CASE REPORT

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Application of the MTA in the management of pulpal floor perforation – a case report

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Keywords

pulpal floor perforation, MTA, endodontic retreatment

Summary

Pulpal floor perforation, defined as the communication between the canal system and the root's external surface, is one of the complications in endodontic treatment. Lack of sufficient closure of the perforation may result in the failure of the treatment. A material dedicated for the closure of the perforation is the MTA (Mineral Trioxide Aggregate) cement.

The study presented herein shows a case of an old pulpal floor perforation in the lower left second molar (tooth 37), co-existing with the damage to the periodontal tissues, omitted mesiolingual canal and the inflammation in the periapical area. An initial cone beam computed tomography analysis helped to plan the retreatment and determine the prognosis. Written consent from the Patient was obtained. The endodontic retreatment, including the disinfection and closure of the perforation with the MTA, was successful. The control radiographs and clinical assessments after 4 months and 3 years showed complete regeneration of inflammatory lesions and new bone structure in the furcal area.

The MTA cement is effective in closing old pulpal floor perforations and allows for the regeneration of the lost bone in the furcal area.

Introduction

Clinical complications of endodontic treatment involve iatrogenic perforations of the canal walls, which may have an impact on the overall result of the treatment. The American Association of Endodontists define perforations as mechanical or pathological communication between the canal system and the external surface of the root. The most imminent causes of such perforation include inappropriate endodontic access, aggressive canal system preparation and non-axial preparation of the root post (1). Iatrogenic perforations are the second most frequent (9.6%) complication in endodontic treatment (2). A perforation located in the furcal area may cause pathological communication between the canal system and the periapical tissues, resulting in bacterial contamination. Therefore, a progressing destruction of the periodontal ligament may be observed, following permanent inflammation (3). The prognosis for a tooth with co-existing perforation depends on its location, time in which the canal system had direct contact with the periapical tissues, the extent of the periodontal ligament irritation and the technical feasibility of closing the perforation (2, 4, 5). Perforations located in the middle third section of the canal length have the best prognosis, while those located in the coronal third section and the pulpal floor have the worst one. In order to eliminate bacterial infection, immediate closing of the perforation is necessary, using bioactive materials with antibacterial properties and short setting time in various pH and moisture conditions, facilitating the regeneration of periodontal tissues and characterised by lack of resorption in tissue liquids, stability of dimensions and radiopacity (2, 4). The MTA (Mineral Trioxide Aggregate) is a material dedicated for perforation closing, which is a blend of Portland cement (70%), bismuth oxide (20%) and gypsum (5%), containing trace quantities of silicon, calcium and magnesium oxides, sulphur acid and sodium sulphate (2, 4, 6-8). Apart from its biocompatibility, the material induces biological response and is conducive for cell adherence and growth (7). Directly after the application, hydroxyapatite crystals are formed on its surface, which indicates its regenerative potential (8). The hydroxyapatites deposited act as scaffolds for further cell growth (5, 6). The MTA promotes cementogenesis owing to the adherence and growth of osteoblasts on its surface, which is followed by their secretion of genes encoding the proteins of mineralised tissues (6). These features of the MTA indicate its potential for usage in regenerative endodontic procedures.

Case report

This paper presents a case of the endodontic retreatment of the second lower molar tooth (tooth no. 37) with co-existing iatrogenic perforation of the pulpal floor, partially unfilled mesiolingual (ML) canal and vast periapical lesion. The patient E.M. aged 51, was referred in writing in September 2014 by a prosthodontist for restorative preparation preceding prosthodontic treatment. The referral letter also included the retreatment of the tooth 37. The Patient brought diagnostic radiographs, such as an orthopantomogram and cone beam computed tomography (CBCT) of the left side of the mandible. In her health questionnaire, the Patient mentioned respiratory allergies and asthma. In her dental questionnaire, the Patient did not report any subjective pain involving the tooth 37, which was endodontically treated in June 2011 due to acute pulpitis. As breathing problems made it impossible for the Patient to be treated in the ergonomic (recumbent) position with rubber dam coverage, the previous treatment was conducted in sitting position and without the rubber dam. The operating dentist had difficulties performing the endodontic procedure, of which the Patient was aware.

