Orthograde mineral trioxide aggregate (MTA) placement against an internal matrix of absorbable collagen sponge: outcome of a case series

Key words absorbable collagen sponge, apexification, apical plug, MTA, open apex

The orthograde intracanal placement of mineral trioxide aggregate (MTA) in the treatment of root canals with an open apex is technique sensitive, primarily because of its poor handling properties. Placement of the material within the confines of the root canal is difficult. The current case series presents the results of 12 treated open apex cases, using MTA condensed by hand against an internal matrix of absorbable collagen sponge (ACS) to create an apical plug. The results of the technique are encouraging, while the success of MTA in apexification has been reiterated.

Introduction

Mineral trioxide aggregate (MTA) has recently received much attention as a substitute for calcium hydroxide-based materials, and has demonstrated promising clinical outcomes. MTA has been reported to have desirable properties such as biocompatibility, fibroblast stimulation, antimicrobial activity and sealing capacity, with an ability to set in a moist environment. It has thus been proposed as a material suitable for a ‘one-visit’ treatment of teeth with open apices by creating an apical MTA plug, compared with the long-term apexification using multiple calcium hydroxide dressings. This has some drawbacks, such as prolonged duration of treatment with multiple visits and increased risk of tooth fracture. An MTA/distilled water mixture, however, does not exhibit all properties of a good root canal-filling material, especially because it does not present an adequate flow. The orthograde apical MTA plug can be accomplished using different methods. Commonly, carriers such as Messing Gun (Produits Dentaires, Vevey, Switzerland) or Dovgan Carriers (Vista Dental Products, Racine, WI, USA) have been used to deliver the material in the apical portion of the root canal, followed by hand or ultrasonic (direct or indirect) condensation. The use of a microscope has also been suggested to aid in this process. In large furcation defects with a clinical situation that mimics an open apex, better sealing ability of materials has been reported if an internal matrix of absorbable collagen sponge was used.

The aim of this report is to present the management of 12 treated teeth with non-vital pulps and open root apices with an MTA apical plug technique, using an internal matrix of absorbable collagen sponge (ACS).
Materials and methods

This report includes 12 maxillary incisors in 11 patients aged between 10 and 14 years who suffered a traumatic injury, and was presented to the Department of Pediatric Dentistry. Ethical approval was sought and granted, and informed consent was obtained from the parents. The patients were selected as follows:

- the minimum time between the trauma and the first visit was at least 2 years
- all traumatised teeth had a necrotic pulp
- all patients presented with incomplete development and/or resorption of the root, leading to an open apex corresponding to Nolla’s stage 8 and 9 (Fig 1a).

Procedure

The teeth were isolated with a rubber dam. A conventional access cavity was prepared in the palatal surface of the incisors. The working length was measured radiographically and recorded for reference. The canals were debrided gently, 1 mm short of the apex. After 2 weeks of intracanal calcium hydroxide medication (Fig 1b), the dressing was removed by irrigating with alternating solutions of sodium hypochlorite 5% and ethylenediaminetetraacetic acid (EDTA) 17%. Small pieces of absorbable collagen sponge (KolSpon, Eucare Pharmaceuticals, Chennai, India) were then condensed beyond the canal apex using endodontic pluggers, until the periapical space was full in order to create a periapical barrier for the MTA. The working length was checked to confirm that the plugger did not traumatise the periapical tissues. The plugger length was then readjusted to 5 mm short of working length, so that a 3 to 5 mm MTA plug could then be formed. Grey MTA-Angelus (Angelus, Londriana, PR, Brazil) was then introduced into the root canal with the help of an amalgam carrier. Previously used pluggers were used to push the MTA towards the apex and then it was condensed against the collagen barrier. Correct placement of MTA was confirmed radiographically (Fig 1c, Figs 2a–2c). A sterile sponge pellet moistened with sterile water was placed over the canal orifice and the access cavity was sealed temporarily with intermediate restorative materials (IRM) (DENTSPLY Caulk, Milford, DE, USA). The MTA was allowed to set for 24 hours (although manufacturers have suggested a final setting time of 15 minutes), after which the root canal was re-entered. The setting of the MTA was confirmed by gentle probing with a file.
rest of the canal space was then obturated by gutta-percha and AH Plus (Dentsply DeTrey, Konstanz, Germany) using a cold lateral compaction technique. At the same appointment, the access cavities were adhesively restored with composite.

