Single-step apexification with Mineral Trioxide Aggregate (MTA) – Case Reports

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Abstract:

lmmature teeth with necrotic pulp pose a clinical challenge as absence of the natural constriction makes control of filling materials difficult. Apexification is the procedure to promote the formation of an apical barrier in an immature non-vital tooth or to create an artificial barrier so that the filling materials can be contained within the root canal. Calcium Hydroxide had been the first choice material for apexification over the ages but Mineral Trioxide Aggregate (MTA) appears to be a promising alternative due to its high biocompatibility, superior sealing ability & reduced treatment time. Here we present a few cases where teeth with open apices and periapical lesions have been successfully treated with MTA apical plugs.

Key words: Immature teeth, one visit apexification, Mineral Trioxide Aggregate, monoblock, artificial barrier.

Introduction

The completion of root development and closure of the apex occurs up to 3 years after eruption of the tooth . The treatment of pulpal injury during this period provides a significant challenge for the clinician.[1]

Complete asepsis and three dimensional obturation of the root canal system are essential for long term endodontic success. In certain cases such as immature teeth, absence of natural apical constriction creates a challenge. One of the aims of endodontic treatment is to form an apical barrier or a stop against which one can place root canal filling material avoiding overextrusion. This technique is termed as apexification.[2] 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.'[3]

Morse et al. defined one-visit apexification as the non-surgical condensation of a biocompatible material into the apical end of the root canal. The rationale is to establish an apical stop that would enable the root canal to be filled immediately. There is no attempt at root end closure. Rather an artificial apical stop is created. A number of materials have been proposed for this purpose including tricalcium phosphate, calcium hydroxide, freeze dried bone and freeze-dried dentin. Favorable results have been reported.[4]

In the past, techniques for management of the open apex in non-vital teeth were confined to custom fitting the filling material, paste fills and apical surgery. A number of authors have described the use of custom fitted gutta-percha cones, but this is not advisable as the apical portion of the root is frequently wider than the coronal portion, making proper condensation of the guttapercha impossible. Sufficient widening of the coronal segment to make its diameter greater than that of the apical portion would significantly weaken the root and increase the risk of fracture.[4]

Calcium hydroxide has been the material of choice for apexification, with repeated changes over the course of 5–20 months to induce the formation of a calcific barrier. The unpredictable and often lengthy course of this treatment

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modality presents challenges, including the vulnerability of the temporary coronal restoration to re-infection. Moreover, the treatment requires a high level of patient compliance.[5]

For these reasons, one visit apexification has been suggested. Mineral trioxide aggregate (MTA) has been proposed as a material suitable for one visit apexification, as it combines biocompatibility, bacteriostatic action, with favourable sealing ability when used to repair root/pulp chamber perforations or as root-end filling material. MTA offers a barrier at the end of the root canal (apical plug) in teeth with necrotic pulps and open apices that permits vertical condensation of warm guttapercha in the remainder of the canal.[5]

This article presents three case reports where teeth with open apices were managed using single step apexification with MTA.

Case reports

Case 1 – A 21-year old male reported to the Department of Conservative Dentistry & Endodontics, Modern Dental College & Research Centre, Indore with a complaint of fractured & discoloured upper right front tooth with a history of trauma at the age of 9 years. Intraoral examination revealed Elli's Class 1 fracture and discolouration with 11. The preoperative radiograph revealed an open apex with 11 & a periapical radiolucency (Fig. 1). The tooth did not respond on pulp sensibility testing. A diagnosis of pulpal necrosis and chronic periradicular abscess was made. Rubber dam isolation was done. Access opening was done. The working length was determined radiographically. Cleaning and shaping was done by light hand filing since the dentinal walls were thin. Irrigation was done with 5.2% sodium hypochlorite & normal saline. The canal was dried followed by placement of calcium hydroxide paste as intracanal medicament. The access cavity was sealed with atemporary cement. After a week, the root canal was found to be completely dry. The canal was irrigated with 5.2% sodium hypochlorite followed by 17% EDTA & final rinse with 2% chlorhexidine. The canal was dried. Mineral trioxide aggregate(MTA) was mixed with distilled water to sandy consistency. The mix was placed with MTA carrier in the apical portion of the canal. Increments were condensed with hand pluggers till thickness of 3-4mm (Fig. 2). A wet cotton was placed and access cavity was sealed. In subsequent appointment, obturation was done by cold lateral condensation technique (Fig. 3).

