Orthodontic and Orthognathic Surgical Treatment of Severe Skeletal Class III with the Use of Resorbable Plates and Screws: A Case Report

SUMMARY

This paper presents a case of a female patient with severe skeletal Class III due to pronounced mandibular macrognathia combined with maxillary hypoplasia. The patient was treated with 2-jaw osteotomy in conjunction with pre- and post-operative orthodontic treatment. Resorbable surgical plates and screws were used for the orthognathic surgery to avoid potential complications from the use of metal plates and screws, even though fixation provided by metal plates is stronger than that provided by resorbable plates.

5 years following treatment, there has been no relapse. Our conclusion is that the resorbable plates and screw provided sufficient fixation and stability with no complications.

Keywords: Class III; Mandibular Macroganathia; Maxillary Hypoplasia; Resorbable Plates Resorbable Screws

Introduction

Treating skeletal asymmetry of the orofacial system involves cooperation of an oral and maxillofacial surgeon and an orthodontist, so that the preoperative orthodontic treatment, the orthognathic surgical correction, as well as the postoperative orthodontic treatment might lead to the best possible result. In severe skeletal Class III cases, treatment planning often includes bilateral Dal Pont sagittal osteotomy of the mandibular rami combined with simultaneous Le Fort I osteotomy performed in the maxilla. This paper describes a case of severe mandibular macrognathia combined with maxillary hypoplasia. It was treated with bimaxillary osteotomy combined with pre- and post-operative orthodontic treatment.

In order to stabilize maxillary and mandibular segments, resorbable surgical plates and screws were used to avoid any potential complications that might appear due to the use of metal plates and screws.

Case Report

Diagnosis and Etiology

A 20-year old woman with maxillofacial Class III sought treatment. The clinical and radiological findings confirmed a brachyfacial type without asymmetry in the transverse dimension, a concave profile of osseous and soft tissues, mandibular protrusion due to anterior position, forward rotation and increased corpus length of the mandible (Fig. 1). When the mandible opened, there was a slight forward excursion from the centric relation position to the maximum intercuspation position. The patient presented no dysfunction of the temporomandibular joint (TMJ).

The patient had an increased caries index, teeth No 15 and 46 were missing, and her periodontal state was good. Dental arches presented some crowding (mild on the mandible, < 2 mm; medium on the maxilla, >4 mm), with a rotation of teeth No 13, 33, 45, and 47, while there was spacing between 45 and 47.
There was posterior, bilateral and anterior cross bite with negative overjet -2 mm, while overbite was +2 mm. There was dental compensation of the skeletal asymmetry: the upper incisors presented pronounced labial inclination and the lower incisors lingual inclination. The upper mid-dental line had shifted 2 mm to the right in relation to the facial midline (Fig. 2).

**Radiological Findings**

Analysis of the lateral cephalometric X-ray (Fig. 3a) confirmed a skeletal Class III with negative convexity (A\(^\prime\)/Na-Pog -8mm) of osseous and soft tissues, due to maxillary hypoplasia (A to Na\(^\prime\)-3 mm) and mandibular protrusion (Po-Or/Na-Pog 95°). Mandibular protrusion was due to an excessively long corpus (Xi-Pm 85 mm), forward rotation (Pt-Gn/Na-Ba 98°) and anterior position of the TMJ (Po- PtV 38mm). The lower anterior facial height was short (ANS-Xi-Pm 44°). Incisors presented negative overjet equal to -2 mm and overbite equal to +2 mm. Upper incisors presented pronounced labial inclination (I/Po-Or 127°) and lower incisors pronounced lingual inclination (i/Go-Me 79°).
The panoramic X-ray confirmed periodontal lesions and apical lesion in tooth No 37 (Fig. 3b).

Preoperative Orthodontics

Initially, caries was treated and tooth No 25 was extracted (due to its bad prognosis), the aim being to relieve crowding in the upper dental arch. Preoperative orthodontic treatment ensued using fixed appliances (Fig. 4). This entailed: (a) dental decompensation, with correction of the labial inclination of upper incisors and lingual inclination of lower incisors; this worsened overjet to -7 mm. Decompensation was of the utmost significance for the pre-operative correction of dental arches in cases of skeletal Class III; (b) resolving crowding, closing spacing between 45 and 47, levelling and alignment of teeth; (c) achievement of the best possible compatibility of the maxillary and mandibular dental arches, which can only be checked on casts. Preoperative orthodontic treatment lasted 15 months. 6 months before its completion, the third molars (18, 28 and 38) were extracted so as to create bone in the region of the extractions, on the one hand, and so as not to burden the patient with extractions intra-operatively, on the other, since the jaw incision goes through the region of the third molars. Tooth No 48 was not extracted, because tooth No 46 was missing and teeth 47 and 48 were moved medially.

The operation was then planned on the basis of the preoperative lateral cephalometric X-ray and the casts mounted on a semi-adaptable articulator; it was decided to shift the maxilla forward by 4 mm and rotate it to the left by 2 mm, using Le Fort I osteotomy, while the mandible would be shifted backward by 6 mm using sagittal osteotomy of its rami. At this stage, 2 surgical splints were prepared. The first one, the intermediary
splint, was constructed in the new position of the maxilla, while the mandible remained unaffected in the initial centric relation position; the second and final splint was constructed so as to contain the new position of the distal mandibular stump in relation to the new maxillary position and determine the ultimate desirable occlusion.

