MTA AS AN APICAL PLUG IN NONVITAL TOOTH WITH OPEN APEX : A CASE REPORT

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KATA KUNCI

Plug apikal, gigi imatur, MTA

ABSTRAK

Gigi imatur dengan nekrosis pulpa akibat trauma , karies atau pathosis pulpa. Dimana pembentukan dentin terganggu dan perkembangan akar berhenti sehingga terjadi perubahan warna gigi. Mineral trioxide aggregate (MTA) adalah bahan alternatif yang dapat digunakan untuk apeksifikasi apeks terbuka karena biokompatibilitasnya, non-mutagenisitas, non-neurotoksisitas, kemampuan regeneratif, dan sifat *seal* yang baik. Pada kasus ini penggunaan MTA sebagai plug apikal, pada gigi yang imature dengan apeks terbuka merupakan keputusan yang tepat. Tujuan dari laporan kasus ini adalah menjelaskan penggunaan MTA sebagai *apical pluq* pada gigi insisivus lateral maksila dengan diagnosis pulpa nekrosis dengan apeks terbuka dan dilanjutkan *bleaching internal*. Seorang pasien pria 43 tahun yang datang ke RSGM, Universitas Sumatera Utara dengan keluhan utama gigi yang berubah warna . Pemeriksaan radiografi menunjukkan apeks terbuka untuk gigi #12. Setelah *cleaning and shapping* dilakukan, kalsium hidroksida ditempatkan sebagai medikamen intracanal. MTA diletakkan kedalam saluran akar dengan ketebalan 3-4 mm menggunakan hand pluggers. Obturasi dengan *gutta-percha* termoplastik. Penggunaan MTA telah banyak direkomendasikan untuk kasus apeks terbuka. Karena memiliki *apical seal* yang baik, biokompatibilitas dan kemampuan regenerasi jaringan periodontal. Setelah di Follow up tidak adanya keluhan baik secara klinis maupun radiografi. Laporan kasus ini menunjukkan MTA sebagai bahan alternatif untuk *apical plug* pada metode konvensional apeksifikasi.

KEYWORDS

Apical plug, Immature tooth, MTA

ABSTRACT

Immature tooth may undergo pulp necrosis due to trauma, caries or other pulpal pathosis. Dentin formation is interrupted and root development ceases and caused discoloration of the tooth. Mineral trioxide aggregate (MTA) is an alternative material that can be used for apexification of an open apices due to its biocompatibility, non-mutagenicity, non-neurotoxicity, regenerative abilities, and good sealing properties. A positive clinical resolution of this case report is to encourage the use of white MTA as an apical plug, in immature tooth with open apex. The aim of this case report is to describe the outcome of apexification in a maxillary lateral incisor with diagnosis necrotic pulp with open apex using MTA as an apical barrier followed by internal bleaching. A 43 years old male patient came to RSGM, University of Sumatera Utara with chief complaint the discoloration of his teeth. Radiographic examination showed the open apex of tooth 12#. Following canal cleaning and shaping, calcium hydroxide was placed as an intracanal medicament. An apical plug of MTA with 3-4

mm thickness was placed using hand pluggers and allow to set. Thereafter, the remainder of the canal system was filled with thermoplasticised gutta-percha.The access cavity was then restored with composite resin. MTA has been widely recommended for plugging open apices.It has good apical seal, biocompatibility and periodontal tissue regenerating capabilities. Follow-up visit the restoration of restored aesthetics and function, and the absence of clinical signs and symptoms. This case report suggests that the use of MTA as an apical sealing material is a significant alternative to the conventional methods of apexification.

BACKGROUND

Root development commences after the completion of enamel formation. The cells of inner and outer enamel epithelia unite at point forming cervical loop, begin to proliferate and form a structure known as the Hertwig epithelial sheath. This sheath determines the size and shape of roots of the tooth. Apical root closure is completed approximately 2-3 years after tooth eruption.[1] Apexification is histological term defined as "a method to induce a calcified barrier in a root with open apex. The infected necrotic pulp is removed up to the apex by means of mechanical debridement and antiseptic chemical irrigation. Apical hard tissue barrier formation following apexification is a reparative process of the dentine-pulp complex. However, continued physiologic root development of immature permanent tooth with infected necrotic pulps and apical periodontitis after apexification procedure with calcium hydroxide was reported.[1]

