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Case Report

Treatment of a non-vital immature incisor with mineral trioxide aggregate (MTA)

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Abstract – A case of severe crown fracture and luxation in the upper permanent incisors of a 9-year-old boy is reported. The treatment of one of the injured teeth included apexification with calcium hydroxide and endodontic treatment with gutta-percha obturation. The other incisor was also treated with calcium hydroxide, but as there was no apical stop after 3 years of treatment, it was decided to use a new root-end filling material: mineral trioxide aggregate (MTA). At follow-up 12 months later, the tooth was asymptomatic and radiographically showed the initial repair of the radiolucent apical lesion.

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Key words: apexification; root-end filling material; mineral trioxide aggregate

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Dental injuries are very common in children and adolescents. Root canal treatment of these immature permanent teeth with wide open apices usually takes a long period of time, and the prognosis is always of uncertain severity (1–5). Apexification with calcium hydroxide is the most accepted procedure for dealing with these cases. The aim of this treatment is to induce the formation of a hard calcific barrier in the apex so that the condensation of gutta-percha in the canal root can be properly achieved (2, 3, 5, 6).

Recently, mineral trioxide aggregate or MTA (ProRoot®, Dentsply) has been shown to be a potential root-end filling material. In recent years, MTA has been investigated in several studies as a material for sealing the communication between root canals and the external area of teeth. *In vitro* (7–11) and *in vivo* studies, first in experimental animals (11–15) and later in humans (1, 4, 11, 16), have shown the good sealing ability of this material, its biocompatibility and low cytotoxicity (11, 17, 18), and also its effect on the induction of odontoblasts and of a hard barrier (1, 11, 14, 15).

The aim of this report was to describe the root canal treatment of two injured immature permanent incisors, one of which was submitted to apexification with calcium hydroxide while the other was sealed with MTA.

Case report

A 9-year-old boy with no general health problems was referred to the School of Dentistry of the Complutense University in Madrid, on June 15, 1998. Sixteen hours before his arrival at the clinic, he suffered an injury to the upper central incisors by falling from a height of 1 m.

The clinical examination (Fig. 1) revealed an intrusion and a complicated enamel-dentine crown fracture in both incisors, also involving the cervical area of the root in the central right incisor. He also presented a laceration of the upper labial mucosa and inflammation of the gingiva around the injured teeth. Periapical radiographic examination (Fig. 2) showed the immature open apices, the lesion in the periodontal ligament as a result of the intrusion and apparently no radiolucent lesion in the apical area of the injured teeth. In the clinical tests, it was found that both incisors were tender to percussion. They did not respond to the vitality tests, but it should be remembered that this reaction is not always significant in immature teeth.

As the soft tissues did not need to be sutured, the treatment consisted of the application of clorhexidine and instructions to the patient about the correct way

Fig. 1. Initial clinical view of the traumatic injury: observe the fracture of enamel-dentine and the intrusive luxation of both incisors. The lesions in the soft tissues can also be seen.

to remove the dental plaque. The intrusion was left to reposition naturally. The first dental treatment included the pulpotomy with calcium hydroxide of the central right incisor and the pulpal capping of the central left incisor. Three months later the control showed an abscess in the labial gingival area of the central left incisor and the incomplete root formation of both incisors. It was then decided to start the treatment of apexification with calcium hydroxide on the injured teeth.

