Mineral Trioxide Aggregate, the biological healer: A case series

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Introduction
The success of endodontic treatment is not only confined to achieving a threedimensional hermetic obturation of the root canal space but also upon the uneventful healing of the periapical tissues. The maintenance of harmony in the biological environment surrounding the tooth root is crucial to the ultimate success of any endodontic procedure. The success of the treatment has lent itself to the advent of newer technologies in instrumentation as well as to the influx of biomimetic materials. These materials have fulfilled the biological objectives of endodontic treatment with their unique biosimulating properties, the most popular and effective among them being MTA.

Case report: This paper includes four case reports. The first two cases describe periapical lesions associated with immature permanent teeth (central incisor and mandibular premolars), where single step apexification was performed with MTA. The healing of the lesion was observed over a follow up of 6 months and 1 year. The third case presented with middle third root fracture in an endodontically treated central incisor where retreatment and intraradicular fixation with fiber post were performed. Mucoperiosteal flap was elevated and the fracture site exposed a cemental tear which was repaired with MTA. The last case revealed a retreatment in maxillary second premolar where apical stop could not be achieved and so intentional bleeding was induced and the canals were filled with MTA. Both the cases showed satisfactory clinical outcome.

Conclusion: The setting reaction of MTA involves hydroxyapatite formation which ensures a close adaptation with the dentin/cementum of root and provide a biomimetic barrier/seal. Its high pH on setting also ensures a healthy environment for the healing of the biological tissues. Thus MTA stands the test of time as an effective material to promote biological healing.

Keywords: ABSTRACT

Aim: The success of endodontic treatment is not only confined to achieving a three dimensional hermetic obturation of the root canal space but also upon the uneventful healing of the periapical tissues. The maintenance of harmony in the biological environment surrounding the tooth root is crucial to the ultimate success of any endodontic procedure. The success of the treatment has lent itself to the advent of newer technologies in instrumentation as well as to the influx of biomimetic materials. These materials have fulfilled the biological objectives of endodontic treatment with their unique biosimulating properties, the most popular and effective among them being MTA.

Case report: This paper describes a series of four cases depicting the different uses of MTA but where the objective remained same, i.e. biological healing of tissues surrounding the tooth.

Case report
Case 1
A 32 year old patient reported to our department of Conservative Dentistry and Endodontics with the chief complaint of recurrent pain since one month and draining sinus in left mandibular posterior tooth. Careful intraoral examination revealed sinus opening in relation to left lower second premolar. Hard tissue examination revealed no caries in this tooth and it was nonresponsive to vitality tests. Radiographic examination revealed the presence of a blunderbass canal associated with a large periapical radiolucency.
of the left mandibular second premolar (Figure 1). Endodontic treatment was planned. Local anesthesia was not required as the tooth was non-vital. Access cavity was prepared under rubber dam isolation and a thorough biomechanical preparation was done including circumferential filing with 80K file (Dentsply, India) to remove any debris or necrotic dentin and irrigation was performed with 1.25% sodium hypochlorite solution. Thereafter calcium hydroxide and iodoform combination (Metapex, META Biomed Co Ltd, Korea) was placed in canal and patient was recalled after 15 days. Recall appointment showed healing sinus and patient was asymptomatic. On confirming dryness of canal, apexification was performed by placing an apical 5 mm plug of MTA (MTA Angelus) with an MTA carrier and finger plugger (Figure 1). Keeping moist cotton pellet over the canal orifice to achieve complete setting of MTA, the access cavity was closed with IRM.

The patient was asymptomatic at the 1-week recall visit and therefore the remaining canal was obturated with gutta-percha using custom roll-cone technique and AH-Plus sealer and the access cavity was restored with Cention (Ivoclar Vivadent).

The 6-month and 12-month follow-up radiographs showed healing of periapical radiolucency (as in reduction of size) (Figure 1, bottom right corner) and the patient was clinically asymptomatic with no pain, swelling nor tenderness on percussion of the concerned tooth.

Case 2
A young patient, a boy aged 12 years, was referred to our department of Conservative Dentistry and Endodontics with the chief complaint of recurrent swelling and discharge in relation to an Ellis class 1 fracture of the upper right front tooth due to trauma 1 year before. Intraoral examination revealed a discharging sinus of tooth 11. There was no pain, no tenderness on percussion. Clinical and radiological examination indicated pulp necrosis and chronic periapical abscess in the right upper central incisor (Figure 2).

Access cavity was prepared under rubber dam isolation. Biomechanical preparation of root canal was performed using standard hand instruments (K files and H files) and the canal was enlarged up to instrument size 80K file and irrigation with 1.25% sodium hypochlorite. Calcium hydroxide (RC-Cal) dressing was applied and the patient was recalled after 1 week. Recall at one week showed resolution of symptoms and apexification was performed with MTA (MTA Angelus) by placing apical 5 mm plug of MTA and the canal was obturated with gutta-percha after one week (Figure 2). The access cavity and the Ellis Class 1 fracture was restored with light curing composite. The 3-month radiograph showed complete healing of periapical radiolucency (Figure 2) and the patient was clinically asymptomatic.