Calcium hydroxide has been the first choice material for apexification, with repeated changes over the course of 5–20 months to induce the formation of a calcific barrier[1]. The unpredictable and often lengthy course of this treatment modality presents challenges, including the vulnerability of the temporary coronal restoration to reinfection[2]. Moreover, the treatment requires a high level of patient compliance. For these reasons, one visit apexification has been suggested[3]. Mineral trioxide aggregate (MTA) has been proposed as a material suitable for one visit apexification[4,5,6], as it combines biocompatibility[7,8] and bacteriostatic action[9] with favourable sealing ability when used to repair root/pulp chamber perforations[10,11] or as a root-end filling material [12,13]. MTA offers a barrier at the end of the root canal (apical plug) in teeth with necrotic pulps and open apices[4] that permits vertical condensation of warm guttapercha in the remainder of the canal. [2]

Mineral trioxide aggregate (MTA) has few potential uses in endodontics as a root canal filling material. The other uses of MTA in dentistry are regeneration of periradicular tissues such as bone, cementum, and periodontal ligament. MTA has an excellent sealing ability, the reason for this is the material is a hydraulic cement that sets even in the presence of moisture. The main goal

of the treatment is to achive apical seal. In the past, this apical seal was achieved by creating a barrier with hard tissue, a procedure known as apexification. Among these materials, MTA is the most popular for this procedure. MTA is composed of fine hydrophilic particles of tricalcium silicate, silicate oxide, and tricalcium oxide. When mixed with sterile water, it forms a colloidal gel and the setting time is 3-4 h in the presence of moisture.[3] Mineral trioxide aggregate (MTA) is an alternative material that can be used for apexification of open apices due to its biocompatibility, non-mutagenicity, non-neurotoxicity, regenerative abilities, and good sealing properties.The MTA offers a series of advantages: (i) shortened treatment time, (ii) the possibility of restoring the tooth with only minimum delay, thereby preventing possible fracture, and (iii) the avoidance of changes in dentin mechanical properties associated with the prolonged use of calcium hydroxide.[14,15,16]

The aim of this case report is to describes the outcome of apexification in a maxillary lateral incisor with diagnose necrotic pulp and open apex by using MTA as an apical barrier followed by internal bleaching.

CASE AND MANAGEMENT

A 43 years old male patient who came to RSGM, University of Sumatera Utara with chief complaint of the discoloration of right maxilary lateral incisor with a history of trauma. No other significant dental or medical history was found and there were no drug allergies noted. Based intraoral examination, the discoloration of tooth was found and radiographic examination an showed open apex in tooth 12# (Figure 1a & 1b). Palpation and percussion test of the involved tooth did not reveal any tenderness. The tooth was not mobile and periodontal probing around the tooth was within physiological limits. Electric pulp testing (Parkell Electronics Division, Farmingdale, NY, USA) of the involved tooth gave no response. The radiographic examination of the tooth revealed a wide canal with an open apex and a marked radiolucency in the periapically. Clinical and radiographic examination a indicated non vital pulp. The available treatment options were discussed with the patient and endodontic treatment with calcium hydroxide dressing, followed by apexification with MTA was selected followed internal bleaching.

(a) (b)

Figure 1. (a). Preoperative radiograph showed open apex to tooth #12 (b) preoperative intraoral form labial view.

Following rubber dam and an endodontic access cavity was established. The root canal was negotiated and with K-file No. #80. As the apex locator (Raypex 6,VDW) produced canal length readings, the working length was established radiographically with a #80 Kfile (Dentsply Maillefer, Ballaigues, Switzerland) (Figure 2) and was recorded for reference. The canal was gently instrumented to #80 Kfiles using a circumferential filing motion with copious irrigation with 1% sodium hypochlorite solution. The canal was dried with sterile paper points, and calcium hydroxide paste (VioPaste®- Spident) was placed as an intracanal medicament and the access cavity was sealed with temporary filling (Fuji I, GC Corp).