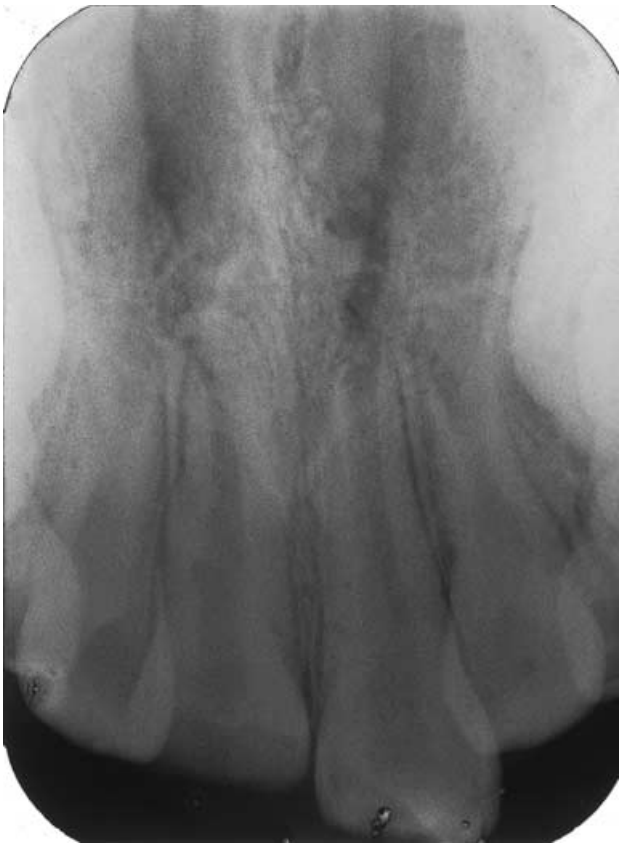

Fig. 2. Periapical radiograph taken 16 h after the traumatic injury. The apices are clearly immature and, apparently, there is not any radiolucent lesion in the apical area of the injured incisors.

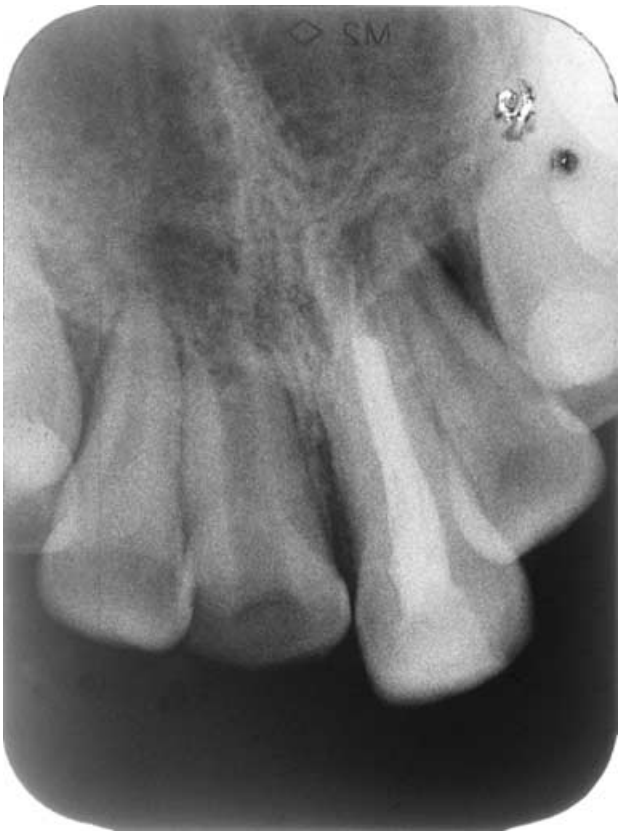

Fig. 3. Periapical radiograph showing the root canal therapy with gutta-percha achieved in the central left incisor and the apical lesion in the central right incisor.

The controls and changes of calcium hydroxide were performed regularly every 3 months. On June 15, 2000, the patient came to the clinic having lost the composite resin restoration of the central right incisor. There was also the presence of an abscess in the buccal area of that tooth. Pulp canals of both incisors were then cleaned and explored, finding a small piece of wooden stick in the apical part of the right incisor, probably introduced by the patient. The left incisor presented a hard bridge across the open apex, and apical radiograph showed not only the bridge but also a radiolucent lesion, revealing an external root resorption in the apical area of the central right incisor.

