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Two Clinical Techniques of Placing MTA Apical Plug in Teeth with Large Foramens-Series of Cases

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CASE REPORT

Abstract

Endodontic retreatment of teeth with periapical lesions and large apical foramens is provocative for clinicians due to the impossibility to fill the root canal only with gutta-percha and sealer. An impenetrable apical seal of Mineral Trioxide Aggregate (MTA) is recommended therefore in these cases to ensure a hard barrier over which gutta-percha could be easily condensed, procedure requiring good clinical skills and magnification under microscope. In many cases, to control the root canal humidity or to prevent the extrusion of MTA into the surrounding periapical tissues, a collagenic membrane has to be placed in direct contact. The present series of cases describes the retreatment and the technical steps of placing MTA apical plug in three teeth where orthograde retreatment has been performed. In one of the cases, a resorbable collagenic membrane was used. The 9 months follow up of the case shows initiation of healing with new bone formation.

Keywords: MTA apical plug, collagenic resorbable membrane, endodontic retreatment.

I. INTRODUCTION

A major problem associated with the endodontic treatment of teeth with pulpal necrosis is to achieve a complete debridement, canal disinfection and an optimal seal in the apical area when large apical foramens or incomplete apical development is associated [1]. In the past, calcium hydroxide $Ca(OH)_2$ apexification procedures were the most used clinical methods for providing an apical bridge to close the apex of the incompletely formed teeth and to allow a permanent root canal filling. Unfortunately, apexification with calcium hydroxide requires excellent patient compliance because of the necessary long-term application of the dressing material, from 3–24 months, to obtain a complete closure of the root apex [2].

In recent years, researchers have been investigating materials capable of being permanently applied at the end of the root canal in teeth with large apical foramens in order to create an artificial barrier, which will allow the immediate filling of the root canal and compress the process of the endodontic treatment into one or maximum two visits [3].

The biocompatibility of mineral trioxide aggregate (MTA), its satisfactory sealing ability in the presence of moisture, including blood [4] and its property to create an apical mechanically resistant barrier over which gutta-percha can be easily compacted to fill the rest of the root canal, are properties that support its successful application in obturating non-vital teeth with open apices consequence of a pulpal necrosis produced during root development or as a result of a periapical lesion resorbing the apex of the tooth [3-5]. Moreover, used in contact with periradicular tissues, MTA has the ability to induce a cement-like hard tissue barrier [5-7]. Thus, the MTA plug placed in the apical third of the root canal promotes apical repair and prevents root canal overfilling, ensuring that in conjunction with a permanently bonded restoration, the retention of the immature teeth on the dental arch is enhanced, and their fracture resistance is increased [8-9].

The aim of the present paper is to report two clinical cases (3 teeth in total) with large apical foramens in need for endodontic orthograde retreatment, performed using magnification under the dental operating microscope. The sealing of the root canals in all three teeth was achieved by using MTA as apical plug. In one of the cases, an upper central incisor, a resorbable collagenic membrane was placed in direct contact with the periapical tissues in order to ensure a proper environment for the compaction of MTA in the root canal. In the second case, two central incisors were retreated in the same manner. The difficulty was represented in this case by the metallic posts cemented in the root canals in the initial enododontic treatment and by the large size of the canals and

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apical foramens observed at the preoperative radiography, necessitating apical MTA plugs.

II. CLINICAL CASES

Case 1

A 22-years-old male patient addressed to the Endodontic Department of the Faculty of Dentistry Timisoara dissatisfied by the aesthetic appearance of his left upper central incisor. Following the clinical and radiological examination (Figure 1) it was observed that the tooth covered by a fixed acrylic prosthetic restoration has been previously treated and presented a large chronical periapical lesion with a sinus tract on the buccal oral mucosa. The patient reported that his permanent maxillary left central incisor was traumatized in his childhood and was endodontically treated 4 years ago because of its appearance, being necrotic and with dyscrhomia. The tooth was also prosthetically restored. At the radiological examination, the previously filled root canal presented a large apical foramen as a result of the resorption process determined by the apical lesion and due to the history of trauma before the complete development of the root. Orthograde endodontic retreatment was decided and the need of an apical MTA plug for root canal obturation.

