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Endodontic management of open apices by two bioactive materials: A case series

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Abstract

Root apex closure may occur up to few years following the eruption of the tooth. Pulpal involvement due to trauma or caries in immature permanent teeth can trigger the loss of pulpal vitality as well as directly affect root development. The treatment approach involves closure of apex with a material having good biocompatibility as well as filling of remaining root canal space with bioceramic material.

Keywords: material, immature, biocompatibility, involvement

Introduction

Root development completion and root apex closure may occur up to 3 years following the eruption of the tooth. Pulpal involvement as a consequence of trauma or caries in immature permanent teeth can trigger the loss of pulpal vitality as well as directly affect root development, resulting in short roots with very thin walls producing a greater risk of fracture and thus hindering the treatment conventional ducts [1]. Apexification is a viable option for management of immature permanent tooth with open apex. It is defined as a method to induce a calcified barrier in a root with an open apex or continued apical development of an incompletely formed root in teeth with necrotic pulp tissue [2]. The walls are divergent and wide open apex makes debridement and obturation difficult [3]. The treatment to be carried out against these pulpal pathologies is the elimination of the pulp tissue, the disinfection of the root canal system through the different irrigants that we have at present, among the most used are sodium hypochlorite and ethylenediaminetetraacetic acid. The apexification may involve one or multiple monthly appointments to place calcium hydroxide (Ca(OH)2) inside the root canal and achieve the elimination of the intracanal infection, which stimulates calcification and produces the apical closure. This step is followed by backfilling with calcium hydroxide to completely fill the canal thus ensuring a bacteria-free canal with little chance of reinfection during the 6 to 18 months required for the hard tissue formation at the apex. But it is established that Ca (OH)2 can alter the mechanical properties of dentin and make these teeth more susceptible to root fracture [4]. The traditional use of Ca (OH)2 to achieve apexification is being gradually replaced by various bioactive materials like mineral trioxide aggregate (MTA) [5]. and biodentine as a one-step technique. MTA or Biodentine can be placed as an apical plug with previous applications intracanal with Ca(OH)2 to produce the disinfection of the same or even can be used as a material of canal filling [6]. Since the advent of mineral trioxide aggregate (MTA), it has been the material of choice for apexification. It's excellent biocompatibility, sealing ability, cementogensis, and several other advantages make it a landmark in the history of endodontics. However, long setting time, poor handling characteristics, high cost, are some of its disadvantages.

Biodentine, a calcium silicate (CaSiO4) material is a novel material introduced by Septodent in September 2010 and made available in January 2011. It can be a substitute for MTA with a composition similar to MTA.

Guttaflow Bioseal is a cold flowing root canal sealer with gutta percha particles as well as the bioceramic component for enhanced healing & biocompatibility.

The following case reports we have discussed the effect of MTA, biodentine and bioceramic sealer in patient with open apices in maxillary anterior teeth with periapical radiolucency.

Case Report: I

A 37-year-old female patient reported to Department of Conservative Dentistry and Endodontics, Guru Nanak Institute of Dental Sciences and Research, West Bengal, with a chief complaint of pain since last 1 week in upper front tooth region which was attempted to treat by some private practitioner dentist. The patient gave a history of fall in her childhood. She was symptomatic 3 month ago and so reported to a private practitioner dentist. After the initial treatment pain was subsided. But again the pain increased in intensity since last 1 week. The medical history of the patient was noncontributory.

The extraoral examination was normal. Intraoral examination revealed Ellis class II fracture in 11. Tooth 11 was discolored. Pain on palpation was felt in the central incisor. The teeth were not mobile and probing depth was within physiological limits. Preoperative IOPA revealed canal was filled with some radiopaque material [Picture 1A].

Apexification was planned as a treatment option. Single visit apexification with MTA was decided. The treatment plan was discussed with the patient and consent was taken.