As apexification with calcium hydroxide induced the formation of the hard barrier in the apex of the central left incisor, it was possible to realize the condensation of gutta-percha to achieve the root canal obturation (Fig. 3). Nevertheless, in the other injured tooth, the infection and continuous resorption of the root made it necessary to refill the pulp canal with

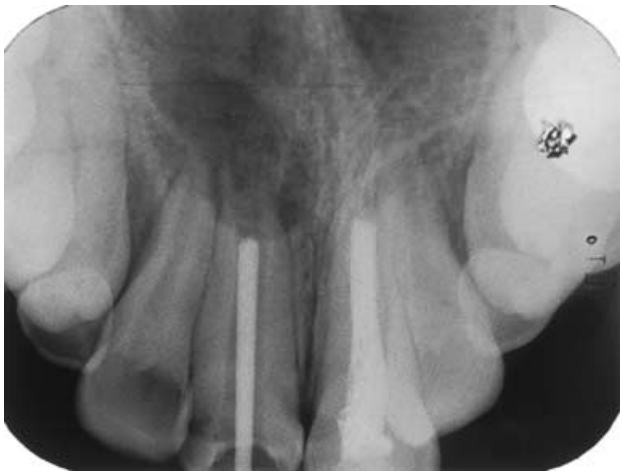

Fig. 4. Periapical radiograph showing the master point leaving 2 mm in the apical part of the root for the obturation with MTA.

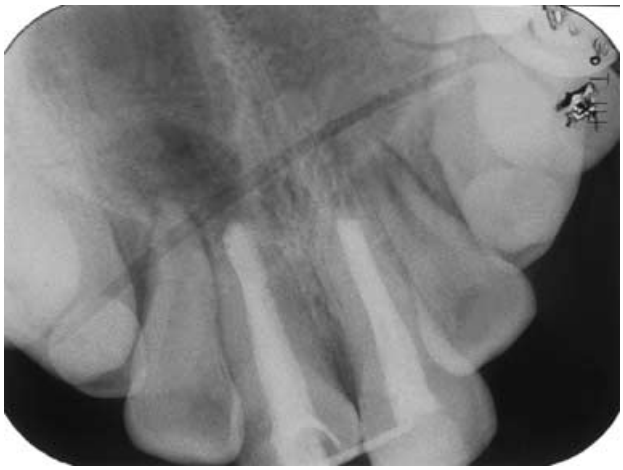

Fig. 6. Periapical radiograph: the central right incisor has been submitted to the root canal obturation with gutta-percha.

calcium hydroxide. The clinical and radiographic follow-up was performed regularly, and the canal material was changed approximately every 3 months.

Finally, on June 27, 2001, as there was no calcific barrier formation in the apex and the radiolucent image persisted in the apical area of the central right incisor, it was decided to use a new root-end filling material: mineral trioxide aggregate or MTA (ProRoot®, Dentsply).

The studies have shown that MTA is apparently equal or superior to other root-end filling materials (amalgam, super-EBA, IRM) with respect to dye and bacterial leakage (7–16), cytotoxicity (11, 17, 18) and marginal adaptation (1, 4, 11–16). A good healing around MTA with formation of cementum and periodontal ligament fibres has also been demonstrated (1, 11, 14, 15). MTA basically consists of a mineral powder whose principal compounds are tricalcium silicate, tricalcium aluminate, tricalcium oxide and other mineral oxides. This powder is hydrated with sterile water, resulting in a colloidal gel that solidifies as a hard structure in approximately 4 h in a humid ambient.

The treatment started with the isolation of the tooth with a rubber dam. The root canal was cleaned with sodium hypochlorite solution and size 90 K-files, and was dried with paper points. The working length

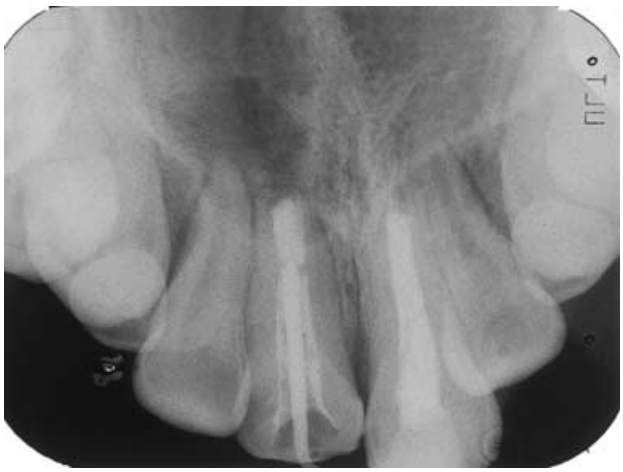

Fig. 5. Periapical radiograph of the condensation of the MTA in the apex with the gutta-percha master point.

