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RESEARCH ARTICLE

MINERAL TRIOXIDE AGGREGATE (MTA) FOR APICAL BARRIER FOR IMMATURE NECROTIC PERMANENT TEETH - FOUR CASE REPORTS

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Abstract

Open apex is a common occurrence and conservative approach should be applied because the affected teeth are immature in nature. This article describes the management of open apices with periapical radiolucencies in maxillary incisors. Mineral trioxide aggregate (MTA) was used to form an apical barrier and rest of the canal was obturated with different technique. The case series intends to testify the efficacy of MTA as an agent for Apexification and its effect on periapical healing.

Introduction:-

A major problem in performing endodontic immature teeth with necrotic pulp and wide open apices is obtaining an optimal seal of root canal system. The complete formation of root and closure of the apical foramen occurs up to 3 years after the eruption. Traumatic dental injuries to young permanent teeth during this period may cause pulpal inflammation or necrosis and subsequent incomplete development of the dentinal walls and root apices [1]. These teeth present wide dentinal tubules that allow the penetration of bacteria and their irritants. The management of a non-vital tooth with open apex consists of the induction of a natural or artificial apical barrier which can act as a stop for the obturating material. **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' [2].

Various techniques were used to induce the apexification process. The most common traditionally used medicament is Calcium Hydroxide. It was first introduced by Kaiser and Frank in 1960's. The approximate time for induction of calcified apical barrier varies between 6 months and 24 months. Although technique is efficient with predictable outcomes, it has several disadvantages like prolonged treatment time, chances of re-infection and risk of cervical fracture [3].

Among the various materials, **Mineral Trioxide Aggregate (MTA)** is considered as one of the most promising materials because of its superior biocompatibility and less cytotoxicity due to its alkaline pH and presence of calcium and phosphate ions resulting in capacity to attract blastic cells and promote favourable conditions for cementum deposition. However MTA has certain disadvantages like high solubility, prolonged setting time of

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In this article, 4 cases are described in which MTA was used to the successful closure of root apex in pulpless permanent maxillary teeth with wide open apex. These cases illustrate the potential benefits of MTA and its relative ease of use for management of open apex and apexification at easily accessed sites.

Case Reports:-

Four cases of open apices reported at different time in the Department of Conservative Dentistry and Endodontics, Guru Nanak Institute of Dental Science and Research, Kolkata- 700114 with the **chief complaint** of discolouration in upper front teeth region of mouth. The age of the patients were in a range between 21 to 25 years.The medical and dental histories were non-contributory. All of the four cases were presented with similar features as follows :-
History- Trauma 12-13 years back.

Clinical presentation:-

1. Discolouration
2. Offending tooth shows negative response in electric pulp test (EPT)
3. Non mobile and non tender

Radiographic presentation:-

Circumferential periapical radiolucency with wide open apex along with thin root dentin. The bony support of the tooth was completely intact.

Treatment procedure:-

The treatment protocol was performed as follows :-access cavity was prepared using no.2 round bur (Dentmark) and refined with endo Z bur (Dentsply) with rubber dam (Coltene) isolation. Working length was established by radiograph. Biomechanical preparation and circumferential filling was done with 80 K file. Irrigation was performed with 3% sodium hypochlorite and normal saline alternatively. Calcium hydroxide as an intracanal medicament was placed in the canal for 1 week and the access cavity was sealed with zinc oxide eugenol.

On recall visit, the tooth was found to be asymptomatic clinically and radiographically. Intracanal medicament was removed by irrigating with alternating solutions of 3% Sodium hypochlorite and saline. The canal was completely dried with size 80 absorbent paper point and the absorbable gelatin base foam (AbGel) placed apically as a barrier.

