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# The Combination of a Mineral Trioxide Aggregate and an Adhesive Restorative Approach to Treat a Crown-root Fracture Coupled with Lateral Root Perforation in a Mandibular Second Molar: A Case Report

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### Clinical Relevance

Crown-root fractures extending well below the alveolar crest, coupled with root perforations of posterior teeth, can be successfully treated with the combination of mineral trioxide aggregate and an adhesive restorative approach in a one-step restoration procedure.


## SUMMARY

**The current paper describes a modified treatment procedure for a traumatized mandibular left second molar resulting in a crown-root fracture and root perforation with the fracture line below the gingival attachment and alveolar bone crest. After the mobile crown-root fragment was extracted, the root perforation was obturated with mineral trioxide aggregate (MTA), and the subgingival defect was directly repaired with polyacid-modified resin composites (Ionosite Baseline). A 24-month recall showed no evidence of periodontal inflammation and no adverse symptoms, and the treated tooth exhibited good healing and normal function.**



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## INTRODUCTION

The outcome of traumatic events involving teeth depends on three factors: the extent of the injury, the quality and timeliness of the initial care and the fol-

low-up evaluation and care. The currently recommended classification for tooth fractures is one based on the World Health Organization's classification of disease and was modified by Andreasen and Andreasen. Tooth fractures can be divided into enamel fractures, uncomplicated crown fractures (no pulp exposure), complicated crown fractures (with pulp exposure), crown-root fractures and root fractures.[1]

In crown-root fractures, enamel, dentin and cementum are involved. In posterior teeth, the cause of crown-root fractures has been attributed to indirect trauma, including large-sized restorations. The restoration of a tooth with a crown-root fracture or a cervical root fracture is unfavorable and can be a difficult procedure when the fracture line extends below the marginal bone level. Such fractured teeth are often considered hopeless.[2] Restorative and functional needs are balanced with the demands of healthy periodontium. Placing the margin of the restoration in the biologic width frequently leads to chronic gingivitis, the loss of clinical attachment, bony pockets and gingival recessions.[3] Crown-root fractures extending well below the alveolar crest may require surgical repositioning of the tissues to expose the level of fracture. Either surgical or orthodontic extrusion can also be done to allow for better restoration of the fractured tooth.[1,4-5]

Depending on the type of trauma, follow-up visits should be planned for reexamination or completion of the treatment. The final treatment will depend on a number of factors, such as the prognosis of the traumatized teeth, the age of the patient, the condition of the remaining dentin and the financial resources and wishes of the patient. First-aid treatment should provide time to allow for development of a definitive treatment plan. In this way, the initial treatment can be evaluated and all the possible solutions can be considered and discussed with the patient.[6]

Mineral trioxide aggregate (MTA) was introduced in 1993 as a root-end filling material that can also be used for the repair of lateral perforation and has been used in endodontics to seal off all pathways of communication between the root canal system and the external surface of the tooth.[7-8] The use of MTA has expanded to many applications, including pulp-capping and pulpotomy, perforation repair and apexification treatment.[9] Both *in vitro* and *in vivo* studies have shown that MTA has anti-inflammatory effects,[10] stimulates bone and cementum formation,[11-12] potently inhibits bacterial-growth[13] and seals furcal and root perforations from bacterial and chemical invasion.[8-9] The excellent biocompatibility of MTA has been demonstrated by studies of MTA showing minimal toxicity and pulpal irritation, mild periapical inflammation, cell adherence and growth, periodontal ligament attachment and dentinal bridge formation.[9,14-15]

The purpose of the current study is to describe a modified treatment procedure for a traumatized mandibular left second molar, resulting in a crown-root fracture and root perforation with the fracture line below the gingival attachment and alveolar bone crest. The tooth was treated by using a resin-ionomer material (Ionosite Baseliner) to restore the defect subgingivally and the lateral root perforation was repaired with MTA.

