Dental Traumatology

Dental Traumatology 2011; **27**: 59–62; doi: 10.1111/j.1600-9657.2010.00941.x

MTA apical plugs in the treatment of traumatized immature teeth with large periapical lesions

CASE REPORT

Zafer C. Cehreli[1], Sezgi Sara[1], Serdar Uysal[2], Melek D. Turgut[1]

[1]Department of Pediatric Dentistry, Faculty of Dentistry; [2]Department of Oral Diagnosis and Radiology, Faculty of Dentistry, Hacettepe University, Ankara, Turkey

Correspondence to: Zafer C. Cehreli, DDS, PhD, Department of Pediatric Dentistry, Faculty of Dentistry, Hacettepe University, Sihhiye 06100, Ankara, Turkey
Tel: +90 312 3052289
Fax: +90 312 3243190
e-mail: zcehreli@hacettepe.edu.tr

Accepted 27 August, 2010

Abstract – This case report describes the management of a late-referral case of periapically involved, traumatized immature permanent incisors by endodontic treatment and the use of mineral trioxide aggregate (MTA) apical plugs. A 10-year-old boy was referred to the clinic with a chief complaint of pain in his maxillary central incisors, which had experienced subluxation trauma 2 years earlier. Periapical radiograph of the teeth showed incomplete root development with wide-open apices and large periradicular lesions. The canals were gently debrided using K-files in conjunction with 2.5% NaOCl irrigation and 2% chlorhexidine for final flush. The root canals became asymptomatic after employing the same endodontic regimen for three visits. MTA plugs were placed in the apical area of the root canals, and the rest of the canal space was obturated by warm compaction of gutta-percha and AH Plus sealer. Resolution of the large periapical lesions was observed 2 months after treatment. At 18 months, the periapical areas revealed radiographic evidence of bone healing. Following successful removal of the toxic content of the root canal, placement of MTA plugs resulted in both healing of the periradicular radiolucency and regeneration of the periapical tissue.

Injuries to young permanent teeth are a frequent finding following orofacial trauma in children and adolescents. The majority of these incidents occurs before root formation is complete and may result in pulpal inflammation or necrosis (1). Such endodontic complications may lead to cessation of root development and compromised apical closure (2). Management of pulpal complications at this time is a significant challenge, because of the thin dentin walls and the wide-open apex, which both render instrumentation of the canal difficult and hinder formation of an adequate apical constriction (3). Because endodontic obturation techniques rely on the presence of an apical closure that an obturation material can be placed against, it is essential to create an artificial apical barrier or to induce the closure of the apical foramen with calcified tissue (2–4).

The traditional apexification technique utilizes long-term intracanal calcium hydroxide to promote the formation of a calcified barrier (4). Apexification has proven to be highly predictable (5, 6), but has the disadvantages of multiple visits during a relatively long period of time and an increased susceptibility to cervical fracture (7, 8). Reinfection may also manifest in the long term (9). Despite these facts, calcium hydroxide apexification still remains the most widely used technique for treatment of necrotic teeth with immature apices.

Artificial apical barriers with a variety of materials have been suggested as an alternative to traditional calcium hydroxide apexification (10–13). Among these, the popularity of mineral trioxide aggregate (MTA) can be attributed to several factors including biocompatibility (14) and good sealing properties (15). The main components of MTA include tricalcium silicate, tricalcium aluminate, tricalcium oxide, and silicate oxide (12). Observations from published reports support MTA as a potentially effective material in regenerating normal periradicular architecture in teeth with immature apices and continued root maturation when pulpal necrosis is present (16, 17). The present report describes the management of a late-referral case of traumatized immature permanent incisors with large periradicular lesions by endodontic treatment and the use of MTA apical plugs.

