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SINGLE-VISIT APEXIFICATION USING MINERAL TRIOXIDE AGGREGATE IN IMMATURE PERMANENT TOOTH WITH OPEN APEX.

Dental Science

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ABSTRACT

Summary: Management of immature permanent teeth with an open apex is an endodontic challenge that requires exquisite management of thin and fragile dentinal walls, blunderbuss canal and an open apical exit. Apexification is one of the most reliable procedures in this regard that has long been used for its management. Various materials have been introduced for this purpose, with calcium hydroxide being the most sought-after material. But recently published articles warrant against the long- term use of calcium hydroxide due its effect on the fracture resistance of dentin. Mineral trioxide aggregate (MTA) is a class of calcium silicate cement with a property of cementogenesis and dentinogenesis, and has become very popular as a retrograde filling material, for perforation repair, and even in regenerative procedures. The present case report highlights at the successful management of an open apex with MTA, with a follow-up period of 2 years.

KEYWORDS

Apexification; Mineral Trioxide Aggregate

BACKGROUND:

Dental trauma to the anterior region of the mouth 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 trauma occurs (1). Management of open apex is threefold, i.e. either apexification, apexogenesis, or more recently, regenerative procedures involving various scaffolds. Apexification is a non-vital procedure where, after disinfection of the root canal system, an apical plug is made using either calcium hydroxide or Mineral Trioxide aggregate (MTA) which leads to formation of a calcific barrier. Apexogenesis is a vital endodontic procedure where, after removal of the coronal infectious pulp, calcium hydroxide or MTA is placed over the remaining healthy pulp, leading to physiological root development. More recently, regenerative endodontic procedures have been described for the management of open apex with incomplete root dentin formation. Various studies have reported a successful outcome with regenerative procedures, but the nature of the tissue forming inside the canal and the vitality is still not conclusive of its acceptance as a routine endodontic procedure for the management of open apices.

Calcium hydroxide has long been used for the management of open apices in the formation of an apical plug, and successful outcomes have been reported. The only drawback that has raised concerns about its use as an apical restorative material is its tendency to cause root fracture due to its long-term usage. Mineral Trioxide Aggregate, introduced by Torabinejad, is now widely used for the same purpose owing to its cementogenic and dentinogenic properties and also because it does not cause any mechanical changes in dentin that might lead to weakening of root dentin (2).

MTA has been suggested by many authors for single-visit apexification and is being seen as a good alternative to Ca(OH)2- based apexification(3). Several advantages in terms of patient compliance and better sealing ability have been suggested (4,5).

The aim of this prospective study was to evaluate the effectiveness of MTA in apexi cation procedure by evaluating the apical closure, Periapical Index score (PAI) and size of the apical lesion over a period of 2 years.

CASE PRESENTATION:

Materials and Methods:

The study period lasted from October 2015 to June 2017 and was performed at the Department of Conservative Dentistry and Endodontics at King George's Medical University, Lucknow, India. A 19 year old male patient referred for root canal treatment with an open apex (Figure 1) was selected for the apexi cation procedure. After discussing all alternative treatment options and obtaining informed consent, the apexi cation procedure was initiated.

Root canal treatment:

All treatments were performed using the same protocol by the same operator:

1. A preoperative radiograph was taken with a film holder using a paralleling technique.
2. Infiltration anaesthesia was carried out using lignocaine and 1/100 000 adrenaline.
3. Restoration of the tooth was done using light curable composite and isolation of the tooth was done with a rubber dam.
4. Access cavity was prepared using Endo access bur and Endo Z bur (Dentsply-France Ballaigues, Switzerland).
5. Canal debridement was done using Hedström file.
6. Copious irrigation was done with 3% sodium hypochlorite.
7. Determination of the working length was done using a radiograph with an MTA plugger placed in the canal.
8. Drying of the canal was done with a sterile blunt paper point.
9. Placement of the a 5mm of MTA (White Pro-Root MTA, Dentsply Maillefer, Ballaigues, Switzerland) apical plug was done and a confirmatory X-ray was taken (figure 2).
10. A temporary filling was placed with a moist cotton pellet and Cavit (ESPE, Cergy Pontoise, France.
14. Filling of the whole canal was completed by Schilder's warm vertical compaction of gutta-percha and AH Plus sealer, and the corono-radicular restoration was completed with a bonded resin composite in the following 7 days. (figure 3)

Evaluation:

Following the completion of treatment, radiographic evaluation of the patient was carried out at intervals of 6, 14 and 24 months. Reduction in the size of periapical radiolucency, formation of calcific barrier and closure of open apex were main criteria for evaluation.

Randomization:
Two observers were assigned to evaluate any reduction in lesion diameter and also to detect the presence or absence of apical closure. The observers were blinded to the stage of treatment.

Outcome and Follow-up:

1. Size of the lesion:
Reduction in the size of periapical radiolucency was observed over time at 6 and 14 months.

2. Closure of the apex:
Formation of calcific barrier was evident at 12 months of observation; not much was appreciable at the 6-month interval (Figure 4a, 4b, 4c).

