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Treatment of Invasive Cervical Resorption With Sandwich Technique Using Mineral Trioxide Aggregate: A Case Report

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Clinical Relevance

MTA combined with glass ionomer cement and composite resin in a "sandwich technique" showed a favourable clinical outcome for treatment of invasive cervical resorption lesions.

SUMMARY

This article presents two cases of large invasive cervical resorption (ICR) with maintenance of pulp vitality after treatment with mineral trioxide aggregate (MTA) in a sandwich technique.

Invasive cervical resorption is a relatively uncommon but aggressive form of external resorption, primarily caused by dental trauma or injury of the cervical periodontal attachment. The resorptive process does not penetrate into the root canal, and the pulp is not involved in the first phase of the resorption. This feature differentiates external resorption from internal resorption. In most cases, invasive cervical resorption is found during routine radiographic or clinical examination. Different materials have been proposed for the treatment of external cervical resorption. Therapy can be effective when it 1) removes the etiological factors and 2) interrupts the progressive resorption mechanism.

The key learning points of this article are the following: treatment strategy to arrest the cervical resorption process and to prevent further resorption without changing pulpal vitality and successful seal of invasive cervical resorption defect using MTA with a sandwich technique.

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INTRODUCTION

Definition of ICR—External root resorption is a progressive and destructive loss of hard dental tissue, initiated by a demineralized or denuded area of the root surface.[1] One of the frequent types of external root resorption is invasive cervical resorption (ICR), described in detail by Heithersay[2]: "*invasive cervical resorption* is a clinical term used to describe a relatively uncommon, insidious and aggressive form of external tooth resorption, which may occur in any tooth in the permanent dentition. The etiologic factors include: traumatic injuries, orthodontic treatment, internal bleaching, periodontal treatment, restorative treatment and idiopathic."[1-3]

Diagnosis of ICR—The diagnosis of ICR is usually achieved by radiographic images or clinical examination. Most ICRs are painless; the clinical features vary from a small root defect in the cervical region to a pink coronal discoloration or enamel lesion. The resorption is associated with inflammation of the periodontal and gingival tissues but primarily does not have any pulpal involvement because of the protective qualities of the predentin layer.[3,4]

Histopathologically, the lesions contain fibrovascular tissue with resorbing clastic cells adjacent to the dentin surface.[5] Bacteria migrating from the gingival sulcus into the dentin tubules are believed to be the resorption trigger.[6]

Therapy of ICR—Three goals have to be achieved to arrest the resorption process:

1. disinfection of the defect to eliminate the original bacterial stimulus,
2. complete seal of the defect to avoid bacterial repopulation, and
3. epithelial attachment to the filling material to avoid contact between the cervical periodontal ligament and bacteria from the gingival sulcus.

Currently, no single material exists that ideally fulfills these criteria. Mineral trioxide aggregate (MTA), glass ionomer, and resin composite have been proposed as resorptive lesion repair materials.[3,7] MTA has favorable chemical and physical properties, sealing ability, antibacterial activity, and biocompatibility and creates an ideal environment for hard-tissue healing.[8,9]

Clinically, successful treatment of ICR depends on the extent of the resorptive process, and the most preferential classification system for ICR used universally was introduced by Heithersay in 1999.[2] The four classifications are as follows.

- Class 1: a small invasive resorptive lesion near the cervical area with shallow penetration into dentin
- Class 2: a well-defined invasive resorptive lesion that has penetrated close to the coronal pulp chamber but shows little or no extension into the radicular dentin
- Class 3: a deeper invasion of dentin by resorbing tissue, involving the coronal third of the root
- Class 4: a large invasive resorptive process that has extended beyond the coronal third of the root canal.

It is important that most ICRs not be treated as a disease that requires conventional endodontic therapy since treatment can be delivered without sacrificing pulpal vitality.[10]

To achieve the three treatment goals, it is further necessary to expose the resorption lacuna orthodontically or surgically and to remove the main bulk of the granulation tissue. As the latter is just a reaction to the bacterial stimulus in the defect, complete removal as proposed in earlier literature[1] is not the main approach. Rather, it is far more important to achieve a definitive seal of the affected dentinal tubules.

