Orthodontic : surgical management in a Class II case with idiopathic root resorption

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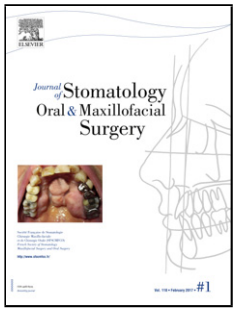

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Title: Orthodontic – Surgical management in a class II case with idiopathic root resorption

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Abstract

Patients with root resorption and malocclusion can benefit from orthodontic treatment with or without surgery. However, orthodontics has a risk of inducing or aggravating root resorption, therefore the duration of the treatment is of utmost importance.

In this paper, a surgery-first protocol with lower jaw advancement and precise interdental alveolar osteotomies was conducted to accelerate the treatment of a 14-year-old female patient who presented with a Class II division 2 malocclusion, anterior dental crowding and idiopathic root resorption. One week after the surgery, the patient received post-operative orthodontic treatment for 6 months with weekly activation the first month. The clinical outcome was satisfactory with complete clinical resolution and no tooth loss. This surgery approach allowed an 'en bloc' tooth movement and induced an increased bone remodelling, which resulted in an accelerated tooth movement. The reduction of treatment time was beneficial and no aggravation of the root resorption was seen.

Keywords: orthognathic, surgery-first, corticotomy, root resorption

Introduction

Patients with malocclusion are frequently treated with orthodontics or a combination of orthodontics and orthognathic surgery. However, when a patient with malocclusion has also root resorption, which can appear isolated or on multiple teeth, certain precautions must be taken.

Root resorption is the progressive loss of dentine and cementum due to the continued action of dentinoclasts and cementoclasts. This is a normal physiological process in the primary/mixed dentition, leading to the exfoliation of deciduous teeth. However, in adult dentition, this phenomenon is largely pathological [1]. Usually, damage to the root tissue is repaired through a process involving osteoblastic and osteoclastic activities. But when too much damage occurs, an overreaction of the osteoclastic process can result in root resorption [1].

Root resorption can occur externally or internally. In the first case, the lesion occurs on the external surface of the root; in the latter, the lesion occurs within the root on the dentine of the root canal and/or pulp chamber [1]. Recognized causes of resorption include orthodontic therapy, periodontal disease, trauma, infection, endodontic treatment, localized pressure, high temperature, cosmetic dentistry and some rare systematic diseases such as hyperparathyroidism or Paget's disease. When no evident etiological factor is present, root resorption can be characterized as idiopathic [1-3].

In the literature, the positive relationship between orthodontic force levels and root resorption is described [4]. Only a few reports have described orthodontic and orthognathic management of patients with root resorption [3,5], however, there are no guidelines concerning the management of these patients. A case report by Rey et al illustrates a good orthodontic treatment of a patient with multiple idiopathic root resorption. They emphasized the use of low forces [3], which can imply a prolonged treatment, also a risk factor for root resorption [6,7]. Longer orthodontic therapy leads to a higher risk of aggravating the resorption [7]. Different surgical and non-surgical methods have been described for accelerating treatment [8,9]. Non-invasive methods range from the application of biological molecules to

new technologies, such as magnetic field forces, low-intensity laser therapy or resonance vibration. The aim of these methods is to act on the alveolar bone turn-over and accelerate the orthodontic tooth movements. More invasive methods are older and well described, such as alveolar osteotomy, alveolar corticotomy, distraction osteogenesis, fiberotomy and orthognathic 'surgery-first' management. The alveolar corticotomy-assisted tooth movement induces a local increase of bone metabolism, generating transient osteopenia and allowing an accelerated tooth movement [9-12]. The same bone action is present with alveolar osteotomy-assisted tooth movement which also allows an 'en bloc' movement of the tooth and the alveolar bone itself [9-12].

Reduction of the total treatment time has the advantage of decreasing unwanted, time-dependent side effects such as caries, root resorption, open gingival embrasure spaces, etc. Post treatment stability has also been demonstrated to improve [9]. In regard to orthognathic surgery, a surgery-first approach, when clinically possible, is advantageous in terms of treatment duration, with immediate aesthetic improvement. In addition, bone surgery induces bone remodelling which could be an advantage for orthodontic tooth movements [11,13].

In this article, a case of idiopathic root resorption is described where a combined orthodontic – orthognathic treatment plan was chosen using a surgery-first approach with lower jaw advancement and precise interdental alveolar osteotomies. The patient's follow-up time was 9 months, and the progress was evaluated using low-dose Cone-Beam Computed Tomography (CBCT) imaging.

