (filler), zirconium oxide (radiopacifier) and water based liquid composed of calcium chloride as a water reducing agent for shorter clinical and final setting time, as it also accelerate the rate of early strength development Biodentine has improved sealing ability, higher compressive strengths, shorter setting time (12 minutes), greater biocompatibility, bioactivity and biomineralization properties than MTA[11,12]. Moreover, Biodentine® shows improved antibacterial properties compared to MTA, as well as a low cytotoxic effect. Biodentine may have a more prominent biomineralisation ability than MTA[14]. Bismuth oxide is replaced by zirconium oxide in Biodentine. These alternative radiopacifers were adequate because both materials produced comparable radiopacity, and they did not interfere with the hydration of the materials. Elumalai et al concluded that MTA and biodentine being bioactive dental materials can be successfully used for various endodontic therepy. Biodentine showed better initial healing while MTA had better long-term effect[11]. Kayahan et al suggested that obturation procedures be postponed at least for 96 hours after mixing MTA to allow the material to achieve its optimum physical properties. [35]However, Bachoo et al. reported that the initial setting reaction of Biodentine takes approximately 12 min and the provision of full maturation takes 2 weeks–1 month. So, that obturation can be done at same appointment[13]. On the basis of sealing ability and biocompatibility, apexification treatment with Biodentine was applied in the present case report. The favorable clinical and radiographic outcome in this case demonstrated that Biodentine may be an efficient alternative to the conventional apexification materials.

5. Conclusions

Biodentine, a popular and contemporary tricalcium silicate based dentine replacement and repair material. The studies are generally in favor of this product in terms of physical and clinical aspects despite a few contradictory reports. Though accumulation of further data is necessary, Biodentine holds promise for clinical dental procedures as a biocompatible and easily handled product with short setting time. As more research is performed regarding this interesting alternative to MTA.

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