Nonsurgical Treatment of External Root Resorption and Furcal Perforation using MTA: A Magical Wand in Endodontics

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Abstract

Mineral trioxide aggregate (MTA) is well known for its great biocompatibility, has demonstrated excellent sealing ability in studies of dyepenetration and bacterial leakage even under blood contamination condition. It is widely applied currently in root end filling, perforation repair and pulp capping. It can induce regeneration of periradicular tissue such as bone and cementum.

In the present case series, a 40 year old male was diagnosed with idiopathic External Root Resorption with tooth #24 on IOPA. Non-surgical root canal therapy was completed by filling the root canal and the resorption defect with mineral trioxide aggregate (MTA). Another case of a 25 year old female suffered from iatrogenic furcal perforation in tooth #26 which was also treated non-surgically by sealing the perforation with MTA. Thus, this case series aims to demonstrate the application andresults obtained by MTA in various endodontic clinical situations.

Introduction

Root resorption associated with primary teeth is physiological and desirable because it results in exfoliation of the teeth, thereby allowing eruption of the permanent teeth. However, root resorption (either internal or external) of permanent dentition is usually pathological and undesirable because it might result in irreversible damage and/or eventual tooth loss. The hard tissues (dentin, cementum, and enamel) of permanent teeth do not normally undergo resorption. External root resorption (ERR) occurs when the periodontal ligament or cementum on the root surface is either damaged or removed[1]. Although the exact cause of ERR is poorly understood, it is generally accepted that the etiology of different types of ERR requires two phases: mechanical or chemical injury to the protective tissues and stimulation by inflammation or pressure[2]. The clinical signs of ERR depend mainly on the extent of the resorption. The usual asymptomatic nature of the early stage of ERR can be explained by the minimal pulp involvement due to protection from the predentin layer. However, some advanced cases develop symptoms of pulp disease when this protective layer is destroyed and the pulp is exposed to oral micro-organisms through the resorptive defect. Therefore, many ERR patients delay treatment because of absence of symptoms and eventually lose the affected tooth.

Also, Furcation perforations are significant iatrogenic complications of endodontic treatment and could lead to endodontic failure[3]. Perforations may occur during preparation of access cavities, post-space preparation or as a result of the extension of an internal resorption into the perirradicular tissues[4]. Factors that influence the outcome of perforated teeth include size of the perforation, time of repair, level and location of the perforation, presence of periodontal disease and pre-endodontic pulp vitality status[5]. On the basis of these characteristics, it can be decided if the perforation can be managed either surgically or non-surgically, and the prognosis is generally excellent if the problem is well diagnosed and the repair is well-performed with a material which can provide proper sealing ability and biocompatibility.

This paper presents 2 cases. The first case is a rare case of an idiopathic ERR of tooth #24 (the left maxillary 1st

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premolar) treated by non-surgical root canal therapy and MTAas an apical plug to promote periapical healing. The second case describes the repair of an iatrogenic furcal perforation in the maxillary 1st molar tooth treated using MTA with the goal of regenerating periodontal attachment.

Mineral trioxide aggregate (MTA) has been regarded as an ideal material for perforation repair, retrograde filling, pulp capping, and apexification, since its introduction in 1993[6]. The principal compounds present in MTA are several mineral oxides that are responsible for the chemical and physical properties of this material[6]. MTA is a mineral powder that consists of hydrophilic particles, with principal components as tricalcium silicate, tricalcium aluminate, tricalcium oxide, and other mineral oxides. It has a pH of 12.5, which is comparable to that of calcium hydroxide, and sets in the presence of moisture in approximately 4 hours[6]. MTA is currently marketed in 2 forms, gray (GMTA) and white (WMTA). Lower amounts of iron, aluminum, and magnesium are present in WMTA compared to GMTA.

Clinical case reports in which GMTA has been used to repair horizontal root fractures, root resorption, internal resorption, and furcation perforations with both clinical and radiographic success have also been reported[7,4,8,9,10,11,12]. When used as a repair material for furcal perforations, MTA has many favorable properties, including good sealing capability, biocompatibility, bactericidal activity, radiopacity, and ability to set up in the presence of blood[6,13]. Several studies have shown better perforations' repair with MTA when compared with that repairs done with amalgam, IRM, Zinc oxide Eugenol (ZOE), or Super EBA, by using both dye and bacteria leakage methods[3,13,14]. Biocompatibility makes MTA a suitable material for the treatment of root perforations with the goal of regenerating periodontal attachment [6,13]. It can also induce osteogenesisandcementogenesis[13,15].

Case Report 1

Patient History

A 40 year old male came to the Department of Conservative Dentistry and Endodontics, Rural Dental College, Loni.The patient presented to our department with non-contributory systemic medical history and with chief complaint of mobility with tooth #24. He had no other discomfort or chief complaint.His dental history excluded tooth trauma, orthodontic treatment, bleaching or periodontal operation. The patient had no other discomfort. He had a strong desire to preservehis tooth and was reluctant to remove it.

