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Non-surgical Treatment of Two Lateral Root Perforations in a Mandibular First Premolar Tooth with Mineral Trioxide Aggregate: A Case Report

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ABSTRACT

Root perforation is an accidental communication between root canal walls and periodontal tissues, which might damage the adjacent periodontal tissues and increase the risk of failure. Perforations might be produced by the clinician during root canal treatment processes, such as access preparation, cleaning and shaping of the root canal system, and post space preparation, or by pathological alternations, such as caries or pathological resorption. The time elapsed since the perforation was made, the size and location of the perforation, patient's gender, the quality of the final restoration, presence of preoperative lesions, and characteristics of repair material are the most important criteria influencing the success of the perforation repair procedure. The sealing ability of the repair material is the key factor in the prognosis of perforation. The present paper reports a case in which perforation accidentally happened in two locations of a mandibular first premolar and was repaired by mineral trioxide aggregate (MTA) as a material with sealing ability.

KEYWORDS

Mineral trioxide aggregate; Non-surgical approach; Perforation

INTRODUCTION

Accidental perforation of the roots or the pulp chamber is considered a significant problem in endodontic and restorative treatments due to the communication between the root space and periodontal tissues, resulting in the loss of integrity of the root and further damage of the adjacent periodontal tissues. In these cases, short-term and long-term complications might arise, including periradicular lesions [1].

Iatrogenic root perforations mainly occur during access cavity preparation, root canal cleaning and shaping, excess dentin elimination in the danger zone, misdirected files while negotiating the root canal, failed efforts to bypass separated instruments, and misaligned instruments during post space preparation [2-6]. The treatment outcomes of 55 perforations monitored for 11 years were analyzed by Kvinnsland et al. They reported that 47% of the perforations occurred during endodontic treatment, and

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53% were associated with a prosthodontic treatment [7]. Root perforation has a prevalence of around 2.3% [6], with an incidence of approximately 2%-12% during root canal treatment [5]. Complications arising from root perforation might lead to tooth extraction. A review of the causes of the extraction of teeth treated endodontically demonstrates that about 4.2% of the teeth underwent extraction due to iatrogenic perforations and stripping [8]. There was a correlation between preoperative perforations and an increased rate of unsuccessful non-surgical retreatment [9]. Root perforations negatively affect the outcome of non-surgical root canal treatments. Prolonged periodontal break-down is the primary cause of unsuccessful root canal treatment in teeth with iatrogenic or pathologic root perforations [6,10].

The prognosis of a tooth with root perforation depends on the time elapsed before sealing the perforation, location and size of the perforation, patient's gender, the quality of the final restoration, and the presence of preoperative lesions. Large and old furcal perforations have a worse prognosis than fresh, small, coronal, and apical ones [11,12]. Root perforations were intentionally produced in dogs, and the periodontal tissue responses to different treatment procedures were assessed (Lantz and Persson). The results showed that periodontal tissues were most severely damaged when the perforations remained open to the oral cavity and also when a sufficient seal could not be achieved due to leakage of restorative materials [13-15]. Besides, perforations in the cervical third of the root have a poorer prognosis than those in the middle and apical thirds. Because of the potential microbial contamination and periodontal break-down, the worst prognosis belongs to those at the alveolar crest [5,10,16].

The cardinal components in the management of root perforations include clinical application of electronic apical locators [17] and dental operation microscopes [18]. However, possibly the most efficacious clinical method for root perforations remains prevention [3]. Besides, it should be noted that the sealing ability of the repair material is the key factor in the prognosis of perforation [19]. Nevertheless, when the perforation site is contaminated, the healing process might occur under less favorable conditions [20].

Ideally, the repair material should induce osteogenesis and cementogenesis and be nontoxic, bacteriostatic, and non-resorbable. It should promote healing and provide an optimal hermetic seal [21-23]. In addition, it must adhere to the root canal walls; it must also be easy to handle, with dimensional stability and radiopacity [23, 24].

Amalgam, zinc oxide eugenol (ZOE), gutta-percha, Super-EBA, glass-ionomers, calcium hydroxide, bonding agents, Cavit, hydroxyapatite, Biodentine, Endosequence, Bioaggregate, Calcium-Enriched Material (CEM), and MTA are usually used for this purpose [25]. The last two materials have provided substantial advantages [21,26]. MTA and CEM are biocompatible materials [25,27-30] and can promote regeneration of the original tissues and stimulate the deposition of newly formed cementum [20,25,31].

