CASE REPORT

Surgical management of iatrogenic perforation in maxillary central incisor using mineral trioxide aggregate

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SUMMARY

Root perforations are undesired complications of endodontic treatment. The repair of root perforation can be accomplished using different materials and techniques. Mineral trioxide aggregate (MTA) is widely used to seal perforations because of its biocompatibility and sealability. This article describes a case report where an iatrogenic root perforation was repaired successfully with MTA in maxillary right central incisor of a 13-year-old boy.

BACKGROUND

The American Association of Endodontists Glossary of Endodontic Terms defines perforations as mechanical or pathological communications between the root canal system and the external tooth surface.¹ 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. Perforations may occur during preparation of access cavities, postspace preparation or as a result of the extension of internal resorption into the periradicular tissues.^{2–4} According to Kvinnsland *et al*⁵ 53% of iatrogenic perforations occur during insertion of posts (prosthodontic treatment); the remaining 47% are induced during routine endodontic treatment.

The prognosis of an endodontic perforation depends on the size and location of the defect, and the rapidity of sealing the perforation area with biocompatible material. A variety of materials such as zinc oxide eugenol, amalgam, Cavit, composite resin, glass-ionomer and mineral trioxide aggregate (MTA) have been suggested to seal these perforations. MTA was developed at Loma Linda University in the 1990s as a root-end filling material. The chemical composition of MTA was determined by Torabinejad *et al*⁶ The main components were tricalcium silicate, tricalcium aluminate, tricalcium oxide and silicate oxide. Calcium and phosphorus were the main ions and bismuth oxide acted as a radio-opacifier. The powder consists of fine hydrophilic particles that harden in the presence of water. Hydration of the powder leads to the formation of a colloidal gel which then solidifies to a hard structure in approximately 4 h. In addition to its superior sealing properties, studies have shown MTA to have excellent biocompatibility when placed in contact with the periradicular tissues. Yildirim *et al*⁷ studied the histological

response to MTA and SuperEBA. MTA had less inflammation than SuperEBA and also showed new cementum deposition in the perforation area. In another experiment, Torabinejad and Chivian⁸ showed histological evidence of cementum deposition around MTA that had been extruded into the surrounding periradicular tissues.

The purpose of this article is to present a case in which MTA was used to seal iatrogenic root perforation in permanent maxillary central incisor.

CASE PRESENTATION

A 13-year-old boy was referred to the clinic with pain in the maxillary anterior region, which was diagnosed as originating from the upper right central incisor. The medical history of the patient indicated that he was in good health and had no systemic diseases. The patient gave a history of dental trauma with crown fracture of the maxillary right central incisor, which took place about 1 year prior, and according to the parents endodontic therapy was carried out at another dental clinic. Clinical examination revealed that the maxillary permanent right central incisor was sensitive to percussion and also showed mild mobility with normal probing depth.

INVESTIGATIONS

Periapical radiograph revealed a metal post in the root canal and gutta-percha perforating the lateral wall of the canal (figure 1).

TREATMENT

The metal post along with the gutta-percha was removed from the canal. The root canal was instrumented and irrigated copiously with 2.5% sodium hypochlorite. The root canal was then filled with calcium hydroxide paste between appointments. Furthermore, the perforation site could not be reached from the access cavity. Therefore, surgical intervention was required to repair the perforation with MTA. Buccal full-thickness mucoperiosteal flap was raised extending from the maxillary right permanent lateral incisor to the maxillary left permanent central incisor tooth, and the perforation site was exposed with a bone window (figure 2). After the surgical field was cleaned, the perforation site was subsequently sealed with MTA (Proroot MTA System; Dentsply, Tulsa; figure 3). The flap was sutured and the access cavity of the root canal was temporarily sealed (figure 4). One week following the surgical procedure, the wound was healing

To cite: Nagpal R, Manuja N, Pandit IK, *et al*. *BMJ Case Rep* Published online: [please include Day Month Year] doi:10.1136/bcr-2013-200124

Figure 1 Periapical radiograph shows a metal post in the root canal and gutta-percha perforating the lateral wall of the canal.

well and no complications were noted (figure 5). The sutures were then removed. The root canal was irrigated and then filled with gutta-percha and AH Plus by using the lateral condensation technique. Postspace was created and the impression was made (figure 6). The metal post was cemented (figures 7 and 8) and tooth was restored with porcelain fused to metal crown (figure 9). The patient was recalled every 3 months. The tooth was clinically and radiographically symptom free. Percussion and mobility of the tooth was also in normal limits.

DISCUSSION

Successful perforation repair depends on the ability to seal the perforation and to re-establish a healthy periodontal ligament. The prognosis of teeth with root perforations depends on the severity of the initial damage to the periodontal tissues, the size of the perforation, the location of the perforation in relation to the gingival sulcus, the time lapse between injury and repair, the adequacy of the perforation seal, the sterility of the perforation and the biocompatibility of the material used to repair the

Figure 2 Buccal full-thickness mucoperiosteal flap raised to show the perforation site.

Figure 3 Perforation site sealed with mineral trioxide aggregate.

perforation.⁹ In the past, many materials were advocated for perforation repair; however, none provided a favourable environment for re-establishing the normal architecture and predictable healing after treatment. The inadequacy of these materials can be attributed to their inability to seal the communication between the oral cavity and the underlying tissues, or their lack of biocompatibility. A characteristic that differentiates MTA from other materials is its ability to promote regeneration of cementum, thus facilitating the regeneration of the periodontal apparatus. Several studies have concluded that MTA establishes an effective seal of root perforations^{10 11} and can be considered as a potential repair material that enhances the prognosis of perforated teeth which would otherwise be compromised.^{12 13} Torabinejad *et al*¹⁴ compared the sealing ability of MTA, amalgam and Super EBA in root-end fillings and showed that MTA leaked significantly less than the other materials. According to Lee *et al*¹⁵ MTA also had superior sealing ability

Figure 4 Sutures placed on the flap.

Figure 5 Sutures removed and surgical wound is healed.

Figure 6 Periapical radiograph shows mineral trioxide aggregate placed and postspace created.

compared with amalgam or IRM when used for perforation repair. The most critical property of any dental material that comes into contact with periapical, pulpal or periodontal tissues is its biocompatibility. Several in vivo animal studies have

Figure 7 Periapical radiograph showing metal postinserted.

Figure 8 Metal postcemented.

Figure 9 Tooth restored with porcelain fused to metal crown.

reported that MTA is a biocompatible material with no adverse effects on the dental tissues.^{16–18} Little or no inflammation was observed with MTA when it was used as a root-end filling material in monkeys¹⁸ and dogs¹⁹ or as a pulpcapping agent in monkeys.¹⁶ Furthermore, these studies identified cells lined along the MTA surface, further supporting that MTA has little or no cytotoxicity.

Learning points

- ▶ Root perforations are severe complications which lower the prognosis of endodontic procedures.
- ▶ Treatment can be challenging and sometimes requires certain creativity.
- ▶ Mineral trioxide aggregate seems to be an excellent and promising material for the repair of root perforations.

Competing interests None.

Patient consent Obtained.

Provenance and peer review Not commissioned; externally peer reviewed.

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