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Research Article

Building the Barrier, A Comparison of Mineral Trioxide Aggregate and Calcium Hydroxide in Apical barrier technique: Report of Three Cases

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Abstract

Management of non-vital teeth with open apices is a challenge to dental practitioners. In this clinical scenario, it is difficult to maintain the obturation material within the confines of root canal without encroaching into periapical area. Also, thin dentinal walls of canal is a matter of concern. These cases cannot be managed by conventional endodontic treatment and need customized treatment plan. Treatment of such teeth with calcium hydroxide may demand long time and patient compliance. But with MTA same treatment can be done in reasonably less time with predictable results. Hence, these three case reports present the use of MTA to form an apical plug in open apex followed by complete root canal obturation .

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Keywords: Mineral trioxide aggregate, Open apices, Calcium hydroxide, Apexification.

Introduction

Three-dimensional obturation of the root-canal system to the canal apex is fundamental for successful endodontic therapy. Inadequate apical seal is a major cause of failure in nonsurgical endodontic treatment. Radiographic interpretation of apical closure is often misleading since dental radiograph is a two dimensional picture of a three dimensional object. Instances where there is lack of an apical constriction, an alternative to standard root canal treatment, apexification or root end closure has been advocated.

Apexification can be defined as a ‘method to induce a calcific barrier in a root with an open apex or continued apical development of teeth with incomplete roots and a necrotic pulp.(1) Apical closure can take various forms. It can be a complete or an incomplete hard tissue bridge a few millimeters short of the end of the root. It can be located at the tip of the root, or the bridging can be an irregular mass of calcification traversing the apical one third of the root Along with apical closure, root development or lengthening may or may not continue, but whatever the form, root development is usually irregular and aberrant.(2).

Three techniques have been suggested to obturate an immature tooth, which involved the use of a root filling material without the induction of apical closure.

These methods are

1)Blunt-end or rolled cone (cnstomized cone)

Filling the root canal with the large (blunt) end of a gutta-pereha cone or customized gutta-percha cones with a sealer;.(3)

2) Short-fill

Filling the root canal well short of the apex (before the walls have diverged) with gutta-percha and sealer or zinc oxide eugenol (ZOE) alone. (4)

3)Periapical surgery

Filling the root canal with gutta-percha and sealer as well as possible and then performing periapical surgery with or without a reverse seal.

The methods of apical closer induction are:-

(1) Apical closure by the formation of an apical stop (calcium hydroxide [$Ca(OH)_2$] is generally used) against which a permanent root canal filing can subsequently be inserted.

(2) Placing a biologically acceptable substance in the apical portion of the root canal (dentinal chips or tricalcium phosphate have been used) thus forming an apical barrier; this is followed by filling the root canal with gutta-percha and sealer. The last procedure has been called one-visit apexification.'

Three techniques have been suggested to obturate an immature tooth, which involved the use of a root filling material without the induction of apical closure.

These techniques did not gain popularity since there was no physical apical barrier to facilitate obturation.

However, two other techniques were reported which aimed to provide an apical barrier.

Calcium Hydroxide

The use of calcium hydroxide for the apexification in the pulpless tooth was first reported by Kaiser and it was popularized by the work of Frank.

The calcium hydroxide can be used alone or it can be mixed with camphorated monochlorophenol (CMCP), metacresyl acetate, Cresanol, physiologic saline, Ringer's solution, distilled water and anesthetic solution. The canal would ideally be completely filled with the paste but not overfilled.

The usual time required to achieve apexification is 3 to 24 months.

Mineral Trioxide Aggregate (MTA)

Many other materials like amalgam, EBA, Super EBS and Mineral trioxide aggregate (MTA) has been indicated as root end filling material. Several studies have reported its excellent biocompatibility, first-rate sealing ability and mechanical properties as apical sealing material. (5,6)

.One of its major advantages is its fast setting time, which makes the process as a single step technique. MTA has been advocated as a material to serve as an apical barrier for root end induction. In the MTA apical barrier technique, a 3 – 4 mm plug of MTA is packed into the apical end of the canal. The canal is then obturated with gutta percha after a period of 4-6 hours.
The aim of this article is to evaluate the influence of mineral trioxide aggregate (MTA)and Calcium hydroxide on apexification and periapical healing of teeth in with incomplete root formation.