Case report

A healthy, 10-year-old boy was admitted to the pediatric dentistry clinic with a chief complaint of pain in his upper incisors. Reportedly, the child had experienced an injury of the front teeth because of a fall accident at the age of 8. The parents recalled the dentist explaining the type of the trauma as subluxation injury and that a splint was not placed on the affected teeth. Two months later, the dentist initiated endodontic therapy of the incisors upon the child's complaint of persistent spontaneous pain, but the patient refused to attend further treatment.

Fig. 1. Intraoral view of the patient.

Clinical examination of the teeth showed an uncomplicated crown fracture of the right central incisor, along with temporized endodontic access cavities on both teeth (Fig. 1). The incisors were slightly tender to percussion and had moderate mobility. Periapical radiograph of the teeth showed incomplete root development with wide-open apices that were associated with large periapical lesions (Fig. 2a). The radiopaque regions within the root canal of the right central incisor were suggestive of remnants of calcium hydroxide dressing (Fig. 2a). Both teeth were non-responsive to electronic pulp testing and thermal tests. On the basis of clinical and radiographic findings, the teeth were diagnosed as having chronic apical periodontitis. The patient and parents were informed about an endodontic treatment plan involving MTA apical plugs. Upon approval of the treatment plan, root canal treatment was initiated at the same appointment.

Following administration of local anesthesia, a rubber dam was placed. The necrotic tissue and remnants of what was regarded as calcium hydroxide were gently removed using #80 K-Files at a working length 1 mm short of the radiographic apex. Slight drainage of pus was observed during debridement and copious irrigation with 2.5% sodium hypochlorite (NaOCl). The use of K-files was limited to the purpose of debridement, with