## CASE REPORT

A healthy 67-year-old male was referred to the Endodontic Clinic of the School of Somatology, the Fourth Military Medical University for evaluation of a sinus tract in the area of his mandibular left posterior region. Based on the dental history that tooth 36 (FDI) and tooth 37 were treated by pulp mummification about 10 years earlier, the patient's past dental history indicated that, for tooth 37, the distolingual crown fractured 3.5 years previously and, at that time, teeth 36 and 37 were treated by conventional root canal treatment. The post spaces were prepared in the distal root of tooth 36 and in the mesial root of tooth 37, active prefabricated metal posts with a 1.38 mm diameter were put in place, the cavities were filled with amalgam and linked metal-ceramic full crowns were placed. Soon after the treatments, a sinus tract developed. The patient said that he had not had his teeth retreated because of psychological and economical reasons.

Clinical examination revealed a sinus tract and some discharge of pus that exudated in the facial region of tooth 37; the tooth was not sensitive to percussion or bite testing. The sulcus around the tooth was probed and, in the distolingual area, the maximum measurement was 5 mm. The radiograph clearly showed that tooth 37 had a root perforation in the mesial root and a loss of radiopacity around the distal surface of the mesial root and on the distal aspect of the tooth (Figure 1).

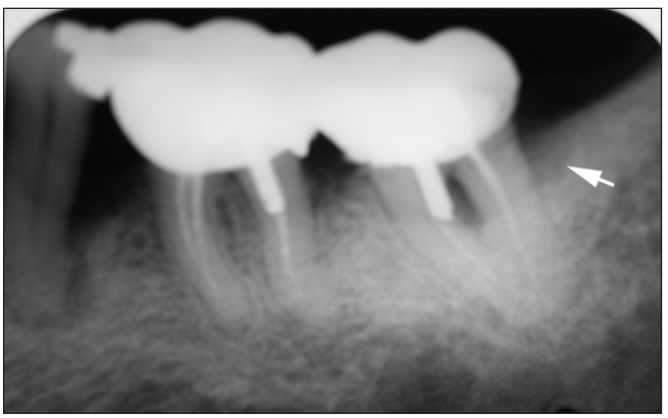

Figure 1. *Preoperative radiograph showing iatrogenic mesial root perforation caused by insertion of the prefabricated post. An area of rarefaction developed on the distal surface of the mesial root and of the tooth (arrow) 37.*

Figure 2. *Directly after the distolingual fragment was removed, the space between the alveolus and root was visible.*

Figure 4. *Photograph of tooth 37 shows the draining sinus tract after finishing the resin restoration (arrow).*

A diagnosis was made of the root perforation in the mesial root of tooth 37. At the same appointment, the crowns of teeth 36 and 37 were removed, as well as the post and an occlusal silver amalgam restoration in tooth 37. A visual examination showed a distolingual fragment that was extremely mobile in the lateral direction, a fracture extending subgingivally to the cementum and root structure and a perforation on the distal surface of the mesial root.

After local anesthetic infiltration, the mobile crown-root fragment was extracted (Figure 2). The post space in the mesial root and subgingival socket was irrigated with 3% hydrogen peroxide solution and the final irrigation was accomplished with sterile physiologic saline. A sterile cotton pellet moistened with saline solution was put in the socket with slight pressure to control gingival bleeding. Visual examination showed that the buccal surface of the extracted segment comprised both the cervical third of the mesial and distal root, as well as the distal root canal and that the fracture of the

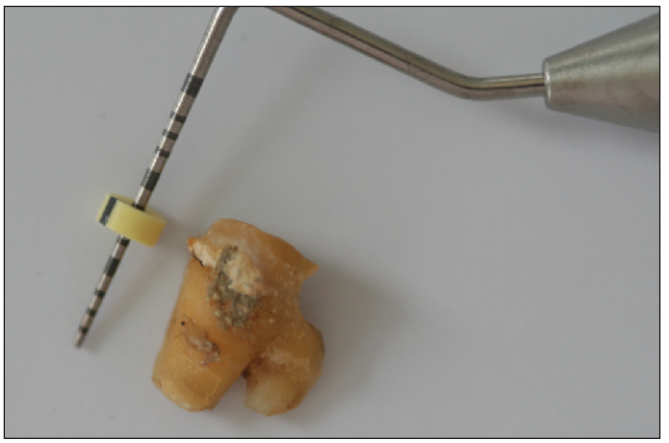

Figure 3. *The distolingual surfaces of the crown-root fractures segment involving both the mesial and distal root. Note the cement material used to place the crown.*