Fig. 1 Preoperative radiograph

Fig. 2 Apical 3-4mm MTA plug

Fig. 3 Postobturation radiograph

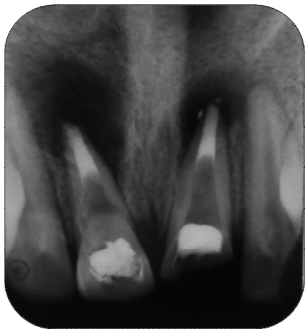
Fig. 4 Preoperative radiograph

Case 2 – A 19-year old male reported to the Department of Conservative Dentistry & Endodontics, Modern Dental College & Research Centre, Indore with a complaint of pus disharge & discolouration with upper right front tooth. Intraoral examination showed a sinus opening and discolouration with 22. Grade I mobility was present. The preoperative radiograph revealed an open apex with 22 & a periapical radiolucency as well as periodontal bone loss with 22 (Fig. 4). The tooth did not respond on pulp sensibility testing. A diagnosis of pulpal necrosis and chronic periradicular abscess was made. The case was managed in a way similar to previous case. (Fig. 5 & 6).

Fig. 5 Apical 3-4mm MTA plug

Fig. 6 Post obturation radiograph

Case 3 – A 18-year old male reported to the Department of Conservative Dentistry & Endodontics, Modern Dental College & Research Centre, Indore with a complaint of pus disharge with & fractured upper front tooth. The patient gave history of root canal treatment of 11 & 21 six months back after which he discontinued the treatment. Intraoral examination showed a sinus opening and discolouration with 11 & 21. Access cavities were seen with 11 & 21. The preoperative radiograph revealed open apices & periapical radiolucencies with 11 & 21 (Fig. 7). Access cavities were modified, all the debris was removed with the H-files & irrigation was done with 5.2% sodium hypochlorite & normal saline. Extensive caries with 11 were excavated. After placement of an intracanal dressing of calcium hydroxide for 1 week, obturation was done by cold lateral condensation technique with 11. 21 was restored with a fiber post & core followed by crown placement. (Fig. 8 & 9)



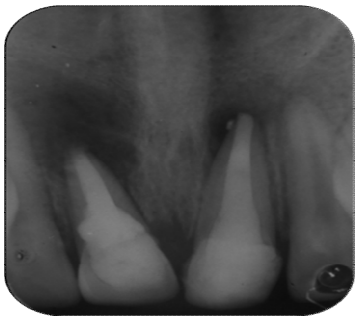


Fig.7 Preoperative radiograph Fig. 8 Apical 3-4mm MTA plug Fig. 9 Postobturation radiograph

Discussion:

When treating nonvital teeth, the main issue is eliminating bacteria from the root canal system. As instruments cannot be used properly in teeth with open apices because of often divergent apices & thin dentinal walls, cleaning and disinfection of the root canal system rely on the chemical

action of NaOCl as an irrigant and calcium hydroxide as an intracanal dressing.[6]

MTA is a powder consisting of fine hydrophilic particles of tricalcium silicate, tricalcium oxide and silicate oxide. It has low solubility and a radiopacity that is slightly greater than that of dentin. This material has demonstrated good sealability and biocompatibility. MTA has a pH of 12.5 after setting which is similar to the pH of calcium hydroxide and it has been suggested that this may impart some antimicrobial properties.[7]

Because of MTA's excellent biological properties and ability to create a good seal, it has been recommended for creating an artificial barrier in the apical area of teeth
with open apices, thus compressing treatment time to 1 or 2 visits.[8] The cell's response to MTA and the mechanism of deposition in barrier formation are unknown and require further investigation.[9]

Mineral trioxide aggregate as an apexification material represents a primary monoblock. Apatite-like interfacial deposits form during the maturation of MTA resulting 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 filling apatite crystals also accounts for seal of MTA. MTA has superior biocomaptibilty and it is less cytotoxic due to its alkaline pH and presence of calcium and phosphate ions in its formulation resulting in capacity to attract blastic cells and promote favorable environment for cementum deposition.[10]