The clinical inspection of the tooth revealed an existing class II (Black's classification) polymer-based restoration. No response in vitality test using methylene chloride, Ist class pathologic mobility (Entin's classification), pain in vertical and horizontal percussion tests and an inclination towards the gap formed by the missing teeth 35, 36 were determined. The examination of the surrounding gingiva by means of a calibrated periodontal probe showed the presence of a pathological periodontal pocket on the lingual side, Ist class furcation involvement in Hamp's classification and bleeding from the pocket on the mesial and lingual side. The orthopantomogram revealed the tooth 37 after root canal treatment with visible filling in two canals, an irregular periapical lesion located around the mesial root and horizontal bone loss including the furcation (fig. 1). The CBCT analysis revealed the presence of a periapical lesion (4.0-7.7 mm depending on the layer) (fig. 2, 3), pulpal floor perforation with bone loss and the presence of material in the furcal area (fig. 4a). It also indicated the location of the previously omitted ML canal (fig. 5). A conditional endodontic retreatment of the tooth 37 involving the closure of the perforation was agreed upon, for which the Patient gave her written consent. The retreatment was performed in lying position, with rubber dam isolation and using an endodontic microscope OPMI Pico Mora (Carl Zeiss AG, Oberkochen, Germany), endodontic rotor X-Smart® Dual (Denstply Sirona, York, USA) and ultrasonic files. The perforation had a diameter of approx. 1 mm and was located in the area of the transition of the pulpal floor into the lingual wall. It was filled with remnants of the material and granuloma. The location of the perforation

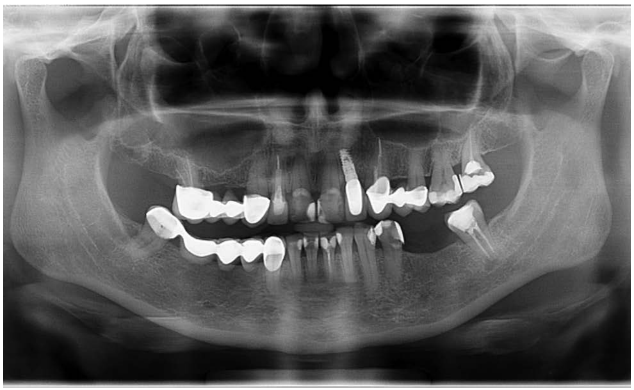

Fig. 1. Panoramic X-ray. State before the endodontic retreatment

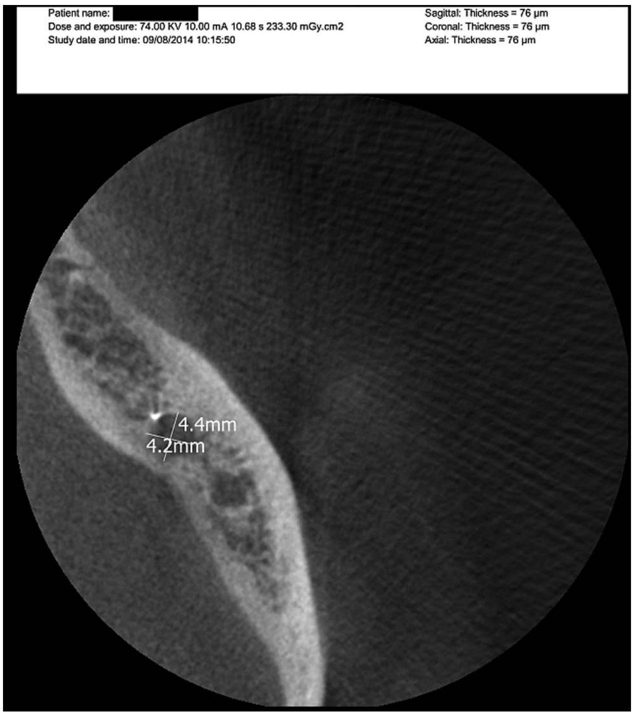

Fig. 2. CBCT (tooth 37) axial view. Dimensions of the periapical lesion before the endodontic retreatment

