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Mini-Implants: When Orthodontists are Caught in their Own Web

Robert Willer Farinazzo Vitral[1], Rodrigo César Santiago[2], Gustavo Saggioro Oliveira[3], Marcelo Reis Fraga[4] and Marcio José da Silva Campos[4]*

[1]*Associate Professor and Chair, Department of Orthodontics, Juiz de Fora Federal University, Brasil*
[2]*Postgraduate student, Department of Orthodontics, Rio de Janeiro Federal University, Brasil*
[3]*Postgraduate student, Department of Medicine, Juiz de Fora Federal University, Brasil*
[4]*Professor, Department of Orthodontics, Juiz de Fora Federal University, Brasil*

Abstract

Introduction: Mini-implants are being extensively used in orthodontics, providing a new field of possibilities for treatment of the cases when a maximum anchorage is required. The procedure is critical during the insertion of mini-implants in the alveolar process between the roots of the tooth, and major complications can include contact and damage to adjacent tooth roots.

Objective: The following case report describes a failure because of unintentional root damage after orthodontic mini-implant placement, resulting in longitudinal root fracture followed by extraction of the damaged mandibular second molar.

Discussion: Factors which might have contributed to the irreversible iatrogenic injury associated with the use of mini-implants in a diabetic patient submitted to orthodontic treatment are discussed and analyzed.

Conclusion: Although mini-implant placement has become a routine procedure in the orthodontic practice, it still represents an intrinsic risk to the process of insertion, which is the damage to adjacent structures. The placement of mini-implants must be carefully monitored, even in those cases which present low risk for iatrogenic injury. However much confident the professional may be, self-confidence in excess often leads to failure, provoking irreversible damages.

Introduction

Anchorage refers to the resistance against displacement by anatomical structures and the control of anchorage is one of the main factors for determining the success of orthodontic treatment [1]. Mini-implants are a temporary anchorage device used as anchorage reinforcement or as the only source of anchorage, preventing unexpected side effects that delay treatment and avoiding the use of complex appliances [2]. Now a days, they are being extensively used in orthodontics, providing a new field of possibilities for treatment of the cases when a maximum anchorage is required, without the need of patient cooperation [2].

The use of mini-implants is growing in popularity because of the small size of the screws, ease of placement, low cost and versatility of the utilization in various types of tooth movement [3]. The interradicular region is the most used site for the insertion of mini-implants. Nevertheless, the procedure is critical during the insertion of mini-implants in the alveolar process between the roots of the tooth, and major complications can include contact and damage to adjacent tooth roots [4-7]. Fabbroni et al. [8] reported that the incidence of screw/tooth contact in the placement of transalveolar mini-implants was 63/232 (27.1%), and this is mainly by the lack of precision during the insertion of the mini-implant [9].

Trauma to the external surface of dental root without pulpar involvement will most likely not influence the tooth's prognosis [10], however, more severe traumas may result in loss of tooth vitality, osteoclerosis, and dentoalveolar ankylosis [9,11,12]. The risks involved with mini-implant placement must be clearly understood by both the clinicians and the patients.

The following case report describes a failure because of unintentional root damage after orthodontic mini-implant placement, resulting in longitudinal root fracture followed by extraction of the damaged mandibular second molar.

Case Report

A 17-year-old male patient with type 1 diabetes (insulin-dependent diabetes) under orthodontic treatment, transferred for personal reasons, presented with the following characteristics: Class III malocclusion, anterior edge-to-edge relationship, and ANB angle of 0 degree. In order to continue his treatment, a 3 mm distalization of all the mandibular molars with subsequent retraction of the anterior segment with skeletal anchorage was planned (Figure 1).

The patient was referred to the maxillofacial surgeon for extraction of both the mandibular third molars, which were impacted and could jeopardize the distalization process (Figure 2). During the extraction procedure, one mini-implant was placed between the first molar and second premolar on each side of the mandible. Mini-implants rather than mini-plates were used because of the systemic condition of the patient, which required a less invasive procedure.

Figure 1: Initial intra-oral view.

***Corresponding author:** Marcio José da Silva Campos, Department of Orthodontics, Juiz de Fora Federal University, R Aristóteles Braga, 85/304, Juiz de Fora-MG, 36.037-010, Brasil, Tel: 55 32 2102-3879; E- mail: drmarciocampos@hotmail.com

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After distalization of the first and second mandibular molars (Figure 3), the patient returned to the maxillofacial surgeon for the repositioning of the mini-implants, which were to be placed in a more posterior location for the retraction of the anterior segment. According to the surgeon, the safest site for the mini-implant placement was the interradicular space between the first and second mandibular molar.

On the left side, during the screwing of the mini-implant, there was perforation and longitudinal fracture of the mesial root of the second mandibular molar (Figure 4). The initial conduct was to remove the molar band and keep the tooth under observation. However, with the appearance of a fistula 2 weeks after perforation, it was decided to extract the damaged tooth (Figure 5).

Figure 6 shows the extracted tooth with the mini-implant in the site of perforation. Figure 7 shows the longitudinal fracture of the tooth root.

Discussion

The main concern with this particular case, which required distalization of the mandibular molars with mini-implants, was the fact that the patient had type 1 diabetes, an autoimmune disease characterized by the destruction of insulin producing beta cells. Several studies have indicated that circulating monocytes from diabetic patients exhibit an exaggerated inflammatory response to Gram-negative bacterial lipoplysaccharides releasing large amounts of inflammatory mediators and proinflammatory cytokines [13,14]. The effects of diabetes on polymorphonuclear cells appear to be similar to those observed for peripheral blood monocytes relative to a hyper inflammatory response and potential predisposition to tissue breakdown. Diabetes induced changes in immune cell function produce an inflammatory immune cell phenotype that predisposes to chronic inflammation, progressive tissue breakdown, and diminished tissue repair capacity [15]. The main reason for using mini-implants rather than mini-plates was the concern with possible inflammatory reactions. As the patient's mother was a physician, all decisions were taken together with her. What was not expected was that the precautions taken would initiate the events that led to a non-programmed extraction of the second mandibular molar and the need for implant placement.

