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Management of Open Apices with Mineral Trioxide Aggregate And Biodentine –A Case Report

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Abstract: *Endodontic management of immature permanent teeth with open apex involves induction of apical closure by apexification procedure. MTA has been proved as a good material for apexification, owing to its superior sealing properties, biocompatibility, cementogenic and dentinogenic properties. Biodentine is bioactive and biocompatible calcium-based cement can regenerate damaged dental tissues and represents a promising substitute for the multi-visit apexification procedure. This case report describes the management of open apices in maxillary central incisors of the same patient with MTA), and Biodentine and compared the biological activity of both materials.*

Keywords*: Apexification, Biodentine, Mineral trioxide aggregate, Open apices*

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I. Introduction

The termination of root development and apical closure occurs up to 3 years following tooth eruption.[1]Dental trauma to the anterior teeth is one of the most common causes leading to an immature permanent tooth having an open apex and sometimes incomplete root dentin formation, depending upon the stage at which the trauma occurs.[2]

The ultimate goal in endodontic practice is to debride and obturate the root canal system as efficiently and three dimensionally as possible. However, achieving an apical seal in non-vital teeth with open apices could be a challenge due to the large open apex, diverging and thin dentinal walls that are vulnerable to fracture.[3]

Open apices are of two types, the first one being a non-blunderbuss open apex where in the root canal walls may be parallel to slightly convergent as the canal exits the root. The other one is a blunderbuss apex in which the walls are divergent, flaring especially in the buccolingual region.[3]

Management of a non-vital tooth with an open apex necessitates stimulating the formation of natural or artificial apical barrier which can function as a stop for the obturating material.[4] Apexification is a method that induces the formation of a calcified barrier in a root with an open apex or effects the continued apical development of an incomplete root in teeth with necrotic pulp.[4]

A number of materials have been proposed to induce the formation of an apical barrier such as calcium hydroxide, freeze-dried cortical bone, freeze-dried dentin, bone morphogenic proteins, Mineral trioxide aggregate and Biodentine .[5]

Calcium hydroxide is a widely used material and is considered to be the gold standard to induce apical barrier formation.[4]However, it has some drawbacks such as prolonged treatment time including the need for multiple visits, reduced fracture resistance of the tooth and the loss of temporary restoration leading to increased chances of reinfection.[6]

Since the advent of MTA by Mahmoud Torabinejad in 1993, it has been considered as the material of choice for apexification due to its excellent biocompatibility, sealing ability and cementogenesis.[7] However, its long setting time, poor handling characteristics and high cost are some of the disadvantages which necessitated the use of a more ideal material with adequate biological and mechanical properties.[7, 1]

Recently, a novel calcium silicate based material; Biodentine by Septodont has been introduced with the purpose of preserving the properties and clinical applications of MTA without its negative characteristics.[1]

The following case report is an effort to assess the effectiveness of MTA (SSDS,MTA forte) and Biodentine (Septodont, St Maur des Fosses, France) in a patient with open apices in the maxillary central incisors.

II. Case Report

A 19-year-old female patient reported to the Department of Conservative Dentistry and Endodontics, DAPM RV Dental College, Bangalore with a chief complaint of fractured and discolored upper front teeth. The patient gave a history of trauma at the age of 9 years. However since she was asymptomatic, she did not undergo any treatment for the same. The medical history of the patient was non-contributory.

Clinical examination showed discoloration of both the teeth and Ellis Class III fracture of 11 and Ellis class II fracture of 21. (Fig.1)The teeth was asymptomatic on clinical examination with no tenderness on palpation and percussion. Mobility and periodontal probing around the teeth was within physiological limits. Vitality testing using heated gutta percha and subsequently with electric pulp tester showed negative response.