Fig. 3. CBCT (tooth 37) frontal view. Dimensions of the periapical lesion before the endodontic retreatment

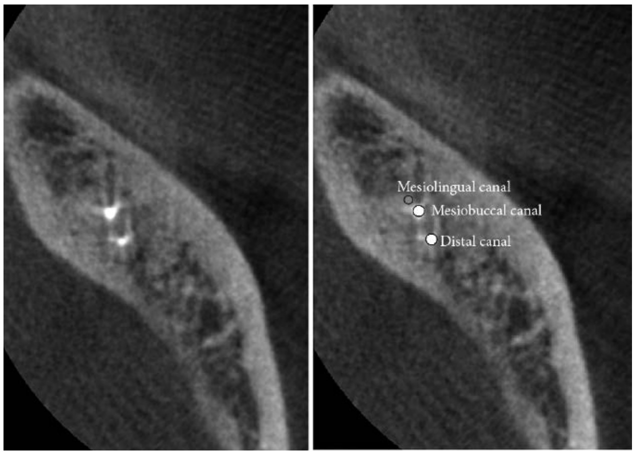

Fig. 5. CBCT (tooth 37) axial view. Location of the omitted mesiolingual canal

was evidence to the previous attempts at finding the ML canal. The perforation was cleaned using the ultrasonic files with diamond grit and endo-chuck nickel-titanium ISO 30 files. The disinfection of the perforation was carried out using 2.0% sodium hypochlorite (NaOCl), 0,9% natrium chloride (NaCl) and 2% digluconate chlorhexidine (CHX). When the hemostasis was reached, the perforation was closed with an approx. 2 mm layer of the MTA+ (Cerkamed, Stalowa Wola, Poland), prepared according to the manufacturer's instructions. A moist cotton pellet was left in the pulp chamber and the cavity was temporarily filled with the resin-modified glass-ionomer cement Fuji II LC® (GC Europe N.V., Leuven, Belgium). The next visit was appointed after 24 h, when the adhesion and toughness of the material were controlled and its surface was protected with flowable resin-based material (Arkona, Niemce, Poland) applied with the self-etching adhesive system Clearfil Protect Bond® (CPB; Kuraray Noritake Dental Inc., Tokyo, Japan). The omitted ML canal was found and its patency was restored. Furthermore, the material from the mesiobuccal (MB) and distal (D) canal was mechanically removed and the canals were chemically disinfected. The working lengths of the canals were determined with the use of Raypex® 5 endometer (VDW GmbH, Munich, Germany). The canals were chemo-mechanically shaped by single-length technique using the rotary files system Mtwo® (10/.04-40/.04; VDW GmbH, Munich, Germany) together with ethylenediaminetetraacetic acid (EDTA) and the urea peroxide RC-Prep® (Premier Dental, Plymouth Meeting, USA). Next, the canals were rinsed with 5.25% NaOCl, 40% citric acid, 0.9% NaCl and 2% CHX with additional ultrasonic activation. After drying and having determined no pathological exudation from the periapical area, the canals were obturated using the continuous wave technique with calibrated gutta-percha points and AH Plus® (Dentsply Sirona, York, USA) sealant. The control radiograph showed a homogenous, full-length filling of the canals, apart from the canal D, which was overfilled (fig. 6). The orifices of the canals were sealed with flowable material with CPB system. The pulp chamber floor was covered with the base cement Fuji II LC and permanent restoration was performed using the resin-based Evetric® (Ivoclar Vivadent AG, Schaan, Liechtenstein) material. The recommendations for the patient included radiographic control of the tooth 37 after 3 months' observation period.

