

TWO SUCCESSFUL CASES OF ROOT PERFORATION REPAIR USING MINERAL TRIOXIDE AGGREGATE

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ABSTRACT

Root perforation repair has historically been an unpredictable treatment modality with an unacceptably high rate of clinical failure. Inadequacy of the repair materials has been a contributing factor to the poor outcome of repair procedures. Mineral trioxide aggregate (MTA) is a relatively new material that is being successfully used to repair perforations. This article reports the findings of research done on MTA used as material to repair root perforations and presents two clinical cases where MTA was successfully utilized to repair root perforation.

INTRODUCTION

Root perforations are undesired complications of endodontic treatment which result in loss of integrity of the root and further destruction of the adjacent periodontal tissues. Ideal material requirements to seal perforations should include the ability to promote regeneration of peri-radicular tissues, antimicrobial activity and the capacity to prevent leakage of microorganism and their by products.¹ The material should ideally be dimensionally stable, radiopaque, insensitive to moisture, adhesive to dentine, non-toxic non-irritant, non-carcinogenic and biocompatible². Several materials that have been documented to be used as sealers in root perforations include amalgam, zinc oxide eugenol, IRM, Super EBA, Cavit, zinc polycarboxylate, zinc phosphate, glass ionomer cement, calcium hydroxide and mineral trioxide aggregate (MTA).³⁻⁶

Mineral trioxide aggregate (MTA) has been recommended as a repair material for root perforations.⁷ It was developed at the Loma Linda University in the

1990's and was initially introduced as a root end filling material. It has been proven to cause less dye leakage (both in dry and blood contaminated field) when compared to most of the commonly used materials like amalgam, Intermediate restorative material (IRM) and Super-EBA.⁸

It is for the same reason that MTA has been considered as a material of choice for repairing root perforations, as it has not only shown biocompatibility to the surrounding periradicular tissue (minimal inflammatory reaction) but also has demonstrated the ability to allow regeneration of hard tissue like cementum, thus facilitating the regeneration of periodontal apparatus.⁷ In a human osteoblast model, Koh *et al* found that MTA stimulated upregulation of cytokines, such as interleukin-1 α , interleukin-1 β , and interleukin-6, which are involved in bone turnover.⁹

The purpose of this article is to present two cases in which MTA (ProRoot® MTA System; DENTSPLY, Tulsa) was used to seal root perforations which

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were then followed for 6 - 8 months to evaluate the prognosis.

MATERIALS AND METHODS

Both the cases presented had root perforations. In Case 1 the perforation was caused during root canal instrumentation while in Case 2 it was caused during access cavity preparation.

After completing the basic examination (including extra-oral and intra-oral examination; with pocket determination), all patients received the basic sterilization protocol including application of rubber dam and usage of intracanal irrigants (sodium hypochlorite 3%, ethylene diamine tetra acetic acid 10%). The procedure was performed under high magnification microscopes (Carl Zeiss). Once the perforation site was visualized, its size and location was estimated. It was temporarily sealed with Cavit and the root canal treatment commenced. The apical thirds of the canals were obturated with warm vertical condensation and the perforation site sealed with MTA. A moist cotton pellet was placed on top of the MTA and the access cavity double sealed.

At the next appointment the hardness of MTA was checked by scratching its surface with a DG-16 probe. Once the hardness was confirmed, the canals were back filled with Gutta Percha using injection-molded technique (Obtura Spartan Corp. Fenton, MO, USA) and the tooth restored with bonded amalgam (ALL-BOND 2; Bisco, Inc. 1100 W. Irving Park Rd. Schaumburg IL, 60193). The cases were clinically

evaluated to determine the presence or absence of a periodontal defect. Radiographs were also taken to evaluate the presence or absence of any radiolucency and to detect signs of healing that might have occurred after the treatment was completed.

Case 1. Radiograph of the mandibular second molar with strip perforation on the distal surface of the mesio-buccal root caused during root canal instrumentation. A, Postoperative radiograph taken immediately after the repair of perforation. B, radiograph taken 2 months after perforation repair.

Case 2. Radiograph of the mandibular first molar with a condition of Generalized Taurodontism with an apical perforation of the distal canal. A, Preoperative radiograph during endodontic consultation, B, Master GP selected for the mesial canals. C, Apical perforation of the distal canal sealed with MTA. D. Postoperative radiograph taken after three months of perforation repair showing no radiolucency. (The patient had no signs and symptoms during the recall examination performed after 6 months).

RESULTS

Both cases showed no sign and symptoms during the recall visits. Periodontal examination either showed improvement in the periodontal pocket depth or no increase when compared to the baseline readings. Even though the recall time period is short, there seems to be a general consensus towards healing of the cases presented above.