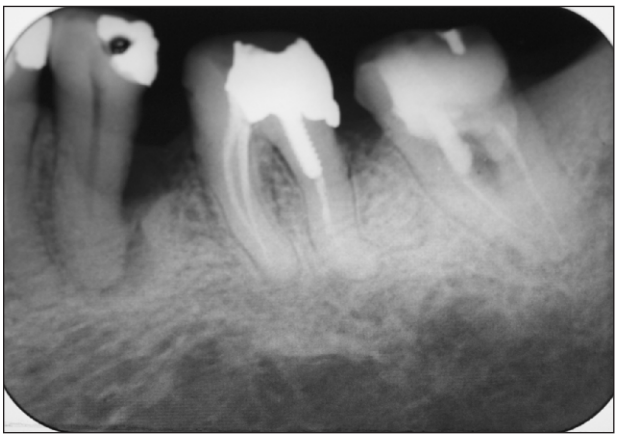

Figure 5. *Radiograph immediately following restoration with direct resin composite restoration.*

roots was oblique in pattern. The cement material used to place the crown was observed on the surface of the segment, with the longest distance from the cement-to-enamel junction to the apical level of the segment being 7 mm (Figure 3).

When hemostasis had been achieved, the wound was gently flushed with distilled water to remove the blood clots and dried with a gentle stream of air. The post channel in the mesial root was obturated with ProRootMTA (Dentsply Tulsa Dental, York, PA, USA). Light-curing polyacid-modified resin composite (Ionosit Baseliner, DMG, Hamburg, Germany) was placed with light pressure into the socket that extended beyond the cervical contours of the tooth and a composite layer of ≈ 1 mm was also placed to cover the whole pulp-chamber floor. Great care was taken in passive re-approximation and perfect adaptation of the wound margins without tension; the cavity was immediately sealed with a resin composite material (Figure 4). At the end of the treatment, a radiograph was made as a control (Figure 5). No antibiotic was given. No endodontic

Figure 6. *Lingual view at the two-year recall. The soft tissue appears healthy.*

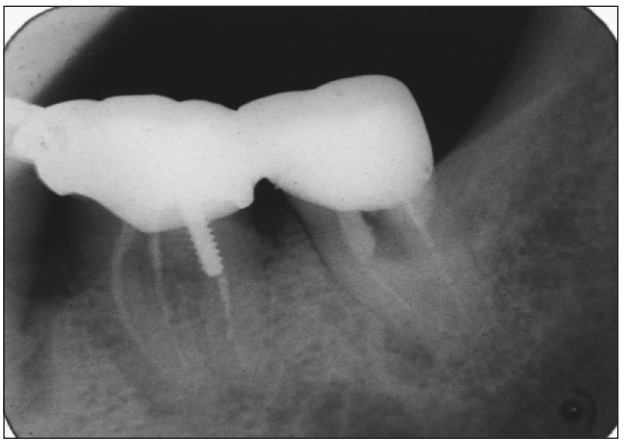

Figure 7. *Radiograph at the two-year recall revealed complete resolution of radiolucency around the distal surface of the tooth 37.*

retreatment was performed, since no periapical pathosis was evident radiographically and no missed root canal was found.

At the seven-day recall, the patient was asymptomatic and the sinus had closed. Linked metal full crowns were chosen to restore the teeth, because the majority of the coronal portion of tooth 37 was missing.

At the two-year recall, the tooth was free of clinical symptoms, functioned normally and had a healthy clinical appearance (Figure 6). Radiographic examination revealed complete resolution of radiolucency around the distal marginal surface of the tooth, no radiographic signs of periapical disease in the tooth and little change in the furca bone area on the tooth when compared with prior films (Figure 7).

## DISCUSSION

In this case report, the cause of the crown-root fracture may have been accidental biting on a hard object before completion of the crown coverage. Considering the history of the trauma in this case, most of the factors were unfavorable, particularly because the time between the trauma and the dental treatment had been significant. This case presents treatment of an oblique crown-root fracture with some modifications; the simple technique presented here seemed to be effective in treating non-restorable teeth.