For the first two cases:-

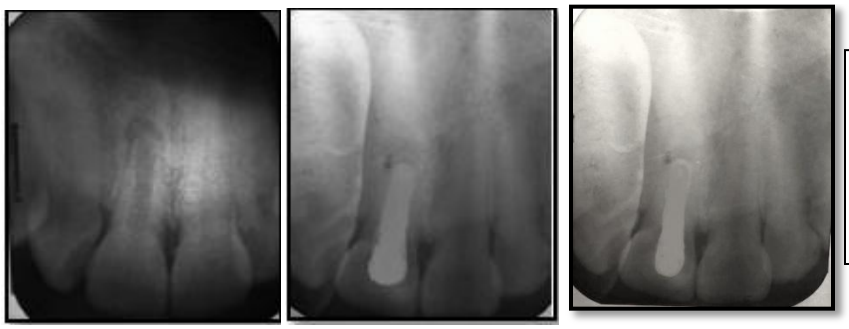
MTA was mixed with manufacturer's supplied liquid to a consistency of wet sand and placed in increments in the apical region of the canal and gently adapted using endodontic pluggers until entire canal was filled with MTA and correct placement of MTA apical plug was assessed radiographically. Access cavity was temporized with zinc oxide eugenol.

For rest of the two cases:-

MTA was mixed with manufacturer's supplied liquid to a consistency of wet sand and placed in increments in the apical region of the canal and gently adapted to the apical portion using endodontic pluggers until an apical plug of 4-5 mm was reached. Correct placement of MTA apical plug was assessed radiographically. Following the placement of MTA over the barrier, butt-end of a paper point was used to clean out any excess material from the walls. Wet sterile cotton was placed in the canal above MTA and access cavity was temporized with zinc oxide eugenol.

On recall visit, the patient was asymptomatic and rest of the canal space was obturated with gutta flow and post obturation access cavity restoration was done with light cure composite resin (Filtek Z 250 XT, 3M ESPE) on the same day. The patients were recalled at every 1 month interval for a period of 6 months for clinical and radiographic assessment during this period.

Case 1:-



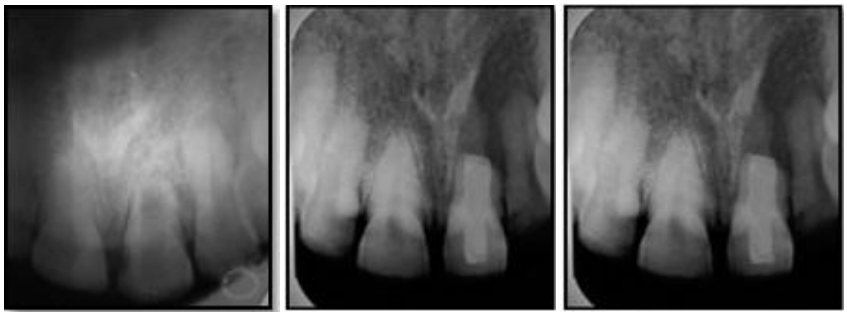
(a) (b) (c)

(a)- Pre operative radiograph (21)

(b)- Post operative radiograph

(c)- 6 months follow up radiograph

Case 2:



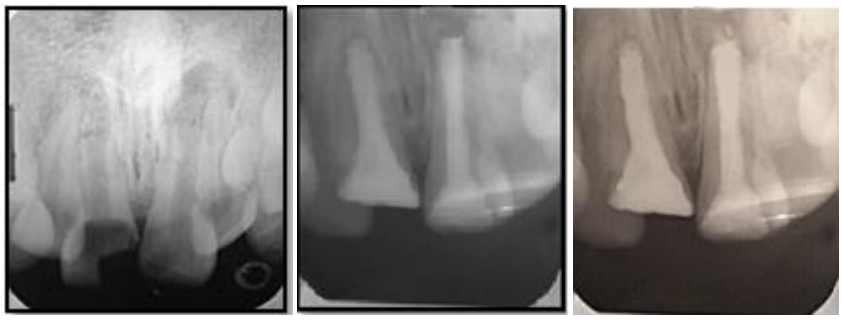
(a) (b) (c)

(a)- Pre operative radiograph (11)

(b)- Post operative radiograph

(c)- 6 months follow up radiograph

Case 3:



