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Prosthetic Rehabilitation and Management of an MTA-Treated Maxillary Central Incisor with Root Perforation and Severe Internal Resorption

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Abstract

Root canal perforation and root resorption are challenging clinical conditions to correctly diagnose and treat, especially when they occur in anterior teeth. This clinical report describes the computed tomography findings, endodontic treatment, prosthetic rehabilitation, and clinical outcome of an iatrogenic root perforation and internal resorption in a maxillary central incisor. The case management consisted of endodontic retreatment, periodontal surgery, and prosthetic rehabilitation. Gray mineral trioxide aggregate (MTA) was used to fill the resorption space and seal the perforation. The prosthetic treatment was performed with glass fiber-reinforced dowels and all-ceramic crowns. No signs or symptoms, including discomfort, pain, or esthetic defects were observed in 30 months of follow-up.

Dental root perforation and root resorption pose difficulties for treatment. The challenge begins with establishing the correct diagnosis, as these findings may sometimes be misinterpreted as root fractures or dental anomalies. In some cases, extraction is the best option due to the complexity of the treatment involved, especially when severe internal root canal resorption is detected.

In general, internal root resorption is diagnosed by routine radiographic evaluation, as it is asymptomatic in nature,[1] and is often discovered in advanced stages. For this reason, most resorbed teeth are usually unrestorable. The use of mineral trioxide aggregate (MTA) in association with fiber-reinforced dowels, however, the use of mineral 50 trioxide aggregate (MTA) in association with fiber-reinforced dowels has been reported to fill the resorption space.

Cone-beam computed tomography (CBCT) has become an important tool in the diagnosis of some endodontic problems, such as identification of anatomic features and variations of the root canal system and determination of the location and extent of root resorptions, fractures, or perforations.[3] In addition, the observation of adjacent anatomical structures is important when a surgical approach is necessary.

Besides treating a single compromised tooth, when formulating a treatment plan, the esthetics of the anterior teeth is an important consideration. The resolution of such cases usually involves a multidisciplinary approach. Therefore, this clinical report describes the CBCT findings, endodontic treatment, periodontal surgery, and prosthetic rehabilitation of an iatrogenic root perforation and internal resorption involving a maxillary central incisor.

Clinical report

A 42-year-old female patient complaining about the esthetics of her smile was referred for prosthetic rehabilitation of her anterior teeth (Fig 1). The patient's medical history was noncontributory, and she reported no pain or discomfort associated with her anterior teeth. Periapical radiography revealed partial endodontic obturation and an irregular radiolucent lesion in the middle third of the root canal of the maxillary right central incisor (Fig 2). The patient was referred for the CBCT study (i-CAT; Imaging Sciences International, Hatfield, PA), with gray scale of 12 bits and voxel size of 0.2 mm. The CBCT

Figure 1 Initial clinical aspect of maxillary anterior teeth with no clinical indication of the perforation and internal root resorption on the right maxillary central incisor.

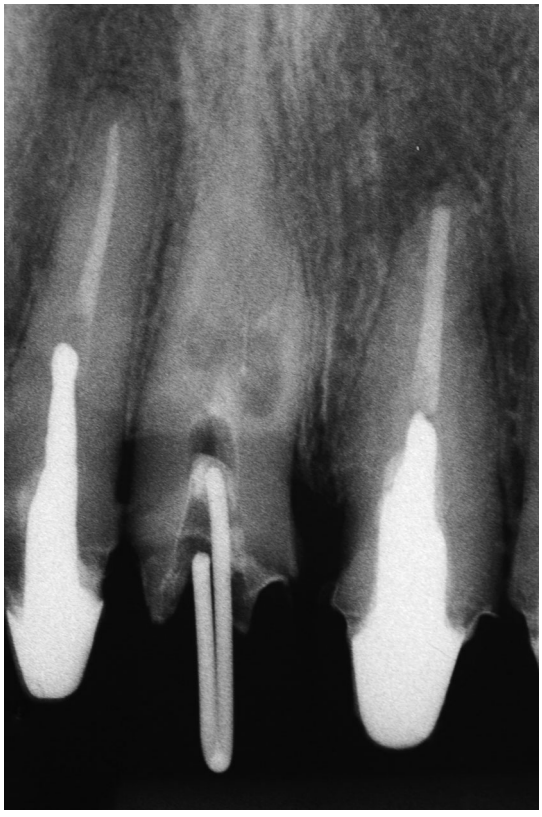

Figure 2 Initial periapical radiograph showing a lesion with severe internal root resorption on the right maxillary central incisor.

