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Extrusion of severely impacted mandibular first molar using partial orthodontics and temporary anchorage miniscrews

ABSTRACT

Background *This study reports a case in which a severely impacted lower first molar was recovered with a combined orthodontic therapy and minimally invasive oral surgery with special focus to patient's aesthetic demands.*

Case report *A 12-year-old female patient was complaining delayed eruption of mandibular right first molar. Radiographic exam showed a severe tooth impaction with a close relationship between tooth roots and mandibular nerve. As the patient refused full arches orthodontic treatment, a partial orthodontic approach was projected. During treatment, temporary miniscrews were placed in both upper and lower arches, in order to allow dental movement with maximum anchorage. After a 24 month-therapy the tooth was extruded, so the appliance and the miniscrews were removed.*

Conclusion *The present case shows that severe tooth impaction can be resolved with a combined partial orthodontic- minimally invasive surgical treatment.*

Keywords *Biomechanics; Extrusion; Impacted teeth; Mandibular nerve; Miniscrews; Oral surgery; Orthodontics.*

Introduction

Dental impaction is the cessation of eruption of a tooth [Fujita et al., 2011; Ferrazzano et al., 2014; Kim et al., 2015]. It is a common clinical occurrence that can affect any tooth in the dental arch. The teeth most often impacted, in order of frequency, are the maxillary and mandibular third molars, maxillary canines and mandibular second molars [Tanaka et al., 2008]. The aetiology of an impaction can involve systemic, local, and periodontal factors, leading to a physical barrier in the eruption path or to an abnormal tooth germ position [Raghoebar et al., 1991].

Impacted third molars can be extracted, whereas orthodontic treatment is needed for other impacted teeth in order to bring them in occlusion [Ma et al., 2014]. Orthodontics allows dental movement by application of brackets onto all permanent teeth (full-arches treatment) or onto a limited number of teeth (partial or sectional treatment) [Takaki et al., 2010].

Stable anchorage is a pre-requisite for orthodontic movement with fixed appliances. Dental implants, mini-plates and mini-screws are excellent orthodontic skeletal anchorage devices for several orthodontic tooth movements including forced eruption [Lee et al., 2014]. The report of impaction of a mandibular first molar is an extremely rare condition [Resch, 2003; Babacan et al., 2006; Fu et al., 2012; Wilson et al., 2013]. Moreover, in literature only few authors reported clinical treatment of these teeth with orthodontic miniscrews and full-arches orthodontic treatment [Kim et al., 2015]. In fact, full arch treatment often does not meet patient's aesthetic demands, and a partial orthodontic approach in these cases would be preferred.

To our knowledge no reports have been published on orthodontic limited (sectional) treatment.

Therefore the purpose of the present case report is to describe a surgical and partial orthodontic approach in a patient with a rare case of lower first molar impaction.

Case Report

Diagnosis and aetiology.

A 12-year-old female patient was referred to a private orthodontic practice, because of delayed eruption of the mandibular right first molar. She was diagnosed with a bilateral Class I canine relationship and left molar Class I in permanent dentition (Fig. 1). Moreover agenesis of lower left second molar and impaction of lower left first molar were reported resulting in vertical collapse of the upper right first molar.

In order to assess the relationship between lower right first molar roots and mandibular nerve, a 3D radiographic examination (Simplant, Materialise, Leuven, Belgium) was performed (Fig. 2). A close

FIG. 1 Initial intraoral photographs.