Clinical features

The extraoral examination revealed negative findings. The intraoral examination revealed slightpain on percussion with grade II mobility andslight swelling. No other findings were seen. IOPA was advised with same tooth.

Radiograghic Features

IOPA was obtained which revealed an irregular, radiolucency localized in the mesial apical-third of root, communicating with the pulp. A widened periodontal ligament space at the periapical area was also observed. The diagnosis made was Idiopathic External Resorption. (Figure 1)

Fig. 1 : Radiograph showing ERR with tooth #24

Fig. 2 : Radiograph showing MTA apical obturation

Treatment plan

Three alternative treatment options were given to the patient. The first was non-surgical root canal treatment and repair with MTA from the inside of the root canal. The second was endodontic surgery and repair from the outside of the root canal. The third was extraction and replacement with an implant. Benefits and risks of each treatment plan were fully discussed with the patient, and the first option was chosen.

Management

During his first visit, after local anesthesia and rubber dam isolation, an access cavity was prepared and necrosed pulp was extirpated. The working length was verified by apex locator(Buccal = 14mm, Palatal = 11mm)

andcleaning and shaping of the canals was done to a size #80 and #50 K file, for buccal and palatal canals respectively. Sodium hypochlorite (3%) was used as the irrigant.Calcium hydroxide (RC-Cal)was employed as an intracanal medication when there was no excessive bleeding and then the access cavity was sealed temporarily (CavitG).

On his second visit 12 days later, the symptoms of slight pain to percussion had been resolved. The tooth manifested very slight mobility as compared to the first visit. Calcium Hydroxide was injected again after saline irrigation to remove the remaining old medicament.

On the third visit after 21 days, the tooth was asymptomatic. After local anesthesia and rubber dam isolation, the intracanal medicament was completely removed by K files and saline irrigation. When there was no obvious bleeding, the root canal was dried by sterilized paper points and the canal along with the resorption defect was sealed with White MTA using root canal vertical condensation hand pluggers. The apical sealing was checked by the periapical radiograph. A small, wet sterilized cotton ball was placed to hydrate the MTA. The access cavity was temporarily sealed, and thenpermanently filled with glass ionomer cement. Follow up radiographs will be taken at 1, 6 and 12 months intervals to evaluate periapical healing.

Case Report 2

Patient History

A healthy 25 year old female came to the Department of Conservative Dentistry and Endodontics, Rural Dental College, Loni, with pain in the left first maxillary molar after undergoingendodontic treatment for irreversible pulpitis by an intern, one week before.

Clinical Features

The intraoral examination revealedthat the tooth was sealed coronally with temporary cement. The tooth was sensitive to percussion. The mean probing pocket depth was within normal level (2 mm). IOPA was advised.

Radiographic Features

Periradicular radiographic examination revealed a little radiolucent area in the furcal region of left first maxillary molar and apical radiolucencies were also observed. (Figure 3)

Treatment Plan

Treatment options which were indicated for the tooth were either extraction or non-surgical repair of the perforation. As per the patient preference, the option of saving the tooth via a non-surgical procedure, that is, furcal perforation repair with MTA was chosen.

Management

During her first visit, after the administration of local anesthesia, the tooth was isolated, temporary restorative material was removed and the access cavity was modified. The perforation area could be clinically seen. Bleeding was controlled with copious irrigation with saline. A cotton pellet was placed in the orifice of the perforation.The working length was then checked by using an apex locator (Mesio-buccal = 18mm, Disto-buccal = 19 mm, Palatal = 19mm). The root canals were cleaned and shaped till hand protaper file #F2. Before the use of each,the canals were irrigated with CHX andsaline. After the root canals were dried with sterile paper points, they were obturated with gutta-percha points andresin based root canal sealer. After obturation, the cotton pellet was removed from the perforation, exposing the site of the perforation. The furcal perforation was irrigated with saline and chlorhexidine. MTA was prepared, and placed into the pulp chamber with an amalgam carrier. It was then gently packed with a cotton pellet to obtain good adaptability. Afterwards, MTA and part of dental floor was covered with a resin composite, and the tooth was restored using the glass ionomer cement. The patient was then referred for a permanent coronal restoration to the Department of Prosthodontics.The patient did not attend the recall of 6, 12 and 18 months as mentioned after the treatment. (Figure 4)

Fig. 3 : Radiograph showing furcal perforation with tooth #26

Fig. 4 : Radiograph showing furcal perforation sealed with MTA with tooth #26

Discussion

Torabenejad, Schwartz, Menezes, White Jr, Sari, Kim have reported both clinical and radiographic success in cases where in MTA was used to repair horizontal root fractures, root resorption, internal resorption, and furcation perforations[7,4,8,9,10,11,12].MTA offers a biologically active substrate for bone and cells, and osteoblasts also have shown a favorable response to MTA[6,13,16]. It also has no mutagenic potential, has low cytotoxicity, and stimulates the formation of mineralized tissue [4,6,13,16]. The high levels of calcium leached out from the cement also account for its biocompatibility [6,16,5].