This report presents the management of two clinical cases of ICR using a combination of MTA and other materials that demonstrate the outcome over a longer observation period.

CASE REPORT

Case 1

Clinical Features—A 31-year-old female patient presented to the Division of Preventive and Operative Dentistry, Endodontics, Pedodontics, and Minimally Invasive Dentistry, Medical University of Graz, in March 2006 with a gingival swelling and pink spot localized in the labial cervical area of the maxillary left central incisor (Figure 1). The medical history of the patient was not relevant for ICR: no history of orthodontic treatment, dental trauma, or bleaching. The patient reported that the gingival swelling and discoloration had increased in size during the past weeks. Intraoral examination showed that the tooth was not sensitive to percussion and responded positively to a thermal sensitivity test. In the cervical region of the labial surface, a pink discoloration under a remaining thin and fragile enamel layer was visible. The resorptive lesion advanced into the periodontal ligament re-

Figure 1. *Initial presentation of the case. Intraoral appearance of the gingival swelling and pink discoloration in the labial surface of tooth.*

gion, and the adjacent papilla showed an erythematous swelling. No caries or restorations were detected. A central diastema was noted. After a clinical examination, a radiograph was obtained using a digital radiographic system (Sirona Dental Systems GmbH, Bensheim, Germany). The radiographic images showed an irregular radiolucent area localized distal in the cervical third of the tooth (Figure 2). The pulp chamber and canal were not involved, and the case was classified a class 2 grade of ICR.

Management—After explaining the therapy plan to the patient, surgical treatment was performed under local infiltration anesthesia (Ultracain D-S, Sanofi-Aventis, Frankfurt, Germany). According to the considerations of Eskici,[11] a minimally invasive mucoperiosteal flap was raised. It combined a vertical incision from the mesial surface of the maxillary left central incisor with a continuing sulcular labial incision to the distal surface of the maxillary left lateral incisor (Figure 3). After the resorption lacuna had been exposed, the granulomatous tissue was removed *in toto* from the resorptive defect using an excavator instrument (Figure 4). The resorption defect was disinfected with 0.1% chlorhexidine solution and subsequently filled using a sandwich technique as follows: the first layer consisted of white MTA (Pro Root, Dentsply, Konstanz, Germany) mixed with 0.1% chlorhexidine.[12-14] This layer was not extended to the margins of the cavity (Figure 5a). The second layer consisted of glass ionomer cement (Fuji IX, Fuji, Tokyo, Japan), which filled out the whole cavity including the margins (Figure 5b). The third layer consisted of light-cured composite (bonding: Excite; composite: Artemis Enamel A2, both by Vivadent, Schaan, Liechtenstein) bonded to the intraenamel margin of the lesion (Figure 5c). After the materials had been placed, the flap was repositioned and sutured with two nonabsorbable sutures (Aesculap AG & CO. KG, Tuttlingen, Germany; Figure 6). The patient was prescribed oral cephalosporin (Ospexin 1000 mg, Sandoz GmbH, Kundl, Austria) for four days and a 0.1% chlorhexidine mouthwash (Chlorhexamed, GlaxoSmithKline Pharma GmbH, Vienna, Austria) for two weeks. At the first control visit one week after treatment, the patient was asymptomatic and the sutures were removed. No more gingival swelling was seen (Figure 7). At the six-month recall, the tooth showed no symptoms and responded normally to sensitivity tests. At the 1½-year follow-up, the radiographic images showed no pathologic changes and good adaption of the MTA to the root anatomy. The patient was free of clinical symptoms, and the pulp sensitivity tests showed a normal response

Figure 2. *Radiographic examination: irregular radiolucent area localized distal in the cervical third of maxillary left central incisor tooth.*