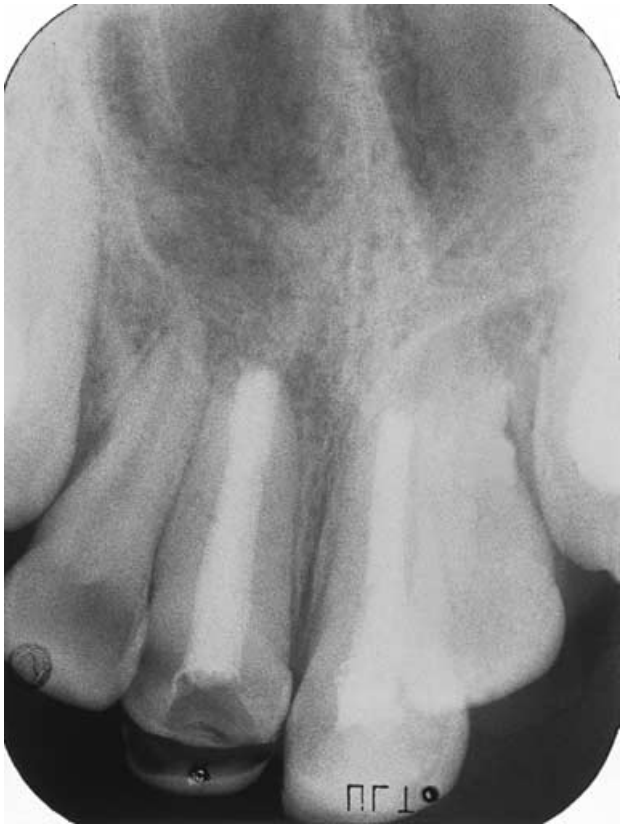

Fig. 7. Control periapical radiograph 4 months after the therapy with MTA. The initial healing of the radiolucent lesion can be seen.

was 18 mm, and the gutta-percha master point was size 90. The master point was placed at 16 mm with the aim of leaving 2 mm in the apical part of the root for obturation with MTA (Fig. 4). The material was mixed with sterile water following the manufacturer's instructions, and the condensation of the material in the apex was performed with the gutta-percha master point (Fig. 5). The correct sealing of the apex was controlled radiographically. A wet cotton pellet was then placed in the pulp chamber to produce a humid ambient for the MTA with the aim of achieving its solidification, and the crown was temporarily filled.

Two days later, the temporary filling was removed, and the hardness of the MTA was checked. Finally, it was possible to perform the root canal obturation with gutta-percha (Fig. 6).

The follow-up radiograph performed 4 months later, on October 11, 2001, showed that both central incisors were correctly sealed, the external inflammatory resorption had stopped, and the radiolucent image was reduced, which meant the initial healing of the lesion (Fig. 7).

The follow-up radiograph performed 12 months after the treatment with MTA (Figs 8 and 9), on June 6, 2002, showed that the radiolucent image of the central right incisor was still present but reduced; therefore, the healing process still went on. There were no clinical signs of pathology.

