Dental Traumatology

Dental Traumatology 2008; **24**: e38–e41; doi: 10.1111/j.1600-9657.2008.00636.x

Mineral trioxide aggregate for obturation of maxillary central incisors with necrotic pulp and open apices

CASE REPORT

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Accepted 22 February, 2008

Abstract – There are few reports on treatment of necrotic pulps with mineral trioxide aggregate (MTA) for apexification. Five immature teeth with necrotic pulps were treated with the use of an apical plug of MTA for apexification. All teeth were central incisors that had premature interruption of root development caused by a previous trauma. According to the treatment protocol, the root canals were rinsed with 5% NaOCl; then calcium hydroxide paste was placed in the canals for 1–6 weeks. The apical portion of the canals were filled with MTA. The rest of the canals were obturated with lateral condensation of the gutta-percha applied with a canal sealer. At 6 months, 1 year and 2 year follow-up periods the clinical and radiographic appearance of the teeth showed the resolution of the periapical lesions and continued root end development in all except in the one case in which the MTA was extruded out the apex. MTA can be considered a very effective option for apexification with the advantage of reduced treatment time, good sealing ability and high biocompatibility.

Traumatic injuries and dental caries in young patients can result in pulp necrosis in immature teeth. If the dental pulp is damaged before development of the root length and closure of the apical foramen, normal root development is altered or halted completely. In teeth with incomplete root formation and necrotic pulps, apexification treatment must be initiated (1).

A major problem in performing endodontics in immature teeth with necrotic pulp and wide open apices is obtaining an optimal seal of the root-canal system. The initial aim of the therapy was to induce a hard tissue barrier at the tooth apex. This process is known as apexification. The aim of the procedure is to limit bacterial infection and create an environment conductive to the production of mineralized tissue barrier or root end formation at the immature root end. Calcium hydroxide is commonly used for this purpose (2, 3). Mineral trioxide aggregate (MTA), has been proposed as a potential material to create an apical plug at the end of the root-canal system, thus preventing the extrusion of filling materails (1, 4). MTA is a powder that consists of fine hydrophilic particles that set in the presence of moisture. The setting time of MTA in moisture is less than 4 h. The major compounds of MTA are tricalcium silicate, tricalcium aluminate, tricalcium oxide and silicate oxide (5, 6). There are few reports in the literature on apexification of teeth with necrotic pulps using MTA.

In this paper, the treatment and follow-up controls of five immature central incisors with necrotic pulps are presented. All cases were maxillary central incisors that had premature interruption of radicular development caused by a previous trauma. The clinical and radiographic signs of pulp necrosis and apical periodontitis were detected in all of the cases.

Cases

In the first case, a 11-year-old girl suffered trauma to her maxillary central incisors 3 years before the first visit. The teeth exhibited an enamel-dentin crown fracture and the mobility was within normal limits. The radiographic examination revealed immature teeth with open apices and radiolucent areas in proximity of the apices of the teeth (Fig. 1a).

In the second case, a 11-year-old boy presented a buccal sinus tract in the area of the upper incisors. At 9 years of age, he suffered trauma to this area and an enamel-dentin crown fracture had occured (Fig. 2a). He had cellulitis on his upper lip; the clinical examination revealed mobility and slight discoloration. Radiographic examination of the teeth revealed wide open apices and radiolucent area at the end of the root canals.

In the third case, a 11-year-old boy suffered trauma to his maxillary central incisor 1 year before the first visit. Clinical examination revealed an enamel-dentin crown fracture, mobility within normal limits and slight discoloration. Radiographic examination of the teeth revealed an immature tooth with an open apex and a radiolucent area at the end of the root- canal system (Fig. 3a).

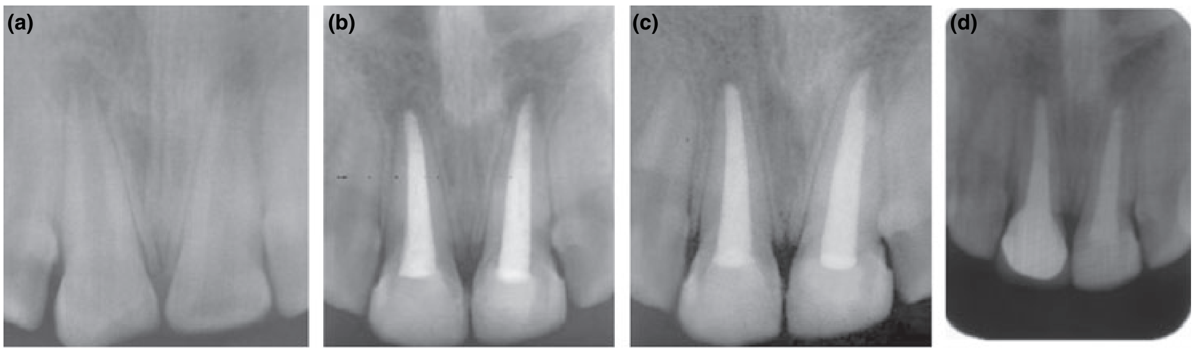

Fig. 1. (a) A preoperative radiograph of maxillary central incisors with open apices. (b) Follow-up after 6 months (c) Follow-up after 1-year (d) Follow-up after 2 years.

