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Mineral trioxide aggregate apical plug of non-vital immature permanent teeth with an open apex, two-year follow-up: A case series

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Abstract

Apexification is a procedure for closure of the open apices in non-vital immature permanent teeth and can be performed either using calcium hydroxide or mineral trioxide aggregate. Apexification with calcium-hydroxide is associated with some disadvantages such as weakened tooth structure, root canal re-infection and long treatment time. Single visit apexification using mineral trioxide aggregate apical plug method is an alternative treatment option for open apices and has gained popularity in the recent times. There are several case reports available describing the use of MTA as an apexification agent in incisors and premolar. In present cases, we have attempted to present successful treatment of three maxillary incisors teeth and one molar tooth with open apices and periapical lesions with mineral trioxide aggregate apical plug.

Keywords: Mineral trioxide aggregate, Apical plug, Apexification, Wide-open apex, Molar tooth.

Introduction

One of the aims of root canal treatment is to fill completely the root canal system to prevent re-infection. The apical closure is essential to endodontic therapy because it properly seals the root canals system as well as maintains the filling material restricted to the root canals[1]. In teeth with incomplete root development the absence of a natural constriction with thin and fragile dentinal wall can create challenging clinical situations[1]. Therefore, it is essential in these situations to create an artificial apical barrier to allow optimal filling of root canal obturating material avoiding over extrusion. The process is known as apexification or root-end-closure, has been advocated by Seltzer (1988) [2, 3].

There are many treatment options for such cases including the use of a rolled blunt-end cone, periapical surgery, short-fill technique, apexification (using calcium hydroxide (CH), mineral trioxide aggregate (MTA) or

biodentine) and pulp revascularization[4]. For many years, CH is the most commonly used material in apexification due to its biological and healing performance. Disadvantages related to the use of CH for a long period is the risk of root weakening along with tooth fracture and coronal microleakage. Additionally, the formed barrier may contain small amounts of soft tissue and porous[5].

To overcome prolonged treatment time, MTA has been reported to be an effective material for root end filling due to its excellent sealing ability and biocompatibility[6]. Several studies have demonstrated its capacity to induce odontoblastic differentiation, good radiopacity, low solubility, high pH, antimicrobial activity and expansion after setting[4, 6]. This paper illustrates case reports of non-vital, immature permanent teeth with open apex and treated by a single-visit apexification procedure using MTA as an apical plug.

Case 1

An 18-year-old male patient reported to the Department of Conservative Dentistry and Endodontics, Maitri College of Dentistry & Research Centre (Anjora; Durg) with chief complaint of pain in right mandibular posterior region for past several days. He had history of taken treatment to a dentist since than he had intermittent pain in affected tooth that is relieved by medicine. Now, he had pain which was increased in intensity since three days and not relieved by medication. Radiographic examination revealed that there was large periapical radiolucency and presence of open apex on distal root of the lower right 1st molar. The canals were also incompletely obturated. Hence, the diagnosis was the periapical abscess without sinus. Medical history was noncontributory.

The treatment plan was discussed with the patient and consent was taken. Isolation was done using rubber dam and access gained without local anesthesia. Old gutta-percha was removed. Apex locator (Root ZX, J. Morita Mfg Corp, Kyoto, Japan) produced inconsistent canal length reading so a check radiovisiography (Sopro Imaging, France) was used to confirm the actual working length of distal canal. Canals were gently instrumented using small number of hand K-file (Mani Japan). Copious irrigation was done with 1.5% sodium hypochloride (Prime Dental India) and sterile saline (Axa Parenterals Ltd India) using side vented needle. Intra-canal medicament calcium hydroxide (RC Cal; Prime dental product, Thane, India) was given. After two weeks the patient remained asymptomatic, the tooth was re-accessed; canals were irrigated with sterile saline and dried with paper points (Dentsply, Maillefer Ballaigues, Switzerland).

