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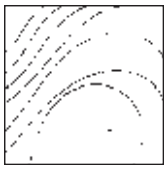
Management of Perforating Internal Root Resorption with Periodontal Surgery and Mineral Trioxide Aggregate: A Case Report with 5-Year Follow-up



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Internal root resorption (IRR) is characterized by progressive loss of tooth substance initiating at the root canal wall as a result of clastic activity. The use of periodontal surgery and mineral trioxide aggregate is a good approach to repair lesions with periodontal communication (perforating IRR). This case describes the treatment and follow-up of a maxillary central incisor with perforating IRR in a 56-year-old male patient where root canal treatment, periodontal surgery, and white mineral trioxide aggregate were employed to achieve complete repair and to restore function. Clinical findings and periapical radiographs indicated success after a 5-year follow-up. (Int J Periodontics Restorative Dent 2013;33:e65–e71. doi: 10.11607/prd.1417)

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Root resorption (RR) is the loss of dental hard tissue as a result of clastic activities.[1] RR might be broadly classified into external or internal by the location of the resorption in relation to the root surface.[2] Internal root resorption (IRR) is a rare condition in permanent teeth[3] characterized by progressive loss of tooth substance initiating at the root canal wall. IRR is usually asymptomatic, slowly progressing, but detectable on routine radiographic examination or by the clinical sign of a "pink spot" visible through the crown of the tooth as a result of IRR in the coronal third of the root canal.[2,4]

Various etiologic factors have been linked to IRR, including trauma, caries and periodontal infections, excessive heat generated during restorative procedures on vital teeth, calcium hydroxide procedures, vital root resections, anachoresis, orthodontic treatment, cracked teeth, or simply idiopathic dystrophic changes within normal pulps. IRR is more frequently observed in male subjects.[3,5,6]

Clastic cells are motile, multinucleated giant cells that are responsible for bone, dentin,

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and cement resorption. They are formed by the fusion of mononuclear precursor cells of the monocyte-macrophage lineage derived from the spleen or bone marrow, as opposed to osteoblasts and osteocytes that are derived from skeletal precursor cells.[2,7,8] Damage to the odontoblast layer and exposure of predentin of the canal wall is a prerequisite for the attachment of clastic cells and the initiation of the resorptive process, but its advancement depends on bacterial stimulation of the clastic cells.[9] Therefore, nonsurgical root canal therapy (pulp removal) is the treatment of choice to hinder the destructive process.[2,10] The irregular confines of the resorptive cavity pose technical difficulties for thorough debridement and obturation of the pulp space. Moreover, tissue loss can be extensive and often unrestorable. Treatment of IRR must aim for complete removal of the resorptive tissue from the root canal system in an attempt to prevent further loss of hard tissue. If the process has extended to the point that it reaches the external root surface, root integrity is lost, and destruction of the adjacent periodontal tissues may occur (perforating IRR).[11] Selecting suitable restorative materials for these cases remains a challenge, especially if tooth loss is extensive; extraction is the only realistic option in some cases.[10]

Mineral trioxide aggregate (MTA) (Dentsply) is a biocompatible cement with good sealing properties, bactericidal effects, radiopacity, and the ability to set in the presence of blood. MTA is ideal as orthograde or retrograde filling material[12] that has been successfully used in pulp capping, pulpotomy, treatment of traumatized teeth with immature apices, and as a root-end filling material.[10,11,13] The use of MTA is a conservative approach to repair resorptive lesions with periodontal communication.[14]

This case report describes the treatment and 5-year follow-up of a maxillary central incisor with perforating IRR in which root canal treatment, periodontal surgery, and white MTA were employed to achieve complete repair and to restore function.

Case report

A 56-year-old man was referred to a privale dental clinic in Malaga, Spain, because of extensive IRR affecting the maxillary left central incisor. The lesion was discovered by the referring dentist on a periapical radiograph taken because of the presence of vague pain in this quadrant and a history of trauma. Clinical examination revealed the maxillary left central incisor to be slightly tender to percussion. Electric and heat pulp tests were negative. Periodontal probing depths were physiologic (< 3 mm) at all sites. The medical history was noncontributory.

Radiographic examination revealed a well-circumscribed, fairly oval radiolucency in the middle third of the root, next to a crescent-shaped radiolucent lesion in the alveolar bone (Fig 1a). No periapical radiolucent lesion was detected. Based on the clinical and radiographic findings, the diagnosis was irreversible pulpitis with perforating IRR.

