Use of mineral trioxide aggregate in endodontic retro-filling

Author: Dr Fernanda Maria Klimpel, Brazil

Mineral trioxide aggregate (MTA) is an endodontic sealer that emerged on the market in 1998. Through proven scientific results it has become the true miracle of endodontics. An excellent sealing material, it provides setting expansion and integrity of the seal owing to low solubility, tissue biocompatibility and high biological regeneration. The release of calcium ions provides antibacterial activity. Its radiopacity is excellent, and it can be used for thermal condensation owing to its melting point of 150 °C.

MTA also has good capacity for adhesion to dentine, making it resistant to the forces of displacement, and greater sealing power than other cements when tested to assess the quantity of bacterial infiltration. It is indicated for treatment of perforations in the furcation region, of internal resorption, and of root perforations via surgery when it is impossible to treat the perforation via the canal or treatment has been unsuccessful; for use in para-endodontic surgery as a retro-filling material; and for direct pulpal protection, pulpotomy, apexogenesis and apexification.
Literature review

MTA is a biocompatible material with numerous clinical applications in endodontics. It was first used experimentally by Lee and Monsef. However, approval of its use in humans by the American Dental Federation was not granted until 1998. It is composed primarily of tricalcium silicate, tricalcium aluminate, tricalcium oxide and silicate oxide, as well as a small quantity of other mineral oxides and the addition of bismuth oxide, which is responsible for the material’s radiopacity. The principal molecules present in MTA are calcium and phosphorus ions, which are also the main components of dental tissue, giving MTA excellent biocompatibility when in contact with cells and tissue.

MTA has been investigated as an alternative material in endodontics and can be used in retro-filling of root canals. Although the retro-filling material is very important, good sealing of the suitable apex is made for this purpose. According to Assis et al., many techniques and instruments have been recommended for carrying out apical preparations.

Both brands of MTA have been significantly evaluated and no other material has shown more progressive results. According to Pozza et al., the use of MTA in cavity walls, unlike other materials, achieves the best seal against infiltrations. Different materials have been used to seal the paths connecting the root canal and the para-endodontic tissue. However, none of them have achieved results as promising as those of MTA, and various studies have proven that MTA is the best on the market today. According to Leal, MTA cement has effective sealing capacity.

According to Bernabé et al., conventional endodontic treatment is not able to resolve some cases and para-endodontic surgery is required to obtain a good result. The filling material used must not be toxic or mutagenic, and has to be biocompatible and insoluble. The material used in retro-filling distinguishes a good para-endodontic surgery from a bad one. MTA achieves the best result specifically for sealing between the tooth and external surface.

Endodontic treatment has become more practical owing to the new methods and techniques, with the emergence of materials with excellent physical and biological properties. The literature deals with various materials used in retro-filling, but generally speaking these materials do not have all the requisite properties to be able to remain in the cavity, such as biocompatibility, radiopacity, insolubility in periapical fluids, easy compounding, non-staining of the periodical tissue, good adaptation and sealing capacity.

An ideal material to replace amalgam should offer adhesion, promote hermetic sealing, be biocompatible, be radiopaque, be easy to compound and provide for an environment favourable for tissue regeneration.

According to Hellwig et al., para-endodontic surgeries expose and remove dental apices, promote retro-cavitations along the axis of the root canals.
Para-endodontic surgeries have various procedural methods that aim to resolve failures or accidents that occur in conventional endodontic treatment.\textsuperscript{15} According to Girardi et al., apicectomy is a method of para-endodontic surgery that entails the separation of the apical portion from the root.\textsuperscript{16}

It is performed when there is no regression of the apical lesion after the alternatives of conventional endodontic therapy have been exhausted in an attempt to eliminate the apical microorganisms and their toxic products.

