Surgical endodontic management of an invasive cervical resorption class 4 with mineral trioxide aggregate: A 6-year follow-up

Rafael Fernández, DDS,[a] and Juan G. Rincón, DDS,[b] Medellín, Colombia
CES UNIVERSITY

Invasive cervical resorption is a type of external resorption rarely seen as an adverse effect after a guided tissue regeneration procedure for a periodontal condition. This case report summarizes the surgical endodontic management of an invasive cervical resorption class 4 (Heithersay) with mineral trioxide aggregate, in a mandibular incisor of a 67-year-old man. A 6-year clinical follow-up with radiovisiography and cone-beam computerized tomography revealed complete healing. A surgical endodontic management could promote healing and survival of a tooth with advanced root resorption due to a periodontal condition. **(Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2011;112:e18-e22)**

Root resorption is a condition associated with a loss of dentin and cementum by tooth-resorbing cells.[1] Invasive cervical resorption (ICR) is a type of external resorption that occurs below the epithelial attachment of the tooth at the cervical area, owing to the injury to or deficient cementum layer covering the external surface of the root.[1,2] Heithersay developed a clinical classification of ICR according to the degree of resorption (classes 1-4).[2] Class 1 denotes the least invasive resorptive lesion, near the cervical area with shallow penetration into dentine, whereas class 4 denotes the most invasive resorptive lesion, extended beyond the coronal third of the root. Although most etiologic factors for ICR include trauma, intracoronal bleaching, orthodontic treatment, dentoalveolar surgery, and periodontal procedures, some cases are idiopathic.[2-4]

Bone grafts and guided tissue regeneration (GTR) are used to regenerate lost periodontal tissues as a result of periodontal diseases.[5] However, root resorption may well be an adverse effect of the GTR procedure.[6] When the resorption invades the root canal in advance stages, endodontic treatment and the surgical exposure of the resorptive cavity must be performed to remove the inflammatory tissue.[3] Finally, an excellent restoration and seal of the resorptive cavity are important for the success of the treatment. Materials such as amalgam, composite resin, glass ionomer, and mineral trioxide aggregate (MTA) have been used for this purpose.[7-9] MTA is a bioactive material made of tricalcium silicate, bismuth oxide, dicalcium silicate, tricalcium aluminate, tetracalcium aluminoferrite, and calcium sulfate dehydrate that is marketed in 2 formulations: gray (GMTA) and white (WMTA).[10] The latter was introduced because of the potential for pigmentation of GMTA.[11] MTA has physical, chemical, and antibacterial properties that have been shown to be successful when used in numerous endodontic situations.[12-15]

Cone-beam computerized tomography (CBCT) is typically used in endodontics for the diagnosis of periapical lesions, the identification of accessory canals and root fractures, and the characterization of internal and external resorption. It produces 3-dimensional (3D) images with very high definition and low radiation, allowing the possibility of improving the diagnosis, treatment, and follow-up of endodontic cases. In contrast, the 2-dimensional (2D) image of the conventional and digital periapical radiograph (radiovisiography) limits its application.[16]

The present case report describes the surgical management of an ICR class 4 with MTA on the lingual surface of a mandibular central incisor, probably as a complication of a GTR procedure. His 6-year radiovisiography and CBCT follow-up is also summarized.

CASE REPORT

A 67-year-old man with noncontributory medical history was referred by the periodontist to the endodontist for evaluation and management of the right mandibular central incisor. Nine years before the referral, tooth #25 had periodontal treatment with scaling and root planing without surgical ap-