External root resorption is a particularly frustrating type of dental abnormality for both patients and practitioners because there is no plausible explanation for the condition and no predictable treatment[17].ERR or IRR may occur on one tooth or on several teeth and it may be caused by trauma, tooth re-implantation, orthodontic treatment, internal bleaching, periodontitis or previous periodontal surgery, pressure from adjacent unerupted teeth, cysts, tumors, or by stimuli from a necrotic dental pulp[18]. ERR may also occur as a result of systemic disease and endocrine disorders, such as hyperparathyroidism, Paget's disease, calcinosis, Gaucher's disease and Turner's syndrome as well as after radiation therapy[19]. There are also some rare ERRs of unknown cause, usually called "idiopathic"[20].In this case report, the ERR of tooth #24 was already present, but not immediately recognized because of absence of symptoms. Etiology was idiopathic according to the history given by the patient and the clinical and radiographic findings. Some articles suggested various treatment options depending on the etiology and type of ERR such as root canal therapy alone, periodontal surgery alone, root canal therapy plus periodontal surgery or extracting the tooth and implantation[21]. However, a recent systematic reviewillustrates that there is no reliable source of evidence regarding the most appropriate means of treating ERR. Moreover, it reveals that in most of the cases, the treatment alternative is case-dependent.

Therefore, the choice of treatment by root canal therapy alone in this case also depends on a complete communication with the patient combining the patient's condition and trust with the clinician's experience. There are several successful case reports about root resorption by root canal therapy alone to support this choice[22,23,24]. The main reasons to suggest preserving the tooth by root canal therapy alone are the patient's desire to preserve the tooth. The patient had a healthy oral hygiene with good periodontal condition. The resorption area was in the apical-third root without communication with the oral cavity. All of these demonstrated the necessity and probability to preserve this tooth.

As aforementioned, ERR can be stimulated by inflammation[2] and, as a result, infection control is the key to success. In this case, rubber dam isolation, complete debridement of necrosed pulp tissue and cleaning with 3% sodium hypochlorite were all very helpful in infection control. The use of Calcium Hydroxide as intracanal medication also helped control the infection for ERR.The most important reason to choose MTA as the permanent repair material in this case is because it has a capacity to promote hard tissue formation and to inhibit osteoclastic bone resorption[25]. In short, with careful clinical procedures, proper disinfectant and superior repair material, successful non-surgical treatment for severe ERR is possible.By the follow-up, the resorption region is expected to heal and the filling material in the root canal is expected to be intact, to demonstrate a favorable clinical outcome.

The clinical applications of MTA have proved that it is suitable for solving the problems derived from perforation[6,5,16]. The desirable properties of MTA make it a useful material in repairing the root and furcal perforations. One of the factors influencing the prognosis of furcal perforations is the period of time elapsed since the occurrence of the perforation, as the possibility of an infection in the wound site increases with the passing time[13,16]. Immediate sealing of perforations enhances the repair process due to the reduced possibility of bacterial contamination of the defect. Root perforations sealed after contamination presented worse repair than the non-contaminated and immediately sealed perforations[16].In our case, even though the tooth was sealed coronally with only temporary cement, the material was present even at the time of presentation, thus avoiding contamination. To achieve a better tissue response, the perforation sites were disinfected with chlorhexidine.

Blood from the site of perforation was adequate to keep the hydrophilic powder moist, and thus the use of cotton pellet could be avoided. After the insertion of MTA, a resin composite was used to cover the MTA and a part of dental floor. As MTA is not an adhesive material, it could suffer a displacement during the coronal restoration of the tooth. Hence, resin composite was used to ensure

that MTA did not suffer any kind of dislodgement. Resin composite could also reinforce the tooth structure as MTA is not a hard enough material.MTA is a suitable material for the treatment of furcal perforations, with the goal of regenerating periodontal attachment. In this case, furcal perforation of the maxillary left first molar was treated using non-surgical placement of MTA. The repaired tooth was clinically and radiographically healthy and continued to satisfy the functional demands. Based on the outcome of the case presented, MTA is a good material for the repair of furcal perforations, and has been proven effective even for larger perforations.

Conclusions

In summary, endodontists should have confidence in treating such extensive ERR and furcation perforation with careful clinical procedures, complete control of infection and superior filling material such as MTA. With proper treatment, the tooth can be preserved for a long time.MTA has thus proved to be a magic wand in endodontics.

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