After administration of local anesthesia (1.7 ml Ubistesin 1/200 000) and removal of the acrylic crown, a rubber dam was placed for isolation directly on tooth 2.1. The access cavity was performed under the dental operating microscope (Alltion, Wuzhou, China) at a magnification of x0.6 on the palatal surface using a round diamond long neck bur at high-speed under water cooling. To remove the old intra-canal filling material, rotary nickel-titanium instruments Reciproc 40/.06 (VDW GmbH Munich, Germany) and hand K-files (Kendo, VDW) were used in a crown-down technique. The working length (WL) was determined using an apex locator and was correlated with the radiographic length of the tooth.

During instrumentation, irrigation was performed using sodium hypochlorite NaOCl solution 2.5% (Chloraxid, Cerkamed, Stalowa Wolla, Poland) in alternation with 20% citric acid solution (Cerkamed) and ultrasonic activation with IRRI #25 US tip (Satelec Acteon Group, Merignac, France) and Satelec P5 Booster (Satelec Acteon Group).

A foramen ISO size #80 was measured using stainless-steel hand K-files in the end of the retreatment. The canal was dried with sterile paper points, and a premixed $Ca(OH)_2$ paste (CALCIPASTE, Cerkamed, Poland) was placed to the working length for two weeks as intermarry medication. The access cavity was sealed with sterile cotton pellets and glass ionomer filling material Ketac Molar (3M Espe AG, Seefeld, Germany).

After 2 weeks, the $Ca(OH)_2$ dressing was removed by repeated rinsing with 2.5% NaOCl and 20% citric-acid solution, and a final flush with distilled water followed. The canal was dried with capillary tips (Aplikatory, Cerkamed) connected to a surgical suction device and then with large paper points. Machtou stainless steel hand plugger no. 3 (Dentsply Sirona, Ballaigues, Switzerland) was fitted 1 mm shorter than the working length (WL) using a silicone stopper and verified in the root canal.

Figure 1. a. Initial periapical X-ray of the failed root canal treatment of the left maxillary central incisor; **b**. control X-ray 9 months after retreatment with MTA plug and restoration with fiber post and a provisional crown

A silicone stopper was placed on a 0.8 mm MTA Carrier (Cerkamed) 2 mm shorter than WL and his depth of penetration into the root canal was verified. Because periapical tisular fluids were unable to be properly controlled in order to obtain a favorable environment for the MTA plug, a resorbable collagenic membrane (Theraform, Sellon Cellontech Co., Ltd., Seoul, Korea) was placed under the microscope at 1.6x magnification into the root canal and condensed in the periapical area in contact with the apical foramen with the Machtou stainless steel hand plugger no. 3 0.8 mm (Dentsply Sirona, Ballaigues, Switzerland), in order to prevent the apical extrusion of the MTA material and to ensure the dryness of the root canal. BIO MTA (Cerkamed) was mixed according to manufacturer's instructions and placed into the root canal using the 0.8 mm MTA Carrier (Cerkamed) at approximately 2.0 mm short of the working length; it was condensed and adapted to the apical canal walls using Machtou hand pluggers no. 3/4 and large sterile paper points 80/.06 (META Biomed, Shanghai, China) to absorb excessive moisture. Multiple waves of placement-compaction were necessary for MTA in order to insure a dense apical plug of 5 mm height (Figure 2a-d). After MTA hardening, a fiber post was adhesively cemented into the root canal using RelyX U 200 (3M ESPE AG, Seefeld, Germany) self-adhesive resin cement and the coronal restoration followed with composite resins. A provisional prosthetic restoration followed. At the 9 months control radiography, the lesion is smaller and signs of healing with new bone formation can be observed (Figure 1b).

