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Endodontic and Surgical Management of Iatrogenic Root Injury Caused by Orthodontic Miniscrew Placement: A Case Report

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ARTICLE INFO

Article Type: Case Report

Received: 26 Dec 2018

Revised: 01 Mar 2019

Accepted: 12 Mar 2019

Doi: 10.22037/iej.v14i2.23491

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ABSTRACT

One of the potential serious complications, associated with the inter-radicular placement of an orthodontic miniscrew, is root injury. This article reports the endodontic and surgical treatments of an iatrogenic root perforation in a mandibular first molar caused by the placement of an orthodontic miniscrew anchorage. The 24-month follow-up showed a successful treatment outcome.

Keywords: Dental Root; Orthodontic Anchorage; Orthodontic Complications

Introduction

Miniscrew placement is being extensively done for orthodontic purposes. However, similar to other surgical procedures, it is not free of complications. Root damage is a significant complication of inter-radicular orthodontic miniscrew placement. Depending on the extent of root damage, complications include loss of tooth vitality, osteosclerosis and dento-alveolar ankylosis [1-4]. Generally, superficial root impingement without pulpal involvement, with complete repair of the periodontium in 12 to 18 weeks after the removal of miniscrew, may not significantly affect the tooth's prognosis [2, 5]. Nevertheless, upon pulpal involvement, the sequel may be loss of tooth vitality with even further destruction of periodontal ligaments [6].

Root perforation may be treated either through the access cavity or *via* surgical intervention. Surgical intervention is warranted if intracanal approach has failed or the repair site is inaccessible through the coronal access cavity [2, 7, 8]. There are very few reports of root damage, particularly pulpal complications following placement of orthodontic miniscrews [9].

The present report describes a case of a mandibular first molar perforated in the mesial root during miniscrew placement.

Following pulpal necrosis, a conventional endodontic treatment along with perforation repair using mineral trioxide aggregate (MTA) and subsequently surgical intervention were carried out for the patient.

Case Report

A 25-year-old woman was referred to the department of endodontics from the department of orthodontics. Her treatment plan consisted of retraction of tooth #30, using miniscrews as anchorage. After 3 days of the miniscrew placement, the patient experienced severe pain and swelling in the buccal region. The patient was prescribed antibiotics and was assured that the symptoms were normal side effects and would subside with time. With the disappearance of swelling, orthodontic treatment began. Eight months following the treatment, the swelling and pain reoccurred and she was referred to the department of endodontics.

Clinical examination revealed a localized swelling in the buccal vestibule of tooth #30. The tooth was slightly sensitive to percussion. Vitality tests, including cold and electrical pulp test, were found to be negative.

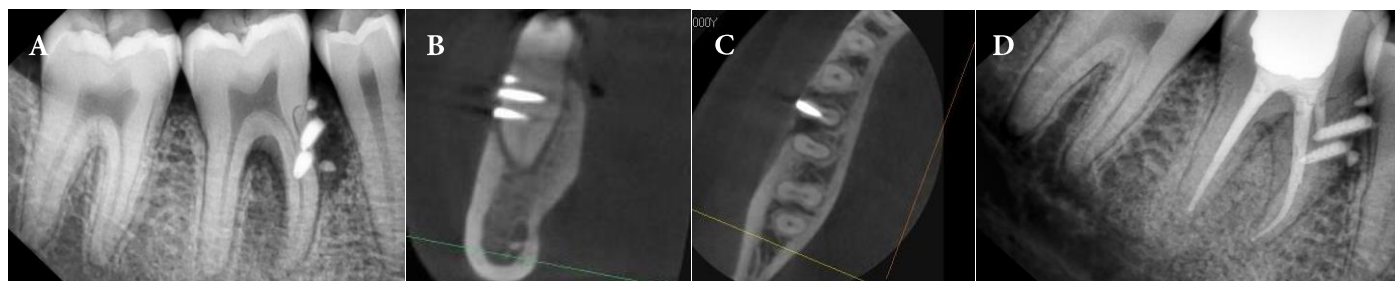


Figure 1. A to C) Periapical and CBCT views of tooth #30 with 3 miniscrews impinging the mesio-buccal canal; D) Periapical graph of tooth #30 following nonsurgical treatment