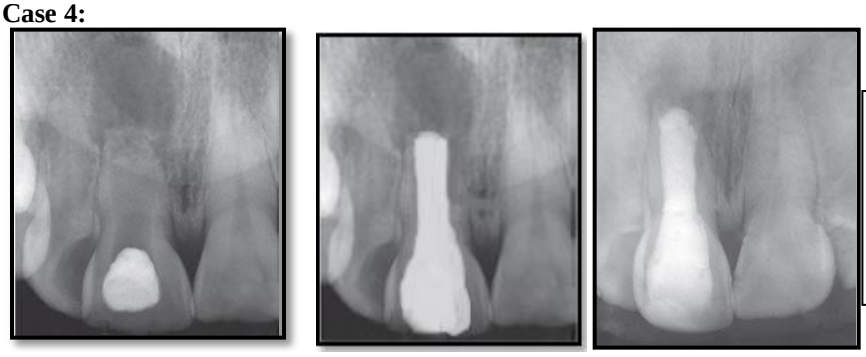
(a) (b) (c)

(a)- Pre operative radiograph (11, 21)

(b)- Post operative radiograph

(c)- 6 months follow up radiograph

Case 4:



(a) (b) (c)

(a)- Pre operative radiograph (21)

(b)- Post operative radiograph

(c)- 6 months follow up radiograph

Discussion:-

The completion of root development and closure of the apex occurs up to 3 years following eruption of the tooth (Nolla 1960). After crown formation, the inner and outer enamel epithelium develop as a two-layered epithelial wall to form Hertwig's epithelial root sheath (HERS), which plays a key role in the differentiation of odontoblasts. When the first layer of dentine has been laid down, HERS begins to disintegrate and only the cell rests of Malassez persist in the periodontal ligament. At the same time, HERS progresses in an apical direction until complete formation of the root. When teeth with incomplete root formation suffer pulp necrosis, the root development ceases and apical closure cannot be achieved. Calcium hydroxide pastes have been considered as the material of choice to induce the formation of a hard tissue apical barrier. In 1966, Coviello and Brilliant [5] in 1979 and Schumacher and Rutledge [6] in 1993 suggested calcium hydroxide as a permanent apical barrier. Its efficiency has been demonstrated by many authors, even in the presence of an apical lesion (Chosack et al. 1997, Felippe et al. 2006). However, calcium hydroxide for apexification requires long treatment period. The intracanal dressing needs to be change at regular intervals. Further, the alkaline pH causes collagen degradation and denaturation of dentinal organic proteins causing weakening of dentinal walls [7].

With the discovery of MTA by Torabinejad et al [8] it has become the material of choice for apexification. Single visit apexification is now a viable treatment option for the immature apex. The main constituents are Calcium silicate, bismuth oxide, calcium carbonate (CaCO3), calcium sulfate, calcium aluminate. It contains a hydrophilic powder that reacts with water and produces calcium hydroxide and CaSiO4 hydrated gel. MTA has a range of advantages such as biocompatibility [8] hard tissue formation, sealing ability, antibacterial property.

Interradicular biofilms are usually present in cases with long- standing periapical lesions. Complete obturation with bioactive materials such as MTA in such cases not only have an advantage of cementum formation, but materials like MTA possess antibacterial properties.[In addition, GP sealer interface can harbor a tenacious gram- positive bacteria and fungi. Such organisms have an ability to survive between GP/sealer and dentin [9]. Further, it is important to seal the canal and prevent bacterial penetration. For this, it is required that the material should adapt and adhere to dentin wall. Various studies have shown MTA forms complete seal due to the interaction of calcium and phosphate ions that facilitates the formation of apatite crystals at material dentin interface hence prevents bacterial leakage [10].

Torabinejad et al. compared the antibacterial property of MTA, amalgam, super EBA (zinc oxide eugenol modified with ethoxybenzoic acid), zinc oxide eugenol (ZOE), and found that MTA has an antibacterial effect on five of nine facultative bacteria but no effect on any of the strict anaerobes. MTA is not affected by the presence of blood. Holland et al. theorized that the tricalcium oxide in MTA reacts with tissue fluids to form calcium hydroxide, resulting in an apical barrier [10].

The patient was kept on 6 months follow- up and radiographic assessment was done during this period. Periapical healing was seen on radiographic observance. This may due to the fact that MTA has superior marginal adaptation. Periapical radiolucency was almost completely healed after 6 months follow- up. In these cases, the circumferential diameter of radiolucency was decreased [11].

Conclusion:-

On the basis of radiographic follow-ups we can conclude that the MTA can be successfully used as an apical plug for apexification and subsequent reduction of periapical radiolucency.

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