Case Reports

Case 1- A female aged 28 year reported to the department of Conservative Dentistry and Endodontics of Guru Nanak Institute of Dental Science And Research, Kolkata with a complaint of swelling of gum & discoloration in upper anterior tooth. Detailed patient's history revealed trauma to the upper front teeth 12 years back. (Fig1) Both the teeth not responded to the hot stimulus in vitality test.

Radiographic examination revealed an immature root apex in relation to 21 and 11 with peri apical pathology. (Fig 2).

21 was planned for root canal treatment using Abgel(absorbable gelatin sponge) as apical stop and MTA as apical barrier.

11 was planned for root canal treatment and plain calcium hydroxide was used to form apical barrier.
Informed consent was obtained from the patient after total explanation of the treatment plan.

After application of rubber dam, access was prepared. Working length17.5mm was determined with radiographic methd . Step back preparation was done using # 70 K-file as apical master file, and irrigation alternately with 2.5% NaOCl and saline.A piece of Abgel (absorbable gelatin sponge) was cut in a square shaped & placed in the apical end,as a apical stop. MTA (Angelus) was mixed to a paste consistency according to manufacturer's recommendations and packed (thickness of 2-5mm) into the apical third of the root canal with the help of MTA carrier.(specially designed lumber puncture needle). A moist cotton pellet was placed in the root canal to hasten the setting reaction of MTA. The patient

was recalled on next day and the remainder of the canal in 21 was sealed with customized gutta percha & coronal access was blocked with Glass Inomer cement (GIC).

Plain calcium hydroxide was placed in root canals of #11,coronal access was blocked with GIC . The patient was recalled after 8 weeks and the access cavity restoration was removed in 11 and the canal was irrigated . On radiographs and instrumentation apical barrior was found.(Fig 3) Rest of canal was obturated with customized gutta percha . Six months follow up radiograph revealed healed periapical lesion.(Fig 4).

Case 2 -A female aged 18 year reported in the department of Conservative Dentistry & Endodontics with a chief complaint of fracture of maxillary left & right central incisor. Detailed patient's history revealed trauma to the upper anterior teeth 9 years 'back. Both the teeth not responded to the hot stimulus in vitality test. Radiographic examination revealed an immature root apex in relation to 21 and 11.

21 was planned for root canal treatment using abgel as apical stop & MTA as apical barrier.

11 was planned for root canal treatment and plain calcium hydroxide was used to form apical barrier.
Informed consent was obtained from the patient after total explanation of the treatment plan.

The biomechanical preparation and MTA placement (in 21) was done in the same way as in the first case.

The patient was recalled on next day and the remainder of the canal in 21 was sealed with customized gutta percha & coronal access was blocked with GIC.(Glass inomer cement).

In 11 removal of calcium hydroxide dressing was done. The patient was recalled after 8 weeks. On radiograph and instrumentation no apical barrior was found. Again application of calcium hydroxide was done and patient was recalled after 4 weeks. After 4 weeks apical barrior was found on instrumentation and radiograph.

Rest of canal was obturated with customized gutta percha . Six months follow up radiograph revealed healed periapical lesion.

Case 3 –A female aged 19 year reported to the dental hospital with a complaint of discoloration in relation to upper front tooth. Detailed patient's history revealed trauma to the upper front teeth 9 yrs back. Both the teeth tested negative to the hot stimulus. Radiographic examination revealed an immature root apex in relation to 21 and 11.

21 was planned for root canal treatment using abgel as apical stop & MTA as apical barrier.

11 was planned for root canal treatment and plain calcium hydroxide was used to form apical barrier. Informed consent was obtained from the patient after total explanation of the treatment plan.

The biomechanical preparation and MTA placement (in 21) was done in the same way as in the previous case.
The patient was recalled on next day and the remainder of the canal in 21 was sealed with customized gutta percha & coronal access was blocked with GIC.(Glass inomer cement).