Endodontic treatment was already attempted to the tooth so anesthesia was needed. Rubber dam was applied. Using # 4 round bur temporary restoration was removed and the access cavity was finished by Endo Access bur. Root canal was filled with some intracanal medicament [Picture 1B]. Minimum instrumentation was performed and circumferential filing was done with 80 K file to remove the old intracanal medicament [Picture 1C]. Copious irrigation was performed with 3% sodium hypochlorite [Cmident, Cmident, New Delhi, India] and normal saline using side vented irrigation needle [R C Twents irrigation needle, Prime Dental Products Pvt. Ltd., Mulund Mumbai, India]. After cleaning and shaping working length was established by radiograph [Picture 1D]. Intracanal dressing with calcium hydroxide [Ultradent Products Inc., USA] was given for 2 week and access cavity was temporized with Cavit. On recall visit, the tooth was asymptomatic. After removing the provisional restoration copious irrigation and circumferential filing was done again to remove calcium hydroxide from the canal. The canal was completely dried with size 80 absorbent paper point [Ultradent Products Inc., USA]. Suitable pluggers were selected to condense MTA. MTA was mixed with distilled water to a consistency of wet sand and placed in increments in the apical region of the canal using micro apical placement (MAP) system in tooth 11. MTA was condensed with light pressure using prefitted hand pluggers until 5 mm canal was filled with MTA [Picture 1E]. The remaining portion of the canal was obturated with GuttaFlow® Bioseal (Roeko-Coltène/Whaledent) [Picture 1F]. Wet sterile cotton was placed in the canal above MTA. The tooth was then given a temporary restoration with Cavit.

On recall visit, the patient was asymptomatic and postendodontic restoration was done with composite (Coltene NT Premium). Subsequently, crown fabrication was done. The patient was recalled after 6months [Picture 1G].

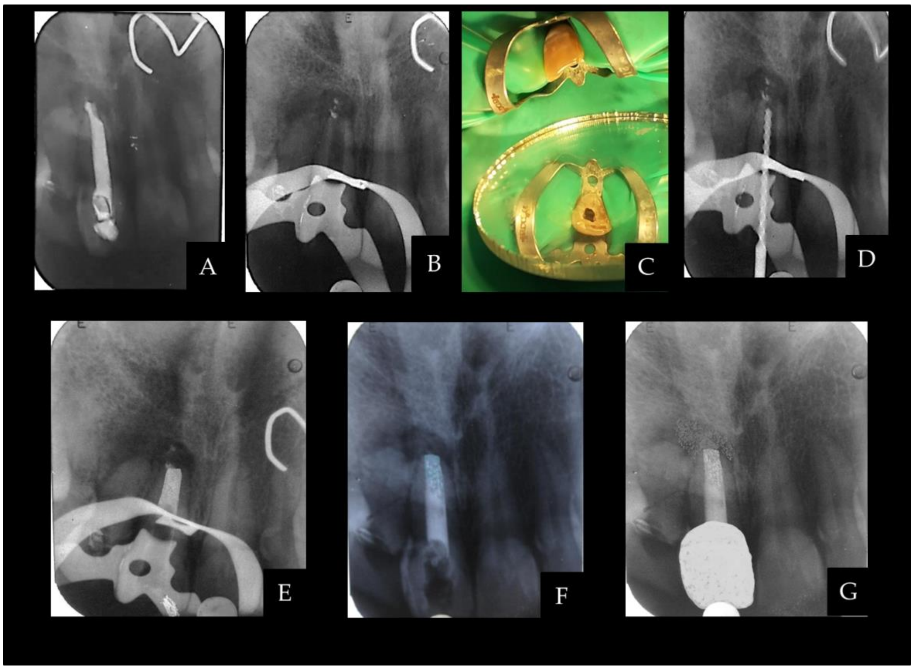

Fig 1: A-Preoperative IOPA, B-After removal of intracanal material, C-Access cavity preparation done, D-Working length determination IOPA, E-Apical 5 mm MTA placement, F-Obturation of the remaining canal by Guttaflow Bioseal, G-followup IOPA after 6 months

Case Report: II

A 45-year-old male patient was reported to the Department of Conservative Dentistry & Endodontics, Guru Nanak Institute of Dental Sciences & Research with a chief complain of pain in the upper front teeth region since 1 week. The patient gave a history of fall in his child hood. Pain was continuous in nature and sudden in onset. Medical history was non-contributory.

The extraoral examination was normal. Intraoral examination revealed there was proximal caries in relation to 23 and discoloration in relation to 22. Both the teeth were tender on vertical percussion. The teeth were not mobile and probing depth was within physiological limits.

Radiographically a well circumscribed radiolucent area present in relation to 22 [Picture 1 A] which was also associated with immature apex formation. There was radiolucent area present distal side of 23 which was closely approximated to dental pulp.

Diagnosis was pulpal necrosis with symptomatic apical periodontitis in relation to 22 and symptomatic irreversible pulpitis in relation to 23.

Treatment plan was single visit apexification with Biodentin in relation to 22 and multiple visit nonsurgical endodontic treatment in relation to 23.