demonstrated extensive internal root resorption on the maxillary right central incisor and communication of the root canal with the periodontal tissues at the buccal middle third (Fig 3).

After analysis of the images, endodontic treatments and periodontal surgery to access the perforation site and improve the gingival contour were planned. The maxillary left central incisor and canine were endodontically retreated due to a periapical lesion and inadequate obturation, respectively, and provisional prosthetic procedures were conducted. For the endodontic retreatment of the maxillary right central incisor, the provisional crown was removed, and the tooth was isolated with a rubber dam. During exploration, it was observed that only endodontic cement filled the root canal space. The cement was removed with Profile #45.04 and 60.04 in a pecking motion under copious irrigation with 2.5% sodium hypochlorite. The root canal was negotiated, patency checked, and working length determined using an apex locator (Root ZX, J. Morita MFG. Corporation, Kyoto, Japan) and confirmed by radiography. Protaper files (Dentsply-Maillefer, Ballaigues, Switzerland) and irrigation with 2.5% sodium hypochlorite were used to clean and shape the canal. The obturation was performed using the lateral compaction technique with AH Plus (Dentsply-Maillefer). The perforation and middle third of the root were filled with gray MTA (Angelus, Londrina, Brazil), while maintaining a dowel space for a future prosthetic procedure (Fig 4). six-, 12-, and 30-month follow-ups of the right incisor revealed satisfactory clinical results, and the patient reported no pain or swelling during this period.

After endodontic treatment and retreatments, a diagnostic stone cast was obtained and recontoured to preview the esthetic effect that would result from increasing the crown lengths. This cast was duplicated, and a surgical guide was obtained. The initial recontoured cast was then waxed up to preview the desired esthetic outcome. Periodontal surgery consisted of curettage on the maxillary right central incisor and crown lengthening of all maxillary anterior teeth (Fig 5A). A buccal flap was surgically elevated, the granulation tissue was removed from the perforation area, and the irregular borders of the perforation site were smoothed with a bur attached to a straight surgical handpiece. By removing the inflammatory tissue at the perforation site and smoothing the edges, the surgery helped the MTA adaptation. The flap was sutured, and the patient was recalled 1 week later for suture removal (Fig 5B).

Five months after endodontic treatments and 4 months after the surgical crown lengthening, prosthetic procedures were conducted. For the rehabilitation, the provisional crowns, cast metal dowels, and cores of the maxillary anterior teeth were replaced, except for the cast metal dowel of the right canine, because it was large and wide, and there was a risk of root fracture. A customized glass fiber dowel was selected for the maxillary right central incisor due to the perforation and the fragility of the root. An indirect technique was used to customize the dowel to minimize the cementation line thickness as much as possible. The dowel and core were obtained on a type IV stone cast using a radiolucent glass fiber dowel embedded in resin composite. The other teeth received glass fiber-reinforced dowels (Superdont, Rio de Janeiro, Brazil). Accessory dowels were used when necessary (Superdont). The root canal space preparations were made with a Largo bur (Dentsply-Maillefer), leaving approximately 5 mm of canal filling at the apex. The dowels were cemented with a self-adhesive resin-based cement (RelyX U100, 3M ESPE, St. Paul, MN), in accordance with the manufacturer's directions. The core was prepared using a resin composite (Opallis, FGM, Joinville, Brazil) with smooth, slightly converging axial walls, well-defined margins, and 2 mm of incisal reduction. Figure 6 shows the radiograph of the customized dowel after installation of a new set of provisional crowns.