Patients were followed up for the first week for any postoperative symptoms. Further follow-up appointments based on clinical and radiographic evaluation were scheduled at 3, 6 and 9 months. Clinically, treatment was considered successful when symptoms such as pain, swelling, buccal sinus tract, or tenderness to apical and gingival palpation or percussion were absent. Radiographically, healing was evaluated, taking into consideration the size of lesion and regeneration of periodontal ligament space.

## Results

The technique using hand condensation of MTA against an ACS barrier resulted in an apical plug of 3 to 5 mm, placed within the confines of the root canal, as seen radiographically in all cases. Two patients (3 teeth) reported postoperative symptoms within a week and analgesics were prescribed. At the 9-month clinical examination, all teeth were free of symptoms, buccal sinus tracts, and swelling. Radiographic examination (Fig 1d) revealed complete healing in eight teeth, while for the remaining four teeth healing was in process.

## Discussion

While the outcome of conventional gutta-percha fillings in immature pulpless teeth is uncertain, MTA has the potential to provide predictable results. Several studies have reported positive outcomes with the use of MTA, and the outcome in this case series is similar to previously reported cases of successful MTA apical plug procedures in teeth with necrotic pulps and open apices.

As postulated by Al-Kahtani et al, the type of intracanal delivery technique may contribute to the final success when using MTA to create an apical plug. Aminoshariae et al suggested that hand condensation of MTA resulted in better adaptation and fewer voids than direct ultrasonic compaction. On the other hand, Yeung et al in a quantitative analysis have found indirect ultrasonic condensation to be superior. However, both studies were conducted in vitro and without the use of an internal matrix, preventing comparison with the current cases.

The percentage of cases with slight overextension using current techniques seems to be relatively high and may be a reason for persistence of periapical lesions. Holland et al reported that overfilling with MTA was associated with an intense, extensive lymphocyte histiocyte-plasmocyte infiltrate with disorganization of the periodontal ligament in animals. Thus regarding the limits of obturation, filling within the root canal space has presented significantly better results than overfilling.
The internal matrix technique involves placing a biodegradable material as a barrier, preventing the different reparative materials from extruding into the periapical tissues. The use of such matrices as calcium sulphate or calcium hydroxide has been advocated in the past for the repair of furcal perforations. When used in vitro to repair furcational defects, ACS significantly improved the sealing ability of MTA. ACS has also been used as an internal matrix in the past. The current case series proposes a repeatable technique of MTA placement and hand condensation against an internal matrix. ACS is being researched extensively for its role as a carrier for bone morphogenetic protein but in the current study it is used primarily as a barrier for MTA to be condensed against, besides possibly providing a scaffold for faster deposition of bone in the periapical area.

One of the important considerations while using ACS is that it should not be used in infected wounds. Similarly, the placement of MTA in a single visit without disinfection of the root canal is not advisable, because the acidic environment of the necrotic pulp tissue may hamper its setting. Thus, the role of calcium hydroxide as a canal disinfectant is indispensable. Even though calcium hydroxide was placed in the canals for 2 weeks in the current study, two cases reported with immediate postoperative pain, a possible indicator that the periapical inflammation had not subsided completely. As such, the placement of calcium hydroxide for a longer duration of up to 4 weeks, but not beyond, should be considered.

**Conclusion**

MTA placement within the confines of the root canal is possible with the use of an internal matrix, against which MTA can be manually condensed. With further evaluation, this technique can help in providing consistent success during apical plug procedures, overcoming some of the difficulties being faced with current materials and techniques.

**References**