MTA has been reliably and successfully used in perforation repair [20], with a success rate of 86% in the retrospective investigation of orthograde perforation repair [32]. A study also applied MTA and reported the retrospective success rate of 73.3% for perforation repair in a 10-years follow-up [10].

This article aims to report a case with two iatrogenic perforations on the buccal surface of the root of the first mandibular premolar tooth, which was successfully treated with MTA.

CASE REPORT

After root canal therapy of the mandibular right first premolar (#28) in a 38-years-old man by a general dentist, a full-crown restoration was recommended to the patient. During post space preparation by Peeso reamer drills, two buccal perforations occurred, approximately in the middle third of the root.

The dentist took two radiographs, and after confirming the perforations, the patient was referred to an endodontist on the same day (Figure 1 and Figure 2). First, medical and dental histories were taken. The patient had no systemic disease. Then, extraoral and intraoral examinations were performed. Moreover, no inflammation, soft tissue injuries, or asymmetry were observed in extraoral and intraoral examinations. A consent form was taken from the patient. Local anesthesia was performed using a mental nerve block technique (2% lidocaine with 1:100,000 epinephrine), the rubber dam was placed, and an access cavity was prepared. The perforation sites were searched using a × 2.5 magnification loupe (Carl-Zeiss, Oberkochen, Germany) and an apex locator (J. Morita Mfg. Corp., Kyoto, Japan). Fortunately, the perforations were accessible through the access cavity.

After complete irrigation with 2% chlorhexidine, the root canal was dried, a paste of white MTA (Angelus Soluções Odontologicas, Londrina, Brazil) was prepared with sterile water according to the ratio recommended by the manufacturer and was delivered with a Messing Gun (Endo Syringe Messing, Produits Dentaires SA, Vevey, Switzerland) into perforation sites under magnification and adapted to the defect. The tip of a paper point was cut off, moistened with normal saline, and placed in contact with the cement. The access cavity was sealed with a temporary filling (Cavit, 3M ESPE, Saint Louis, MN). The patient was dismissed, and another appointment was scheduled 48 hours later. In the next appointment, the tooth was isolated with a rubber dam. The temporary dressing and paper point was removed, and the setting of the MTA cement was checked with an endodontic explorer. After confirming its setting, the patient was referred to another dentist for restorative treatment.

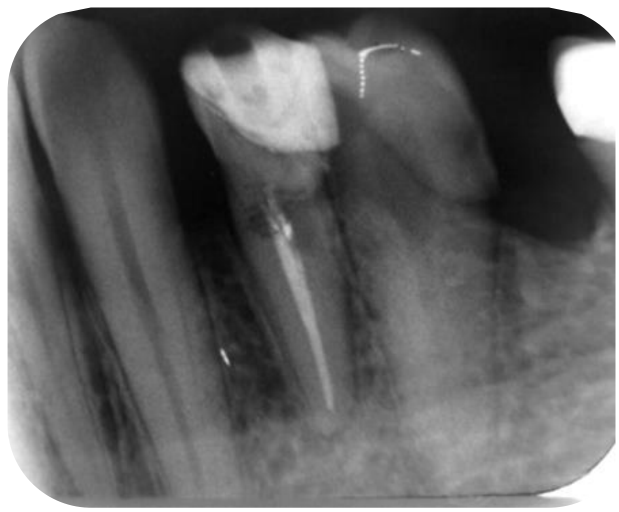

Figure 1: Before post space preparation.

Figure 2: Determination of perforation.

Figure 3: Follow-up radiographs: A) Immediately after perforation repair. B) After 13 months. C) After 30 months.

Figure 4: Immediately after perforation repair.

Figure 5: After 30 months.

In Figures 3 - Figure 5, the healing process of the tooth is shown after 13 months and 30 months, respectively. After 30 months, there was no radiolucency adjacent to the perforation site, no apical periodontitis, no clinical symptoms (pain, swelling, pain on palpation or percussion, sinus tract), and no loss of function [10,33]. The pocket probing depth was normal around the tooth. However, two white eminences were still visible on the buccal mucosa, which appeared after MTA insertion.