[a]Endodontist, Affiliated Professor, Department of Endodontics, CES University, Medellín, Colombia.
[b]Undergraduate Division, School of Dentistry, CES University, Medellín, Colombia.
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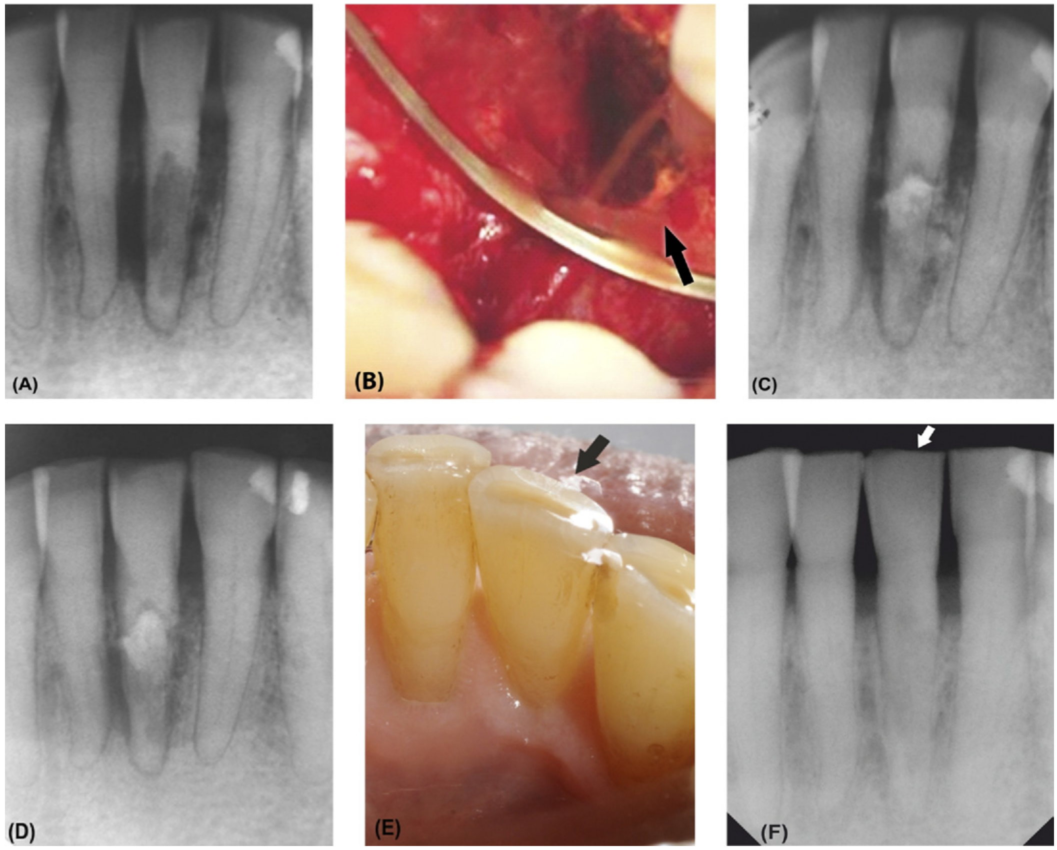

Fig. 1. Clinical and radiovisiography images of tooth #25. **A,** Diagnostic radiovisiography image; **B,** resorption area visualized during the surgical procedure (*arrow*); **C,** filling of the resorptive cavity and the root canal with white mineral trioxide aggregate; **D,** 6-month follow-up radiovisiography image; **E,** clinical situation after 6 years (*arrow* indicates tooth #25); **F,** 6-year follow-up radiovisiography image (*arrow* indicates tooth #25).

proach. Six months later, a GTR procedure was performed, where an expanded polytetrafluoroethylene nonresorbable membrane (Gore-Tex; Gore, Flagstaff, AZ) was placed on the lingual surface. The clinical examination at that time revealed grade I mobility, normal probing depths except a periodontal pocket of 7 mm in the midlingual surface, and a 3-wall intrabony defect.[17]