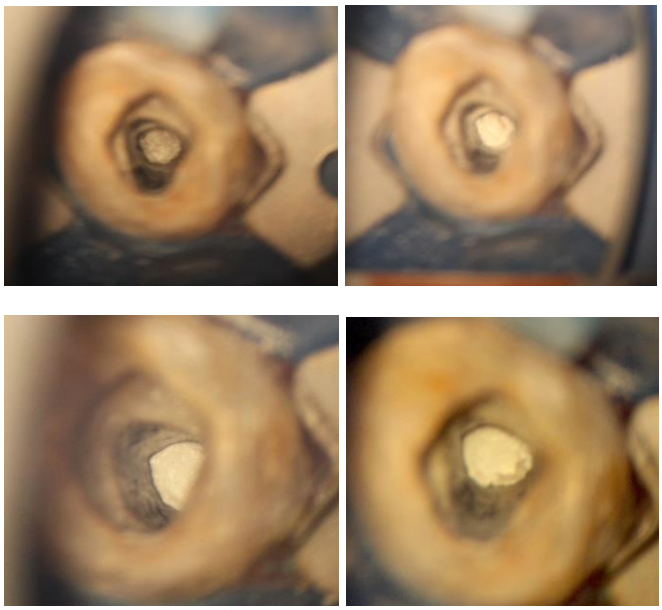

Figure 2. a. Placement of the resorbable collagenic membrane in contact with the periapical tissues; **b-d.** Successive compaction of the MTA apical plug (x1.6)

Case 2

A 39 years-old female patient with no general health problems presented to a private dental clinic complaining about gum bleeding and poor aesthetic regarding her frontal prosthetic restorations on the four upper incisors. When the patient was referred to the endodontist, the prosthetic restorations on teeth 1.2, 1.1, 2.1, 2.2 have already been removed. The clinical and radiological examination on the panoramical X-ray revealed that teeth 1.2, 1.1, 2.1, 2.2 have received previous root canal treatment and crown build-ups with metallic posts cemented into root canals, with small periapical lesions and large apical foramens on teeth 1.1 and 2.1 (Figure 3a). Orthograde retreatment with the removal of the metallic posts was decided for both teeth, which were retreated in separate appointments.

After the administration of local anesthesia (1.7 ml Ubistesin forte, 1/100.000), rubber dam was placed on each tooth using a #212 rubber dam clamp and the removal of metallic posts followed first by using a metal bur at high speed to reduce its height and dimension. Flame diamond high-speed burs (Frank Dental, Germany) were initially used to expose and isolate the cement around the post. Ultrasonic dedicated tips (ET20, Acteon) under 1.6x magnification were used for the complete removal of the cement and for direct vibration of the post under water-cooling. When completely mobilized, the post was removed using a hemostat plier. The same technique was used for the removal of the metallic post on tooth 2.1. Control radiographies were taken for both teeth after the removal of each metallic post (Figures 3b-c). For the removal of the rest of the root canal filling material, stainless steel ISO hand K-files second series with one drop of eucalyptol (Eucalyptol, Cerkamed) were used in a crown-down technique until reaching the working length, confirmed by the use of an apex locator.

The shaping of the root canal was completed using ProTaper Next instruments X3-X5 (Denstply Sirona, Ballaigues, Switzerland) connected at the hand-piece of an endodontic motor (X-Smart Plus, Dentsply Sirona). After successive apical gauging with second series hand K-files and final preparation of the apical third of the root canal in a step-back technique, ISO K-file #80 was reaching the working length, perfectly fitting to the foramen, showing the necessity of placing an MTA apical plug.

During instrumentation, the canal content was chemically cleansed using NaOCl 5.25% solution (Chloraxid, Cerkamed), 20% citric acid for the removal of the smear layer and distilled water as final flush. On tooth 1.1, the canal was dried with sterile paper points and $Ca(OH)_2$ paste (CALCIPASTE, Cerkamed) was placed as medication for 2 weeks, because of the inability of drying the root canal in the same appointment after the final irrigation protocol. The access cavity was sealed with sterile cotton pellets and Coltosol F (Coltene Whaledent) temporary cement.

