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Perforation Repair using MTA: A Case Series

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Abstract

Iatrogenic perforation is a common complication in endodontic treatment or restoration procedure. Unpredictable endodontic root/pulp chamber floor perforations resulting in unacceptable high rate of clinical failure has now been a lesser threat with the advent of new technologies and biocompatible materials that utilize the applications of basic research along with tissue engineering concept in clinical practice. Present case report illustrates the use of MTA for the repair of the perforation defect. The autologous and biocompatible nature of the components of MTA seems to be beneficial for the long term clinical results obtained in our case. In Conclusion Angelus MTA have good sealing ability marginal adaptation, and the absence of calcium sulfate had reduced the setting time of the material. It is a suitable material to seal iatrogenic furcal perforation due to its biocompatibility, antimicrobial, good sealing ability, and low solubility.

Keywords: Iatrogenic Perforation, Root Canal Treatment, Furcal Perforation, Non Surgical Perforation Repair, MTA

Introduction

Perforation is one of the complications that could occur during root canal treatment. Root perforations may arise pathologically (i.e., by resorptive process or by caries), or iatrogenically. According to Kvinnsland *et al.* iatrogenic perforations mostly occur during endodontic treatment and insertion of posts [1,2]. In 73% of all cases, complications occur in maxilla and Tsesis *et al* reported that 55% of perforations occurred in lower molar teeth [3]. Perforations define as a mechanical or pathological communications between the root canal system and the external tooth surface [1,4]. The injury to the periodontium results in the development of inflammation, destruction of periodontal fibers, bone resorption, formation of granulomatous tissue, proliferation of epithelium, and ultimately in the development of a periodontal pocket [1].

Repair of perforations was dependent on the location and the time elapsed before sealing the perforation [5].

Perforations can be managed surgically or nonsurgically. In nonsurgical treatment, perforations should be repaired with a biomaterial to prevent bacterial contamination and communication between perforation site and gingival sulcus. Several materials have been used to repair furcation perforations, including zinc oxide eugenol cements (IRM and Super-EBA), glass ionomer cement, composite resins, resin-glass ionomer hybrids, and mineral trioxide aggregate (MTA) [6].

Bioceramic materials are biocompatible ceramic materials suitable for its use in human body and an inovation in dental materials for endodontic treatments [7]. MTA is a bioceramic material that has become recognized as the gold-standard material for a variety of clinical situations. MTA has been applied with good outcomes in root-end surgery, direct pulpal coverage, apexification, radicular resorption, and repair of lateral radicular and furcal perforation [8].

Case Report

Case 1: A 30 year old male patient reported to the Department of Conservative Dentistry and Endodontics with a chief complaint of pain in his lower left back tooth region since 3 months. Intra oral examination revealed a deep carious lesion wrt 36. Radiographic examination showed deep caries involving the enamel, dentin and pulp. The diagnosis for tooth 36 is chronic irreversible pulpitis with chronic apical periodontitis.

In the first appointment patient had cavity access preparation. After access preparation, working length was determined followed by biomechanical preparation and a closed calcium hydroxide dressing. (Figure 1a)

In the second appointment when the patient reported for obturation there was persistent bleeding near the mesiolingual orifice after the root canal preparation pointing to furcal perforation. (Figure 1b)

Case Management

Non-Surgical repair of perforation with MTA was planned. The tooth was isolated with rubber dam and after bleeding control, the perforation site was cleaned and sealed with Angelus *White* MTA using MAP System (Figure 1c). A moist cotton pellet was inserted over the MTA in the chamber and sealed with a temporary filling. After 2 days, the patient was recalled and RCT was completed (Figure 1d). The patient was recalled after one week and 3 months for follow-up and there was no sign and symptom (Figure 1e).