During endodontic evaluation, the patient did not report a history of traumatic lesions, orthodontic treatment, or bleaching. The intraoral clinical examination of tooth #25 showed normal probing depths of 3 mm, with bleeding on the lingual aspect, grade II mobility, and pain to vertical and horizontal percussion. Electrical pulpal test of this tooth was negative. Radioviosiography images (Gendex, Hamburg, Germany) from different angles revealed pulp chamber calcification, large external resorption on the lingual aspect of the root, mesial and distal bone loss below the alveolar crests, and thickening of the periodontal ligament (PDL) (Fig. 1, *A*). A diagnosis of pulp necrosis associated with invasive cervical resorption class 4 (Heithersay) and symptomatic apical periodontitis was made. The patient was informed about the diagnosis and alternative treatments, which included extraction and prosthodontic replacement or surgical endodontic management of the root canal and the resorptive cavity with a questionable failure rate. A written consent was obtained from the patient, who decided for the endodontic management.

Local anesthesia with Roxicaina (2% lidocaine chlorhydrate and 1/80.000 epinephrine; Ropsohn Therapeutics, Bogotá, Colombia) was applied on both the inferior alveolar and the lingual nerves. Under ×6.0 magnification, intrasulcular incisions were made on the lingual aspect of tooth #25, extending them 1 tooth on each side, and 2 vertical incisions to complete the full-thickness flap. Once the flap was raised, a 90% aqueous solution of trichloroacetic acid on a microapplicator (Ultradent Products, South Jordan, UT) was carefully applied for 2 minutes to the resorptive tissue. Gentle pressure was applied to allow complete coagulation necrosis, before protective application of glycerol to adjacent soft tissues. The devitalized tissue was then curetted from the resorptive cavity. The ICR with perforation into the root canal and a horizontal bone loss compromising the coronal and middle radicular third were observed (Fig. 1, *B*).

ET20D and ET40D ultrasonic tips (Satelec, Cherry Hill, NJ) were used for the debridement of the root canal through