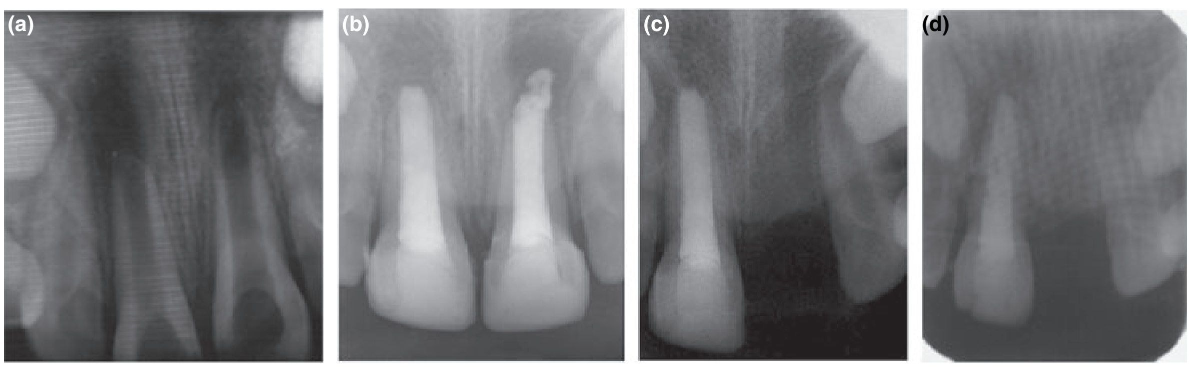

Fig. 2. (a) A preoperative radiograph of maxillary central incisors with open apices. (b) Follow-up after 6 months (c) Follow-up after 1-year (d) Follow-up after 2 years.

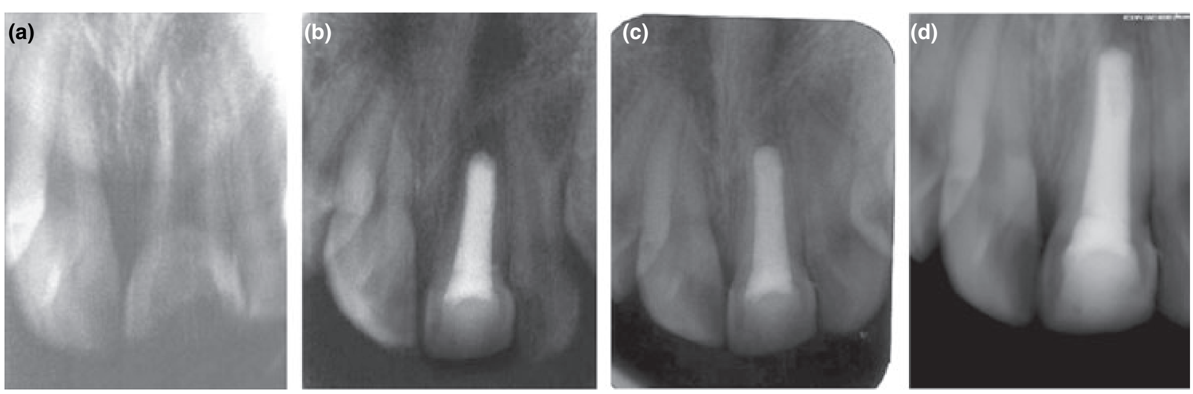

Fig. 3. (a) A preoperative radiograph of maxillary central incisors with open apices. (b) Follow-up after 6 months (c) Follow-up after 1-year (d) Follow-up after 2 years.

Treatment of the five immature maxillary central incisors with MTA and the clinical follow-up

In all cases, after the application of the rubber dam and access cavity preparation, the working length was obtained. The canals of the five central incisors were then carried out using Hedstroem files (Dentsply, UK) under irrigation with 5% sodium hypochloride (NaOCl; Niclor OGNA). Then, the canals were dried with sterile paper points and calcium hydroxide (Ultracalxs, Ultradent) was placed in the root canals. After 1 week, the calcium hydroxide was removed by rinsing with 5% NaOCl. The canals were dried with sterile paper points. However, in the second case the calcium hydroxide was placed into the root-canal system of both teeth for 2 weeks at three different appointments. In the third case the calcium hydroxide was placed into the root-canal system for 2 weeks at two different appointments. Once the drainage from the apical tissues resolved, then a MTA plug was placed at the apex. The MTA mixture (Dental Tulsa; Dentsply) was used exactly according to manufacturer's instructions and placed with a small amalgam carrier to the canals and adapted to the canal walls using Schilder's plugger. Radiographic control was performed to check the correct position of the apical plug. But in the second case, although in the right maxillary incisor, the MTA plug was placed sealing the apical 3–4 mm. In the left maxillary incisor, the MTA was extruded beyond the apex. A wet cotton pellet with sterile water was placed in the pulp chamber and the access cavity was closed with temporary zincoxide-eugenol-based cement Kalzinol (Densply De trey). After a week, Kalzinol and the cotton pellet was removed and the set of the MTA was gently tested. The rest of the canal was obturated with lateral condensation of the gutta-percha applied with a canal sealer Roekoseal (Coltene). Later the teeth were restored with a hybrid composite resin (Renew, Bisco, USA). A porcelain veneer was applied to one of the cases because of severe crown fracture at 2 years follow up.