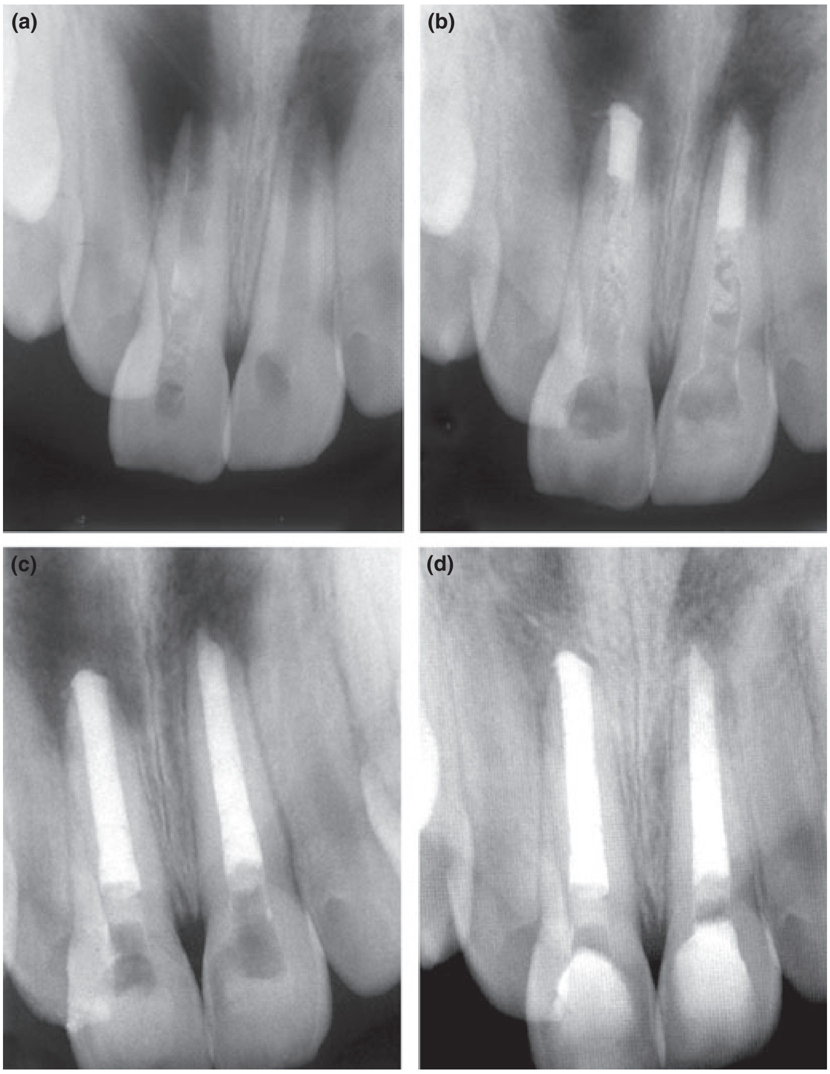

Fig. 2. (a) Periapical radiograph of the patient showing incomplete root development of central incisors with large periapical lesions. Note the radiopaque regions within the root canal of the right incisors regarded as remnants of calcium hydroxide dressing. (b) Radiograph of the incisors after placement of mineral trioxide aggregate apical plugs. (c) Radiographic view of completed root canal obturation. (d) Radiographic view at 18-month recall, demonstrating advanced osseous repair of periapical lesions.

no attempt to further enlarge the root canals. A final irrigation was made with 2% chlorhexidine and sterile saline. Assuming that the root canals had been exposed to calcium hydroxide for an extended period of time, a calcium hydroxide dressing was not placed so as to discard further risk of tooth fracture. The root canals were dried, sterile cotton pellets were placed into the access cavities, and the temporary fillings were placed. The patient was scheduled for three consecutive weekly visits after which implementation of the same debridement and irrigation regimen lead to cessation of pus drainage and the absence of symptoms. Following irrigation of the root canals with sterile saline and drying with sterile paper points, MTA (White Pro-Root MTA; Dentsply Maillefer, Ballaigues, Switzerland) was prepared according to the manufacturer's instructions, and a small portion of the material was deposited 1 mm below the working length using ProRoot MTA delivery gun (Dentsply). Then, MTA was gently condensed with an endodontic plugger and a #80 gutta-percha point to the working length. MTA plugs were placed to the apex with a minimum 4-mm thickness. Correct placement of the MTA plugs was verified with a periapical radiograph, which showed minimal extrusion of MTA into the periapical lesion of the right central incisor (Fig. 2b).

A moistened cotton pellet was placed in the pulp chamber, and the access cavity was closed with a temporary filling material (Cavit; 3M/ESPE, Seefeld, Germany). One week later, the temporary filling was removed, and the setting of the MTA was confirmed with a hand plugger. Finally, the remaining root canal was obturated by warm compaction of gutta-percha in association with AH Plus sealer (Fig. 2c). The coronal restoration was made with hybrid resin composite (TPH Spectrum DENTSPLY/DeTrey Konstanz, Germany), bonded with an etch-and-rinse adhesive (Prime& Bond NT, DENTSPLY/DeTrey). The patient was, then, scheduled for regular clinical and radiographic follow-up visits. The radiographic follow up at 18 months (Fig. 2d) showed advanced healing of the periapical radiolucency and regeneration of the periradicular tissue.

Discussion

Subluxation injuries seldom result in pulp necrosis in immature teeth (19). Within the limitations of patient history and clinical/radiographic findings, the initial diagnosis and further endodontic intervention of the first dentist can be readily justified for the upper right incisor, because a crown fracture coupled with a luxation injury can significantly increase the likelihood of pulp necrosis (19, 20). However, in the absence of an associated crown fracture of the upper left incisor, the same post-traumatic pulpal symptoms that led to endodontic intervention strongly suggest that either both teeth had experienced another type of injury that was more severe than subluxation, or that the affected incisors failed to heal in the lack of treatment for this trauma entity (20). Finally, the rare but not impossible occurrence of pulp necrosis in subluxated immature teeth should not be overlooked (18). These considerations highlight the importance of precise diagnosis of the trauma lesion, the knowledge of its prognostics, and the consequent follow up, so as to avoid an infection process.