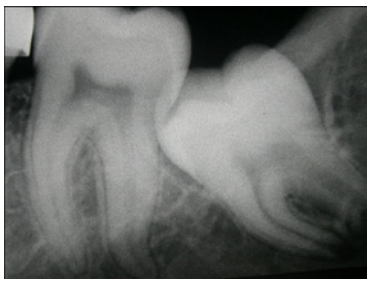

Figure 2: Periapical radiograph of the left third mandibular molar.

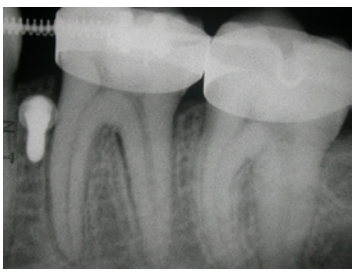

Figure 3: Post distalization periapical radiograph of the left first and second mandibular molars.

a) b)

Figure 4: Radiograph of the mini-implant inserted in the mesial root of the left second mandibular molar.

Figure 5: Post extraction intra-oral photograph.

Figure 6: Extracted second molar with mini-implant in the position of the perforation.

Potential complications of root injury owing to mini-implant placement mentioned in the literature include loss of tooth vitality, osteoclerosis and dentoalveolar ankylosis [2,9,11]. Superficial dental roots damaged by mini-implants have minimal clinical significance, even where screw/root contact is radiographically evident [8], and demonstrated complete repair of tooth and periodontum in 12 to 18 weeks after removal of the mini-implant [6,9]. In this case, when the patient returned for his orthodontic consultation both he and the orthodontist were informed by the oral surgeon of the fractured tooth root, and decided for the removal of the molar band and of any orthodontic force applied on the tooth. Nevertheless, the appearance of a fistula on the buccal surface of the fractured root tooth revealed a greater severity of the damage, and, at this point, extraction of the tooth was required.

The interradicular space between the second and first molar is the safer site available in the posterior part of the mandible for mini-implant positioning. It is important to combine the interradicular

Figure 7: Longitudinal fracture of the mesial root of the left second mandibular molar (lingual view).

space measurements with the mini-implants diameters and the bone clearance needed for both periodontal health and mini-implant stability. In such cases, a short, thin mini-implant with low insertion torque is recommended to avoid root contact and to reduce damage [16]. In the presented case, the selected interradicular site had 2.8 mm of space available. A self-drilling mini-implant (diameter, 1.2 mm; length, 12 mm) was used, resulting in 0.80 mm of space of alveolar bone around the screw. The relationship between the mini-implant/interradicular space might have been one of the factors that contributed to the root fracture in that a minimum clearance of 1 mm of alveolar bone around the screw is required for periodontal health [17,18]. Thus, bone clearance of 3 mm is insufficient for the insertion of mini-implants whose diameter is greater than 1.0 mm.

In general, in the interradicular regions of the posterior teeth, bone clearance for mini-implant placement increases in the cervico-apical direction, what minimizes the risk of damage to adjacent tooth roots during the insertion of mini-implants next to the apical area [4,5]. However, the more apical the region, the lesser the possibility of finding attached gingiva. It is recommended to position mini-implants in keratinized gingiva rather than non-keratinized mucosa to reduce the development of hypertrophic tissues and inflammation [10,19].

Surgical guide techniques may be used to enhance precision during mini-implants placement. More recently, Morea et al. [20] did not observe contact between the implant and the tooth root during mini-implant insertion using a stereo lithographic surgical guide based on CBCT data. Clinicians generally place mini-implants without surgical guides in patients with sufficient interradicular space and no visible complex anatomic structures [21]. In the presented case, although there were no visible complex anatomic structures, interradicular space was insufficient. Thus, exact knowledge of the anatomy of the insertion area was crucial for avoiding unintentional perforation.

Another factor that might be related to injury during mini-implant insertion is the side of placement in that mini-implants placed on the left side by right-handed dentists showed a significant variation in their ideal inclination and greater prevalence of clinical complications, suggesting that right-handed clinicians should be more careful in the placement of mini-implants on the left side [21]. In our case, that was the clinical situation, where the surgeon was right-handed and the mini-implant placed on the left side of the patient.

In the clinical environment, a patient under minimum infiltration anesthesia for the gingiva can still feel discomfort when a mini implant contacts a root surface, and the clinician can easily change the placement direction to minimize or avoid root contact [21]. By being questioned about the experience of pain during mini-implant placement, the patient reported a sensation of pain that increased considerably in the last two turns of the screw. In comparison with the other three previously placed mini-implants, these last ones showed an insignificant level of pain when compared to the last mini-implant. What motivated the continuation of the placement of the mini-implant in the presence of such level of pain is still unknown.

Conclusion

Although mini-implant placement has become a routine procedure in the orthodontic practice, it still represents an intrinsic risk to the process of insertion, which is the damage to adjacent structures. The placement of mini-implants must be carefully monitored, even in those cases which present low risk for iatrogenic injury. However much confident the professional may be, self-confidence in excess often leads to failure, provoking irreversible damages.

This case illustrates and discusses the factors that might have contributed to an irreversible iatrogenic injury associated with the use of mini-implants in a diabetic patient under orthodontic treatment.

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