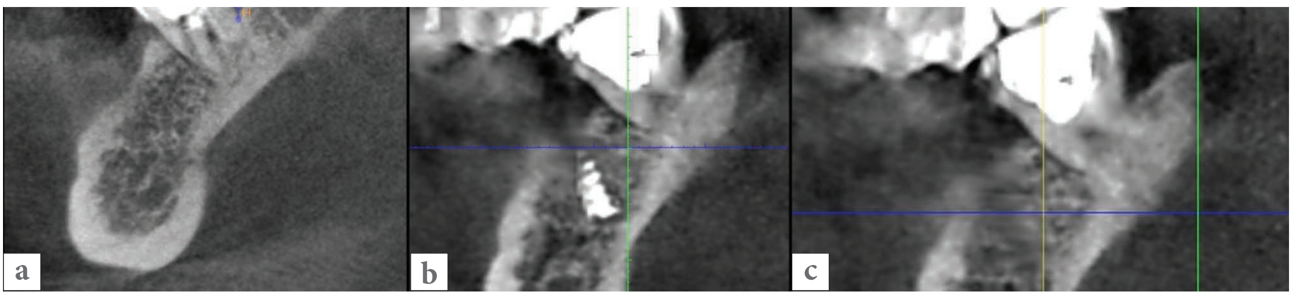

Fig. 4a-c. CBCT (tooth 37) frontal view. (a) Bone structure loss with the visible foreign material in the furcal area before the endodontic retreatment; (b, c) control CBCT after 4 months' observation. Reconstruction of the bone structure in the furcal area

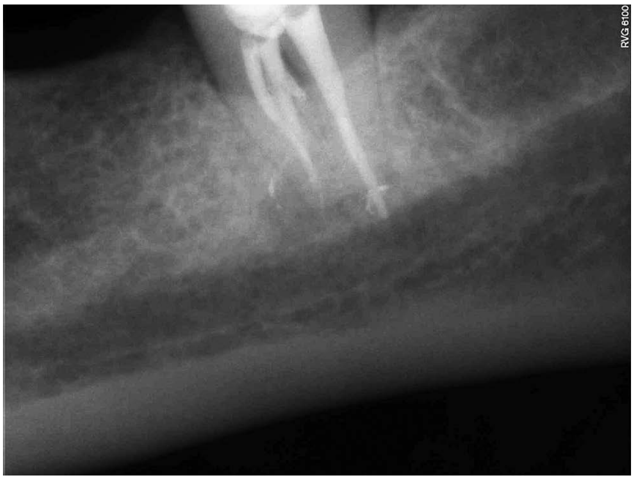

Fig. 6. Intraoral teeth imaging (tooth 37). State after the endodontic retreatment. The material closing the perforation in the furcal area and excessive material filling the distal canal visible

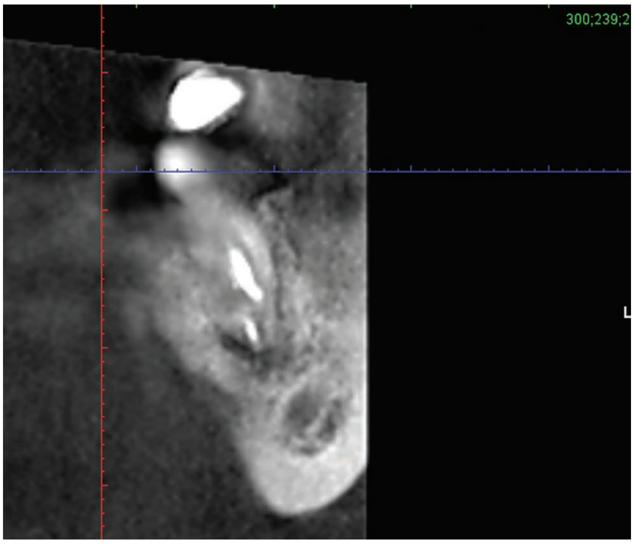

Fig. 8. CBCT (tooth 37) frontal view. Reconstruction of the bone structure in the area of the periapical lesion

