Management of a non-vital central incisor with an open apex

Using a novel MTA-based repair material in a young patient

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The treatment of immature necrotic teeth with non-vital pulps and open apices often presents a challenge to the clinician. Cleaning and shaping the thin canal walls, controlling the infection, and performing satisfactory sealing of the apex are sometimes not possible. In most cases, the treatment involves the induction of apical closure by apexification procedures to allow more favourable conditions for the conventional treatment.

Traditionally, calcium hydroxide has been the material of choice used to induce the formation of an apical hard tissue barrier before placing the permanent filling. Although many studies have reported favourable outcomes when this treatment is used, disadvantages have also been reported. The use of calcium hydroxide apical barriers has been associated with some problems, such as unpredictability of apical closure, risk of reinfection due to leakage of the provisional filling and risk of root fracture as a result of the long-term application of calcium hydroxide. Furthermore, poor patient compliance has a negative influence on the prognosis of conventional apexification procedures.

With the advent of the mineral trioxide aggregate (MTA), a calcium silicate-based, biocompatible, non-absorbable material, another treatment option was proposed. This material has the ability to set in a short period and in the presence of moisture. It solidifies into a hard structure in less than three hours. This property, along with its capability of inducing cementum-like hard tissue when used in the periradicular tissue, allows its use in the immediate obturation of an open apex.

Several studies show that apexification with MTA has a high success rate with fewer visits and less time to completion. Also, in a study that compared clinical and radiographic results of apexification with MTA or calcium hydroxide, all of the cases sealed with MTA healed, whereas in the calcium hydroxide cases, two out of 15 did not heal. However, MTA has some disadvantages too. Because of its consistency, its manipulation and placement in the site of repair can be challenging. Additionally, its use can cause discoloration of the tooth, and it should be used with caution in aesthetic zones. A novel material, MTA REPAIR HP (high plasticity; Angelus), was recently introduced with the intention of improving some of those characteristics. This new formula retains all the chemical and biological properties of the original MTA; however, it changes its physical properties of manipulation, resulting in greater plasticity, thereby facilitat-
Case report

A 12-year-old male patient with a non-contributory medical history presented for examination with the chief complaint of pain in tooth #11. Clinical examination found that the tooth had been restored with a temporary filling and responded with pain to percussion and palpation and presented with a discrete oedema in the area. There was no probing defect or sinus tract stoma. According to the patient, root canal therapy had been started in the tooth approximately 12 months before. In the radiographic examination, a radiopaque material inside the canal a few millimetres short of the apex could be observed. Also, on the radiograph, it could be seen that the apex was not completely formed and presented with a periapical lesion (Fig. 1). A clinical diagnosis of a pulpless tooth with unsatisfactory previously initiated therapy and symptomatic periapical periodontitis was established.

The treatment plan was to first perform the cleaning and shaping of the canal and to place a calcium hydroxide dressing. Then, after one to two weeks, with the regression of the symptoms, we would recreate an apical barrier with a new MTA-based material, obturate the tooth and restore it. The treatment plan was presented to the patient’s parents, who agreed to it.

After the consent form had been signed, 1.8 ml of local anaesthetic (2% lidocaine with adrenaline 1:100,000) was administered, the restorative material was removed, and endodontic access corrected. After rubber dam isolation, the material inside the canal was removed under thorough irrigation using a 2.5% sodium hypochlorite solution (Fórmula & Ação) and a CPR-7 ultrasonic tip (Obtura Spartan Endodontics). After the removal of the material from the canal, #2 and #3 Largo burs were used to prepare the first two-thirds of the canal. Then, the apical foramen was located with the aid of an apex locator (RAYPEX, VDW), and the working length was established at 0.0 and confirmed with a radiograph. Instrumentation proceeded using stainless steel K-type hand files in a crown-down technique until a #80 hand file achieved the working length. Between each file change, copious irrigation with 2.5% sodium hypochlorite solution was performed (approximately 100 ml throughout the entire treatment).