The clinical follow-up of the four teeth at 6 months, 1 year and 2 years revealed an adequate clinical function with absence of clinical symptoms such as spontaneous or stimulated pain, swelling or fistula. The radiographic follow up at 6 months (Figs 1b, 2b and 3b) revealed a decrease of the periapical rarefaction, regeneration of the periradicular tissue and hard tissue deposition and at 1 and 2 years (Figs 1c,d, 2c,d and 3c,d) apexification was observed clearly. But in the teeth in which the MTA was extruded no healing in the radiolucent area of the incisor and buccal sinus tract was observed. Severe mobility was detected and the tooth had to be extracted at 1 year. A space maintenance was achieved with fiber splint.

Discussion

Successful apexification depends on the formation of a hard tissue barrier by cells that migrate from the healing periradicular tissues to the apex and differentiate under the influence of specific cellular signals to become cells capable of secreting a cementum or osteodentin organic matrix (7). Hertwig's sheath is a very important and resistant tissue in the development of an apical barrier. The sheath may remain vital even after complete pulpal necrosis and periradicular tissue changes and it can initiate root growth even after treatment (8).

For more than 40 years, the placement of calcium hydroxide within the root canal space has been the standart treatment to stimulate apical closure in a developing tooth with a necrotic pulp. Despite its popularity for the apexification procedure, calcium hydroxide therapy has some inherent disadvantages that include variability of treatment time (3–21 months), unpredictability of apical closure, difficulty in patient follow up and delayed treatment (3, 6, 9, 10). In addition, the canal is susceptible to reinfection because it is covered by a temporary seal and also susceptible to fracture during treatment (6). Therefore, the search continues for procedures and materials that may allow for continued apical closure in teeth with immature apices. An alternative treatment to long-term apexification procedure is to use an artificial apical barrier that allows immediate obturation of the canal. MTA is a potential apical barrier material with good sealing ability (2, 4), good marginal adaptation (11), a high degree of biocompatibility (12, 13) and a reasonable setting time (about 4 h) (6).

With the MTA apical plug technique, a one-step obturation after short canal disinfection with calcium hydroxide could be performed. The application of MTA mixture should be preceded by a temporary calcium hydroxide dressing in order to limit bacterial infection in the tooth. This technique of one-step obturation offers effective and efficient results in apexification of immature teeth, allows for permanent restorations to be done in a more timely manner, prolonging the longevity of these teeth (14).

In these cases, at 6 months, 1 year and 2 years follow-up periods the clinical and radiographic appearance of the teeth showed the resolution of the periapical lesions and continued root end development in all except in the one case in which the MTA was extruded from the apex.

The application of MTA mixture was suggested to be used in the presence of moisture in the root canals in teeth with necrotic pulps and inflamed periapical lesions (6). With current concepts and armamentarium MTA can be placed without difficulty in root canals in the presence of moisture. The results of the presented cases except case 2, are similar to other clinical reports (5, 6), where MTA was used as an apical plug in the central incisor with an open apex.

The extrusion of MTA from the operation site was suggested not to prevent the healing procedure (3, 12, 15). We also suggest that a slight overfill of MTA would not prevent the healing process. In our opinion, case 2 may have several possible reasons for that failure. Because of the considerable width and unusual shape of the canal, preparation of such cases is often very difficult. When compared with narrow canals, it is extremely doubtful whether these canals ever be truly debrided. As mentioned by several researchers (2, 3, 16) these canals are difficult to cleanse thoroughly and then obliterate, which leaves open spaces that later may harbor bacteria and tissue breakdown products. Another potential for failure may be the porous structure of the apical calcification barrier.

For successful results in apexification treatment, considerable care must be taken during the initial and final canal preparation procedures, even acknowledging that these canals may be virtually impossible to cleanse perfectly. Wiping the walls with cotton-wrapped broaches, using effective irrigants, and utilizing ultrasonic preparation are encouraged for optimal canal cleaning (16).

For clinical success, the application of the MTA mixture must not be pushed at the end of the root canal, but only fitted with a Schilder's plugger to the wall of the root-canal system to prevent the extrusion of the material. The prolonged use of calcium hydroxide paste may cause formation of barriers beyond the limits of the root-canal walls. Special instrumentation and the improved visualization provided by an operative microscopy enhances the success in accurate placement of the material.

To conclude, although MTA can be considered a very effective material and a valid option for apexification in infected teeth with open apices with the added advantage of speed of completion of therapy, long-term follow up is needed.

Acknowledgement

This study was supported by the research fund of the University of Istanbul; project no.: UDP-718/18042006.

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