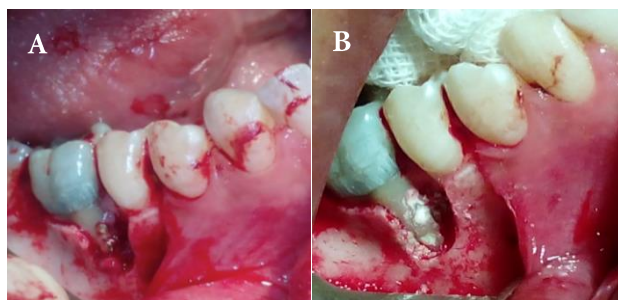


Figure 2. A) Three miniscrews perforating the mesial root were observed following flap reflection and removal of granulation tissue; B) Perforation sites were sealed with MTA

Her medical history was non-contributory. “Cone-beam Computed Tomography” (CBCT) revealed two miniscrews impinging the mesial root of tooth #30, completely blocking the mesiobuccal (MB) canal, and another one located in the bone mesial to tooth #30. A fracture line was evident in the cervical third of the mesial root, which was located below the bone crest and did not involve the canal. Radiolucency was also present adjacent to the mesial root in the cervical area, which was also observed in the initial periapical radiograph (Figure 1A to C).

Diagnosis of pulp necrosis, following root perforation by orthodontic miniscrews, was established.

Considering the large diameter and the head fracture of screws, a non-surgical endodontic treatment was opted for this patient; in order to avoid further damage to the root in the process of removal. The diagnosis and the treatment plan were discussed with the patient and a written consent was obtained.

Following the administration of 2% lidocaine with 1:80000 epinephrine (Daroupakhsh, Tehran, Iran), the tooth was isolated with rubber dam. Access cavity was made and initial scouting of the canals was attempted. The MB canal was found to be obstructed in the cervical third. Multiple attempts at bypassing the obstruction, using #8 and #10 K-files, were exhausted. Afterwards, it was decided to place MTA in the MB canal to the level of the obstruction. The remainder of the root canal system was thoroughly cleaned and shaped using ProTaper system (Densply Maillefer, Ballaigues, Switzerland). Copious irrigation

with NaOCl was made throughout the procedure. At this point, calcium hydroxide dressing was placed in the canals.

In the second session, the swelling was found to be significantly subsided and the tooth was asymptomatic. ProRoot MTA (Dental Tulsa; Dentsply, DeTrey Konstanz, Germany) was placed in the MB canal and the remainder of the root canal was obturated with cold lateral condensation technique using gutta-percha (Gapadent, Hamburg, Germany) and AH-plus sealer (Densply Maillefer, Ballaigues, Switzerland). A wet cotton pellet was placed in the pulp chamber to serve as moisture ambient for MTA solidification and the tooth was temporarily sealed using Cavit (ESPE, Seefeld, Germany). Three days later, the patient returned to the clinic, the cotton pellet was removed and the tooth was permanently restored with Amalgam (Figure 1D).

In the first recall visit, 3 months after the initial endodontic treatment, the swelling had reappeared and the tooth was found to be sensitive to percussion. Therefore, the patient was scheduled for a surgery appointment.

Following the administration of 2% lidocaine with 1:80000 epinephrine, a full mucoperiosteal flap was elevated using a vertical incision on the mesial aspect of tooth #30. A large bony lesion was observed extending from the crestal bone to the mid root. The granulation tissues were removed and 3 miniscrews were located and then removed using a hemostat (Figures 2A and 3B). A radiograph was taken and the perforation sites were restored with MTA. The bony defect was filled using demineralized cortical bone



Figure 3. Periapical views of tooth #30 following surgical removal of the miniscrews and MTA placement



Figure 4. Six, 12 and 24-month follow-up of tooth #30

powder (SureOss, Hans Biomed, Daejeon, Korea) and a resorbable membrane (SureDerm, Hans Biomed, Daejeon, Korea). The flap was repositioned and sutured (Figure 3).

