Chapter 96

MTA In The Treatment Of Furcation Perforation In Upper Molars Under Operative Microscopy: Case Report

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ABSTRACT

During endodontic procedures, the occurrence of iatrogenesis can compromise the success of the treatment and knowing how to conduct them is essential for a favorable outcome. Endodontic perforation is a communication between the pulp space and the external surface of the tooth. The most suitable material for sealing perforations is Mineral Trioxide Aggregate (MTA), a bioceramic capable of inducing the formation of mineralized tissue. The use of loupes or operating microscope is an important tool in the management of complex cases, as it allows magnification and illumination of the operating field. The objective of this study is to report a case of a patient submitted to endodontic treatment and sealing of furcation perforation, with the aid of operative microscopy, evidencing the use of MTA. The patient was referred to Faculdade São Leopoldo Mandic for endodontic treatment of tooth 26, which included sealing a perforation and locating the mesiobuccal canal. Chemical-mechanical preparation of root canals was performed with ProDesign Logic instruments, 2% chlorhexidine gel, and distilled water as irrigant. The sealing of the perforation was performed with MTA Angelus. After a period of three months, the patient remained asymptomatic. It was concluded that the treatment was satisfactorily completed, considering the complexity of the case, influenced by patient's age, the difficult access and direct visualization of the tooth and the presence of complications. The use of an operating microscope provided field magnification and illumination, necessary for the detection of the mesiobuccal canal and greater accuracy in the application of the repair material.

Keywords: Endodontics, Root Canal Therapy, Root Canal Preparation, Teaching.

1 INTRODUCTION

Complications related to endodontic treatment can occur during diagnosis and planning, coronal access, instrumentation, irrigation and obturation. With proper management, many complications can be corrected in a predictable manner without significantly worsening the prognosis of the case (Bhuva & Ikram, 2020).

Root perforation is characterized by a communication, iatrogenic or pathological, between the root canal system (RSC) and the external tooth surface, and can compromise the outcome of endodontic treatment (Siew et al., 2015; Estrela et al., 2018; Lagisetti et al., 2018). The American Association of Endodontists characterizes endodontic perforations as apical perforations, furcation perforations, and band/rag perforations. Furcation perforations are generally related to complications during access, while apical perforations and tears occur during instrumentation (AAE, 2020; Bhuva & Ikram, 2020).

Periapical radiography is the most frequently indicated imaging method for diagnosis, treatment plan and follow-up of perforations, however, due to its most characteristic limitation - the two-dimensionality - the incorporation of cone beam computed tomography (CBCT) in endodontic procedures ensures new parameters to assist in the diagnosis and prognosis of these pathological and iatrogenic conditions (Estrela et al., 2018).

The prognosis of root perforations can be influenced by the following factors: the time elapsed between the occurrence of the perforation and its adequate filling, the extent of the injury - a small perforation causes less tissue destruction and less inflammatory response - and the location - root perforations more apical to the bone crest region have a better prognosis (Estrela et al., 2018; Fuss & Trope, 1996).

The ideal material for the treatment of endodontic perforations should induce the formation of mineralized tissue, be biocompatible, nonabsorbable, radiopaque, bacteriostatic or bactericidal, and easy to apply, as well as completely seal the perforation, preventing microleakage (Lagisetti et al., 2018).

Various dental materials have been proposed over the years for the repair of perforations, with varying degrees of success. The use of bioceramic materials increases the success rate of such repairs due to their bioactivity (Siew et al., 2015; Kakani & Veeramachaneni, 2020). Mineral trioxide aggregate (MTA) is a hydrophilic and biocompatible endodontic cement that stimulates healing and osteogenesis. MTA, when placed in direct contact with the tissues, is able to release calcium ions for cell proliferation. In addition, it creates an antibacterial environment due to its alkaline pH, regulating cytokine production. Therefore, it favors the migration and differentiation of cells producing mineralized tissue, forming hydroxyapatite on the MTA surface and providing a biological seal (Cervino et al., 2020).

Based on the available evidence, a relatively high success rate (80.9%) can be achieved by the non-surgical repair of root perforations when using MTA in their sealing, suggesting that it is a valid attempt at maintaining the tooth in the arch (Siew et al., 2015; Cervino et al., 2020; Kakani & Veeramachaneni, 2020).