According to the manufacturer's instruction, MTA (Angelus, Londrina, PR, Brazil) powder was mixed with sterile water into a thick, grainy paste. MTA was placed with the help of MTA carrier and condensed using prefitted pluggers on to the apical end of the canal to create apical plug. To check the correct placement of MTA at apex a radiograph was taken. Once a plug of 4 mm is confirmed all excess MTAs were removed to the canal. Wet cotton pellet was placed in the pulp chamber and the access cavity was covered with temporary filling material Cavit G (3M ESPE Germany). The next day the access filling was removed and gently tested the set of MTA. The remaining distal canal and both the mesial canals were obturated using cold laterally condensed gutta-percha (Dentsply, Maillefer Ballaigues, Switzerland) and sealapex sealer (Sybron Endo, West Collins orange CA, USA). The access cavity was closed with glass ionomer cement. After the evidence of healing the tooth was restored with full coverage of metal-ceramic crown. (Figure 1)

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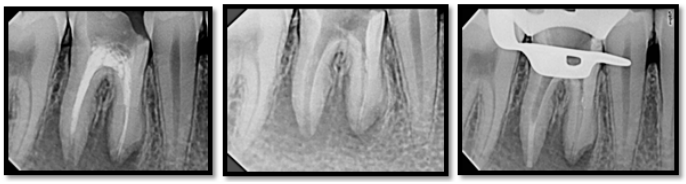
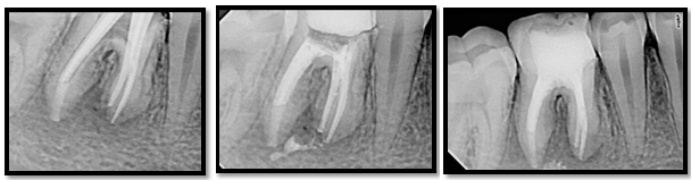


Figure 1. (a) Preoperative (b) Old guttapercha removed (c) Apical plug



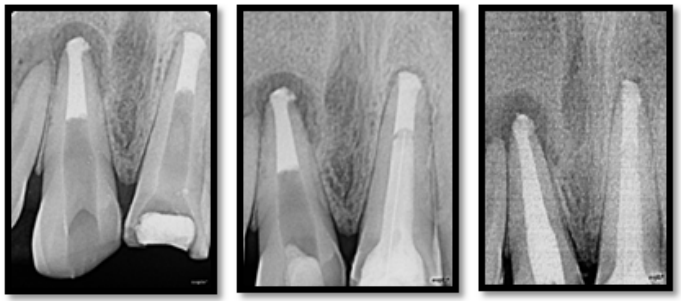
(d) Mastercone (e) Obturation (f) Follow up

Case 2

20-year-old male patient visited the Department of Conservative Dentistry and Endodontics, having chief complaint of discoloration and fracture of both upper front teeth about 8–9 years back due to trauma. Intraoral examination showed fractured and discolored both upper central incisors teeth. Loss of more than half of the tooth structure of left maxillary central incisor and enamel fractured in right central incisor. Hard swelling was present on labial mucosa near the root apex of the right central incisor. No intraoral draining sinus was present on the labial or palatal aspect. The fractured teeth were firm with no signs of tenderness on percussion and mobility was in normal physiological limits. All other maxillary and mandibular anterior teeth were normal with no signs of trauma or fracture. Radiographic examination showed that there was periapical radiolucency and presence of open apex on the roots of the both upper central incisors teeth. Medical history was noncontributory.

The diagnosis was Ellis Class IV fracture with open apex and discoloration. The treatment plan was discussed with the patient and consent was taken. Now, the root canal treatment was started. Isolation was done using rubber dam (Optra rubber dam, Ivoclar Vivadent USA) and access gained without local anesthesia. The same procedure was continued and MTA was filled as an apical plug. Right central incisor was obturated using cold laterally condensed gutta-percha (Dentsply, Maillefer) and sealapex sealer (Sybron Endo, West Collins orange CA, USA) and the left central incisor was restored with fiber post and core (Angelus, Londrina, Brazil). After the evidence of healing full coverage of metal-ceramic crowns were given. (Figure 2)

Figure 2: (a) Clinical photograph (b) Preoprative (c) Working length



(d) Apical plug (e) Fiber post (f) Post oprative

Case 3

22-year-old male patient visited the Department of Conservative Dentistry and Endodontics, having chief complaint of pain in upper right front tooth. He gave the history of trauma about 10–11 years back. At that time, he had taken treatment to a dentist. Last 15 days he had pain and swelling which was not relieved by medicine. On clinical examination, swelling was present on labial mucosa near the apex of the root of right central incisor. Tooth was slight rotated and tender on percussion without any opening sinus. Radiographic examination showed that periapical lesion was present on the apical region of the

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right central incisor and wide open apices with incomplete obturation. Hence, the diagnosis was the periapical abscess without sinus.