Two weeks later, the calcium hydroxide was removed from the canal aided by careful instrumentation with K-files (Dentsply Maillefer, Ballaigues, Switzerland) and sodium hypochlorite irrigation, and the root canal was dried with sterile paper tips. We then mixed powdered MTA Rootdent (Dentsply Tulsa Dental, Johnson City, TN, USA) with physiological saline solution in 3:1 proportion, and transferred the mixture to the interior of the canal with an amalgam carrier. The material was condensed with blunt paper tips until reaching the apical extremity of the root to form a 4-mm MTA plug. A humid cotton pellet in turn was placed at the entry to the canal to facilitate setting of the MTA and the cavity was sealed with temporary filling (Cavit, 3M ESPE)

(2)

Figure 2. Working length determination.

After 3 days, the hardness of the MTA was examined using a plugger to confirm its set. The canal was back-filled with injection-moulded thermoplasticized gutta-percha (Diagun cordless backfill obturation system, Diadent) (Figure 3a & 3b). The radiographs to assess the quality of obturation was done. Cavity was sealed with RMGIC for barrier.

(a) (b)

Figure 3. (a) Clinical view after backfill obturation. (b) Periapical radiograph showed placement of apical plug of MTA of 4 mm thickness and obturation of the canal using thermoplasticized gutta percha

Next visit, tooth color was evaluated with shade guide (VITA Classic). The patient's initial shade is an C4 in 2/3 cervical Fig 4.a. The root filling in the coronal pulp chamber was removed to 2-3 mm below the facial cemento enamel junction. The resin modified glass ionomer cement was placed as >2 mm above the GP as a protective seal. The coronal height of barrier should protect the dentinal tubules and conform to the external epithelial attachment. One day later, temporary filling was removed, 35%. Hidrogen peroxide whitening gel (Opalescence endo ®, Ultradent) was placed into pulp chamber (Figure 4a & 4b). After removing the excess bleaching paste, temporary restoration was placed over it.

(a) (b)

Figure 4. (a) initial shade is an C4 in 2/3 cervical. (b) 35% Hidrogen peroxide whitening gel (Opalescence endo ®, Ultradent) was placed into pulp chamber

The patient was recalled after 1 week. Desired shade is achieved in one time bleach. The postoperative shade is now an A3. Patient had at least 7 vita scale tabs change from a dark tab to a lighter tab in 2/3 cervical (Figure 5a & 5b). One week later, It was restored with direct composite resin (Filtek Z350 XT, 3M). The patient noticed a marked improvement and was very pleased with the final outcome. Patient was recalled after 3, 6, 9 and 12 months for follow-up.

(a) (b)

Figure 5 (a) The postoperative shade is now an A3. (b). Final bleaching

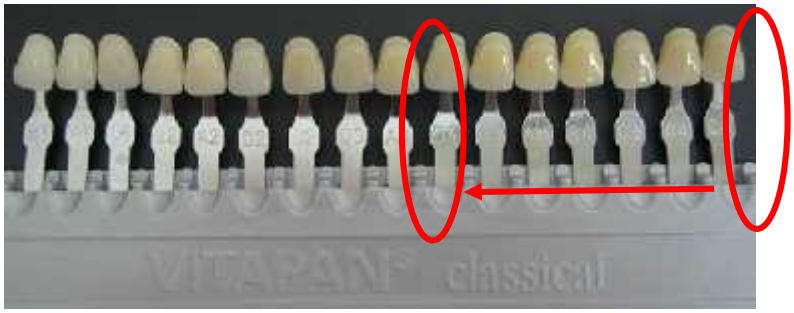

Figure 6. Patient had at least 7 vita scale tabs change from a dark tab to a lighter tab in 2/3 cervical

(a) (b) (c)

Figure 7. (a) Preoperative radiograph. (b) Postoperative radiograph. (c) three months postoperative follow-up

DISCUSSION

Calcium hydroxide has been used with great success to effect an apical hard tissue barrier in immature open apices.The time interval for calcium hydroxide apexification has been reported to be variable, ranging from 3-24 months. In this case, the speedy barrier formation could be attributed to the frequent calcium hydroxide dressing replacement. The barrier produced by calcium hydroxide apexification has been reported to be incomplete having swiss cheese appearance, and can allow apical microleakage. Thus a permanent root canal filling is still mandatory. Pulp revascularization remains a good treatment option for such cases but the patient was not agreeable due to the time constraints. So, one step apexification with MTA was decided for this case[17].