Discussion:
Apexification has long been used as a predictable approach for the management of open apices in immature permanent teeth. Earlier, calcium hydroxide was used to form an apical plug of 4-5mm, which led to the formation of a calcific barrier and following which, obturation was completed. Various authors have reported a successful outcome with calcium hydroxide. But there are certain limitations that led to the search for better materials than calcium hydroxide for apexification. These limitations include: (i) high alkaline pH of calcium hydroxide can lead to necrotic zone in the periapical area following its long-term placement, (ii) long-term placement of calcium hydroxide has been associated with a signifcant decrease in the intrinsic properties of dentin. This second limitation is mainly responsible for the fracture of the root(6). Moreover, obturation of the root canal system cannot be done until the calci c barrier formation has occurred.

To avoid this risk of root fracture, various authors have suggested single-visit apexification with MTA. MTA apexification gives the advantage of obturation in the same visit and completion of the coronal restoration immediately following completion of treatment (7). Studies conducted on dogs' teeth have shown closure of apex in nearly all the cases that were treated using MTA (8). Following this evidence, the present case was completed using MTA as an apical plug and monitored periodically over a period of 6,14 and 24 months to evaluate the treatment outcome.

In a study reported by El-Meligy and Avery, persistent periradicular inflammation and tenderness to percussion was detected at 6 and 14 months when calcium hydroxide was used as an apical plug material. In their study, none of the MTA-treated teeth showed any clinical or radiographic pathology (9). Hence in the present study apexification was completed using MTA as an apical plug material.

Another advantage of using MTA as an apical plug material is the immediate completion of root canal treatment following completion of MTA plug formation, which provides the advantage of shorter treatment period and improved patient compliance (10, 11). In the case of calcium hydroxide, root canal treatment cannot be completed until a calci c barrier formation has occurred against which the material can be condensed (9).

In a study by Pradhan et al, MTA showed a lesser period of time in formation of apical barrier in comparison to calcium hydroxide i.e. in 3.0 v/s 7.0 months, respectively. In their study, both groups showed nearly the same time for the resolution of the periapical radiolucency (11). Although, in the present case report, apical barrier was noticed at 6 months of time.

Conclusion:
The positive clinical outcome in this case is encouraging for the use of MTA in immature teeth with necrotic pulps and wide-open apices. Newer materials like Biodentine are now used for similar applications. Further clinical and randomized clinical control trial studies are needed to evaluate these newer materials for their regular use as a routine root end filling material

Learning points:
- Apexification is a novel method of management of immature permanent tooth with an open apex
- Newer materials like MTA and Biodentine are now available, which have the properties of cementogenesis and dentinogenesis which has allowed apexification to become more predictable.
- A follow-up of two- and a half years in this study and in various studies reported earlier makes this procedure very effective and efficient.

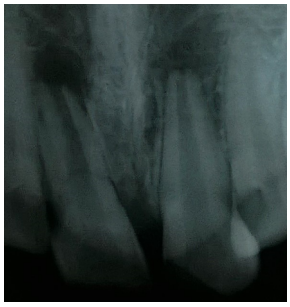

Figure 1. Preoperative radiograph showing open apex w.r.t. 11, 21

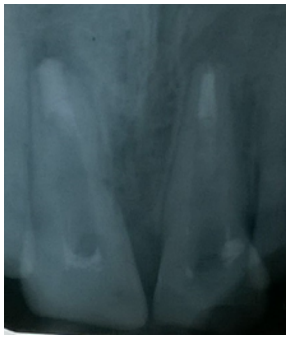

Figure 2. Showing MTA plug made in apical one third w.r.t. 11, 21.

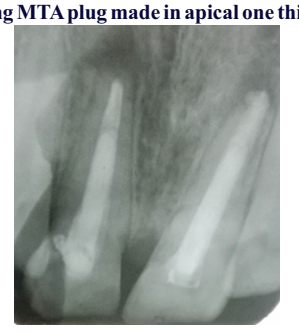

Figure 3. Showing obturation w.r.t 11, 21

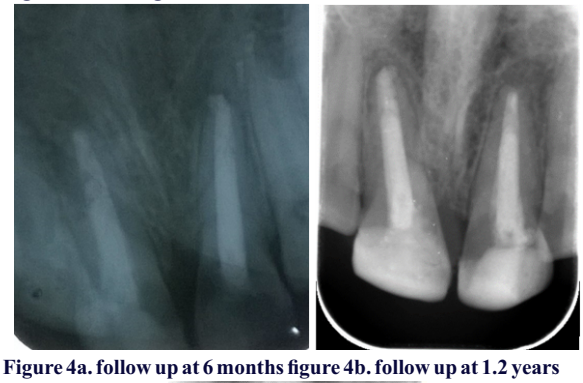

Figure 4a. follow up at 6 months figure 4b. follow up at 1.2 years

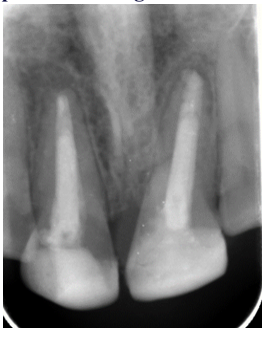

Figure 4c. follow up at 2 years.

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