Four days following the surgery, the patient was recalled, the sutures were removed and a follow-up of three months interval was scheduled for the patient.

After the follow-up of 6, 12 and 24 months, the patient was symptom-free and significant bone healing was observed (Figure 4).

Discussion

Orthodontic miniscrews have been widely used to serve as anchorage for various orthodontic treatments including intrusion, retraction and protraction. The clinical use of miniscrew anchorage includes risks and complications which can occur during insertion, orthodontic loading, peri-implant soft tissue health and removal.

A lot of factors are proposed to relate with screw failure. Screw-root proximity and the mandible are considered as two common factors. Inter-radicular placement of miniscrews requires determination of the safest site for the placement [10]. In the mandibular buccal region, the greatest amount of inter-radicular bone is either between the second premolar and the first molar, or between the first molar and the second molar, approximately 11 mm from the alveolar crest [1]. According to some studies, the recommended inter-radicular space for miniscrew placement is 3mm (a minimum of 1 mm clearance

around the miniscrew has been recommended to preserve periodontal health) [10, 11]. Although the placement of miniscrews in the inter-radicular area is considered a relatively simple and predictable procedure [12], root damage may ensue if appropriate pre-placement assessments, namely radiographic evaluations, are not taken into account.

Radiographic planning along with surgical guide and panoramic and periapical radiographs are invaluable means for the detection of the safest location for miniscrew placement [13, 14]. Depending on the structures involved, root damage may have various outcomes. If screw is only in contact with PDL, the injury is most likely healed without side effects [15]. When cementum is damaged and dentine is exposed, resorption takes place but complete repair ensues within 2 to 3 weeks [16]. Ankylosis is the probable result of screw-root contact of more than 4 mm or 20% of the root surface [16]. While according to some studies, damage to the outer dental root without pulpal impingement can be completely repaired in 12-18 weeks [2, 5], root injury, involving the pulp, leads to loss of tooth vitality and even further periodontal breakdown [6].

In this case, CBCT showed complete blockage of the MB canal as a result of two large and fractured head screws. Considering the number, diameter and head fracture of the miniscrews, further damage to the root during miniscrew removal was a major concern. Finding the mesiolingual (ML) canal patent in a Vertucci type II system, it was finally decided to seal the mesial root apex via the ML canal in a conventional root canal treatment.

Afterwards, we decided to place MTA in the coronal segment of the blocked MB canal with a view to carry out surgical intervention. After 3 months, however, since no resolution of the symptoms was observed, a surgical approach was employed. After removing the fractured screws, MTA was used as a sealing material. MTA has been reported to be the material of choice for achieving a seal in perforation sites [17]. Therefore, it was used to seal the coronal segment of the MB canal.

More attention should be paid to determine the correct site for the insertion of miniscrews to avoid root injury. In this case, pretreatment panoramic image was used to evaluate possible sites for miniscrew placement. It is impossible to accurately predict the corresponding sites using a two dimensional image. CBCT is an invaluable tool to quantify the periradicular space and provide practical guidelines for miniscrew insertion.

Conclusion

Although the patient was managed successfully without further complications, "Root Perforation" is a potential cause for legal problems. Every effort should be made to avoid root damage during the insertion of miniscrews *via* preoperative radiographs and surgical guide.

Acknowledgement

We thank our patient for her participation and cooperation.

Conflict of Interest: 'None declared'.

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Please cite this paper as: Ali Saber *Ea*, Farhad-Mollashahi N, Havaei SR. Endodontic and Surgical Management of Iatrogenic Root Injury Caused by Orthodontic Miniscrew Placement: A Case Report. *Iran Endod J.* 2019;14(2): 156-9. *Doi:* 10.22037/iej.v14i2.23491.

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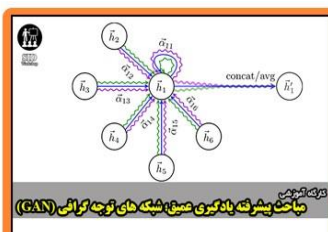


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