Management of dental injuries may be neglected or lately referred by parents, because of the child's inability to cope with treatment (7, 21). As with the present case, this may not only cause interruption of the healing process, but may also jeopardize the integrity of periradicular tissues and the root. Regarding the latter factor, Andreasen et al. (7) calculated a reduction of as great as 50% in the fracture strength of mature roots subjected to 1-year application of intracanal calcium hydroxide. In the present case, calcium hydroxide dressing had possibly been inside the root canal(s) for more than 1.5 years. Because the root structure in those teeth had already been compromised (7, 8), care was given not to cause additional weakening. Accordingly, the endodontic treatment plan did not include placement of intracanal calcium hydroxide for elimination of the root canal flora (22), despite the apparent need for more endodontic visits to obtain the latter goal. On the other hand, no special obturation technique was utilized to reinforce the roots, because the extent of reinforcement provided by current endodontic obturation systems is known to be far less effective than the actual levels of adhesion necessary to prevent root fractures (23). More importantly, much of the fracture susceptibility is intrinsic to the root canal morphology (dentin thickness, canal shape and size, external root shape) and cannot be altered or controlled by the practitioner (24).

An ever-increasing number of reports support the use of MTA apical barriers as an alternative apexification technique (3, 4). In most cases, the procedure can be completed in a maximum of two sessions, making it possible to restore the teeth without adversely affecting the mechanical properties of root dentin. In addition to its well-documented biocompatibility (14, 25), the production of bone morphogenetic protein-2 (BMP-2) and transforming growth factor beta-1 (TGF ß-1) could be two important contributors to the favorable biologic response stimulated by MTA in human periapical tissues (26). It has also been shown that the stimulation of interleukin production by MTA may allow for the overgrowth of cementum and facilitate the regeneration of the periodontal ligament and formation of bone (14, 25, 27, 28). In the present case, advanced osseous healing of the periapical lesions was evident even 6 months after placement of the MTA apical plugs. More importantly, the periapical healing of the upper right incisor was not affected by the extrusion of MTA beyond the root end. This finding corroborates with those of previous animal (29) and human (3) studies demonstrating that the contact of extruded MTA with the periapical tissue does not elicit a host response and thus is not an obstacle to healing.

The present case confirms that MTA acts an apical barrier and can be considered to be a very effective material to support regeneration of apical tissue and to promote apical obturation in traumatized, infected immature teeth with open apices. Both clinical and radiographic follow ups showed optimal healing of the apical periodontitis and new hard tissue formation in the apical area of the traumatized incisors. Thus, it can be concluded that MTA plugs offer the advantage of high predictability of apical closure, along with shorter treatment time and less dependence on patient compliance.