Case 3
A 42 year old patient reported to our department of Conservative Dentistry and Endodontics with the chief complaint of mild mobility and recurrent sinus with respect to the left upper front tooth. The patient had a history of trauma of the left upper front tooth two years before and had undergone root canal treatment.
Clinical examination revealed unaesthetic joint of porcelain fused to metal crowns present on teeth 21 and 22, a sinus present not in the periapical area but around the midroot region of tooth 21; this tooth had grade 1 mobility and mild tenderness on percussion, whereas 22 was asymptomatic and non-tender on percussion. Radiological CBCT examination (Figure 3) revealed presence of horizontal fracture in the middle third of root of 21 along with endodontic treatment of teeth 21 and 22. The quality of the obturation was deemed to be less than satisfactory for both teeth. Retreatment was therefore attempted under rubber dam isolation, gutta-percha was removed with H files and Protaper Retreatment files D1, D2, and D3. Biomechanical preparation was done under copious irrigation with 2.5% sodium hypochlorite solution and enlargement was done up to F5 and F4 in tooth 21 and 22 respectively. Obturation was done with gutta-percha and AH Plus Sealer by cold lateral compaction. The fracture in 21 was managed by intraradicular fixation with glass fiber post (Ivoclar Vivadent) luted with Paracore after gutta-percha removal with heated pluggers (Figure 3). The mobility of 21 was reduced but the sinus failed to disappear. Therefore, at a subsequent visit, full thickness mucoperiosteal flap was elevated under local anesthesia, the fracture site was exposed, a cemental tear was observed at the site which was repaired with MTA (MTA, Angelus) (Figure 4).

At present, the patient is clinically asymptomatic with no sinus and mobility of both teeth 21 and 22. The joined porcelain fused to metal crowns of 21 and 22 were removed and aesthetic rehabilitation was done with full ceramic Emax crowns of the teeth and Emax veneer of tooth 11, thereby closing a preexisting midline diastema (Figure 5).

Case 4
A 45 year old male patient reported to our department with periapical sinus of tooth 25, which had a history of endodontic treatment. Retreatment was attempted and the tooth was observed to have a short root (Figure 6). Biomechanical preparation was performed under copious irrigation with 2.5% sodium hypochlorite with ultrasonic activation and apical enlargement was done up to 50 K file. During obturation, it was observed that the apical stop was difficult to achieve so, intentional bleeding was induced by intentionally pushing the 50 k file 1 mm beyond the apex. The entire canal was then filled with MTA (MTA Angelus) (Figure 6). The 1 week clinical follow-up showed disappearance of periapical sinus and the patient is currently asymptomatic. The radiological follow-up is awaited.

Discussion
Mineral Trioxide Aggregate (MTA) was developed in early 1990s by Torabinejad and Dentsply Tulsa Dental (ProRoot MTA, Dentsply Tulsa Dental, Johnson City, TN, USA). MTA was originally developed for perforation repair and root end filling (1,2); due to its clinical success, MTA has expanded its uses to one-visit apexification, pulp capping, and so on (3,4). Since its introduction to endodontics, MTA has shown great clinical success due to its good sealing ability and biocompatibility (5,6).

Among the many advantages of MTA, the main
and unique ones being that the setting of MTA is not adversely affected by presence of water. Indeed, MTA needs water in its setting reaction, thus it is considered hydrophilic and water tolerant (7).

Calcium hydroxide is known to be formed as a result of the hydration reaction of MTA (8). Calcium hydroxide explains the high pH of MTA, and it was postulated that the formation of calcium hydroxide attributed the hard tissue forming ability of MTA. MTA has been shown to promote favourable tissue reactions characterized by the absence of severe inflammation, the presence of a fibrous capsule and induction of mineralized tissue repair. The calcium hydroxide with its high pH exerts antibacterial action by inhibiting bacterial enzymes and activates tissue enzymes like alkaline phosphatase resulting in a mineralizing effect (9).

As the MTA matures in phosphate containing body fluids, the calcium deficient hydroxyapatite (CDHA) is formed at the surface of MTA (10). Reyes-carmona et al. and Dreger et al. reported that this interfacial layer was formed as a result of biomineralization and some tag-like structures were formed in this process (11, 12). Bird et al. also reported that the interfacial layer made of hydroxyapatite was formed between MTA and dentin, which yielded chemical bonding between MTA and dentin (13,14). This explains its superior sealing ability and combined with the high pH after setting provides a favourable environment for the repair and healing of biological tissues in and around the tooth.

In the fourth case report, intentional bleeding was induced to increase the local availability of undifferentiated mesenchymal stem cells in the periapical area to promote repair and healing of the hard tissues. In the first two cases, successful clinical and radiological outcome have been achieved. However, the clinical outcome of the last two cases is satisfactory and radiological follow up is awaited.

Conclusion
This paper reports various clinical situations where MTA as a material of choice has proved to be effective and stands the test of time as a material which promotes biological healing.

Conflict of interest
None.

References