Now, the root canal treatment was started. Isolation was done using rubber dam (Optra rubber dam, Ivoclar Vivadent USA) and access gained without local anesthesia. Old gutta-percha was removed. The same procedure was continued and MTA was filled as an apical plug. Complete resolution of the symptoms was observed in subsequent follow-ups. (Figure 3)

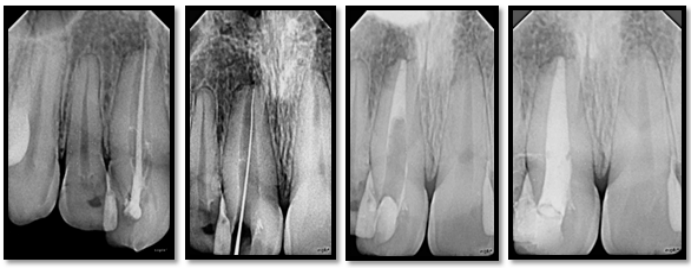

Figure 3: (a) Preoperative (b) Working length (c) Apical plug (d) Obturation

Discussion

Treatment of non-vital immature permanent teeth with open apices creates endodontic complications due to the thin and fragile dentinal walls. For many decades apexification using CH has been the treatment of choice aiming the formation of hard tissue barrier and healing in such conditions. However problems associated with CH such as multiple visits, reduced root strength and incomplete “Swiss cheese like” hard-tissue barrier formation has resulted in unpredictable outcome[7, 8].

Many materials have been proposed for apexification; however, MTA by Torabinejad et al has become material of choice for such cases[9]. MTA has a range of advantages such as antibacterial property, hard tissue formation, excellent sealing ability and biocompatibility[1, 10]. MTA is not affected by the presence of blood[11]. During the apexification procedure canals were gently instrumented till the correct working length due to the thin and fragile dentin walls and irrigated with 1.5% sodium hypochlorite (NaOCl) to disinfect the root canals. NaOCl is known to be toxic to the periapical tissues if goes beyond the apex; hence, it is advisable to use a less concentrated form which reduces its toxicity[1]. CH intra-canal medicament was placed in the canal and left for 2 week to control bacterial infection and creates an alkaline environment which is more ideal for MTA[1, 3].

It is recommended that a 3–5 mm thick plug of MTA should be placed at the apex for apexification procedures. Several authors successfully treated open apex cases by placing 2–5 mm of thickness of MTA at the apical end which provided an adequate seal[3]. In the present study, the thickness of the MTA apical plug varied from 4 mm to 5 mm which provide sufficient resistance for displacement as previous studies suggested. MTA needs 3–4 hours and moisture for complete setting and to become hard. Therefore, moist cotton is left in the canal and sealed temporarily for a day for complete setting[12].

Besides the apexification with CH and MTA apical plug placement techniques pulp revascularization is also a treatment option for non-vital immature permanent teeth. Pulp revascularization involves disinfecting the root canal system providing a matrix of blood clot into which cells could grow[1, 5]. The decision for apexification instead of revascularization was made primarily because,

1. The tooth length is comparable to neighboring teeth which all had closed apices. (case -1&3)
2. The diameter of the open apex was not more than 2 mm, which may be difficult to induce bleeding. (case -1&3)
3. One tooth is indicated for post and core; hence, revascularization did not seem the right treatment option because the vital tissue in apical two thirds of

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the canal cannot be violated for post placement. (case -2)

The outcomes in this case series are similar to previously reported cases of successful MTA apical plug procedures in non-vital immature permanent teeth with open apices Gunes B et al[13] (2012), Singh N et al[12] (2019) and Gautam R et al[8] (2020). In the present study, the two-year follow-up evaluation revealed complete healing in all the cases.

Conclusion

MTA apexification is the recommended procedure for non-vital immature permanent teeth with wide-open apices because the procedure is simple, predictable, well accepted by the patient and less time-consuming. MTA apical plug is an alternative treatment option where tooth requires immediate reinforcement by fiber posts. MTA is a promising biocompatible material which is used as an apical plug to seal the wide-open apex.

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