The formation of an apical barrier is necessary in order to fill the root canal system without the risk of overfilling. In this

sense, apexification with MTA offers an alternative for conventional treatment with calcium hydroxide. Clinical and radiographic examination showed success after MTA treatment. When treating a tooth with necrotic pulp, the main objective is to eliminate bacteria from the root canal system. Since instruments cannot be properly used in teeth with open apexes, disinfection and cleaning of the root canal depends on the chemical action of the sodium hypochlorite used as irrigant and calcium hydroxide used as canal lining material. Some authors use a 1% sodium hypochlorite concentration, while others prefer 5% concentration. In this case, sodium hypochlorite was used at a concentration of 2.5% Such overfilling could have been avoided by placing resorbable collagen sponges at apical level. Studies in patient confirmed bone healing, and the patient were seen to be asymptomatic[18,19].

One visit apexification technique using Mineral Trioxide Aggregate (MTA) as osteoconductive apical barrier. MTA is relatively non cytotoxic and stimulates cementogenesis. This Portland cement-based material generates a high alkaline aqueous environment by leaching the calcium and hydroxyl ions, rendering its bioactive by forming hydroxyappatite in the presence of phosphate containing fluids. Unlike the extended use of Ca(OH)2 in immature roots, prolonged filling of these roots with MTA did not reduce their fracture resistance. 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[17,18].

Calcium hydroxide has been used with great success to effect as an apical hard tissue barrier in immature open apices.The time interval for calcium hydroxide apexification has been reported to be variable, ranging from 3-24 months. In this case, the speedy barrier formation could be attributed to the frequent calcium hydroxide dressing replacement . The barrier produced by calcium hydroxide apexification has been reported to be incomplete having swiss cheese appearance, and can allow apical microleakage. Thus a permanent root canal filling is still mandatory. Pulp revascularization remains a good treatment option for such cases but the patient was not agreeable to the time constraints. Hence, one step apexification with MTA was decided for this case. MTA has been widely recommended for plugging open apices.It has good apical seal, biocompatible and has a good pulpal and periodontal tissue regenerating capabilities. Authors have reported that MTA root fillings placed at the border of the cemental canal showed better results than overfillings .Various materials have been used to prevent MTA extrusion into the periodontal tissues, including hyroxyapatite, collagen, calcium phosphate cement and calcium sulphate. In this case, the apical stop gained by calcium hydroxide

was used to obtain a dense MTA plug within the apical border of the tooth. The three months follow up showed clinical and radiographic signs of healing[15,17].

Tooth bleaching today use hydrogen peroxide as the active agent. Hydrogen peroxide acts as a strong oxidizing agent through the formation of free radicals, reactive oxygen molecules and hydrogen peroxide anions. These reactive molecules attack the long chained, dark colored chromophore molecules and split them into smaller, less colored and more diffusible molecules. The outcome of bleaching procedure depends mainly on the concentration of bleaching agents, the ability of the agents to reach the chromophore molecules and the duration and number of times the agent is in contact with chromophore molecules. Hydrogen Peroxide (H_2O_2) breaks down in to water and nascent oxygen. It also forms free radical perhydroxyl (HO_2) which is responsible for bleaching action[20].

Mechanism of bleaching is mainly linked to degradation of high molecular weight complex organic molecules that reflect a specific wavelength of light that is responsible for color of stain. The result of degradation are the lower molecular weight and composed of less[21] complex molecules composition that reflect less light, resulting in a reduction or elimination of discoloration.

Intracoronal technique can be used for whitening of discolored non vital teeth, which is simple and time-saving method with superior esthetic results and safety. Hydrogen peroxide may be applied directly or produced in a chemical reaction from sodium perborate or carbamid peroxide in the coronal portion of the pulp chamber. Lim et al found that 30% carbamide peroxide and 35% hydrogen peroxide were equally effective for intracoronal bleaching, and significantly better than sodium perborate after one bleaching treatment for 7 days. After a second bleaching treatment for another 7 days, there were no significant differences between the groups. First generation bleaching materials were available in liquid and then was modified more viscous (gel). One of bleaching material commonly used for non vital teeth is Opalescence® Endo®, a 35% hydrogen peroxide material with high viscosity formula allows for easy placement and no curing light needed (activated by intra-oral temperature)[22].

CONCLUSION

Placement of an apical barrier using MTA is an alternative to conventional long-term calcium hydroxide therapy, which reduces the treatment time. Moreover, MTA apical plug can be considered very effective in stimulating regeneration of apical tissue in immature permanent teeth with open apices.

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