Figure A

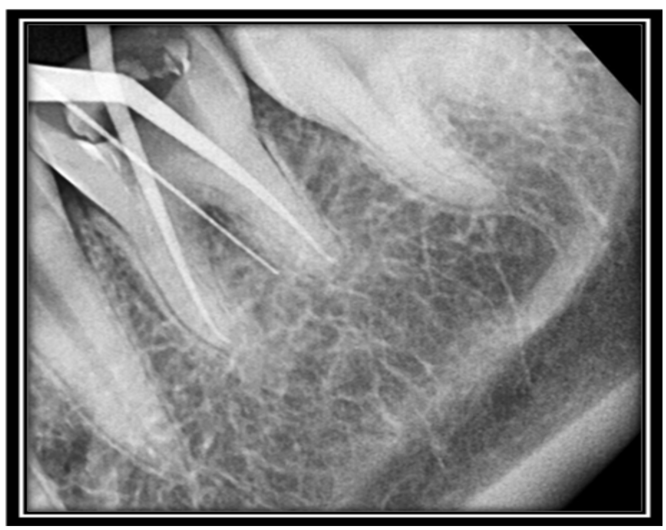

Figure B

Figure C

Figure D

Figure E

Figure 1 : Non-Surgical repair of perforation with MTA wrt 36 for Case 1: a) Working length radiograph; b) Furcal Perforation towards the mesiolingual surface; c) Radiographic view after repair with MTA; d) RCT completed followed by Post Endodontic Restoration wrt 36; e) 3 months follow-up.

Case 2: A 25 year old male patient reported to the Department of Conservative Dentistry and Endodontics with a chief complaint of pain and intermittent bleeding from his lower right back tooth region since 20 days. Intra oral examination revealed a failed attempt of root canal treatment wrt 46. Access opening was done previously with and a cotton plug placed in it. The tooth was painful on percussion. Radiographic examination revealed furcation perforation in 36. The diagnosis for tooth 36 is attempted RCT with furcal perforation.

Case Management

Re-RCT followed by Non-Surgical repair of perforation with MTA was planned. The tooth was isolated with rubber dam and after bleeding control, the perforation site was cleaned and sealed with Angelus *White* MTA using MAP System. A moist cotton pellet was inserted over the MTA in the chamber and sealed with a temporary filling. After 2 days, the patient was recalled and RCT was completed. The patient was recalled after one week and 3 months for follow-up and there was no sign and symptom.

Figure A

Figure B

Figure C

Figure D

Figure 2 : Non-Surgical repair of perforation with MTA wrt 36 for Case 2: a) Pre Operative Radiograph with Furcal Perforation; b) Working Length Radiograph; c) Mastercone Radiographic view after repair with MTA; d) RCT completed followed by Post Endodontic Restoration wrt 36.

Case 3: A 30 year old male patient reported to the Department of Conservative Dentistry and Endodontics with a chief complaint of missing tooth in his lower left back tooth region since. An Intentional RCT was planned wrt 35 followed by bridge wrt 35, 36 and 37.

While doing the access opening an iatrogenic coronal perforation occurred wrt 35.

Case Management

RCT followed by Non-Surgical repair of perforation with MTA was planned. The tooth was isolated and obturation was done and after bleeding control, the perforation site was cleaned and sealed with Angelus *White* MTA using MAP System. A moist cotton pellet was inserted over the MTA in the chamber and sealed with a temporary filling. After 2 days, the patient was recalled and post endodontic restoration was completed. The patient was recalled after one week and 3 months for follow-up and there was no sign and symptom. After 3 month recall the non-symptomatic tooth was referred to department of Prosthodontics for further rehablitation.