The patient showed up for a check-up in January 2015 with a radiograph of the tooth 37 and a CBCT image of the mandible. She reported no subjective pain. The clinical inspection revealed neither pathological mobility of the tooth nor pain reaction to horizontal and vertical percussions. The probing of the periodontal pocket showed no bleeding. The radiograph showed partial resorption of the filling material in the overfilled canal D (fig. 7), diminishing of the periapical lesion (2.61-6.22 mm depending on the layer) and formation of new bone structure in the periapical and furcal areas (fig. 4b-c and 8). The control CBCT confirmed the presence of the MTA layer in 2,04 mm thickness in the perforation area (fig. 9).

A radiograph taken in March 2018 confirmed full healing of the periapical area (fig. 10). Clinical inspection showed no deviation from the normal. As the Patient had recently been subjected to radiotherapy, she did not consent to a control CBCT.

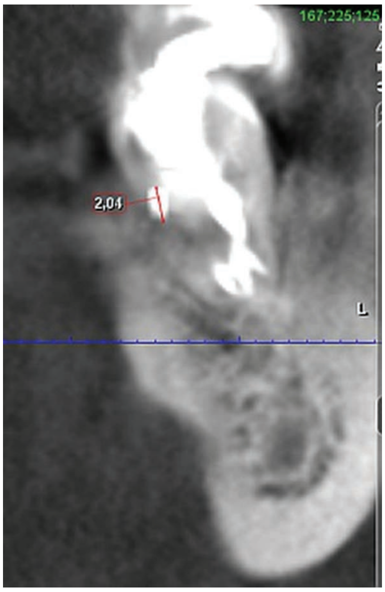

Fig. 9. CBCT (tooth 37) frontal view. The presence of the MTA closing the perforation in the periapical area

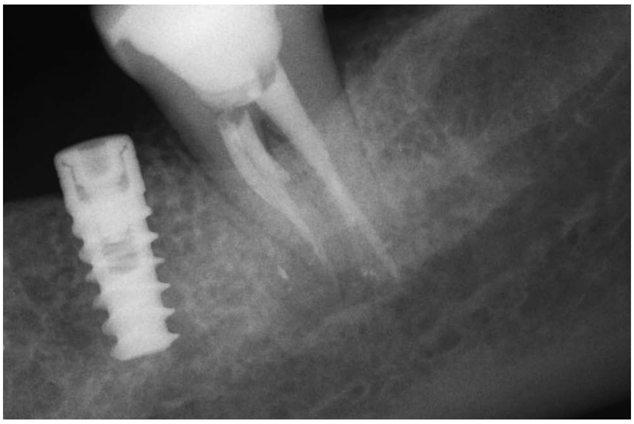

Fig. 7. Intraoral teeth imaging (tooth 37). Control image after 4 months, partial resorption of the material filling the distal canal visible

Discussion

In the case presented, the endodontic retreatment of the tooth 37 was performed. The primary treatment was complicated by pulpal floor perforation, probably due to the fact that it was performed in an enforced position, disadvantageous for the operator. When the Patient's health situation stabilised, she was able to undergo specialist treatment in lying position with the use of an endodontic microscope and ultrasonic devices. Modern diagnostics, such as CBCT, enabled the operator to assess the condition of the tooth before the retreatment, plan the procedure and provide the prognosis. The perforation revealed in the operating