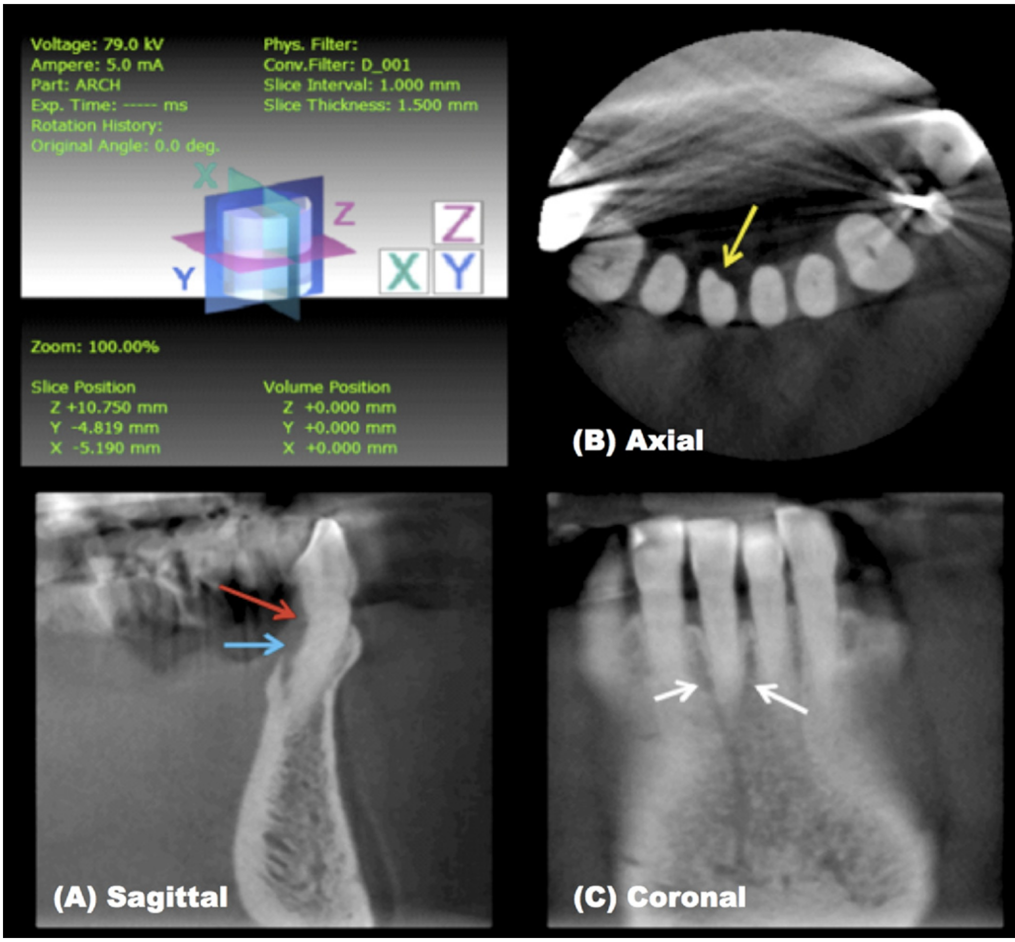

Fig. 2. Three-dimensional high-resolution images obtained with cone-beam computerized tomography (Veraviewepocs 3D) at the sixth-year follow-up of tooth #25. **A,** White mineral trioxide aggregate (WMTA) partially filling the resorptive cavity and the root canal (*red arrow*), and the height of the lingual bony defect surgically visualized and which remained stable during the follow-up period (*blue arrow*); **B,** the WMTA did not completely restore the radicular contour (*yellow arrow*); **C,** WMTA partially filling the resorptive cavity and the root canal, and complete bone healing of the initial lesions (*white arrows*).

the resorptive cavity from the coronal to the apical third, to avoid a root-end resection and additional bone loss and to preserve the retentive configuration of the cavity. Chlorhexidine gluconate gel (2%; Clorhexol; Farpag, Bogotá, Colombia) was used as irrigant for 10 minutes in the root canal and resorptive cavity. The surgical area was subsequently rinsed with sterile saline solution and dried with sterile gauze. ProRoot WMTA (Dentsply/Tulsa Dental, Tulsa, OK) was prepared following the manufacturer's instructions and placed with the use of a Carver Glick #1 hand instrument (Vista Dental, Racine, WI) to seal the root canal and the resorptive cavity (Fig. 1, *C*). The flap was sutured in place with nonabsorbable suture (Prolene 5-0; Ethicon; Johnson & Johnson, São José dos Campos, SP, Brazil), and postsurgical instructions were given to the patient. A week later, the sutures were removed. The patient did not report pain or inflammation.

Clinical and radiovisiography evaluations were scheduled every 3 and 6 months, respectively (Fig. 1, *D*). During the first postsurgical months, no communication was found between the gingival sulcus and the coronal aspect of the resorptive cavity sealed with WMTA. Six months later, a small gingival retraction exposed part of the cured WMTA, which was then covered with flowable compomer (Dyract Flow; Dentsply Caulk, Milford, CT). The patient was evaluated 6 years after, and optimal levels of oral hygiene and physiologic mobility and healthy periodontal tissues with no probing depths or bleeding were found (Fig. 1, *E*). The sixth-year follow up radiovisiography (Fig. 1, *F*) and CBCT (Veraviewepocs 3D; J. Morita USA, Irvine, CA; Fig. 2, *A-C*) showed complete healing of the bone lesions on the mesial, distal, and apical aspects of the tooth.

DISCUSSION

Many injuries have been associated with the presence of ICR.[2-4] In the present case, medical and dental history from the patient suggested that the periodontal disease and periodontal root planing and scaling might have triggered the ICR initiation. In addition, the GTR treatment performed afterward could have had an important role in the progression and severity of the resorption. It has been shown that GTR procedures prevent the epithelial cells apical migration and favor the repopulation of the root surfaces by undifferentiated mesenchymal cells of the PDL. As a consequence, promotion of periodontal regeneration with formation of bone, PDL, and cementum through membranes happen.[5] Although GTR therapy has been associated with a high rate of clinical success,[18,19] ankylosis and root resorption can be adverse effects of this procedure.[6] The present report is consistent with other studies,[20-22] where a possible relationship between GTR procedure and root resorption has been established.