Figure A

Figure B

Figure C

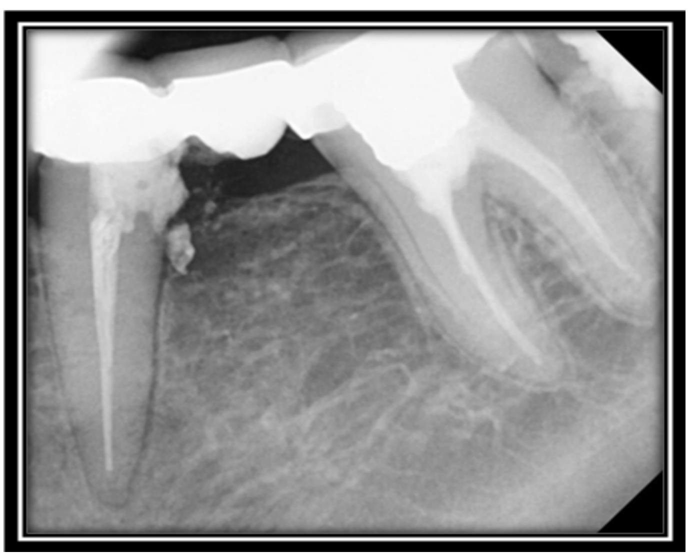

Figure D

Figure 3 : Non-Surgical repair of perforation with MTA wrt 35 for Case 3: a) Pre Operative Radiograph; b) Iatrogenic Coronal Perforation on the distal aspect; c) Radiographic view after repair with MTA; d) 3 month follow-up after Prosthetic rehabilitation.

Discussion

Mineral trioxide aggregate (MTA) is a material that has been widely used in dentistry. MTA is an appropriate material to seal the iatrogenic perforations on the tooth bifurcation because of its biocompatibility, favoring alkaline phosphatase activity, mineralized formation and cell proliferation, as well as lower incidence of inflammatory chemical mediators favoring local tissue repair [9,10].

MTA was first described in the scientific literature in 1993 as an aggregate of mineral oxides added to “trioxides” of tricalcium silicate, tricalcium aluminate, and tricalcium oxide silicate oxide, that comprised primarily of Portland cement. MTA is approximately 75 wt% Portland cement, 20 wt% bismuth oxide (Bi_2O_3), and 5 wt% calcium sulfate dihydrate or gypsum ($CaSO_4 \cdot 2H_2O$) [11]. MTA is used for forming an apical plug during apexification, repairing root perforations and the treatment of internal root resorption and used as a root-end filling material and pulp capping material [7].

MTA releases calcium ions and promotes an alkaline pH. It leach calcium ions several days after the initiation of hydration and setting of the material. These calcium ions diffuse through the defects in the dentin in root canals filled with MTA, and the concentration increases with time. The bioactivity of MTA has been attributed to its capacity of hydroxyapatite production, when the calcium ions released by the MTA came into contact with tissue fluid [12]. When in contact with tissue fluid, an amorphous calcium phosphate phase initially formed, which later transformed to an apatite phase, with the latter consisting of calcium-deficient, poorly crystalline, B-type carbonated apatite crystallites. Amorphous calcium phosphate is a key intermediate that precedes biological apatite formation in skeletal calcification [13].

MTA consist of a white or gray particle powders [14,15], where the more aesthetic white coloured preparation lacks the tetracalcium aluminoferrite [7,14]. The difference between White and Grey MTA is primarily a result of the lower iron oxide content used in the White MTA. Reasonably, the absence of significant Ferric Oxide (FeO) in White MTA. [14] These two types of MTA has the same physical properties [13,15]. White MTA was recently introduced by the addition of bismuth trioxide to white Portland cement [15]. The MTA pH was 9 after 168 hours, biocompatibility, and antimicrobial activity. The absence of significant FeO in White MTA causes the colour change from Gray to White, and changes the percentage of silica and alumina in each material [14]. The white version gives a better final appearance than the original grey MTA, which can create a shadow under thin tissue [16].

MTA was utilized in these cases because it has a good sealing ability, good marginal adaptation, and superior biocompatibility [17]. MTA can be used in a moist condition or contaminated with blood and sets only in contact with moisture. Due to the abovementioned characteristics and primarily because it is hydrophilic property, MTA was considered the ideal material to seal perforations. Many histologic investigation suggests that MTA produces the best histologic results compared with other perforation repair materials such as amalgam, glass ionomer, calcium hyroxide [7, 18, 19].

Conclusion

The material to repair iatrogenic furcal perforation should be able to seal the pathways of communication between the root canal system and its surrounding tissues. Scientific research has demonstrated the effectiveness of MTA in a various clinical applications of endodontic procedures.

MTA has antimicrobial properties, sealing ability, setting reaction, and good clinical performance to promote the growth of cementum and formation of bone. MTA considered as an effective sealing material and biocompatibility.

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