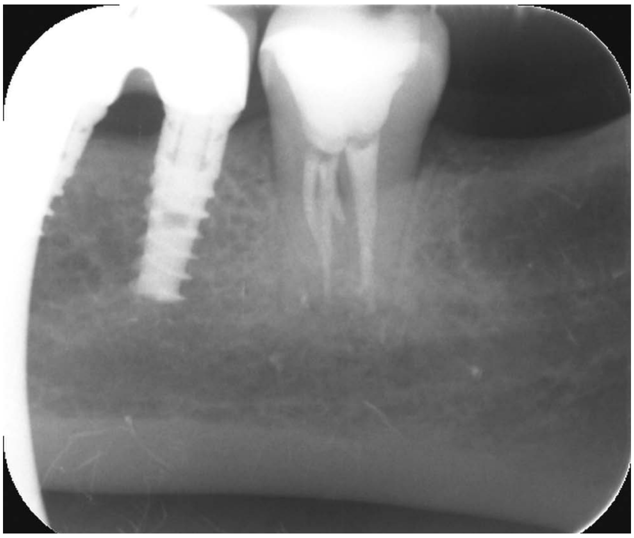

Fig. 10. Intraoral teeth imaging (tooth 37). Control image after 3 years, complete bone structure reconstruction in the area of the periapical lesion

microscope was cleaned of debris and closed with the MTA. Leaving the perforation unclosed before the further disinfection and shaping of the canal system would put it at risk of a continuous bacterial contamination. A hermetic 3D seal of the canals, minimising the risk of microleakage and bacterial reinfection, is vital in endodontic treatment. The materials used for both the permanent canal filling and perforation closing should therefore be non-porous, resistant to mechanical deformation during mastication, able to set in the moist environment and radiopaque. Many materials were used for perforation closing, such as amalgam, zinc oxide cement, super-EBA cement, calcium hydroxide, glass-ionomer cement, resin-based materials and decalcified freeze-dried bone allograft (1, 3). Sadly, none of them induced the regeneration process of the lost periodontal and/or bone tissues. It wasn't until the combination of the Portland cement and gypsum was invented and patented in 1995 by Torabinejad and White at the Lima Loma University in the USA, that a breakthrough in endodontics could come (9). The MTA is proven to be less permeable and cytotoxic (5). Moreover, relevantly higher vitality of the fibroblast was observed on its surface compared to other materials (5). These features indicate its effectiveness in the regeneration of damaged periodontal tissues.

Successful perforation closing depends on many factors, including the time which passes between the occurrence of the complication and its sealing, as well as the size of the perforation. In the case presented herein, the perforation was closed after three years. Along with the bone loss in the furcal area, the contamination of the canal system progressed. It is advised that the perforation should be closed before the further intervention in the canals, even though the MTA's application creates a need for arranging another appointment, as it needs water to fully set (10). After its placement, the material should be covered with a moist cotton pellet, left in the cavity for 3-4 h (the full setting time varies between 50 min. and 2 h 45 min.), which means that the treatment must be divided into several appointments (3, 6, 7). In order to obtain proper sealing and physical endurance of the created barrier, the layer applied should be thick. The manufacturer advises the use of a 3-5 mm layer, which was confirmed in an independent study (11). In the case presented, the thickness of the MTA layer was 2 mm, which proved to be sufficient for bone healing in the furcal area. The sealing of the perforation before the endodontic retreatment creates a risk of the material coming into contact with rinsing solutions indispensable for the chemical disinfection of the canals. Solutions containing calcium, such as EDTA, may react chemically with the MTA damaging its surface, diminishing its adhesion to dentin and/or causing its displacement outside the perforation area (4, 12). It was demonstrated that both 5.25% NaOCl and 2% CHX had a negative impact on the MTA's adhesion to dentin in the first setting phase, therefore, the continuation of the endodontic treatment should be performed after the material fully sets and is covered with the base liner (4, 13). The interactions between the MTA and the base liners are not fully known. The material should be covered with neither ZOE, as zinc interferes with its setting process and increases porosity, nor GICs, as their water sorption is very high (14). In the presented case, the MTA was covered with the resin-based flowable material, which provided a hermetic seal and enabled further treatment. Additional disinfection of the perforation site was obtained using the CPB system, whose antibacterial action against *Streptococcus mutans*, *Lactobacillus* (*L.*) *acidophilus*, *L. casei* and *Actinomyces naeslundii* was well documented (15).

Conclusions

The MTA cement is effective in the repair of old pulpal floor iatrogenic perforations and promotes the regeneration of the lost bone tissue in the furcal area, even if applied in a 2 mm layer.

Conflict of interest

None

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