Procedures were described, the risks and benefits were explained and a signed consent was obtained from the patient.

Adequate anaesthesia was achieved by buccal infiltration technique by Lignocaine Hydrochloride (2%) & Adrenaline Bitartrate (1: 80000). The field was isolated with a rubber dam to ensure moisture control. Access cavity was prepared with endo Z bur [Picture 2B]. Working length was

established at 0.5 mm short of the apex with # 35 stainless steel K file by radiographic method to the length of 20 mm in relation to 22 [Picture 2C] and 23.5 mm in relation to 23.
Cleaning and shaping was done #80 hand file in a step back technique. The canals were irrigated with 2 ml 2.5% Sodium hypochlorite and 17% EDTA after each instrumentation. Final irrigation was done with 2 ml 0.9% normal saline. Root canal was dried with sterile paper points. Canal was obturated with corresponding gutta-percha points & GuttaFlow Bioseal sealer using in relation to 23.
Intracanal dressing with iodoform based calcium hydroxide was given for 1 week and access cavity was temporized with Cavit in relation to 22 [Picture 2 D].
On recall visit, the tooth was asymptomatic. After removing the provisional restoration copious irrigation and circumferential filing was done again to remove calcium hydroxide from the canal. The canal was completely dried with size 80 absorbent paper point.
Suitable pluggers were selected and radiograph was taken by inserting plugger into the canal. A 2”x 2” piece of absorbable gel was cut and inserted into the canal using plugger. Care should be taken not to extrude the absorbable gel periapically.
Biodentin was mixed with auto mixer and placed in increments in the apical region of the canal using micro apical placement (MAP) system. Biodentin was condensed with light pressure using prefitted hand pluggers until 5 mm canal was filled with Biodentin. The remaining portion of the canal was obturated with GuttaFlow® Bioseal (Coltene) [Picture: 2E]. Postendodontic restoration was done using light cure composite resin. Occlusion was checked in centric relation for any interferences and post-operative instruction was given to the patient. Follow ups were carried out after 24 hours and 6 months.

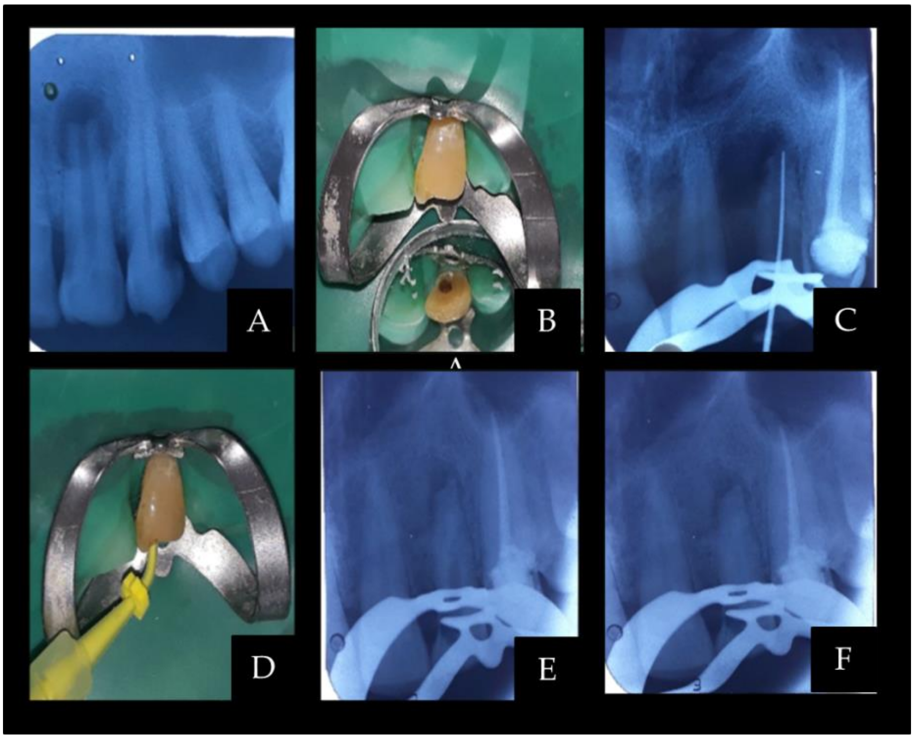

Fig 2: A. Pre-operative radiograph, B- Access cavity was prepared, C-IOPA radiograph of working length determination, D- Intracanal dressing with iodoform based calcium hydroxide was given for 1 week, E- Apical 5 mm canal was filled with Biodentin, E- The remaining portion of the canal was obturated with GuttaFlow ® BIOSEAL