Case description

A 14-year-old female patient with anterior dental crowding presented herself at the orthodontic consultation for treatment. She had a convex profile and mandibular retrognathia. The intraoral examination revealed a Class II division 2 malocclusion with an overjet of 2 mm, an overbite of 4 mm, superior anterior crowding with a labial position and inclination of the left central upper incisor. Furthermore, a 3 mm deviation of the inferior midline was observed (Figure 1). Radiographic examination (iCAT, Imaging Sciences International, LLC, Hatfield, USA) confirmed a Class 2 skeletal

pattern with mandibular retrognathia, however, it revealed also an unfavourable crown-root proportion, which was most severe on the incisors and premolars. There was no root crowding and the root of the left lateral upper incisor was almost entirely resorbed.

The patient was in otherwise good health and had good oral hygiene. The tooth mobility was physiological except for the left lateral incisor which had grade II mobility. Periodontal examination was normal as well as the anatomy and colours of the crowns. The patient did not have pain and the teeth were negative to percussion. There was no history of previous orthodontic treatment nevertheless a classic history of trauma in childhood was found; at 5 years old, the patient fell on her anterior lacteal teeth.

Objectives and treatment

The treatment objective was to achieve a Class I occlusion, a harmonic smile, closure of the overjet, midline correction and maintenance of the crown-root proportion. The patient was informed about the limitations, risks and objectives of the treatment and consented to the treatment plan. An informed consent was signed.

The treatment plan was orthodontic treatment with orthognathic surgery using a surgery-first approach and, at the same time, alveolar osteotomy of the anterior teeth from the upper and lower jaws and the second left inferior premolar. Orthodontic treatment started 1 week after surgery. The orthodontic brackets (Standard (Twin) edgewise brackets 018".022" (GC orthodontics)) were placed 2 days before the surgery, on the buccal side of the upper and lower teeth, combined with a palatal bar as anchorage, with the application of a 0.12 wire Smartclip™ Nitinol Classic. The central upper left incisor was excluded from the wire.

Under general anaesthesia, a bilateral sagittal split osteotomy (BSSO) was performed to advance the lower jaw. Alveolar osteotomies around the upper and lower incisors and the left upper second premolar were performed via a local mucoperiosteal flap using a piezoelectrical device (Piezotome M+ Solo, Acteon), cutting through the buccal cortical, trabecular and palatal/lingual cortical bone (Figure

2). Positioning of the lower jaw was predicted by the surgeon and the orthodontist based on cephalometric, clinical and dental cast studies.

Orthodontic therapy (edgewise-standard technique) started 1 week after surgery, including the upper central incisor, and lasted 6 months. Weekly activation controls were performed for the first four weeks and monthly thereafter. Retention was completed using mandibular and maxillary fixed bonded retainers from canine to canine and a clear overlay retainer at night.

Results

After surgery and 6 months of orthodontic treatment, a Class I occlusion was achieved with corrected overjet and overbite (Figure 3). A harmonic profile and smile were obtained. Radiographic evaluation 6 weeks and 9 months after the start of treatment did not reveal any progression of root resorption (Figure 4). Pre- and post-treatment cephalometric evaluation was obtained which resulted in an improvement of ANB from 5.76 to 2.68 degrees. A comparison of the CBCT images was performed using the fusion module in OnDemand3D®, an image analysis software package (version1.0 (Build 1.0.10.5385), Cybermed, Inc., Korea) (Figure 4). With this module the post-operative CBCT scan is registered to the pre-operative image dataset and changes are highlighted. Post-treatment dental clinical examination was comparable to pre-treatment evaluation. The patient was satisfied with the result and had no complaints.

Discussion

Orthodontic therapy is controversial in root resorption cases for fear of aggravating the situation and losing teeth. In this article, the combined orthodontic and surgical management of a patient with idiopathic root resorption is presented. In this case, the procedure did not aggravate the root resorption, improved the function and global aesthetic.

Prior to any treatment, the origin of resorption should be evaluated before even classifying the condition as idiopathic [1,9].