The apical plug created with MTA can be interpreted as an artificial barrier to condense the subsequent root canal filling material, in order to prevent reinfection of the canal system.[5] Some authors have postulated that possible leakage of MTA could be influenced by the thickness of the apical plug. A recent study reported that the orthograde use of MTA provided an adequate seal against bacterial infiltration regardless of the thickness of the apical plug.[11] Hachmeister et al underlined that the thickness of the apical plug may have a significant impact only on displacement resistance.[12]

In the present case reports, the thickness of the MTA apical plug varied from 3 mm to 5 mm. In teeth with a short root canal the thickness of the apical plug was reduced to 3 mm to allow for the subsequent filling of the more superficial portion of the canal with resin materials. 5mm barrier is significantly stronger and shows less leakage than 2 mm barrier.[13]

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 a 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.[14]

The choice of treatment regimen for teeth with open apices depends on the individual case and operator experience and familiarity with handling the various materials. Patient availability for follow-up appointments should be considered as well if multiple sessions are required.[15]

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.

References:

1. Bhasker SN. Orban's Oral histology and Embryology, 11th edn. St. Louis: Mosby-Year Book;1991.
2. Felippe WT, Felippe MC, Rocha MJ. The effect of mineral trioxide aggregate on the apexification and periapical healing of

teeth with incomplete root formation. Int Endod J 2006;39(1):2-9.
3. American Association of Endodontists. Glossary of endodontic terms, 7th edn. Chicago: American Association of Endodontists; 2003.
4. Rafter M. Apexification: a review. Dent Traumatol 2005;21:1–8.
5. Pace R, Giuliani V, Pini Prato L, Baccetti T, Pagavino G. Apical plug technique using
mineral trioxide aggregate: results from a case series. Int Endod J 2007;40:478-84.
6. Siqueira JF Jr, Guimarães-Pinto T, Rôças IN. Effects of chemomechanical preparation with 2.5% sodium hypochlorite and intracanal medication with calcium hydroxide on cultivable bacteria in infected root canals. J Endod 2007;33(7):800-5.
7. Parirokh M, Torabinejad M. Mineral Trioxide Aggregate: A Comprehensive Literature
Review—Part I: Chemical, Physical, and Antibacterial Properties. J Endod 2010;36:16–27.
8. Shabahang S, Torabinejad M, Boyne PP, Abedi H, McMillan P. A comparative study of root-end induction using osteogenic protein-1, calcium hydroxide, and mineral trioxide aggregate in dogs. J Endod 1999;25(1):1-5.
9. Felippe MC, Felippe WT, Marques MM, Antoniazzi JH. The effect of renewal of calcium hydroxide paste on the apexification and periapical healing of teeth with incomplete root formation. Int Endod J 2005;38(7):436-42.
10. Tay FR, Pashley DH. Monoblocks in root canals: A hypothetical or a tangible goal. J Endod 2007;33:391–8.
11. de Leimburg ML, Angeretti A, Ceruti P, Lendini M, Pasqualini D, Berutti E. MTA obturation of pulpless teeth with open apices: bacterial leakage as detected by polymerase chain reaction assay. J Endod 2004;30:883–6.
12. Hachmeister DR, Schindler G, Walker WA, Thomas DD. The sealing ability and retention characteristics of mineral trioxide aggregate in a model of apexification. J Endod 2002;28:386–90.
13. Matt GD ,Thorpe JR, Strother JM, McClanahan SB. Comparative study of white and gray mineral trioxide aggregate (MTA) simulating a one- or two-step apical barrier technique. J Endod 2004;30:876-879.
14. Kubasad GC, Ghivari SB. Apexification with apical plug of MTA-Report of cases. Archives of Oral Sciences & Research 2011;1(2):104-107.
15. Raldi DP, Mello I, Habitante SM, Lage-Marques JL, Coil J. Treatment Options for Teeth with Open Apices and Apical Periodontitis. Journal of Canadian Dental Association 2009;75(8):591-596.
15. Raldi DP, Mello I, Habitante SM, Lage-Marques JL, Coil J. Treatment Options for Teeth with Open Apices and Apical Periodontitis. Journal of Canadian Dental Association. 2009; 75(8): 591-596.

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