The use of operative field magnification, via operative microscopy may not have a statistically significant effect on the outcome of the perforation repair. However, it provides an enhanced field of view, which facilitates the repair procedure (Daoudi & Saunders, 2002).

Accidental endodontic perforations are reported in 2-12% of endodontic treatment cases (Tsesis et al., 2010; Krupp et al., 2013), and can lead to implications such as tooth loss. Knowing how to properly manage a root perforation can prevent such an outcome. The aim of this study was to report a clinical case of sealing of a perforation in the furcation region using MTA.

2. METHODOLOGY

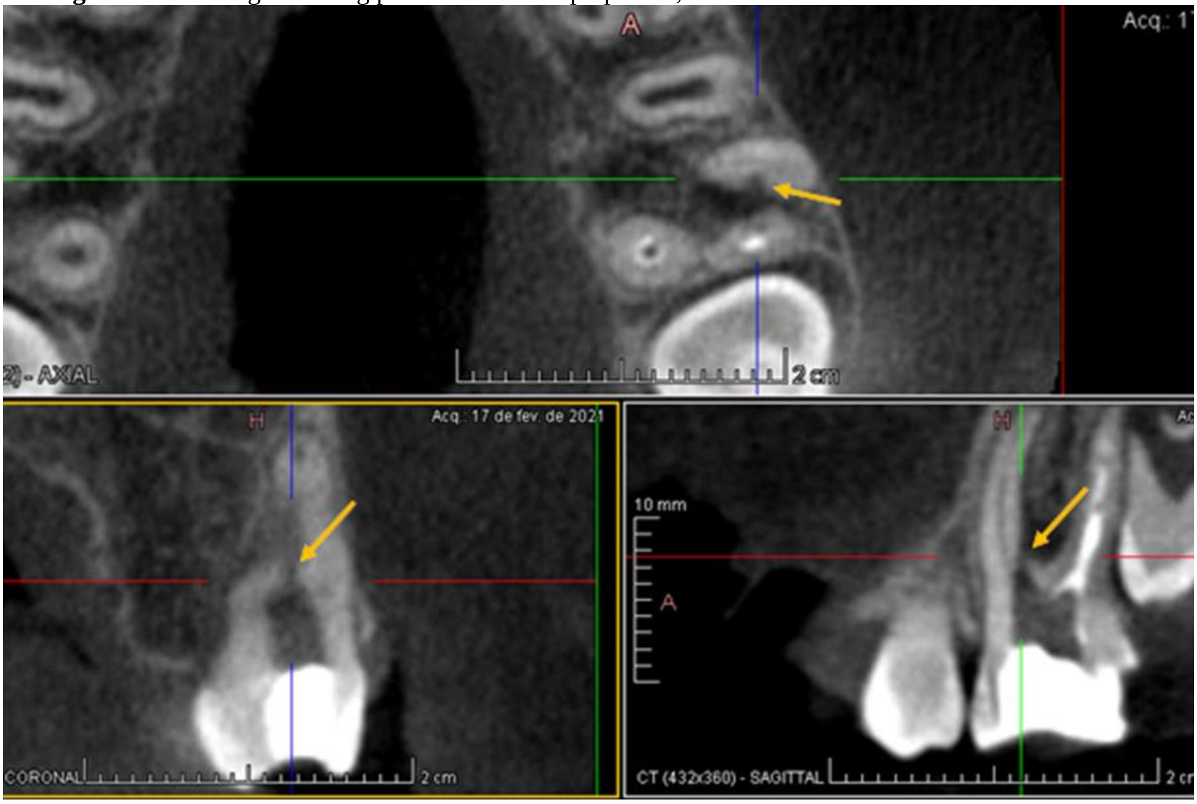
This is a descriptive, case report type study with a qualitative and exploratory approach (Freire & Pattussi, 2018), with the purpose of detailing techniques and materials employed (Oliveira et al., 2015; Freire & Pattussi, 2018), for the endodontic treatment of tooth 26 of a patient referred to Faculdade São Leopoldo Mandic, Belo Horizonte unit, with the presence of iatrogenic endodontic perforation and a root canal not located by the first operator.