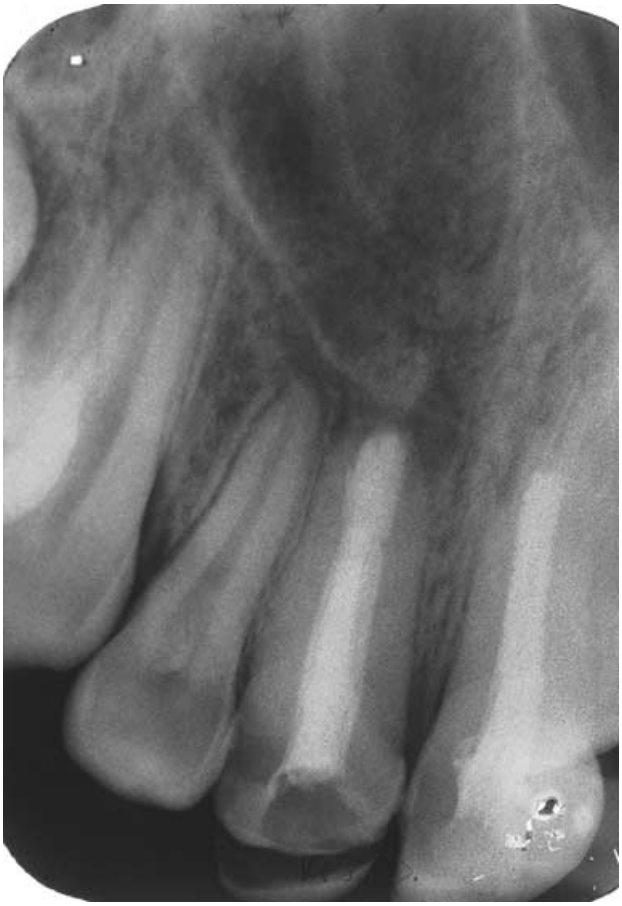

Fig. 8. Control periapical radiograph 12 months after the therapy with MTA.

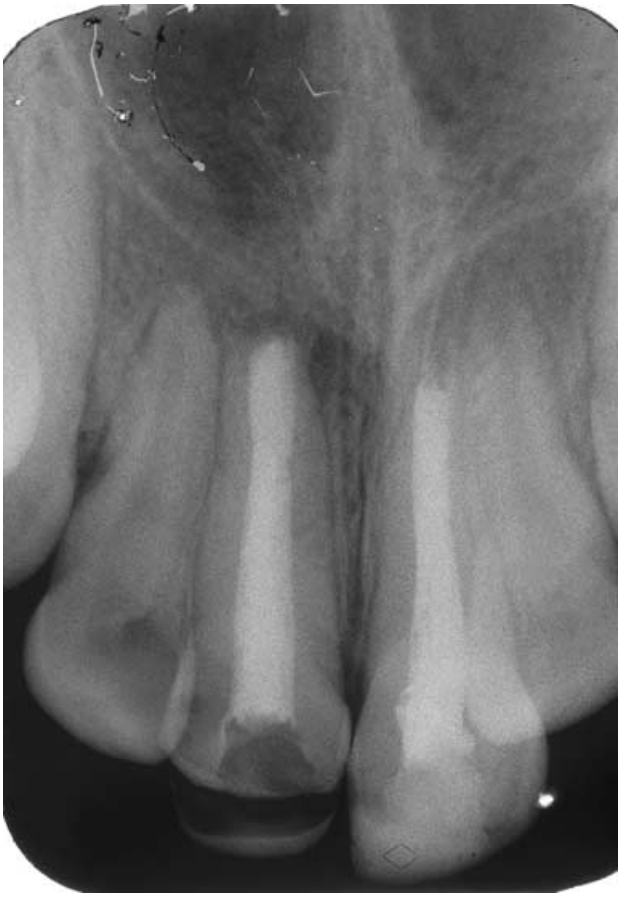

Fig. 9. Another view of the radiographic control 12 months after the treatment with MTA.

Discussion

It is necessary to offer our patients the best solutions that we can to solve complicated situations like tooth injuries. It has been demonstrated in several studies that calcium hydroxide has a high rate of success in cases of immature permanent teeth. But, one negative aspect of the apexification with this material is that the treatment can take a very long time and complications can then appear, as in the case reported.

Therefore, it may be suitable to investigate new solutions for these situations. It has already been demonstrated that MTA has very good sealing abilities, so it can be correctly used as a root-end filling material. Nevertheless, more long-term follow-up studies in humans are necessary to confirm these conclusions.

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