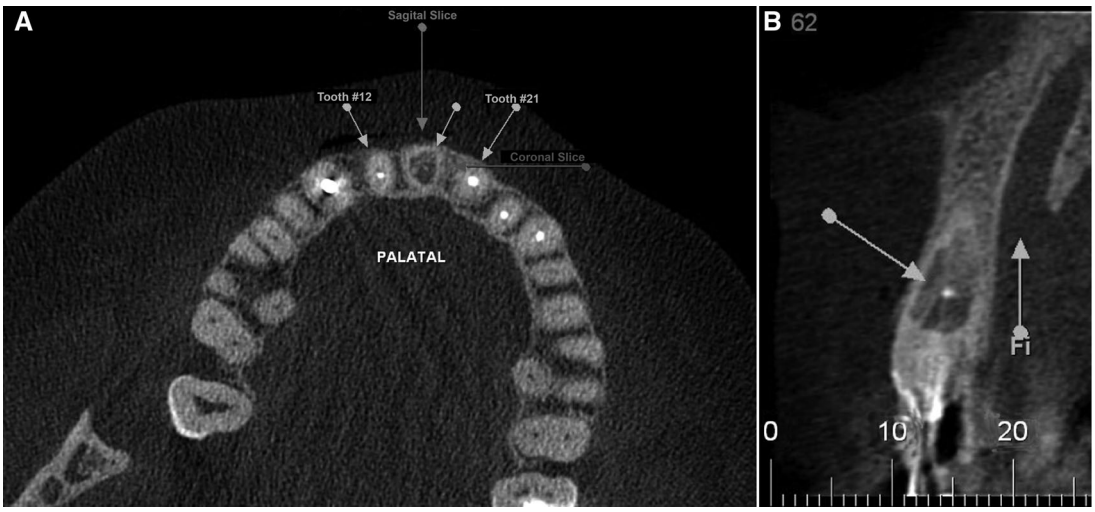

Figure 3 Initial CBCT images confirming the extension of the internal root resorption lesion on the right maxillary central incisor: (A) coronal and (B) transaxial sections.

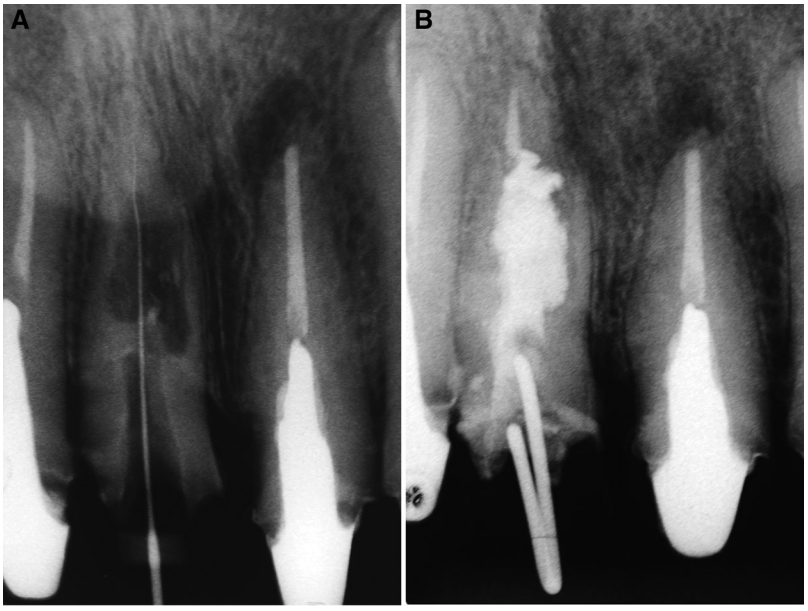

Figure 4 Endodontic retreatment of the right maxillary central incisor: (A) periapical radiograph showing the root canal negotiation; (B) radiographic image of the resorption lesion filled with MTA.