The possibility of conserving the maxillary left central incisor was considered through a combination of treatments: nonsurgical root canal therapy to remove the necrotic pulp and disinfect the root canal system, followed by surgical treatment to expose the resorptive defect. The resorptive defect would then be filled with MTA. The patient's consent was obtained, and root canal treatment was accomplished by established methods. Anesthesia was administered accordingly, and the tooth was isolated using a rubber dam. The access cavity was opened on the palatal surface, and the pulp tissue was removed. Length determination was performed electronically using the DentaPort ZX (J. Morita Manufacturing) and confirmed radiographically. During root canal instrumentation, communication between the resorption cavity and the distal periodontium was observed as a hemorrhagic area. A no. 25 K-File (Medensco) was introduced through the perforation (Fig 1b).

The canal was prepared using an X-Smart motor (Dentsply Maillefer) connected to an F1 instrument of the ProTaper System (Dentsply-Maillefer). An apical stop was created with a K3 rotary nickel-titanium file (size 35/.06; Sybron Endo Dental Specialties). Intracanal irrigation was performed using

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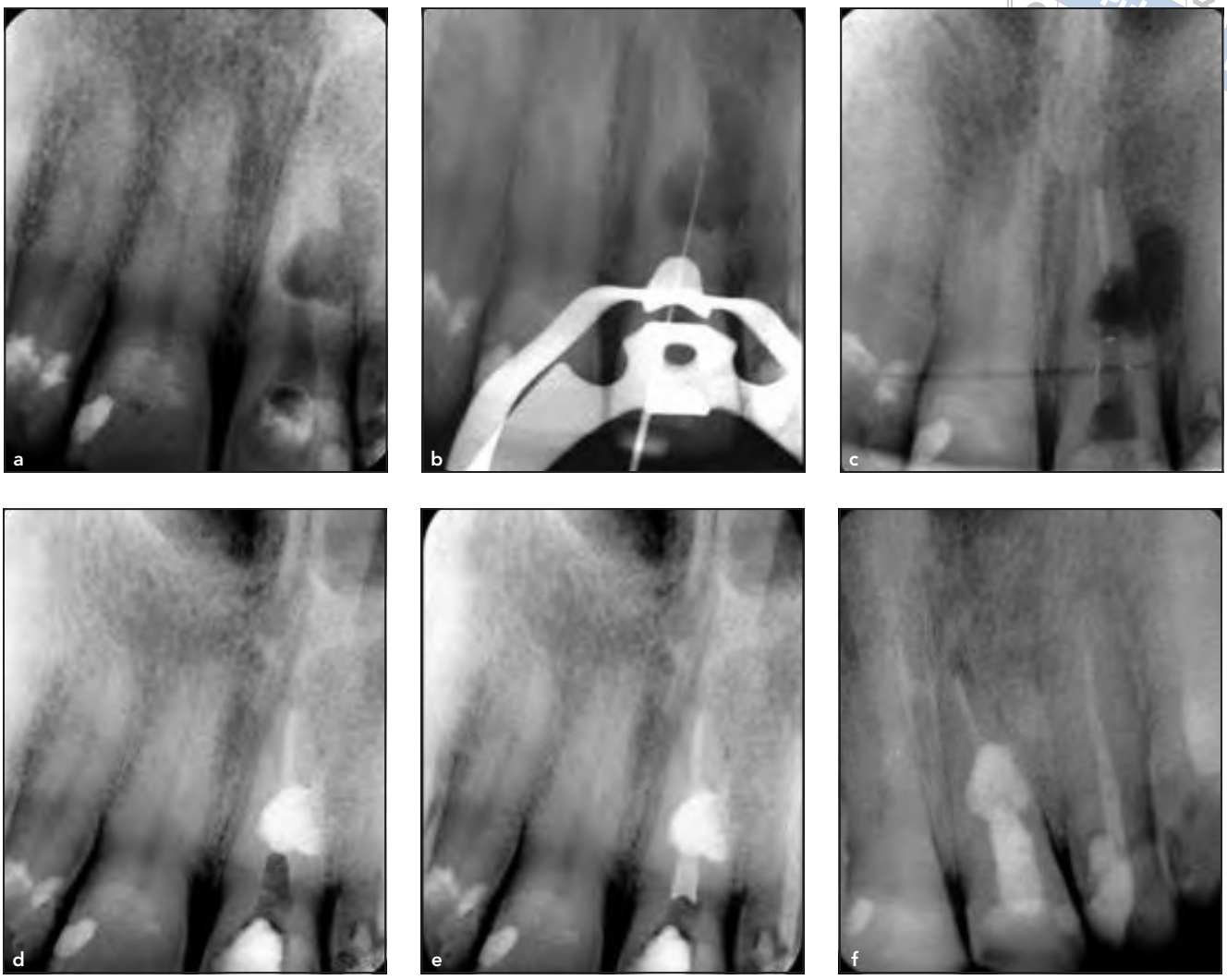