Bone loss produced by chronic inflammation along vertical root fractures will often lead to the development of periodontal pockets that extend from the gingival sulcus part way or all of the way to the apex, as well as to the eventual destruction of the periodontal ligament and bone, which occurs in a linear fashion adjacent to the fracture. Because a periodontal defect will usually be present to the apical level of the fracture,[16] the aim of treatment was to place the most apical point of the fracture above or coronal to the epithelial attachment. The selection of a treatment for this kind of problem will depend on the extent of the subgingival lesion and the length and/or morphology of the lesion.[17] The treatment can be accomplished by surgical crown lengthening and/or orthodontic extrusion.[4-5]

The choice of different treatment modalities is determined primarily by information on the site and type of fracture, but cost and complexity of treatment can also be deciding factors. Reattachment of a fragment of a crown-root fractured tooth may be an option, but the immediate shortcoming is the frequent refracture of the reattached fragment or the loss of the resin composite buildup due to the steep non-retentive inclination of the fracture surface. Thus, these treatments are best described as provisional until definitive treatment can be provided.[16-17]

The objective here is to eliminate the fracture, while at the same time preserving the original root length; therefore, the entire fractured segment was removed, which allowed the tooth to keep its original position. The success of this conservative treatment is based on the fit with gingival morphology. The subgingival defect can be covered directly with an adhesive, as long as the bleeding is controlled.

A tooth with a crown-root fracture presents many problems related to coronal rehabilitation, especially when the fractured line extends below the marginal bone level. The treatment must therefore try to expose the fractured margin, so that all clinical procedures can be managed with strict moisture control and bleeding control. In the current study, this could be easily achieved soon after the distolingual segment was extracted. The fracture site should be covered as soon as possible to prevent further gingival tissue overgrowth. The placement of a direct adhesive restoration will seal the dentin and restore the original morphology of the tooth. To make sure that Ionosit Baseliner adheres tightly to dentin, the authors put the materi-

al on the entire cavity floor to provide a large area of contact between the Ionosit Baseliner and dentin.

Recently, there have been rapid developments in the field of hybrid resin-ionomer restorative materials. Ionosit Baseliner is a kind of polyacid-modified resin composite (compomers).[18] Ionosit Baseliner is an ideal cavity lining material suitable for amalgam, porcelain or composite restorations. Due to its unique chemical composition, it can be used to compensate for voids and polymerization deficiencies. It has been proven that Ionosit Baseliner reacts with dentin and this effectively prevents the formation of a marginal gap and associated bacterial penetration. Ionosit Baseliner produces a continuous, long-term release of fluoride and zinc ions, which provide protection at the junction between the tooth surface and the restoration, a particularly vulnerable area. Zinc ion release has an antimicrobial effect and can prevent the formation of secondary caries.[19] These properties may make Ionosit Baseliner a suitable subgingival restorative material. The treatment is easy to perform and definitive restoration can be completed soon after injury. After two years, complete bone healing around the distal marginal surface of the tooth was observed by radiograph and no inflammation of the surrounding gingiva was noted.

Root perforations are undesired complications of endodontic treatment that result in the loss of integrity of the root and further destruction of the adjacent periodontal tissues. MTA has been regarded as an ideal material for perforation repair.[20] An *in vivo* histological study has found that the repair of perforations was dependent on the location of the perforation and the time lapse before sealing the defect.[21] Perforation in the middle or apical third of the root is less serious than what may occur in the coronal third of the root or the floor of the pulp chamber of multi-rooted teeth.[22] When the site of the perforation is contaminated, the healing process might occur under less favorable conditions.[23-24] For example, in the current case, the iatrogenic mesial root perforation located in the coronal third of the canal on tooth 37 had formed over a period of 3.5 years and was contaminated (based on the sinus tract presented). At the two-year recall after obturation with MTA, although there appeared to be little change in the furca bone area when compared with prior film, there were no signs of the sinus tract.

## CONCLUSIONS

Because this is a case report, the findings of the current study cannot be considered conclusive. More controlled clinical studies are required to evaluate the clinical success of this one-step restoration procedure. Although this case report evaluated the effect of Ionosit Baseliner for subgingival restoration, no histological studies have been conducted to evaluate the histological response of Ionosit Baseliner with periodontal tissues. In conclusion, a two-year follow-up of a subgingivally fractured tooth restored by Ionosit Baseliner was found to be successful clinically. Root perforations with periodontal inflammation can be successfully treated with MTA. The advantages of this alternative treatment method include the rapid and conservative nature of the treatment, simplicity of the procedure, economical advantages given the one-visit treatment and the higher likelihood of cooperation from the patient.

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