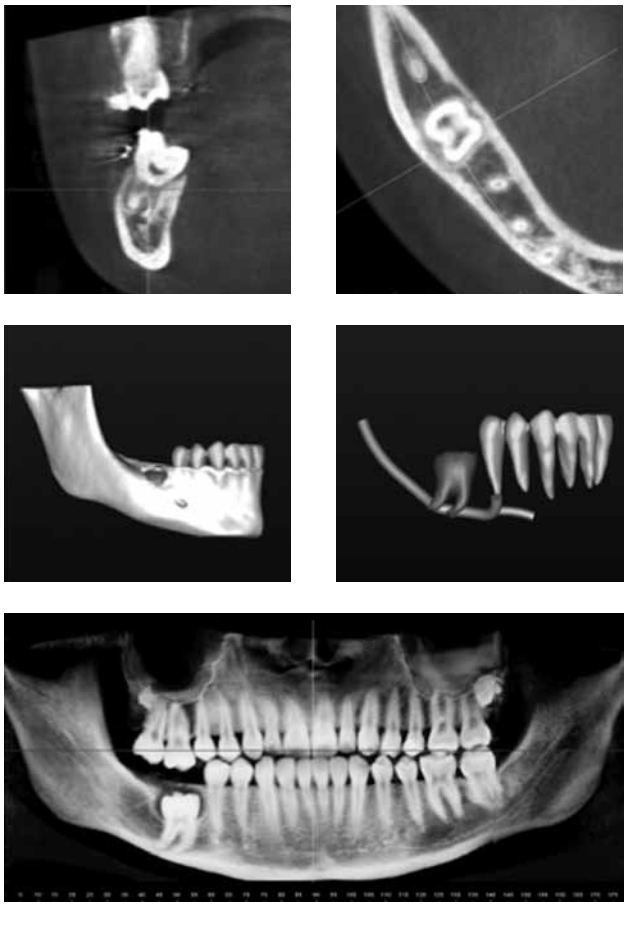

FIG. 2 3D imaging analysis.

relationship was reported and the roots appeared to be leaned to the mandibular nerve. No previous orthopaedic or orthodontic treatments have been reported.

Treatment objectives

As the patient refused full arches orthodontic treatment, a sectional orthodontic approach was planned. The treatment objectives included: selective intrusion of the upper right first molar and orthodontic guided eruption of the lower right first molar.

In the upper arch, orthodontic treatment mechanics included placement of brackets to the upper right first and second molars and upper right first and second premolars. In the lower arch treatment consisted in the placement of brackets to the lower right first and second premolars and lower right canine. In addition, surgical exposure for orthodontic traction of the lower right first molar was planned.

In order to control the vertical position of the upper right overerupted first molar, the placement of two miniscrews was planned in the upper arch. Also, to manage anchorage while extruding the lower right first molar a miniscrew was planned also in the lower arch.

Treatment alternatives

A possible treatment alternative for impacted mandibular molar entails orthodontic alignment and surgical repositioning. As surgical repositioning could be complicated by loss of tooth vitality, ankylosis and resorption, autotransplantation of first molar was not deemed to be a good alternative.

Another possible alternative to orthodontic treatment involves the extraction of the lower right first molar and the placement of an osteointegrated dental implant. Lowered vertical space due to overeruption of the upper right first molar could however have represented an important limitation.

FIG. 3 Initial orthodontic mechanics.

FIG. 4 Final orthodontic mechanics.

Treatment progress

Patient and parents informed consent was achieved and treatment started. As the patient wanted to avoid full arch orthodontic treatment for a particular aesthetic demand, a sectional approach was taken (Fig. 3 and 4). The upper right first and second premolars and upper right first and second molars were initially bonded (Magnum Brackets, ODP, G&H Orthodontics, Franklin, IN, USA). An anchorage palatal miniscrew (VectorTAS, 12 mm length, 1.4 mm diameter, Ormco, Orange, CA, USA) was placed between first and second upper right premolars.

An active 0.016x0.022 nickel titanium archwire (3M Unitek, Monrovia, CA, USA) was placed to intrude the upper right first molar in the vestibular side. Moreover a palatal eyelet was bonded onto the upper right first molar. A 0.017x0.025 TMA (Ormco, Orange, CA, USA) sectional was prepared following the palatal surface of the upper right first and second premolars and then engaging the miniscrew head. The TMA sectional was fixed with flow composite to the upper right first and second premolars and to the miniscrew. The terminal part of the wire was activated by means of an elastomeric ligature in order to intrude the tooth also in the palatal side. In the lower arch, the right canine and first premolar were bonded. An vestibular miniscrew (VectorTAS, 12 mm length, 1.4 mm diameter, Ormco, Orange, CA, USA) was placed between the first and second lower right premolars for anchorage.