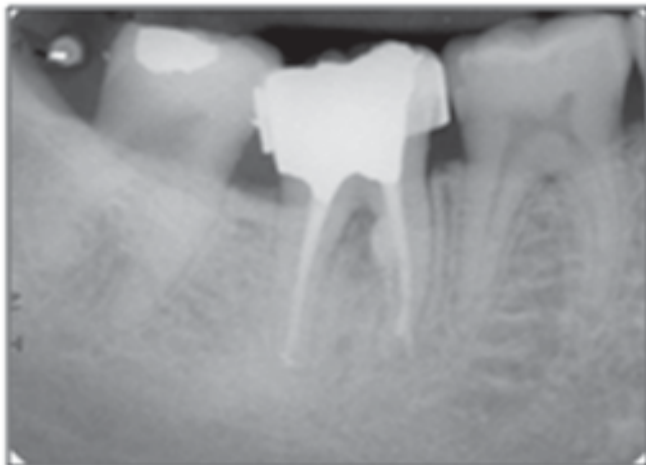


Fig. 1A

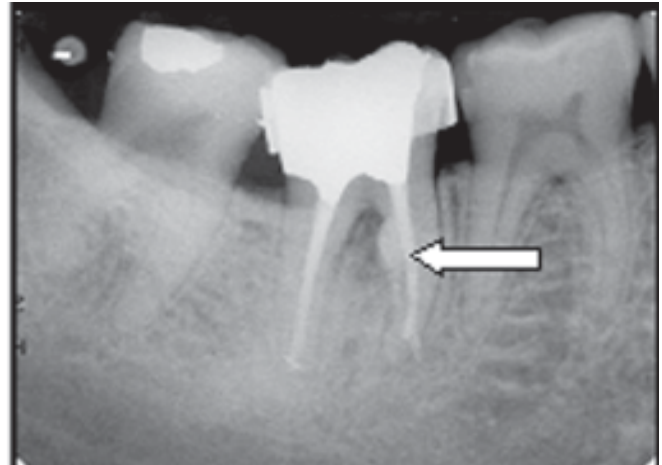


Fig. 1B

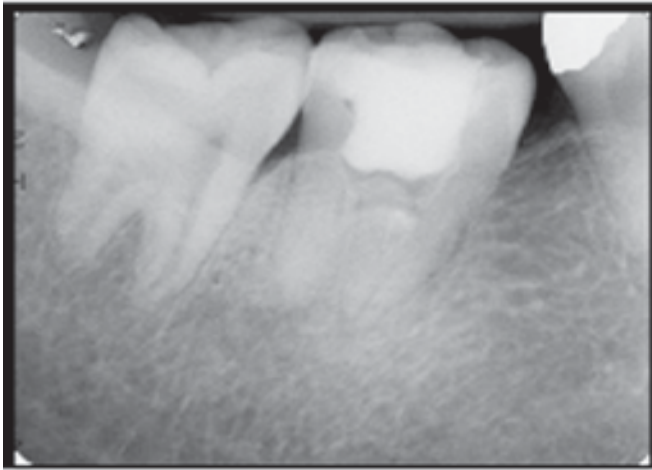


Fig. 2A

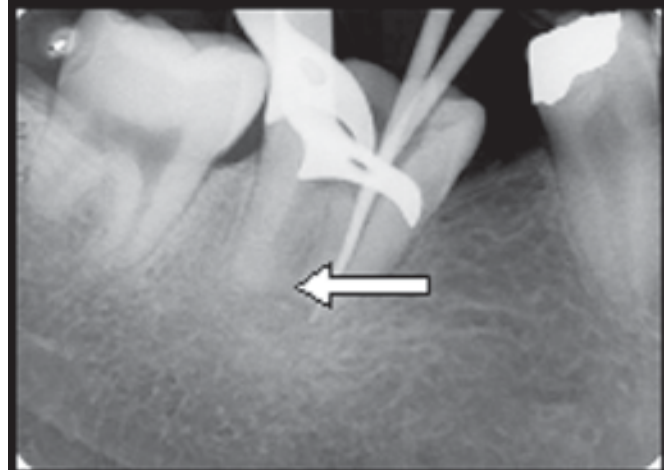


Fig. 2B

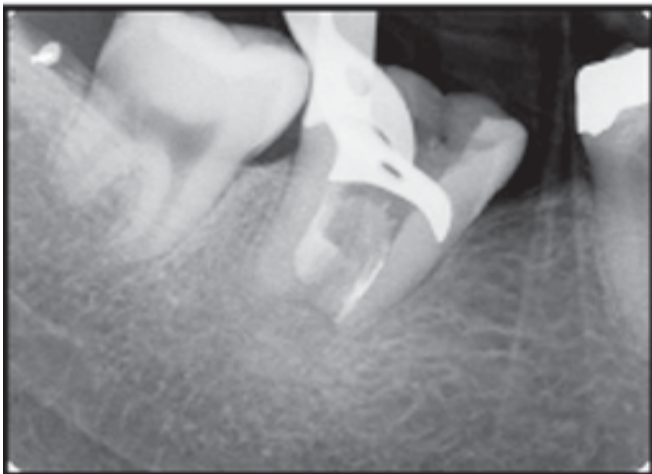


Fig. 2C

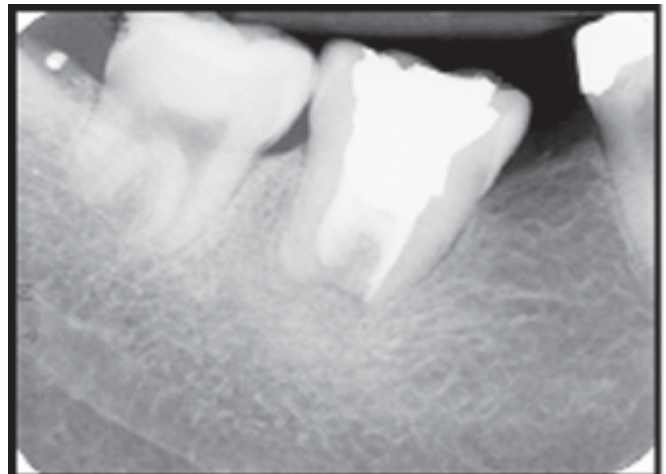


Fig. 2D

DISCUSSION

Although MTA is one of the most researched materials in dentistry today, showing remarkable results, the majority of the published data are based on *in vitro* and animal studies, thus research must be continued to evaluate the clinical outcome in human subjects⁶. In this article we presented just two cases that have demonstrated healing when MTA was used to repair the perforation and therefore the need of the hour is to conduct clinical trials with larger sample sizes and longer durations of follow up.

A perforation is defined as the pathologic or iatrogenic communication between root canal space and the periodontal tissue¹⁰. It is an artificial opening in the root canal created by boring, piercing, cutting or resorption¹¹. Iatrogenic perforations are often a result of deviation from the pre-existing internal anatomy during access preparation, root canal preparation, post

space preparation, or by aggressive canal enlargement¹¹. Pathological perforations may be due to tooth resorption, either external or internal¹².

Case 1 presents strip perforation of the mesial root of a mandibular second molar which might have been caused by overzealous root canal instrumentation. To avoid such an occurrence, instrumentation must be carried out with regard to the anatomy of the tooth and over-enlargement must be avoided.

Case 2 presents a patient having generalized taurodontism. In this case the perforation was caused during exploration of the root canal system while preparation. Taurodontism can be defined as a change in tooth shape caused by the failure of Hertwig's epithelial sheath diaphragm to invaginate at the proper horizontal level¹³. An enlarged pulp chamber, apical displacement of the pulpal floor, and no constriction at the level of the cemento-enamel junction are the char-