Fig 1 (a) *Preoperative radiograph.* (b) *A no. 25 K-File introduced through the perforation.* (c) *Gutta-percha cone used to fill the apical root canal.* (d) *Periapical radiograph after MTA placement.* (e) *Postoperative radiograph.* (f) *Radiograph at 18 months postsurgery.*

1% sodium hypochlorite (Farmacia Del Campo), and calcium hydroxide paste (Calcipulpe, Septodont) was placed to alkalinize the environment, remove remaining pulp tissue, control bleeding at the perforation, and ensure complete elimination of the granulation tissue.

After 15 days, the dressing material was removed with 1% sodium hypochlorite irrigation, and the root canal was dried using paper points. A 35.06 autofit gutta-percha cone (Analytic Endodontics) was used to fill the apical root canal with a downpack motion using the System B unit (SybronEndo) and sealer cement (Topseal, Dentsply-Maillefer) (Fig 1c). The access cavity was sealed using Cavit G temporary filling material (3M ESPE).

At the same time, a flap that exposed the granulation tissue and the bone destruction was elevated. The granulation tissue was removed, and the irregular borders of the perforation site were smoothed using a bur attached to a straight surgical handpiece (3610 N1;

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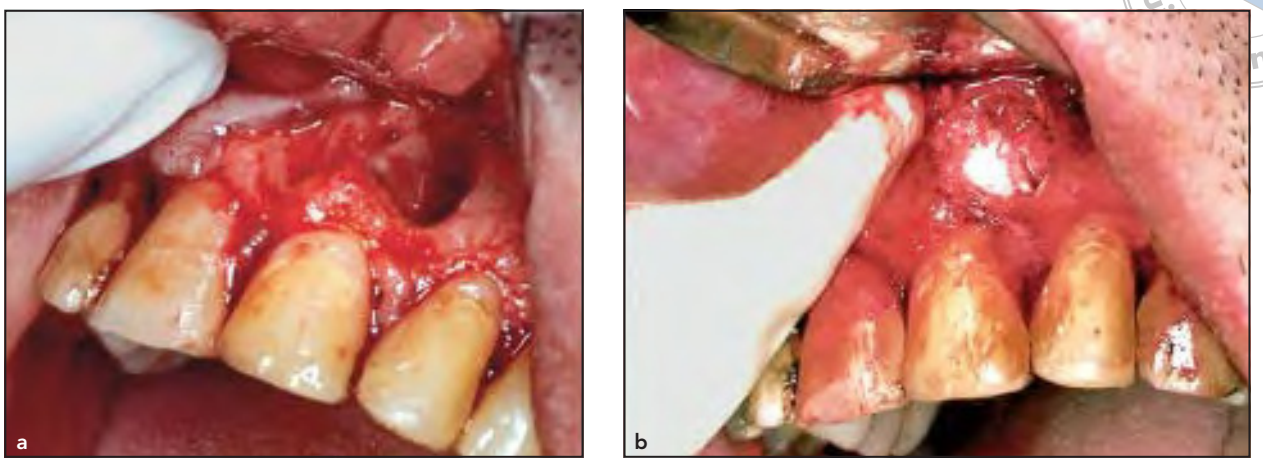

Fig 2 (a) *Appearance of the perforation defect after removal of the granulation tissue.* (b) *MTA sealing of the perforation defect.*

Fig 3 *Five-year follow-up.* (a) *Radiographic and* (b) *clinical views. Note the healthy gingiva.*

KaVo Dental) (Fig 2a). MTA powder was mixed according to the manufacturer's instructions and placed with an MTA carrier. MTA was firmly condensed with the use of a plugger and wet cotton pellets (Figs 1d and 2b). Bone graft material (Bio-Oss, Geistlich Pharma) was placed over the MTA to fill the bony defect. The flap was sutured, and the patient was recalled 1 week later for suture removal.

The provisional obturation was then removed, and warm gutta-percha was injected using an extruder (Elements Obturation Unit; SybronEndo Dental Specialties). An immediate postoperative radiograph was taken, confirming satisfactory filling of the root canal and resorptive defect (Fig 1e).

The patient remained free of symptoms at 18 months, and the periapical radiograph showed satisfactory healing of the distal radiolucent lesion in the alveolar bone (Fig 1f). After 5 years, the patient remains asymptomatic, the tooth shows no sensitivity to percussion, periapical radiography shows complete repair of the resorptive lesion (Fig 3a), and gingiva is healthy without periodontal pockets (Fig 3b).