Figure 3. *Clinical/intrasurgical view after flap preparation.*

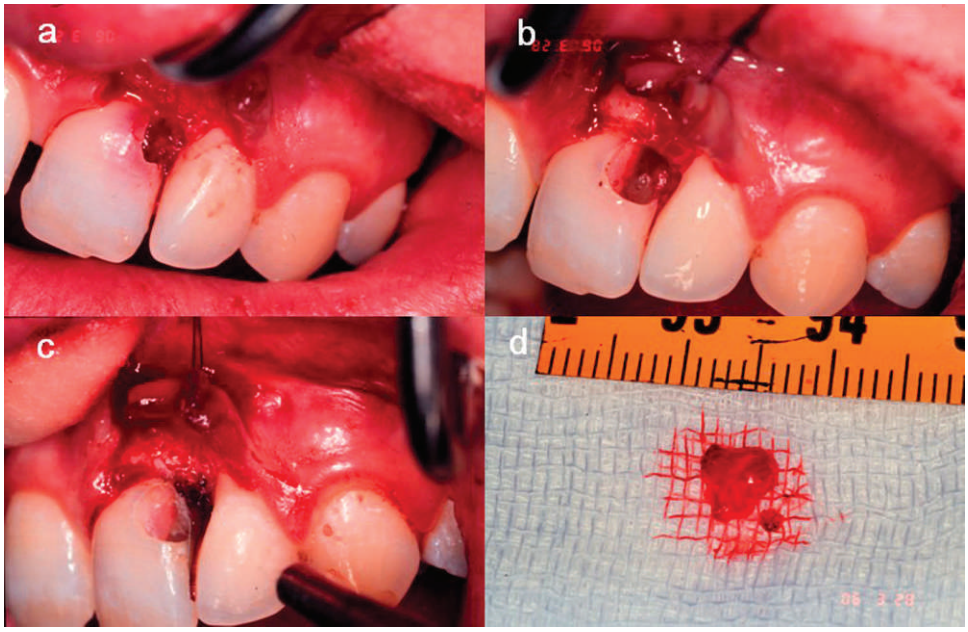

Figure 4. *Exposition of resorption defect. (a, b): Resorption defect after removal of granulation tissue. Note that the resorption defect is surrounding the intact pulp chamber. (c): Clinical view after complete cleaning of resorption defect. (d): Granulation tissue in toto.*

Figure 5. *The resorption defect filled with sandwich technique. (a): Layer of mineral trioxide aggregate. (b): Layer of glass ionomer cement. (c): Layer of light-cured composite.*

(Figures 8 and 9). At the four-year follow-up, the pulp responded positively to sensibility tests, no pink discoloration or caries were detected, and the radiographic examination showed no pathologic changes of the tooth and surrounding tissues (Figures 10 and 11).

Figure 6. *Flap repositioned and sutured. Note the hyperplastic papilla due to the preexisting inflammation.*

Case 2

Medical History and Clinical Features—A 16-year-old male patient presented to the Division of Preventive and Operative Dentistry, Endodontics, Pedodontics, and Minimally Invasive Dentistry, Medical University of Graz, in January 1998 with dental trauma caused by a skateboard accident. The Periotest device revealed that 11 and 21 were mobile (subluxation), and the patient had orthodontic treatment at this time. In the initial treatment, teeth were repositioned and splinted with passive wire and composite. Systemic antibiotic coverage was achieved by oral penicillin (Augmentin 625 mg, GlaxoSmithKline Pharma GmbH) for four days. Local disinfection during the first two weeks was achieved by a 0.1% chlorhexidine mouthwash three times a day. Follow-up after four weeks consisted of

Figure 7. *Gingival healing after one week. The papilla appears to be of normal size and color.*

a clinical and radiographic evaluation. Pulp vitality testing with carbon dioxide snow was negative for both subluxated teeth. No pathologic changes were seen in radiographic images. At the six-month recall, the teeth showed no clinical symptoms and responded negatively to vitality tests. One year after initial treatment, the patient was still free of symptoms and both pulp vitality tests were positive. No further appointment was made. Ten years later, the patient was sent to our division by the local dentist because of a defect localized in the cervical region of the labial and palatal surface in the maxillary right central incisor. The radiographic images showed an irregular radiolucent area in the cervical region of this tooth (Figure 12). Cone-beam computed tomography (CBTC) was performed to confirm the diagnosis of a class 3 lesion of ICR according to Heithersay[2] on the palatal aspect of the root (Figure 13). It was composed of an external destructive part with access