In 11 removal of calcium hydroxide dressing was done. Freshly mixed calcium hydroxide in normal saline was given and coronal access was blocked with GIC . The patient was recalled after 8 weeks and the access cavity restoration was removed in 11 and the canal was irrigated . On radiograph and instrumentation no apical barrior was found. Again application of calcium hydroxide was done and patient was recalled after 4 weeks. After 4 weeks apical barrior was not found on instrumentation and radiograph. So Calcium hydroxide and iodoform combination (Meta pex) was placed in the root canal and patient recalled after 3 weeks. After 3weeks apical barrior was found on instrumentation and radiograph.

Rest of canal was obturated with customized gutta percha . Six months follow up radiograph revealed healed periapical lesion.

Discussion

Apexification treatment is supposed to create an environment to permit deposition of cementum, bone and periodontal ligament to continue its function of root development. The goal of this treatment is to obtain an apical barrier to prevent the passage of toxins and bacteria into periapical tissues from root canal. Technically this barrier is necessary to allow compaction of root filling material.(8,9).

Despite higher success rate of apical barrier formation using calcium hydroxide long term follow-up is essential.

Fig 1- shows patients profile photograph with discolored maxillary right and left central incisor

Fig 2 - pre operative radiograph shows open apex in both maxillary central incisors,

Fig 3-maxillary right central incisor, MTA barrior was formed, and in maxillary left central incisor barrior was formed with calcium hydroxide.

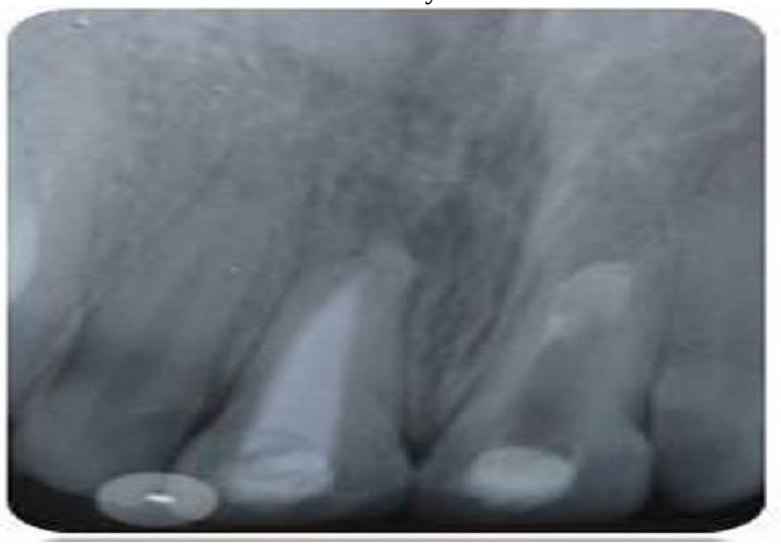

Fig 4- Six months follow up radiograph revealed healed periapical lesion

Previous studies have described the disadvantages of calcium hydroxide apexification such as failure to control infection, recurrence of infection and cervical fracture.(10).

Mineral trioxide aggregate as an apexification material represents a primary monoblock. Appetite like interfacial deposits form during the maturation of MTA result in filling the gap induced during material shrinkage phase and improves the frictional resistance of MTA to root canal walls. The formation of nonbonding and gap filing appetite crystals also accounts for seal of MTA.(11)
MTA has superior biocomaptibilty and it is less cytotoxic due to it's alkaline pH and presence of calcium and phosphate ions in its formulation results in capacity to attract blastic cells and promote favorable environment for cementum deposition.(12,13).

5mm barrier is significantly stronger and shows less leakage than 2mm barrier.(14)

The novel approach of apexification using MTA lessens the patient's treatment time between first appointment and final restoration. Importance of this approach lies in thorough cleaning of root canal followed by apical seal with material that favors regeneration. In addition there is less chance of root fracture in immature teeth with thin roots because the material immediately bonds with the roots and strengthens it.

Conclusion

Single visit apexification with a novel biocompatible material like MTA is a new boon in effective management of teeth with open apex .This innovative procedure is predictable and less time consuming one .However more numbers of case report / studies are required to substantiate single visit apexifiation.

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