Figure 3 a. Initial radiographic aspect of teeth 1.1 and 2.1; **b, c.** control radiography after the removal of the metallic posts

Tooth 2.1 was obturated with 5 mm of MTA placed as apical plug under the microscope in the same appointment with the retreatment. The MTA powder was mixed with sterile water at the consistency recommended by the manufacturer and the material was transported into the root canal with an MTA Medium Applicator of 1.2 mm diameter (Angelus, Brazil) and large sterile paper points 80/.06 to absorb the excessive moisture. Condensation at the desired level, starting 1 mm shorter than the working length was successively achieved using Machtou hand plugger no. 3/4 0.8/1.0 mm (Dentsply Sirona). A fiber post (EXACTO glass fiber post no.3, Angelus, LondrinaPR, Brazil) was cemented in the same

appointment after MTA's hardening, using a self-adhesive resin cement (RelyX U200, 3M ESPE) and coronal build up was done using Adper Single Bond 2 (3M ESPE) universal adhesive and a flowable composite Filtek Ultimate Flow (3M ESPE), in the shade A2. A provisional prosthetic restoration followed.

On tooth 1.1, the $Ca(OH)_2$ medication was removed from the root canal in a second appointment, by alternative rinses with 5.25 % NaOCl and 20% citric acid solution and a final flush of distilled water followed. After drying with paper points, the root canal was obturated with an MTA apical plug of 7 mm height and the coronal build up was done with a fiber post and composite resin in the same manner described for tooth 2.1 (Figure 4).

Figure 4. The MTA apical plug, the root canal filling and the coronal restoration with fiber post on tooth 1.1

III. DISCUSSION

Since its introduction in dentistry in 1993 by M. Torabinejad [4], MTA has been widely used by clinicians as the choice material in different procedures such as direct pulp capping, perforation repairs, pulpotomy or as orthograde or retrograde apical plug [5-7, 10]. Because of its high biocompatibility, low solubility, mechanical resistance and periodontal tissue regenerating capacity [4-7] and its indication as an apical plug [11], MTA was used in the retreatment of the 3 teeth with large foramens described in the present case report to seal the apical root third before obturation with gutta-percha and sealer. Moreover, the development and the initial recommendation of MTA were especially to be used as a root-end filling material, because the existing available materials did not have ideal characteristics for this purpose [4].

Based on the mentioned properties and by the favorable response that MTA induces in the surrounding periapical tissues after its placement as apical plug [12, 13], healing of the periapical lesions is to be expected, combined with good cleaning-shaping during the retreatment procedures.

Use of calcium hydroxide as interim root canal medication between appointments is recommended in the literature not only for its antibacterial properties, but also as a good mean of humidity control in the root canal before sealing its apical part with MTA [14]. In the first case report, this was the main reason of its application. Although, the root canal could not be properly dried before the application of the MTA plug in the second appointment, and a collagenic resorbable membrane was placed in contact with the periapical tissues.

The placement of MTA apical plug requires good clinical skills and always the use of magnification. It presents the advantage that fast setting MTA will limit the procedure to one appointment, allowing the placement of a fiber post and the coronal restoration in the same appointment with the apical plug. This will prevent the tooth from fracture in comparison with the long-term apexification with calcium hydroxide [15].

The use of a collagenic resorbable membrane as a periapical barrier over which MTA will be condensed was described as technique in other case reports [16, 17]. This membrane will not only create a favorable environment for MTA compaction, but will also prevent its extrusion in the periapical tissues [16, 17].

Our experience with this technique not only before placing MTA apical plugs, but also in perforation repair with MTA, allows us to consider it the best solution when the operator cannot control bleeding or excessive humidity. It presents the advantage that once placed in the proper position, MTA can be easily transported to the desired level and compacted, without altering the quality of its seal due to blood contamination. This will lead to the clinical success of the MTA-plug orthograde procedure.

IV. CONCLUSION

Many endodontically retreated teeth need to be sealed with MTA apical plug due to their large foraminal diameter. The resorbable collagenic membrane placed under the endodontic microscope in direct contact with the periapical tissues is a solution in controlling excessive moisture before MTA compaction. Good clinical skills, dedicated instruments and magnification are mandatory for the success of this procedure.

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