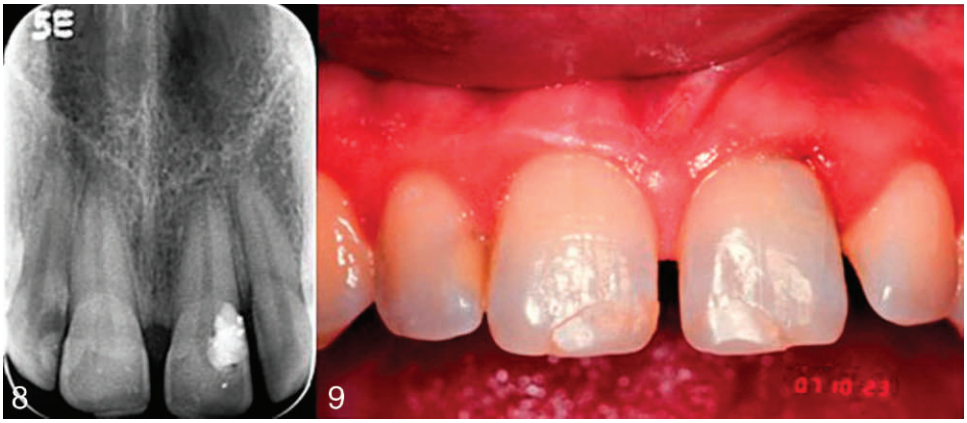

Figure 8. *Radiographic and clinical examination after 1½-year follow-up.*
Figure 9. *Radiographic and clinical examination after 1½-year follow-up.*

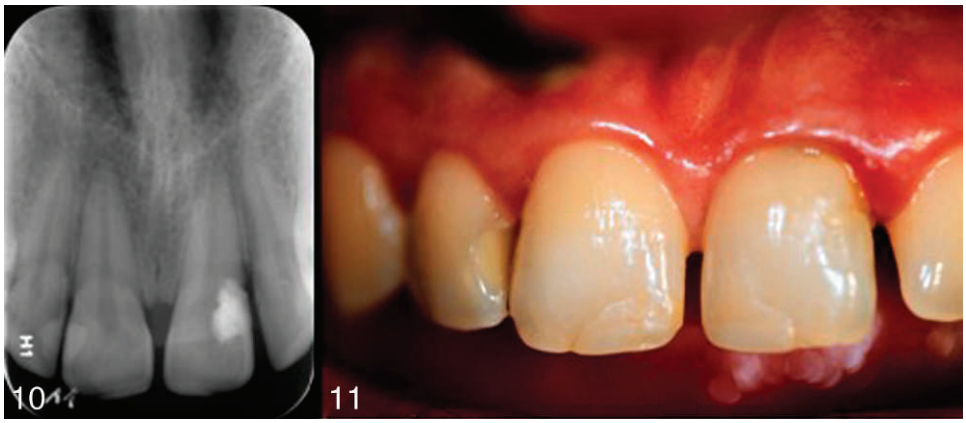

Figure 10. *Radiographic and clinical examination after four-year follow-up.*
Figure 11. *Radiographic and clinical examination after four-year follow-up.*

Figure 12. *Radiographic result after 11½ years, irregular radiolucent area localized in maxillary right central incisor tooth.*

to the sulcular region and a corresponding internal part with bone formation. It was decided to treat only the external part as it seemed to be the primary source of infection.

Management

Surgical treatment under local infiltration anesthesia was performed according to the method described in case 1. The patient was prescribed oral penicillin (Augmentin 625 mg, GlaxoSmithKline Pharma GmbH) for one week and a 0.1% chlorhexidine mouthwash for two weeks. At the first control visit one week after treatment, the patient was symptomless and the sutures were removed. The radiographic examination showed good adaption of the MTA to the root anatomy (Figure 14). Six months after surgical treatment, the tooth showed no further pathological symptoms. The radiographic images showed no further pathologic changes of tooth and surrounding tissues (Figure 15). Further control was scheduled after another six months.