acteristic features, all of which are evident in the radiographs shown. Clinically, a taurodont appears as a normal tooth, because its body and roots lie below the alveolar margin, its distinguishing features cannot be recognized. Therefore, the diagnosis is usually a subjective determination made from diagnostic radiographs. Taurodont teeth show wide variations in the size and shape of pulp chambers, varying degrees of obliteration and canal complexity, and apically positioned canal orifices, thus making root canal treatment a challenge. Careful exploration of the grooves between all orifices, particularly with magnification; ultrasonic irrigation; and a modified filling technique are recommended¹³.

Successful treatment of perforations depends mainly on the immediate sealing of the perforation and prevention of infection¹⁴. Factors, such as time elapsed since the perforation and size of the perforation^{14,15}, as well as the repair material are important for a better prognosis following perforation¹⁴. Another important factor is the location of the perforation as the more apical the perforation, the better the prognosis, the more coronal the perforation, the lesser the prognosis¹². This is due to the fact that perforation of the crown or root causes an inflammatory process which causes break down of the periodontium which may extend to the gingival sulcus, producing a deep and un-manageable periodontal defect, the chances of which is higher when the perforation is coronal as compared to one that is apical¹¹.

Any material or technique may have certain properties that must be considered during clinical use. MTA is a fine powder primarily composed of tricalcium silicate, tricalcium aluminate, tricalcium oxide, and silicon oxide that, upon hydration, forms a colloidal gel that solidifies in approximately 3 hours⁷. Therefore, when used as a root repair material, moisture must be provided from the internal aspect of the root (using a moist cotton pellet). MTA was initially introduced as a root end filling material, however because of its biocompatibility it is now also considered as a material of choice to seal perforations. It has also been considered as a pulp capping agent and has been used in pulpotomy showing favorable results¹⁶.

Based on the outcome of the cases presented in this article, MTA seems to be an excellent material for the repair of perforations and there seems to be a marked improvement in the prognosis of teeth repaired with MTA. However, further long term studies are needed to further evaluate the prognosis of MTA in sealing root perforation.

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