DISCUSSION

The main consequence of root perforation is the potential for secondary inflammation of the periodontal attachment with eventual infection, ultimately resulting in tooth loss [34]. The literature strongly advocates immediate closure of the communication between periodontal tissues and the root canal system to help induce a superior healing potential [12,35]. Therefore, the time between the sealing of the perforation and its inception plays a vital role in periodontal repair [6,12]. Also, a higher success rate was obtained for the perforation repair performed by endodontists [32,36]. Fortunately, in this case, the patient was referred to an endodontist on the same day, and perforation closure was performed immediately.

Also, the perforation location influences the prognosis of the perforated tooth [6]. Apical perforation usually occurs during instrumentation by violating apical constriction due to the use of large inflexible files in curved canals [37].

Mid-root perforations happen mainly during post space preparation and cleaning and shaping the mid-root area of the canal. Preparation of the post space must carefully follow the long axis of the root. Safe removal of coronal gutta-percha with heat and hand instruments provides a pilot track that keeps drills in the center of the canal [15].

Perforations might occur during access cavity preparation and locating root canal orifices [38,39].

In this case, perforations were created during post space preparation. Of course, in the past, perforations have been treated mainly through surgical approaches. However, nowadays, after the introduction of the operating microscope, with the benefits of increased magnification and dual light source, the non-surgical repair of perforation is more predictable and safer; it has also been performed with increased efficiency [10,40,41]. In this case, performing the treatment without a microscope could be viewed as a weakness; however, a × 2.5 magnification dental loupe (Carl-Zeiss, Oberkochen, Germany) was used, and long-term success was achieved.

Another factor that influences perforation repair is the size of the defect [6]. In small perforations of the canal space, direct and immediate restoration of the defect is possible [42], with a lower possibility for periodontal break-down and epithelial proliferation within the perforation site. In this case, although the perforations were not small, the long-term result was good, demonstrating that rapidity and quality of perforation sealing are more important than perforation size. This supports the assumption that the size of the perforation does not affect the healing rate [10,42].

A final factor and one of the most investigated issues in recent years is the material used to repair a perforation defect [37,43]. Recently, a clinical study posed questions about current information concerning perforation repair prognosis. According to the trial, when a bioactive cement is applied for perforation repair, it might not be possible to apply the classic negative prognostic factors [5]. Therefore, MTA has been an ideally accepted material for perforation repair [44]. A common outcome is the creation of fibrous tissues encapsulating or walling off other materials, including composite resin, intermediate restorative material, or zinc ethoxy benzoic acid cement. In most cases, variable amounts of chronic inflammation might exist in the periodontal tissue neighboring these materials. Moisture also negatively influences the sealing ability of such materials, while MTA does not undergo such an impact (33). The investigation highlighted a general success rate of 72.5% for perforation repair, which increased to 80.9% with MTA as the repair material [5]. The observations implied that the use of MTA for non-surgical repair could lead to a greater success rate than other materials [33]. Various studies have demonstrated that it has very good sealing ability and biocompatibility [12,23,42,45,46]. It can also be considered a potential repair material, improving the prognosis of perforated teeth that would otherwise be compromised [47,48]. In addition, MTA has a high pH value and low compressive strength. It possesses some antibacterial and antifungal properties, depending on its powder-to-liquid ratio [22,49,50]. MTA has some known drawbacks, such as a long setting time, high cost, and potential of discoloration [44]. As reported by case studies, extruded bioactive cements might be completely absorbed during protracted periods (4 years to 7 years). Nonetheless, it is necessary to use biocompatible, sterile barriers (e.g., collagen) to prevent extrusion of root canal filling materials (including perforation repair materials) into the periodontium [5].

In this case, despite using MTA as a barrier material, the appearance of the perforation sites was affected by two white eminences appearing on the gums; however, they were not very important as they were not in the visual field.

CONCLUSION

Perforations are considered mishaps in endodontics, and knowledge, experience, training, and technology allow clinicians to treat these accidents successfully. In the current case report, perforation repair was performed using a dental loupe from the access cavity non-surgically, and MTA was used as a sealing material to seal perforation sites. This treatment was successful in a 30-months follow-up.

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COMPETING INTERESTS

The authors deny any conflict of interest.

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