Our case showed an advanced resorptive process on the lingual aspect of the lower right central incisor with invasion of the root canal and bone loss. The surgical approach was selected, because under these circumstances it is not possible to control the chemomechanical and obturation procedures in the root canal and the resorptive cavity through an orthograde route. Once the resorptive cavity was exposed, the topical application of trichloroacetic acid was used to inactivate all resorption tissue and render the area avascular, which is of considerable clinical importance in the treatment of ICR.[23]

When the resorptive defect restoration procedure is preceded by a surgical approach, the materials are frequently placed in close contact with the periodontium. Therefore, it is important to consider that although materials are not sensitive to moisture, blood contamination, biocompatibility, and sealing ability, these conditions may induce periodontal regeneration and bony repair during the healing process. Available evidence suggests that MTA is the material of choice in a clinical condition in which the resorptive process never reaches the supragingival area before the surgical approach. As in the present case, MTA favors its full setting and isolates the area from a possible microbial contamination.[13,24,25] Although it was not possible to achieve a complete filling of the root canal and the resorptive cavity, and some dilution of the WMTA was observed, a complete bone healing of the initial lesions occurred. We think that these findings may be associated with the antimicrobial properties of chlorhexidine[26] and/or the remaining alkalinity of WMTA. WMTA promotes the release of calcium ions and calcium hydroxide formation that maintains an antimicrobial activity and creates a favorable environment for cell division.[27] Several authors have demonstrated that both MTA formulations (gray and white) induce metabolic activity on the PDL cells, stimulating its adhesion and modulating an osteogenic phenotype on the fibroblasts of the PDL, which is reflected with the increased expression of alkaline phosphatase, osteonidogen, osteonectin, and osteopontin.[28,29] Recent studies have confirmed cementoconductivity, cementoinductivity, and osteoconductivity of WMTA.[30,31] The horizontal lingual bone defect did not receive a bone graft, because its use for this type of defect has been associated with low success rates.[32]

Heithersay reported the success rate of the treatment in ICR (classes 1-4) as determined by an absence of resorption and pulpal or periradicular pathosis. It is typically 100% in all classes 1 and 2, although in class 3 lesions 77.8% are reasonably successful. For cases similar to the one in the present report (class 4) a low success rate of 12.5% is expected, and therefore tooth extraction followed by prosthodontic replacement has been suggested.[23] However, if the patient is informed of the treatment and rejects the extraction and wants try to save his tooth, the surgical endodontic management with MTA may be justified, as reported here.

The effectiveness of CBCT in diagnostic imaging of external root resorption has been demonstrated.[16,33] In the present case, CBCT evaluation could be done only on the sixth-year follow-up; therefore, the extension of ICR at the beginning of the treatment was never observed in 3D. In the follow-up period, CBCT allowed corroboration of the successful healing findings observed with radiovisiography and provided new image information about the features of the filling unobserved by radiovisiography. The clinical periodontal conditions also led us to hypothesize that this case was an example of a periodontal healing with a long periodontal junction over the WMTA remaining. The success of this treatment is consistent with other reports in which MTA was used for the treatment of ICR.[22,34,35]

CONCLUSION

Although the described surgical endodontic management of an ICR class 4 with MTA could promote healing and survival of a tooth, more scientific evidence with longer follow-up periods is needed to support its use in this type of case.

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Reprint requests:

Rafael Fernández, DDS
Calle 33 #42 b 06 Torre Sur
Cons. 1010, Medellín
Colombia
rfernandez@ces.edu.co