DISCUSSION

The exact etiology of ICR is still unknown. It is supposed that ICR requires two phases: injury and stimulation.[1,15] Injury can be caused by mechanical

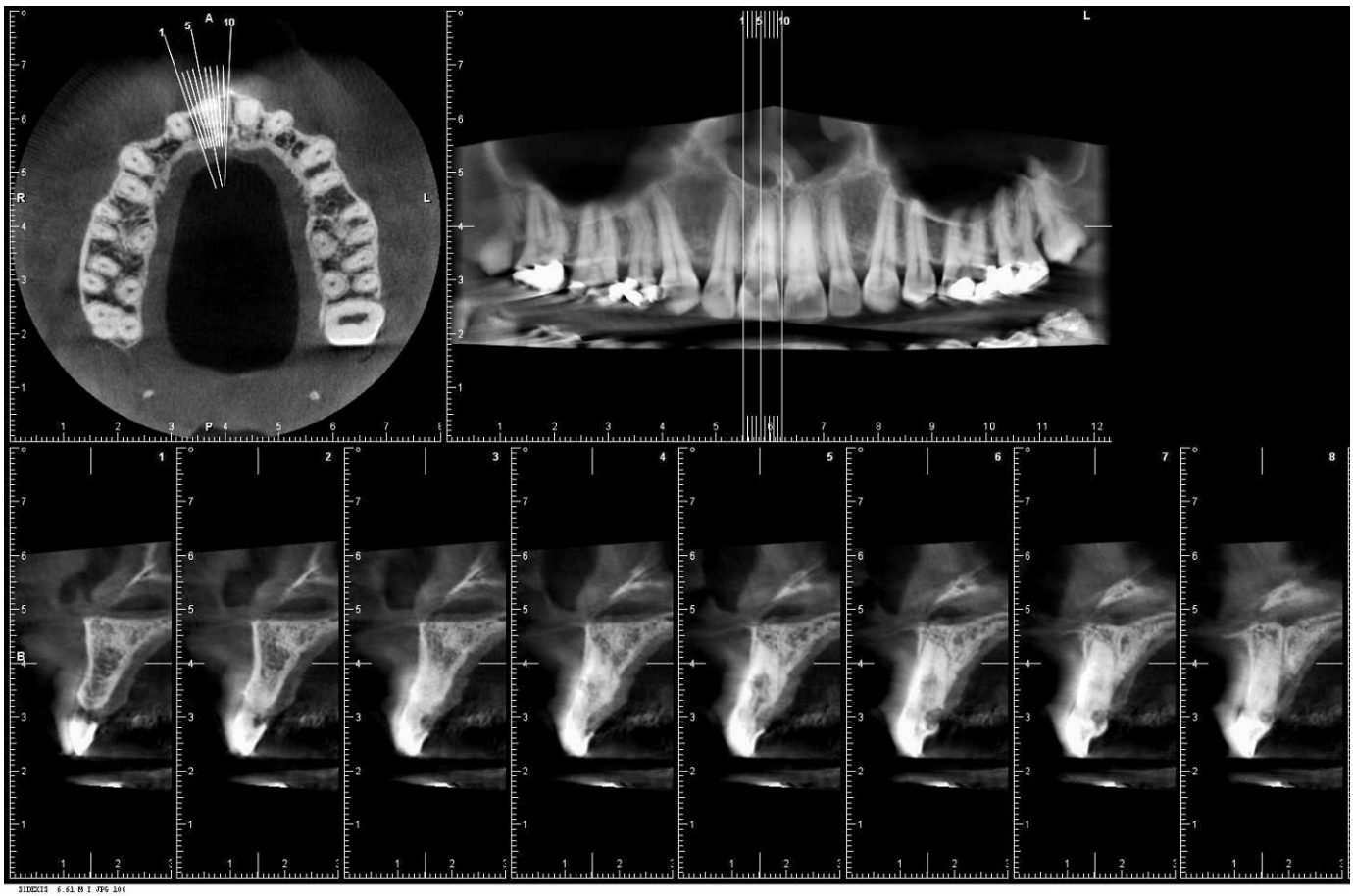

Figure 13. *Cone-beam computed tomography after 11½ years. Note the two components of the resorptive process especially in the sixth saggital section: a destructive part in the cervical-peripheral region and an underlying reparative part (bone formation) extending to the apical-central region.*