Considering the ethical and legal aspects, the study participant signed the Free and Informed Consent Form (TALE), since he was a minor; and his guardian signed the Informed Consent Form (TCLE), both aware of the benefits and risks of participation in the study, releasing the use of images related to the case for academic purposes. This report has the approval of the Research Ethics Committee of the Faculdade São Leopoldo Mandic, registered under CAAE number: 46365621.8.0000.5374 and opinion number: 4.790.880.

3. CASE REPORT

Male patient, nine years old. He came with his guardian to the Endodontics Specialization Clinic of São Leopoldo Mandic School, Belo Horizonte - MG, for endodontic treatment of tooth 26. During anamnesis it was reported that the patient had already started treatment in a private practice, when there was a perforation of the tooth. The professional requested a CT scan and referred the patient to the college clinic. Figure 1 illustrates the presence of perforation visualized in the CBCT scan.

Figure 1 - CT image showing perforation of the pulp floor, near the entrance of the mesiobuccal canal.



Source: Authors' personal file.

In the figure above, it is possible to observe a hypodense image, indicated by the yellow arrows that point to the pulp floor region in direct communication with the adjacent supporting tissues. The perforation is very evident in the three tomographic sections (arrows). The hyperdense image in the distobuccal and palatal canals (axial and sagittal sections) suggests the presence of intracanal medication applied by the first operator.

After careful evaluation of the clinical and imaging examinations, treatment planning was performed for endodontic therapy and sealing of the iatrogenic perforation.

The patient was anesthetized with a tube of Alphacaine 100 (DFL, Rio de Janeiro, Brazil). The coronary seal was removed. Under light microscopy at 8x magnification, a perforation was observed in the furcation region near the mesiobuccal (MV) root. The MV canal was not located, suggesting that the perforation occurred in an attempt to find it.

We opted for a chemical-mechanical preparation (PQM) and obturation of the distal vestibular (DV) and palatal (P) canals, to later locate and instrument the mesiobuccal canal and seal the perforation.

For the mechanical preparation of the DV and P canals, the working length was determined 1 mm beyond the patency length, adopting the philosophy of foraminal enlargement.

C-pilot (VDW, Munich, Germany) #10 and #15 manual instruments were used for canal exploration and patency. The ProDesign Logic rotary system (Easy Equipamentos Odontológicos, Belo Horizonte, Brazil) was used to shape the canals, with a torque of 4N and a speed of 800 rpm.

As auxiliary chemical substance for cleaning and disinfection of the canals was used chlorhexidine gel 2% (LenzaFarm, Belo Horizonte, Brazil), and distilled water as irrigating solution. The obturation of the canals was performed applying the single cone technique, in which guttapercha cones FM (Odous de Deus, Belo Horizonte, Brazil) and endodontic bioceramic cement Bio-C Sealer (Angelus, Londrina, Brazil) were used. The cervical limit of the gutta-percha was kept at 2 mm above the cementoenamel junction, and the backfill in these two millimeters was performed with Coltosol (Coltene/Whaledent, Altstätten, Switzerland).

Calcium hydroxide P.A. was placed over the perforation, condensing the material over the region. The tooth was sealed with chemically activated glass ionomer cement (CIV) - Riva Self Cure (SDI, Victoria, Australia), and the patient was rescheduled for further treatment at a subsequent session.

In the following session, after removal of the coronary seal, the search for the MV canal was started. For this purpose, a #2S ball drill with a long shank (figure 2) was used, coupled to a counter-angle and a low rotation micromotor, in order to perform a small selective abrasion on the dentin, exposing the entrance of the canal. This procedure was performed using the initial tomographic exam as a guide, in addition to the use of microscopy for visual magnification of the operative field.

Figure 2 - Carbide bur used for selective dentin grinding in the MV canal location.

Source: Authors' personal file.

The Carbide bur used for selective dentin wear, as seen in the image above, had a long shank, allowing better access to the region of the root canal entrance that was desired to be located.

The MV canal was located, prepared and filled according to the protocol followed for the other two root canals. The CBCT did not indicate the presence of a second canal in this root - the MV2. Thus, the procedure for sealing the endodontic perforation was initiated.

The region was irrigated, abundantly and vigorously, with distilled water to remove any excess of obturating cement and calcium hydroxide paste. Under magnification of the operative field, the perforation was sealed by applying white MTA Angelus (Angelus, Londrina, Brazil). This restorative cement was brought to the perforation with the aid of a child's amalgam carrier (Golgran, São Caetano do Sul, Brazil) (figure 3). The material was condensed in the region, with Schilder condenser, and sterile paper cone slightly moistened in distilled water.