Surgical exposure of the lower right first molar was performed, and a bracket was bonded onto the vestibular portion of the tooth crown. A 0.017x0.075 TMA sectional was prepared following the vestibular alignment of the lower right canine and first premolar and then engaging the miniscrew head. Sectional wire has been engaged in bracket slots with elastomeric ligatures and then enrolled around miniscrew head. The terminal part of the wire was activated and fixed with metallic ligature to the bracket of the lower right first molar in order to extrude the tooth. The distal part

FIG. 5 Final intraoral photographs.

of the sectional wire (section 0.017x0.025 TMA) was fully covered with flow composite to avoid discomfort to soft tissues.

After initial vertical movement of the lower right first molar and clinical exposure of the bracket an active NiTi coil spring (Open Coil Spring, Leone, Sesto Fiorentino, Italy) was activated to distalise and extrude the tooth.

During the final stages of therapy four orthodontic brackets were bonded to the lower incisors to align them. Finally, after extrusion and alignment of the impacted molar, the miniscrews were removed, occlusion was restored with upper and lower sectional NiTi wires (0.017x0.025, 3M Unitek, Monrovia, CA, USA) and subsequently sectional stainless steel wires (0.019x0.025, 3M Unitek, Monrovia, CA, USA).

Treatment results

After 24 months of treatment the brackets were removed (Fig. 5), the final radiographs were taken (Fig. 6), the enamel was polished and a fixed retainer was bonded to the lower incisors. Moreover upper removable retention (Essix) was prepared in order to avoid upper right second molar extrusion.

FIG. 6 Final radiographic analysis.

Clinical significance

The management of impacted first molars is an orthodontic challenge. Although many orthodontic treatment mechanics encompassing different levels of complexity have been described in the literature, in patients with aesthetic demands who do not accept full-arches treatment, a partial orthodontic approach in combination with temporary anchorage miniscrews represent a viable alternative.

Discussion and conclusion

In the present report the impacted lower right first molar has been guided in occlusion using partial orthodontic treatment in combination with orthodontic miniscrews. In fact, as described, the patient did not show sufficient compliance to front full arch treatment and accepted only a partial orthodontic approach. It is often difficult to have full compliance from orthodontic patients. In fact in the recent years noncompliance therapies have become more popular in the correction of orthodontic discrepancies [Prasad and Sreevalli, 2012]. A limited orthodontic therapy, as that described in the present report, is particularly stressing for the anchorage unit.

Anchorage has always been one of the most difficult aspects of orthodontic treatment. Traditional methods of anchorage preparation often rely on patients' cooperation and thus may be unpredictable. To ensure achievement of ideal treatment goals, miniscrews as temporary anchorage devices are gaining importance with their advantages over the traditional treatment modalities [Yi Lin et al., 2015]. Miniscrews are convenient, save time, and do not require patient

cooperation [Lee et al., 2014; Grauer et al., 2014]. These devices are temporarily fixed to the bone for the purpose of enhancing orthodontic anchorage and are subsequently removed after use. Mechanical stability is obtained without the intention of osseointegration [Yi Lin et al., 2015]. Success rate is reported to be over 90% [Takaki et al., 2010].

The orthodontic literature reports various clinical applications of miniscrews as temporary anchorage devices: dental extrusion [Horliana et al., 2015] intrusion [Agarwal et al., 2014], space closure [Mesko et al., 2013] and uprighting [Ruellas et al., 2013]. In the present case miniscrews were placed in both the upper and lower arches, and were removed at the end of their use, thus leading to clinical success. Miniscrew location-related factors proved to have no significant effect on success but careful site selection is imperative in order to avoid proximity with vital structures and to enhance orthodontic mechanics [Yi Lin et al., 2015]. Moreover in our case miniscrews have been loaded immediately after positioning. In fact it has been demonstrated that immediate loading of miniscrews does not impair their stability. On the contrary, loaded screws showed better stability than unloaded screws [Topcuoglu et al., 2013]. The use of orthodontic miniscrews is quite safe, even if some cases of damages to dental roots have been reported [Lim et al., 2013].

In the present report, after achieving a correct occlusal relationship, miniscrews and brackets were removed and a removable retention appliance was delivered to the patient. In fact stabilisation is crucial for the maintenance of post-orthodontic occlusion and for final patient satisfaction.

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

Authors' Contribution

All authors have made substantive contribution to this study and/or paper and all have reviewed the final paper prior to its submission.

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Consent

Written informed consent was obtained from the patient treated for publication of case reports and any accompanying images.

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