Discussion

The presented case shows successful management of immature permanent teeth with the periapical lesion. Revascularization was not attempted for this case because of the chronic nature of the lesion. Literature suggests that goal of apexification procedure is to obtain an apical barrier to prevent the passage of toxins and bacteria into periapical tissues from root canal. Technically, this barrier is required for compaction of root filling material [7].
Previously Calcium Hydroxide was the most commonly used material for inducing biological sealing in teeth with incompletely formed apices. Though the material was efficient in creating an artificial barrier, the technique had some disadvantages such as the prolonged treatment time, risk of recontamination of the root canal system and a chance of cervical tooth fracture during treatment. MTA is the preferred material for single visit apexification due to its bio-compatibility, less cytotoxicity, osteo-conductive properties, bio-remineralisation abilities and hydrophilic nature. MTA offers faster treatment outcome in comparison with Ca(OH)2, with high clinical success rates. But it has some drawbacks like long setting time, difficulty in handling, and low compressive and flexural strengths [8].
Biodentine is a recently introduced bioactive dentine substitute based on “Active Biosilicate Technology” [9]. It has good biocompatibility, fast setting time, less micro leakage and better handling properties. Biodentine has the ability to create a tag-like crystalline structure within the dentinal tubules which may contribute to the micromechanical bond between dentin and novel calcium silicate material. There might be a possibility of ion exchange between natural dentin and dentin substitute material as result of this micromechanical bond formation. [10]. Comparatively reduced size of powder particles and presence of an accelerator in the liquid attributed to fast the setting time of Biodentine (9-12 minutes) [7]. Calcium

silicate–based materials might produce tighter but less soluble seals at the interface. Mechanism behind this property may be their ability to produce surface apatite crystals by interacting with the phosphates present in oral tissue fluids. Root canal dentinal uptake of calcium and silicon from MTA and Biodentine found it to be higher for the latter [9]. When comparing with other calcium silicate dental materials Biodentine has many advantages. The properties such as compressive strength, elasticity modulus and microhardness of Biodentine are more similar to that of natural dentine, hence an ideal material for apexification. Biodentine is stable, less soluble, nonresorbable and easy to prepare and place, needs less setting time, and produces a tighter seal [11]. This novel bioactive material provides a good biological seal and excellent marginal adaptation, having better handling properties and with fast setting time comparing to MTA. Antibacterial and hard tissue healing properties of biodentine are closely associated with pH and calcium release. When used as root end filling material Biodentine and MTA show similar antibacterial action and hard tissue healing [12].

About *et al*. investigated the bio activity of Biodentine on dentin. They concluded that Biodentine induces dentin regeneration by stimulating pulp progenitor cells [12] Studies by Han and Okiji concluded that calcium and silicon uptake by root dentin and the thickness of the hard tissue barrier formed in the case of Biodentine are comparable to pro-root MTA [13]. Due to its superior material properties, Biodentine has a distinct advantage over its closest alternatives in the treatment of teeth with open apex. The material is still under study and several advancements in its clinical applications may be expected in the near future. Complete disinfection of root canal is mandatory before obturation.

GuttaFlow bioseal demonstrated significant shorter setting times, moderate porosity and water sorption. Due to the good alkalinizing activity, combined with low solubility, slight calcium release and ideal Ca/P ratio, GuttaFlow bioseal has apatite forming and bioactive abilities and represents the first choice for optimal root canal sealing and regeneration of bone and dentin tissue [14].

Conclusion

This case report presents favorable clinical outcomes for Biodentine and MTA used as an apexification material. But faster bone deposition was observed for the Biodentine. Taking into account the healing outcome and other clinical factors like setting time, handling properties and better marginal adaptation Biodentine has an edge over MTA. Hence, Biodentine can be a good alternative to MTA as an apexification material. With GuttaFlow bioseal, an launching an intelligent obturation material that can do more than seal and fill the root canal. Upon contact with fluids, the bioactive material provides natural repair constituents such as calcium and silicates. It also activates biochemical processes that provide additional support for regeneration in the root canal. The idea is remarkably simple: after curing, the new GuttaFlow bioseal forms hydroxylapatite crystals on the surface. The crystals significantly improve adhesion and also stimulate natural triggers, especially the regeneration of bone and dentine tissue.

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