During the procedure, passive ultrasonic irrigation was performed for one minute several times to ensure complete removal of the old material and to maximise the irrigation technique. After the completion of instrumentation, the canal was irrigated with 5 ml of 17% EDTA (Fórmula & Ação) for three minutes and a final rinse with 5 ml of saline solution. A calcium hydroxide-based paste was placed in the canal as an inter-appointment dressing, and the tooth was temporarily restored (Fig. 2). After ten days, the patient came to the clinic for conclusion of treatment. The tooth was asymptomatic, and the area was no longer

Figs. 4a & b: CBCT images. Axial view just after MTA REPAIR HP placement (a). Axial view at the nine-month follow-up. The bone formation, including the cortical plate, can be observed (b).

Figs. 5a & b: CBCT images. Sagittal view just after MTA REPAIR HP placement (a). Sagittal view at the nine-month follow-up. Reformulation of the cortical plate is visible, as well as partial apical closure (b).
swollen. The temporary filling was removed, and the calcium hydroxide paste was removed from the canal using a 2.5% sodium hypochlorite solution and passive ultrasonic irrigation as previously described. The #80 hand file was used again to working length. The canal was then irrigated with 5 ml of 17% EDTA for three minutes to remove the smear layer, and 5 ml of saline solution was used for the final rinse. The canal was dried with paper points, and MTA REPAIR HP was manipulated according to the manufacturer’s instructions and placed with the aid of pluggers (B&L Biotech) in the last 3 mm of the root canal, forming an apical plug. After ten minutes, the material had set, and the tooth was obturated using BC Sealer (Brasseler USA) and gutta-percha cones with the lateral condensation technique (Figs. 3a & 6b).

The pulp chamber was cleaned with a sponge soaked in 70% alcohol, and the access cavity was restored using composite (Figs. 4a & 6b). A high-resolution CBCT scan of the patient was requested immediately after treatment so that it could be used for comparison later in the follow-up.

The patient presented for recall one month later without any symptoms. Postoperative radiographic and clinical evaluations were performed at three, six and nine months. The tooth was asymptomatic, and the area did not have any signs of inflammation. After nine months, another CBCT examination was conducted. Comparison of the CBCT images was performed, and bone healing and apical closure of the open apex could be observed (Figs. 4a & 6b, 5a & 6b).

**Discussion**

Previous clinical studies in humans have demonstrated that an apical barrier of MTA can be used with success in the technique of apexification of teeth with open apices. El-Meligy and Avery ran a clinical trial comparing the use of calcium hydroxide and MTA in 30 teeth of 15 patients who had lost pulp vitality through caries or trauma. The conventional technique of apexification with calcium hydroxide was performed in one tooth, whereas the barrier technique with MTA was applied to the other tooth in the same patient. The teeth were then followed up for three, six and 12 months. Two of the teeth filled using calcium hydroxide failed, while none of the teeth filled with MTA showed clinical or radiographic signs of pathology. Simon et al. carried out a prospective clinical trial in 57 teeth of 50 patients with open apices treated with MTA plugs and definitive filling of the canal and observed success in 81% of the cases.

In this case report, the use of a modified MTA (MTA—bioceramic-based high-plasticity reparative cement) achieved a good clinical result over the short follow-up period. Comparison of CBCT images just after placement of the MTA barrier and after a nine-month period demonstrated bone formation and apical closure by hard tissue. It should be noted that a radiolucent area too could be seen at this time. Such a healing pattern could be classified as incomplete healing, according to Molven et al. From a clinical perspective, the handling and placement of the MTA REPAIR HP was easier than with the conventional MTA. According to the manufacturer, the difference between MTA REPAIR HP and the original Angelus MTA is the replacement of distilled water with a liquid that contains water and another organic plasticiser that gives the new product high plasticity (Fig. 6). The manufacturer claim that the new MTA does not promote dental discoloration could not be studied in this case, since the material was placed in the apical portion of the canal.

The importance of case reports is the demonstration of what is possible in our patients using scientific clinical treatment protocols. Reports from clinical practitioners have played important roles in the field of dentistry, but should be validated through proper laboratory and clinical research studies. In conclusion, the clinical protocol using the new MTA REPAIR HP, as described in this case report, enabled the successful apexification of a central incisor in a young patient.

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