For a long time, alveolar osteotomies were described in literature as a surgical technique for the acceleration of orthodontic tooth movement. However, alveolar osteotomies were also reported to have a negative effect on tooth vitality or to induce bone necrosis. It was first described as an 'en bloc' movement of the tooth with the tissues surrounding it. Recently it has been used for its metabolic response and regional acceleratory phenomenon (RAP) that leads to facilitated tooth movement. Less invasive methods, such as corticotomy, minimize tooth injuries, maintain the nutritive function of the spongiosa and also allows a RAP [9,10,11].

In this report, the position of the roots allowed us to choose a treatment with alveolar osteotomies. This choice was influenced by the need to create low orthodontic forces and obtain results in a short time frame. Performing alveolar osteotomies allowed us to have an 'en bloc' movement of each targeted tooth and made also use of the positive effect of the osteotomy on bone remodelling, resulting in accelerated orthodontic tooth movement. Furthermore, it allowed the orthodontist to activate the wire on a weekly basis for the first four weeks after the surgery. To minimize the potential side effects of the classic osteotomy on the teeth and bone (heat, vessels trauma, …), a piezotome device was used. A recent study suggests a greater bone remodelling and more rapid bone healing when osteotomies are performed with a piezoelectrical device than a conventional rotatory osteotomes [14]. The localized bone action allowed the orthodontist to activate the orthodontic treatment weekly for the first four weeks rather than monthly, and this without any difficulties. In this way the total orthodontic treatment time was reduced.

The surgery first approach in orthognathic surgery is still controversial but more and more satisfactory results are reported [13,15]. This approach is however not feasible for all orthognathic patients. They should be well evaluated before any surgery-first protocol can be proposed. In this case report, the clinical evaluation of the patient and her cephalometric and dental cast analysis showed that a surgery-first approach was possible. She benefited from the lower jaw advancement at the same time as the alveolar osteotomies. Excellent communication between the surgeon and the orthodontist was required for good patient management. Advantages of surgery-first were a reduction in treatment time with no preoperative orthodontics, a positive action on bone metabolism and remodelling and immediate aesthetic improvement. When after clinical evaluation a surgery-first approach seems not possible, the use of localized bone surgery such as corticotomies or alveolar osteotomies at the start of the orthodontic treatment can still reduce the time of the pre-orthognathic-surgery phase.

Radiographic evaluation with CBCT before treatment, 8 weeks and 9 months after surgery allowed us to follow the potential negative effect of the surgery and orthodontic treatment on the roots, but none were observed (Figure 4). The clinical outcome was satisfactory and the result is stable, evaluated at 9 months.

Conclusion

Using a surgery-first protocol for orthognathic surgery, associated to more localized bone stimulation with alveolar osteotomies using a piezotome, allowed us to reduce the total time of orthodontic treatment and did not aggravate further root resorption when an idiopathic root resorption was pre-existing. Taking advantages of specific technics led us to an optimal result for the patient.

Conflicts of interest

The authors declare that there are no conflicts of interest to disclose.

References

1. Darcey J and Qualtrough A. Resorption: part 1. Pathology, classification and aetiology. British Dental Journal 2013a; 214: 439-451
2. Darcey J and Qualtrough A. Resorption: part 2. Diagnosis and management. British Dental Journal 2013b; 214: 493-509
3. Rey D, Smit RM, Gamboa L. Orthodontic treatment in patient with idiopathic root resorption: A case report. Dental Press J Orthod. 2015 Jan-Feb;20(1):108-17
4. Roscoe MG, Meira JBC, Cattaneo PM. Association of orthodontic force system and root resorption: A systematic review. Am J Orthod Dentofacial Orthop 2015; 147: 610-26
5. Doğramacı EJ, Rossi-Fedele G and Jones AG. Multi-disciplinary management of a patient with a post traumatised incisor presenting concurrent replacement and inflammatory resorption: a case report. Aust Orthod J 2015; 31: 216-225
6. Viecilli RF, Kar-kuri MH, Varriale J, Budiman A and Janal M. Effects of initial stresses and time on orthodontic external root resorption. J Dent Res 2013; 92: 346
7. Maués CPR, Nascimento RR, Vilella OV. Severe root resorption resulting from orthodontic treatment: Prevalence and risk factors. Dental Press J Orthod. 2015 Jan-Feb;20(1):52-8.
8. Almpani K and Kantarci A. Nonsurgical Methods for the Acceleration of the Orthodontic Tooth Movement. Front Oral Biol. Basel, Karger, 2016a, vol 18, pp 80–91
9. Almpani K and Kantarci A. Surgical Methods for the Acceleration of the Orthodontic Tooth Movement. Front Oral Biol. Basel, Karger, 2016b, vol 18, pp 92–101
10. Moreau N and Charrier JB. Formation osseuse et corticotomies à visée de facilitation métabolique: existe-t-il une ostéogénèse induite par les corticotomies alvéolaires? Orthod Fr 2015; 86:113–120
11. Teng G and Liou E. Interdental Osteotomies Induce Regional Acceleratory Phenomenon and Accelerate Orthodontic Tooth Movement. J Oral Maxillofac Surg. 2014; 72:19-29, 2014