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Discussion

IRR is an insidious pathologic process initiated within the pulp space and associated with loss of dentin. It is often described as oval-shaped and symmetrically distributed over the root with enlargement of the root canal space, and is usually asymptomatic but detectable on radiographs.[15] However, in this case, the location of the resorptive lesion was eccentric. This feature has also been described by other authors.[10] Furthermore, radiolucency in the alveolar bone next to the cavity was present.

In this patient, the preferred treatment consisted of sealing the apical root canal with a gutta-percha cone after placement of MTA in the defect cavity, and then sealing the rest of canal with warm gutta-percha. Yildirim and Dalci[16] sealed an iatrogenic root perforation with MTA after the root canal was filled with gutta-percha and AH plus sealer. In other cases, the root canal was filled after repair of the resorptive lesion.[10,11,17]

Previous animal studies have evaluated the repair of uncontaminated and contaminated lateral root perforations sealed with MTA and the effect of temporarily filling the contaminated perforations with a calcium-hydroxide based dressing before MTA placement. According to the results of those studies, the lateral root perforations sealed with MTA after contamination presented inferior repair compared with the uncontaminated perforations, and placement of an antibacterial agent between visits failed to improve repair of contaminated perforations.[18] Calcium hydroxide is antibacterial and has been shown to effectively eradicate bacteria that persist after chemomechanical instrumentation.[19,20] Calcium hydroxide has also been shown to have a synergistic effect when used in conjunction with sodium hypochlorite to remove organic debris from the root canal.[21] Nevertheless, some case reports demonstrated the inability of calcium hydroxide to eliminate bacteria because of its low solubility and inactivation by dentin, tissue fluids, and organic matter.[22] Despite these limitations, the use of multiple calcium hydroxide dressings has been advocated to enhance chemomechanical debridement of the IRR defect.[19,22]

The sealing ability of different formulations of MTA (MTA Bio and MTA-Angelus; Angelus) has been compared with intermediate restorative material (IRM, Caulk, Dentsply).[23] It has been suggested that the use of IRM to seal large perforations should be limited, whereas all other formulations of MTA and Portland cement had a somewhat similar ability to seal perforations. MTA was used to repair the defect.

MTA is biocompatible[24] and has been shown to be effective in repairing furcation perforations[25] and lateral root perforations[26] and in the treatment of large periapical lesions.[27] The material is well tolerated by periradicular tissues and has been shown to support almost complete regeneration of the periodontium.[25] In addition, MTA has superior sealing properties when compared with other materials.[28] A hybrid technique might also be used to obturate canals: the canal apical to the resorption defect is obturated with gutta-percha, and then the defect and associated perforation are sealed with MTA.[11]

Two disadvantages have been described for MTA (difficulty with handling and management and its color). With respect to management, the use of various additives has been suggested to improve its handling characteristics. Recently, AlAnezi et al[29] reported that adding KY liquid, calcium chloride, and sodium hypochlorite to gray MTA improved the handling properties and decreased setting time. With respect to the color of MTA, discoloration of marginal gingiva after perforation repair with gray MTA has been reported.[30] In this case, replacing gray MTA with recently introduced white MTA allowed for a complete resolution of discoloration. No gingival discoloration was observed after 5 years. The potential for gingival discoloration should be considered in perforations located proximal to the marginal area. White MTA should be the material of choice to repair defects in which direct contact with gingival tissues is expected.

The procedures were lengthy, costly, diificult, and mostly unpredictable. After debate among the authors, the following treatment options were discussed: *(1)* extraction and implantation or *(2)* heroic efforts to treat the tooth. Moreover, the patient's preference was to save the tooth if possible. It cannot be

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known if predictability would be increased if the patient were treated with extraction and placement of an implant because the scientific literature does not provide evidence regarding this election.

The endodontic literature generally lacks long-term follow-up of treated teeth with root resorptions. However, there are previous cases reporting root canal therapy combined with periodontal surgery in the treatment of advanced stages of root resorption.[31,32] Root fracture has been reported as a complication of this treatment, so clinical and radiographic examination during the follow-up period must be performed.[33] Although root fracture associated with internal resorption had been reported, the paucity of such reports preclude drawing any evidence-based conclusions regarding the correlation between teeth with histories of root canal replacement resorption and their fracture resistance.[2]

It is important for clinicians to understand the endodontic, periodontal, and restorative aspects of treating perforating root resorptions. Teeth are often structurally compromised and may eventually fail even though endodontic treatment is successful. The endodontic treatment is irrelevant if the resorption is not eliminated and the restorative aspects are not managed properly.[32] Proper management requires knowledge and skills in endodontics, surgery, and restorative dentistry.

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