Radiographic examination of 11 showed an oblique fracture line at the coronal portion involving the pulp suggestive of crown fracture. The pulp chamber appears enlarged with wide root canal and open apex. Well-defined radio opacity was noted at the apex measuring approximately 2 mm × 1 mm, which can be a possible apical third fracture of the root. Circumferential radiolucency with loss of continuity of lamina dura was noted. Evidently, development of the tooth had been interrupted by the trauma suffered years ago. An oblique fracture line was noted at the coronal portion of 21 suggestive of crown fracture. The pulp chamber appears enlarged with wide root canal and incomplete fusion of apex was noted. Periapical radiolucency measuring 3×4 mm was evident.(Fig.2)

A definitive treatment was planned which included single visit apexification with MTA (SSDS,MTA forte) for 21 and Biodentine for 11, followed by obturation and placement of a post-endodontic restoration in relation to 11 and 21.The treatment plan was discussed with the patient and consent was taken.

The teeth were anesthetized with 1.8 ml of 2% Lignocaine containing 1:800,000 adrenaline (lignox 2%, Indigo remedies Ltd., Mumbai, India] and rubber dam was applied. An endodontic access was established using Endo Access bur [Dentsply Maillefer, Ballaigue, Switzerland]. Working length was determined and maintained 2mm short of the radiographic apex. Minimum instrumentation was performed and circumferential filing was done with 50 K file. Copious irrigation was done with 2% Chlorhexidine and normal saline. Access cavity was sealed with an intermediate restorative material (IRM® – Dentsply International)(Fig.3).

The patient was recalled after one week. Under rubber dam, access was regained and irrigation done with Chlorhexidine 2% and saline. The canal was completely dried with size 80 absorbent paper points. MTA was dispensed and mixed according to the manufactures instruction and placed in increments in the apical region of 21 using amalgam carrier. MTA was condensed with light pressure using prefitted hand pluggers and packed to form an apical plug of approximately 3 mm. A radiograph was taken to confirm the thickness of the apical barrier. A moist cotton pellet was placed over the barrier and the access cavity was sealed(Fig 4). Biodentine (Septodont, Saint-Maur-des-Fossés, France) was mixed according to the manufacturer's recommendation and placed in increments at the apical region of 11 using an amalgam carrier, the material was then condensed with suitable prefitted pluggers and packed to form an apical plug of approximately 4mm. A radiograph was taken to confirm the thickness of the apical barrier (Fig .5). Access cavity was sealed with an intermediate restorative material (IRM® – Dentsply International).On the next day, access was regained for 11 and 21,and the cotton pellet was removed from 21.The canals were dried with absorbent points and obturation was done with gutta-percha using lateral condensation technique(Fig.6). Access sealed with composite restoration. Follow up was done for 6 and 9 month, for clinical and radiographic evaluation (Fig 7&8). Subsequently, PFM crowns were placed on 11 and 21 once satisfactory periapical healing was observed (Fig. 9).

Fig 1: Pre-operative

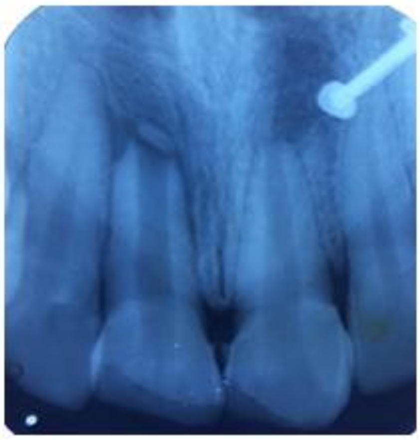

Fig 2: Pre-operative radiograph

Fig 3: working length radiograph

Fig 4: Apexification with MTA

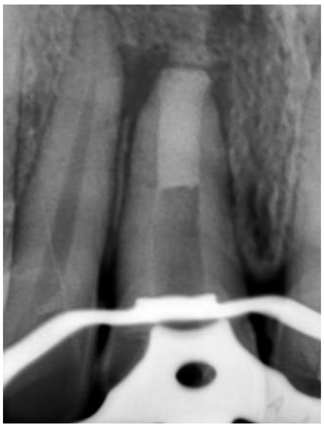

Fig 5: Apexificacation with BIODENTINE

Fig 6: Obturation radiograph

Fig 7: 6 month follows up radiograph

Fig 8: 9 month follows up radiograph

Fig 9: Post-operative

III. Discussion

The basis of this case report is to evaluate of the effect of MTA and Biodentine used for apexification in the same patient so that host's ability to resist the infection is the same, thus allowing the biological activity of both the materials to be compared.[7]