12. Patterson BM, Dalci O, Darendeliler MA, Papadopoulou AK. Corticotomies and Orthodontic Tooth Movement : A Systematic Review. J Oral Maxillofac Surg. 2016 Mar; 74(3):453-73

13. Peiro-Guijarro M, Guijarro-Martınez R and Hernandez-Alfaro F. Surgery first in orthognathic surgery: A systematic review of the literature. Am J Orthod Dentofacial Orthop 2016; 149:448-62

14. Anesi A, Ferretti M, Cavani F, Salvatori R, Bianchi M, Russo A, Chiarini L, Palumbo C, Structural and Ultrastructural Analyses of Bone Regeneration in Rabbit Cranial Osteotomy: Piezosurgery Versus Traditional Osteotomes. Journal of Cranio-Maxillofacial Surgery 2017, doi: 10.1016/j.jcms.2017.10.004.

15. Hernández-Alfaro F, Guijarro-Martínez R, Peiró-Guijarro MA. Surgery First in Orthognathic Surgery: What Have We Learned? A Comprehensive Workflow Based on 45 Consecutive Cases. Journal of Oral and Maxillofacial Surgery 2014; 72(2):376-90.

Figure captions

Figure 1. Initial photographs: The patient presented a convex profile. The intraoral examination revealed a Class II division 2 malocclusion with a superior anterior crowding, a labial position and inclination of the left central upper incisor and a deviation of the inferior midline.

Figure 2. Per operative photograph: alveolar osteotomies (illustration with the upper incisors).

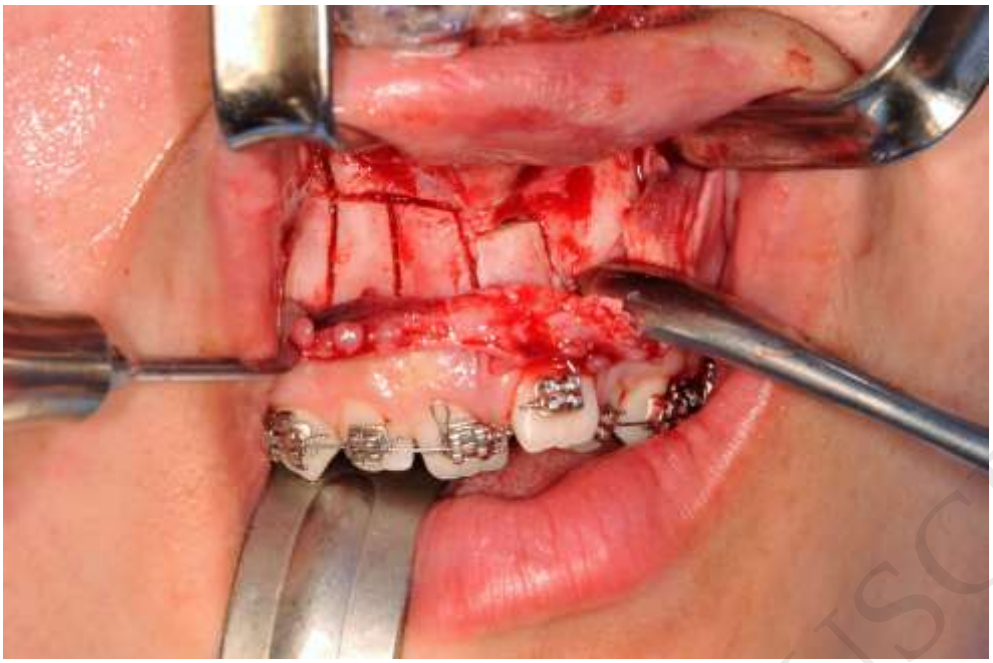

Figure 3. Post treatment photographs. The patient presented a harmonic profile. The intraoral examination revealed a Class I occlusion.

Figure 4. Comparison of the CBCT images with the software OnDemand3DApplication® using the fusion module. a) tooth 22, b) tooth 21.