References

1. Andreasen JO, Ravn JJ. Epidemiology of traumatic dental injuries to primary and permanent teeth in a Danish population sample. Int J Oral Surg 1972;1:235–9.
2. Bogen G, Kuttler S. Mineral trioxide aggregate obturation: a review and case series. J Endod 2009;35:777–90.
3. Mente J, Hage N, Pfefferle T, Koch MJ, Dreyhaupt J, Staehle HJ et al. Mineral trioxide aggregate apical plugs in teeth with open apical foramina: a retrospective analysis of treatment outcome. J Endod 2009;35:1354–8.
4. Al Ansary MA, Day PF, Duggal MS, Brunton PA. Interventions for treating traumatized necrotic immature permanent anterior teeth: inducing a calcific barrier & root strengthening. Dent Traumatol 2009;25:367–79.
5. Yates JA. Barrier formation time in non-vital teeth with open apices. Int Endod J 1988;21:313–9.
6. Ghose LJ, Baghdady VS, Hikmat YM. Apexification of immature apices of pulpless permanent anterior teeth with calcium hydroxide. J Endod 1987;13:285–90.
7. Andreasen JO, Farik B, Munksgaard EC. Long-term calcium hydroxide as a root canal dressing may increase risk of root fracture. Dent Traumatol 2002;18:134–7.
8. Sahebi S, Moazami F, Abbott P. The effects of short-term calcium hydroxide application on the strength of dentine. Dent Traumatol 2010;26:43–6.
9. Sheehy EC, Roberts GJ. Use of calcium hydroxide for apical barrier formation and healing in non-vital immature permanent teeth: a review. Br Dent J 1997;183:241–6.
10. Coviello J, Brilliant JD. A preliminary clinical study on the use of tricalcium phosphate as an apical barrier. J Endod 1979;5:6–13.
11. Pitts DL, Jones JE, Oswald RJ. A histological comparison of calcium hydroxide plugs and dentin plugs used for the control of gutta-percha root canal filling material. J Endod 1984;10:283–93.
12. Torabinejad M, Chivian N. Clinical applications of mineral trioxide aggregate. J Endod 1999;25:197–205.
13. Shabahang S, Torabinejad M. Treatment of teeth with open apices using mineral trioxide aggregate. Pract Periodontics Aesthet Dent 2000;12:315–20.
14. Mitchell PJ, Pitt Ford TR, Torabinejad M, McDonald F. Osteoblast biocompatibility of mineral trioxide aggregate. Biomaterials 1999;20:167–73.
15. Al-Kahtani A, Shostad S, Schifferle R, Bhambhani S. In-vitro evaluation of microleakage of an orthograde apical plug of mineral trioxide aggregate in permanent teeth with simulated immature apices. J Endod 2005;31:117–9.
16. El-Meligy OA, Avery DR. Comparison of apexification with mineral trioxide aggregate and calcium hydroxide. Pediatr Dent 2006;28:248–53.
17. Holden DT, Schwartz SA, Kirkpatrick TC, Schindler WG. Clinical outcomes of artificial root-barriers with mineral trioxide aggregate in teeth with immature apices. J Endod 2008;34:812–7.
18. Andreasen FM, Pedersen BV. Prognosis of luxated permanent teeth – the development of pulp necrosis. Endod Dent Traumatol 1985;1:207–20.
19. Robertson A, Andreasen FM, Andreasen JO, Norén JG. Long-term prognosis of crown-fractured permanent incisors. The effect of stage of root development and associated luxation injury. IntJ Paediatric Dent 2000;10:191–9.
20. Andreasen JO, Andreasen FM, Skeie A, Hjørting-Hansen E, Schwartz O. Effect of treatment delay upon pulp and periodontal healing of traumatic dental injuries: a review article. Dent Traumatol 2002;18:116–28.
21. Flores MT. Traumatic injuries in the primary dentition. Dent Traumatol 2002;18:287–98.
22. Sjögren U, Figdor D, Spangberg L, Sundqvist G. The antimicrobial effect of calcium hydroxide as a short-term intracanal dressing. Int Endod J 1991;24:119–25.
23. Gesi A, Raffaelli O, Goracci C, Pashley DH, Tay FR, Ferrari M. Interfacial strength of Resilon and gutta-percha to intraradicular dentin. J Endod. 2005;31:809–13.
24. Sathorn C, Palamara JE, Palamara D, Messer HH. Effect of root canal size and external root surface morphology on fracture susceptibility and pattern: a finite element analysis. J Endod 2005;31:288–92.
25. Oviir T, Pagoria D, Ibarra G, Geurtsen W. Effects of gray and white mineral trioxide aggregate on the proliferation of oral keratinocytes and cementoblasts. J Endod 2006;32:210–3.
26. Guven G, Cehreli ZC, Ural A, Serdar MA, Basak F. Effect of mineral trioxide aggregate cements on transforming growth factor beta1 and bone morphogenetic protein production by human fibroblasts *in vitro*. J Endod 2007;33:447–50.
27. Koh ET, Torabinejad M, Pitt Ford TR, Brady K, McDonald F. Mineral trioxide aggregate stimulates a biological response in human osteoblasts. J Biomed Mater Res 1997;37:432–9.
28. Al-Rabeah E, Perinpanayagam H, MacFarland D. Human alveolar bone cells interact with ProRoot and tooth-colored MTA. J Endod 2006;32:872–5.
29. 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;25:1–5.