Provisional crowns were maintained for 8 months before the final rehabilitation. An impression was taken with poly(vinyl siloxane) (Honigum Pro, DMG, Hamburg, Germany), and all-ceramic crowns with zirconium copings (AmannGirrbach GmbH, Koblach, Austria) veneered with e.max Ceram (Ivoclar-Vivadent, Schaan, Liechtenstein) were cemented with a self-adhesive resin cement (RelyX U100) (Figs 7–9). Figure 10 shows the 9-month follow-up panoramic radiograph. A 15-month follow-up radiograph is shown in Figure 11.

Discussion

Root perforations present significant complications and adversely affect the prognosis of endodontic treatment. They often occur during preparation of access cavities, dowel space preparation, or as a result of the extension of internal resorption into the periradicular tissues. In this report, the root canal was probably perforated during the first endodontic therapy a few years ago. Such perforations result in loss of integrity of the root and further destruction of the adjacent periodontal tissues. A complete dental history and CBCT are important tools for establishing a diagnosis.

Perforations may be asymptomatic. Therefore, the clinician treating the perforation has no influence regarding its onset or time of development.[4] In this report, the patient did not report pain or swelling, and the perforation and root resorption were incidental findings during radiological examination for prosthetic rehabilitation of the anterior teeth. The location and size of a root perforation are important factors affecting treatment

Figure 5 Periodontal surgery: (A) buccal flap elevation and root perforation on the right maxillary central incisor and (B) sutured flap immediately after the surgery.

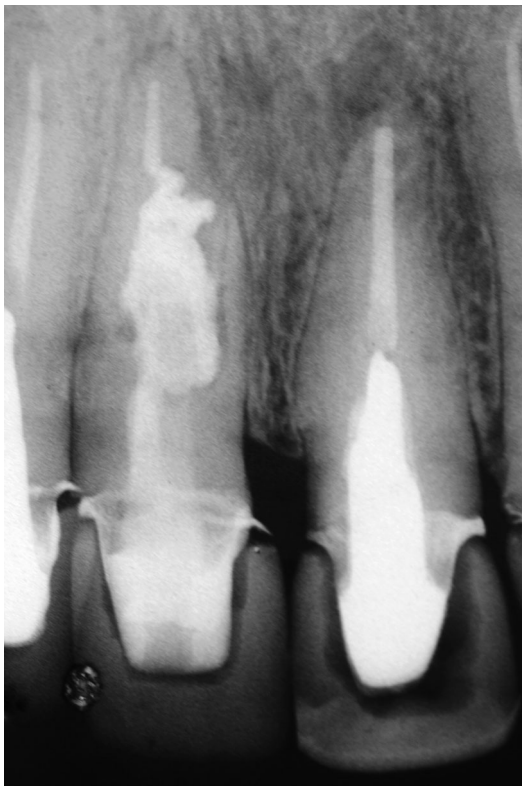

Figure 6 Periapical radiograph of the customized dowel after placement of a new set of provisional crowns.

Figure 7 Core preparations using direct resin composite on all maxillary anterior teeth, except for the right canine, in which the cast metal dowel was not removed.

Figure 8 Zirconia copings were tried and adjusted before the application of the veneering ceramic.

Figure 9 Final clinical aspect of all maxillary anterior teeth after the cementation of the all-ceramic crowns.

prognosis. Close proximity of the perforation to the gingival sulcus can lead to contamination of the perforation with bacteria from the oral cavity through gingival sulcus and can create a periodontal defect.[4]

MTA has been developed for endodontic use, including root perforations.[5–8] Several in vitro and in vivo studies have shown that MTA prevents microleakage, is biocompatible, and promotes regeneration of the original tissues when it is placed

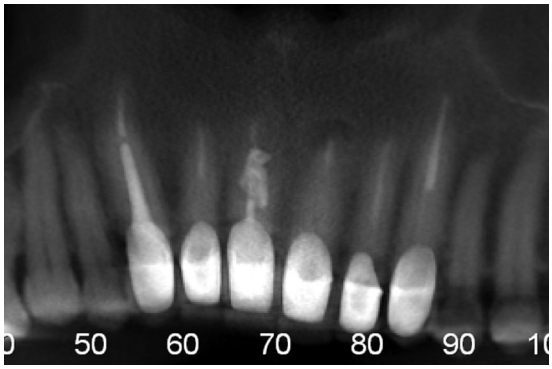

Figure 10 Nine-month follow-up panoramic radiograph.