Figure 3 - Material used for sealing the perforation.

Source: Authors' personal file.

The image above shows some of the materials that were used for the sealing of the endodontic perforation. From left to right: packaging of MTA Angelus and next to it, the distilled water bottle and sachet containing the restorative cement powder; child's amalgam holder - used for insertion of the already manipulated MTA in the perforation region - an alternative to the MTA applicators; flexible spatula and glass plate for manipulation of the MTA.

The region was protected with a chemically activated glass ionomer cement liner. The tooth was sealed with sterile sponge and GIC, and the patient was referred for definitive restoration.

4. RESULTS

The final periapical radiograph can be seen in figure 4. After three months, the patient was asymptomatic and under proservation.

Figure 4 - Periapical radiograph after endodontic treatment of tooth 26.

Source: Authors' personal file.

In the image above, it is possible to observe the material applied in the region of the perforation (as indicated by the arrow), promoting its sealing.

5. DISCUSSION

The primary cause of periradicular inflammation, therefore leading to failure of endodontic treatment, is bacterial contamination, not the perforation itself (Lin *et al*., 2005), so it is important to use a repair material that, in addition to a good sealing capacity, also has antibacterial activity. MTA has an alkaline pH, ranging from 10.2 to 12.5, which theoretically is unfavorable to bacterial growth. However, studies show limited inhibitory effect of this material against some microbial species, such as *Enterococcus faecalis* (Kim *et al*., 2015; Parirokh & Torabinejad, 2010b; Esteki *et al*., 2021; Pelepenko *et al*., 2021). Thus, disinfection maneuvers during chemical-mechanical preparation and maintenance of the aseptic chain should also not be neglected.

MTA is a calcium silicate-based cement initially idealized for the treatment of perforations. The first published papers reporting the use of this material for the repair of perforations and as a material for retro-obturation date from the early 1990s (Lee *et al*., 1993; Torabinejad *et al*., 1993). Its bioactivity and sealing capacity result from physical-chemical reactions between MTA and tissue fluids, with the formation of a layer similar to hydroxyapatite on its surface. This compound has the ability to release calcium and phosphorus ions, a process necessary for bone metabolism (Parirokh & Torabinejad, 2010a).

Studies evaluating the immune response induced by MTA have observed that this material is able to stimulate a protective host inflammatory response, positively regulating the expression of pro-inflammatory cytokines in the early phase after its application (7 to 14 days), while favoring the expression of immunoregulatory cytokines in a late phase (21 days), which would be able to lead to tissue repair (Lara *et al*., 2015; Espaladori *et al*., 2018).

In this case, Angelus MTA® was used to repair an iatrogenic perforation in tooth 26. The patient was asymptomatic after three months of treatment.

Although, many times, there is no significant difference for the success of the treatment, regarding the sealing of a perforation (Daoudi & Saunders, 2002), the use of the operating microscope in the reported case was essential in the conduction of the procedure. Mainly because it was a small perforation (approximately 1.2 mm in its greatest extension), not only the visual magnification of the operative field, but also the better lighting offered by the equipment, provided greater accuracy in the application of the repair material.

For Perrin *et al*. (2019), the optical microscope offers superior visualization during endodontic procedures, however, some magnifiers are even able to replace the microscope for procedures in the pulp chamber. In this case, we chose to use the operating microscope, since it is available at the facilities of São Leopoldo Mandic School - Belo Horizonte unit, and is able to offer higher magnification and better illumination compared to magnifiers.

6 CONCLUSION

It was concluded that the treatment was completed satisfactorily, considering the complexity of the case, influenced by the patient's age, the difficult access and direct visualization to the tooth, and the presence of complications such as perforation and a root canal not initially located. The use of the operating microscope to conduct the procedure provided magnification and illumination of the operative field, necessary for detection of the unidentified canal and for greater accuracy in the application of the repair material.

We suggest future studies that address the importance of the dental surgeon in knowing the technological advances in endodontics for the management of complex cases, and thus know how to guide the patient appropriately, as well as how to conduct the case or refer it to the appropriate specialty.

7 RECOGNITIONS

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