Apexification is the treatment of choice for immature teeth with open apex and necrotic pulp; to obtain a superior seal.[12] .The goal of apexification is to obtain an apical barrier that would prevent the passage of toxins and bacteria from the root canal system into the periapical tissues.[8]

The long established use of calcium hydroxide barrier has been associated with uncertain apical closure, prolonged time taken for the barrier formation, difficulties in patient compliance and the risk of reinfection resulting from the placement of provisional restoration and susceptibility to root fracture occurring due to the presence of thin roots or prolonged exposure of the root dentine to the material.[8]

However, with the passage of time materials have been modified by research in material sciences that has evolved in dentistry to prove or disprove or facilitate treatment approaches in the management of such cases[.4]

Single visit apexification is defined as the non-surgical condensation of a biocompatible material into the apical end of the root canal system thereby, establishing an apical stop that would enable the canal to be filled immediately.[8]

An appropriate alternative to calcium hydroxide for performing apexification is mineral trioxide aggregate.[3] MTA is a bioactive cement consisting of calcium silicate, bismuth oxide, calcium carbonate and calcium aluminate, which forms a hydrophilic powder that reacts with water and produces calcium hydroxide and calcium silicate hydrated gel[.7]. It has the capacity to induce the formation of new cementum and periodontal ligament therefore making this material biologically acceptable for closing a root canal system with an open apex[.9]. The mechanism of action of MTA involves releasing calcium ions that activate cell attachment and proliferation while the high pH creates an antibacterial environment.[9]According to a study conducted by Shabahang et al, it was concluded that MTA produced apical hard tissue formation with significantly greater consistency than calcium hydroxide.[10]

Disadvantages of MTA such as long setting time, poor handling characteristics, low resistance to compression, limited resistance to washout before setting ,possibility of staining of tooth structure, presence and release of arsenic and high cost ,the need for more ideal restorative material has increased.[7]

Biodentine introduced by Septodont is a new bioactive dentine substitute that is available in a powder and liquid system .[9]The powder is chiefly composed of tricalcium silicate, dicalcium silicate, calcium carbonate, calcium oxide, zirconium oxide and calcium hydroxide, while the liquid consists of calcium chloride and water-soluble polymer[.9]. It has a setting time of 12 minutes as compared to MTA which is 2hrs 45 minutes.[9]According to a study conducted by Zaini et al it was suggested that Biodentine is bioactive because it induces differentiation of odontoblast like cells and increases murine pulp cell proliferation and biomineralization..However, the main disadvantage of Biodentine is its high alkalinity, which induces denaturing of the organic matrix.[9]

Apexification of 11 was done with Biodentine, in cases with wide-open apex, adequate condensation of MTA is difficult to achieve as the material may get extruded beyond the apex[.11] Chlorhexidine 2% was used as a primary irrigant due to its increased antimicrobial activity and substantivity.[12]

Patient was asymptomatic during the follow up period. Radiographic assessment was done. based on reduction in the size of periapical radiolucency, formation of calcific barrier and closure of open apex .[10]

At the end of 6-month follow up, satisfactory healing of periapical lesion, calcific barrier formation and root end closure was evident in case of 21. In case of 11 circumferential diameter of radiolucency was decreased, 7 calcific barrier formation and root end closure was not much appreciated.[10]

Nine month follow up radiographic assessment of 11 revealed, calcific barrier formation and root end closure. Trabeculae formation and increase in density was also noticed.[10] In the present case MTA has taken lesser period of time in the formation of apical barrier in comparison to Biodentine .Superior marginal adaptation of MTA over biodentine may influence the sealing ability and clinical success.[7]

IV. Conclusion

MTA and Biodentine are bioactive materials and successfully used for root end closure of open apices. Within the limitation of this study, Biodentine can be considered as a possible alternative to the MTA. However, MTA remains as one of the important materials used in apical barrier technique. Further clinical studies with larger sample sizes and longer follow-up periods are required to find the best apical barrier material in dental practice.

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