Figure 14. *Radiographic examinations immediately after surgical treatment.*

Figure 15. *Six-month follow-up.*

(orthodontics, trauma) or chemical stress (internal bleaching). Gold and Hasselgren[16] suggested that there are three environmental factors that in general may contribute to root resorption: absence of protection for the root surface, presence of vascular connective tissue, and an inflammatory stimulus. The origin of stimulation factors is different for each type of root resorption, and when these stimulating factors are identified, it may be possible to reverse the process by removing the etiological factor.[6] External resorptions associated with inflammation in the marginal tissue can present a difficult clinical situation.[10] When the infection originates from the periodontal sulcus and stimulates the resorption process, removal of the granulation tissue from the resorption lacuna and reliable sealing are necessary for repair since the elimination of micro-organisms in the periodontal sulcus is unlikely.[6] Case 1 demonstrates the outcome of sealing a resorptive defect with advanced repair materials. Although the latter showed an invasive gingival ingrowth, one week after therapy the gingiva appeared to be healed, and neither showed an inflammatory response nor recurrent aggressive ingrowth, which indicates that no further inflammatory stimulus had been present.

In previously published investigations, MTA was successfully used as a barrier between the pulp canal space and the periodontal tissue in root perforations in dogs and humans.[17-19] Hiremath and others[20] used calcium hydroxide and glass ionomer cement for the treatment of ICR and found that the tooth was without symptoms for only six months, but at the follow-up after six months, healing was incomplete. The use of MTA for treatment of ICR showed favorable healing compared with composite.[21] In this report, a case is described in which an ICR defect was sealed with dentin adhesive and composite and treatment failure was noted after six months. After retreatment with MTA, the tooth was asymptomatic at the three- and nine-month follow-up with continued pulp vitality. It can now be reported that this favorable outcome has continued for four years.

Orthodontic treatment, dental trauma, and bleaching were the most common potential predisposing factors for ICR.[22] External root resorption may occur after injury of precementum by dental trauma or ischemic necrosis of cementoblasts in the pressure zone during orthodontic treatment. Consequently, the damaged area of the root surface is colonized by hard-tissue resorbing cells. With orthodontic pressure resorption, the correct treatment is the removal of the source of the pressure.[6] In case 2, a tooth undergoing orthodontic movement was subjected to periodontal trauma, which means that the patient exhibited two of three predisposing etiologic factors for ICR. We assume that the preexisting cervical resorption lacunae (caused by the orthodontic pressure) were initiated by the traumatic event. As a result, resorption advanced although the orthodontic pressure was removed by splinting the tooth with a passive wire. Thus, the sulcular region may have been compromised with subsequent ongoing bacterial invasion that acted as an ICR stimulus.

The topical application of a 90% solution of trichloracetic acid, curettage, and restoration of resorptive lesion with glass ionomer cement has been recommended by Heithersay.[23] In the present cases, trichloracetic acid was not used because the granulomatous tissue was only a clinical symptom but not the etiological factor. Instead, MTA with its high pH was chosen as the disinfectant on one hand

and as filling material on the other hand because of its biocompatibility and its favorable potential as a pulp-capping material during vital pulp therapy.[24] It forms an apatite-like layer on its surface when it comes into contact with physiologic fluids.[25] In both cases, MTA was used to arrest cervical resorption, to prevent further resorption, and to preserve pulp vitality also in a class 3 defect, in which, according to Heithersay.[2] the pulp should be sacrificed. In case 2, the resorption was arrested although the filling did not reach the reparative portion of the resorption defect.

In previous case reports, MTA or glass ionomer cement were successfully used for treatment of ICR but not combined with other materials.[20,26-28]

CONCLUSIONS

In summary, MTA combined with glass ionomer cement and composite in a sandwich technique has not previously been reported over a long-term observation period without sacrificing pulp vitality. This report demonstrates a favorable clinical outcome for surgically accessible ICR lesions when MTA is used as a repair material in combination with a glass ionomer cement and composite resin.

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