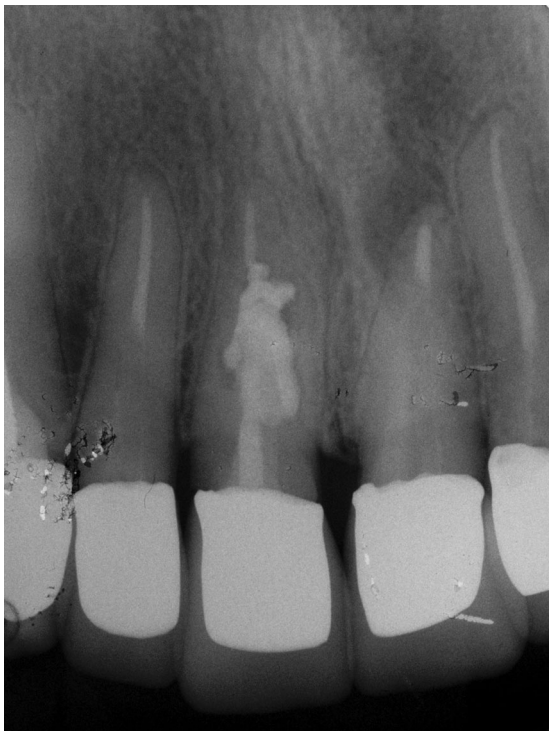

Figure 11 Fifteen-month follow-up periapical radiograph after cementation of the all-ceramic crowns.

in contact with the dental pulp or periradicular tissues.[7,9,10] It allows overgrowth of cementum and may facilitate regeneration of the periodontal ligament.[8] As a disadvantage, gray MTA may discolor marginal gingiva after perforation repair.[9] White MTA was recently introduced and reduces the possibility of this problem.[11] In the case presented, gray MTA was used because the perforation was in the middle third of the root, and the possibility of esthetic problems was considered nonsignificant.

The restoration of endodontically treated teeth is a procedure that still raises clinicians' doubts. This concern increases when little remaining dental structure is available to retain the future restoration. Moreover, it is well known that the more severely damaged the tooth, the worse the prognosis of the case, and that the long-term success of the endodontic therapy is closely related to the success of the restorative procedure.[12] Thus, the use of fiber-reinforced dowels associated with adhesive dentistry has increased the rate of success of such cases.[13] In this case, when the dowel spaces were considered to be too wide for using a single dowel, glass fiber-reinforced dowels were used with accessory dowels to diminish the amount of resin cement necessary. The maxillary right central incisor received a customized dowel prepared with a glass fiber dowel embedded in resin composite with the same purpose of diminishing the resin cement line. This issue is important because thick cement lines may negatively influence the bond strength of dowels cemented to the root dentin.[14]

Some aspects regarding the present clinical report should be addressed. At the end of the treatment, the lower midline was not aligned with the upper one. The maxillary midline was aligned with the facial midline. Zirconia copings were used in the anterior teeth. Although these copings limited the translucency, they were necessary to cover the metallic cast core in the canine. The treatment of root resorption due to root perforation during the endodontic preparation involved periodontal surgery to remove the granulation tissue and endodontic retreatment, followed by repair of the perforation site and the adjacent bone defect.

The patient returned after 30 months with no signs or symptoms. The tooth and periodontal tissues were functioning with no discomfort, pain, or esthetic defects. Treatment of the root perforation with MTA was considered successful as evidenced by clinical and radiographic follow-ups.

The treatment of root resorption due to root perforation during the endodontic preparation involved periodontal surgery to remove the granulation tissue and endodontic retreatment, followed by repair of the perforation site and the adjacent bone defect. The patient returned after 30 months with no signs or symptoms. The tooth and periodontal tissues were functioning with no discomfort, pain, or esthetic defects. Treatment of the root perforation with MTA was considered successful as evidenced by clinical and radiographic follow-ups.

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