The use of a high-quality retro-filling material is indispensable; if an inferior quality material is used, an increase in apical infiltration may occur, since the dentinal tubules are more exposed by certain cutting angles and permeability is hence increased, and this is important at the time of applying the filling material.\textsuperscript{17}

According to Oliveira et al., in an apicectomy with retro-filling using MTA and monitoring after five years, it was observed that teeth with a persistent periapical fistula, after having undergone a suitable endodontic treatment, the surgical retreatment with retro-filling may be an efficient option in the resolution of the infection and repair of the periapical tissue.\textsuperscript{18}

The literature confirms that MTA presents excellent physical, chemical and biological properties, which justify it as the material of choice in the treatment of radicular resorption. It is a material that, compared with other restorative materials, has less microleakage and is capable of inducing the formation of mineralised tissue, such as bone, dentine and cementum, owing to it reaching a pH plateau of around 12.5 in 3 hours. According to Costa et al., who analysed the clinical application of MTA in relation to radicular resorption, in cases in which radicular resorption is minimal, the canal is filled with calcium hydroxide to stimulate the repair, closing the access cavity with zinc oxide and eugenol.\textsuperscript{19}
Among the various advantages of MTA is minimal radiopacity, which has proven to be an important criterion and contributes to it being considered the best choice by the dental surgeon in relation to biomaterials to be used in para-endodontic surgery. According to Barros and Araújo Filho, MTA has been used successfully in filling the apical space of the root canal. In addition to its excellent sealing capacity, it is biocompatible with the periradicular tissue, and induces the formation of cementoblasts and osteoblasts.

Clinical case

This case illustrates the use of MTA for sealing the root perforation and the effectiveness of the retrofitting material after apicectomy (additional surgery; Figs. 1–17). A 51-year-old patient presented to the Universidade Tuiuti do Paraná dental clinic (Brazil) complaining about a gap in the gingiva above tooth #11, from which a large quantity of purulent discharge was draining. In the radiographic examination, an extensive radiolucent area was found, indicating a fistula (periapical lesion) involving the periapical region of the tooth in question.

During the endodontic treatment, the secretion into the tooth could not be controlled. Even 23 days after treatment, with changes to the intra-canal medication, the fistula returned and the exudate drainage via the canal persisted. Definitive sealing of the root perforation was then opted for, utilising MTA and continuing with changes of calcium hydroxide in the root canal. Owing to the persistence of the exudate via the canal, it was decided to perform endodontic filling, followed by supplementary surgical treatment (apicectomy) with retrofitting with MTA, conserving the tooth structure as much as possible.

The surgery was performed under local anaesthetic with an infraorbital nerve block and supplementary infiltrative anaesthesia at the apex of the tooth, as well as a nasopalatine nerve block. The anaesthesia used was 3% mepivacaine with 1:1,000,000 adrenaline.

The incision was made with a #15 scalpel blade and a flap was raised. The osteotomy was performed with a high-rotation drill of the 700 series in order to gain access to the periapical region. The lesion was curetted with a short curette. An apicectomy was performed with the drill and 2 mm of the apex was removed. The cavity for retrofitting was prepared with a spherical drill under constant irrigation with saline solution, and then the retrofitting with MTA was performed. After condensation of the material in the cavity, the excess was removed with a periodontal curette. Finally, the flap was repositioned and then sutured.

One 750 mg pill of acetaminophen every 6 hours for two days was prescribed. In the seven-day postoperative control period, the patient had no symptoms incompatible with the surgery performed and the healing appeared normal. These circumstances held for the full monitoring period, over the course of a year, as the radiograph one year after treatment established new bone formation in the region, proving the success of the case. At the end of the surgical treatment, the patient was referred for prosthetic treatment.

Conclusion

According to the methodology used in this case and considering its results, it can be concluded that the MTA material used was efficient in the formation of a new mineralised tissue barrier, completely sealing the apical portion of the canal.

The author would like to thank Prof. Luciano Loureiro de Melo for his advises and help with this article, and Prof. Yasmine Mendes Pupo for the photographs.

about

Dr Fernanda Maria Klimpel is working as a dentist in Brazil.