**Surgery and Postoperative Orthodontics**

Bimaxillary osteotomy was performed (Fig. 5). Initially, a Le Fort I osteotomy was performed to move the maxilla forward by 4 mm, after the pre-constructed intermediary occlusal splint had led to temporary maxillo-mandibular fixation and osteosynthesis of the osteotomised maxilla with resorbable surgical plates and screws (Fig. 6). When the intermediary occlusal splint was removed, bilateral sagittal osteotomy of the mandibular rami was performed. The distal segment was shifted backward by 6 mm and osteosynthesis of 3 mandibular segments was performed using lag screws after the desirable occlusion had been achieved through the pre-planned use of the final splint3-5 (Fig. 7). Maxillo-mandibular fixation lasted 6 weeks. The patient’s post-operative course was uneventful.

In order to correct any imperfections of dental occlusion in the best possible way, post-operative orthodontic treatment followed 6 weeks later (Fig. 8); this was mainly based on maxillo-mandibular elastic traction forces and lasted 5 months. The patient’s fixed appliances were left for 10 months for retention purposes.

At the end of the treatment the periodontium was healthy and teeth responded normally to vitality tests. The sagittal relation of the upper and lower molars was Angle Class II and of the rest of the teeth Class I. Incisor overjet was positive at +2 mm and incisor overbite was about 1/3 of the height of mandibular teeth (Fig. 9). Cephalometric comparison of the initial, pre-operative and final cephalometric X-ray (Fig. 10) is presented in table 1. These were the following main changes: Facial angle changed from 95° to 91°; facial convexity improved from -8 mm to -0 mm; the maxilla was placed in a more anterior position, since the distance of point A from MacNamara line improved from -3 mm to the ideal of 0 mm6,7; mandibular corpus length was reduced from 85 mm to 80 mm and facial height was increased from 44 mm to 47 mm.

Overall, there was a significant improvement in the patient’s dental (Fig. 9) and skeletal relations, in her aesthetic appearance (Fig. 11), the function of her dental-jaw system, as well as her psychological state. 5 years following treatment, there has been no relapse and the patient’s aesthetic and functional improvement has been preserved to date.
Figure 7. Final splint

Figure 8. Postoperative orthodontic treatment

Figure 9. Post-treatment intraoral photographs
Figure 10. Post-treatment X-rays: a. cephalometric radiograph; b. panoramic radiograph

Figure 11. Post-treatment extraoral photographs

Table 1. Cephalometric comparison between initial, preoperative and final cephalometric analysis

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Normal Values</th>
<th>Initial</th>
<th>Preoperative</th>
<th>Final</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facial Axis (Pt-Gn/Na-Ba)</td>
<td>90° ± 3</td>
<td>98</td>
<td>98</td>
<td>84</td>
</tr>
<tr>
<td>Facial angle (Po-Or/Na-Pog)</td>
<td>87° ± 3</td>
<td>95</td>
<td>95</td>
<td>91</td>
</tr>
<tr>
<td>Mandibular plane (Po-Or/Go-Me)</td>
<td>26° ± 4</td>
<td>25</td>
<td>25</td>
<td>27</td>
</tr>
<tr>
<td>Lower facial height angle (ANS-Xi-Pm)</td>
<td>47° ± 4</td>
<td>44</td>
<td>44</td>
<td>47</td>
</tr>
<tr>
<td>Mandibular arc angle (DC-Xi-Pm)</td>
<td>26° ± 4</td>
<td>26</td>
<td>27</td>
<td>22</td>
</tr>
<tr>
<td>Convexity at point A (A⊥Na-Pog)</td>
<td>2 mm ± 2</td>
<td>-8 mm</td>
<td>-8 mm</td>
<td>0 mm</td>
</tr>
<tr>
<td>Point A to MacNamara line (A to Na⊥)</td>
<td>0 mm ± 2</td>
<td>-3 mm</td>
<td>-3 mm</td>
<td>0 mm</td>
</tr>
<tr>
<td>Mandibular Incisor inclination</td>
<td>22° ± 4</td>
<td>79</td>
<td>89</td>
<td>83</td>
</tr>
<tr>
<td>Mandibular Incisor to APog</td>
<td>1 mm ± 2</td>
<td>-6 mm</td>
<td>-8 mm</td>
<td>4 mm</td>
</tr>
<tr>
<td>Maxillary Incisor inclination</td>
<td>112° ± 6</td>
<td>127</td>
<td>121</td>
<td>123</td>
</tr>
<tr>
<td>E line</td>
<td>-2 mm ± 2</td>
<td>-4</td>
<td>-3</td>
<td>-4</td>
</tr>
<tr>
<td>Mandibular body length (Xi-Pm)</td>
<td>66 mm ± 3</td>
<td>85 mm</td>
<td>85 mm</td>
<td>80 mm</td>
</tr>
<tr>
<td>Porion position (Po-PtV)</td>
<td>39 m ± 2.2</td>
<td>38 mm</td>
<td>39 mm</td>
<td>39 mm</td>
</tr>
</tbody>
</table>
Discussion

Pre-operative orthodontic treatment of this case aimed at dental decompensation of the skeletal anomaly and at aligning the teeth so that, mainly, maxillary and mandibular incisors would be properly corrected on the dental arches in the anteroposterior and vertical levels. This approach is called the theory of “2 patients”\(^\text{9}\); according to this, the upper and lower dental arches are treated independently, as if they belonged to 2 patients\(^\text{8}\). Correction of the inclination of maxillary and mandibular incisors, which compensates skeletal asymmetry, allows 5 times as much posterior surgical shifting of the distal mandibular segment as compared to its potential shift, if there was no decompensation\(^\text{9}\).

 Initially, a Le Fort I osteotomy was performed, which was followed by osteosynthesis of the osteotomised maxilla using resorbable surgical plates and screws, with the help of the pre-constructed intermediary occlusion splint. Resorbable surgical screws were also used following bilateral sagittal osteotomy of the mandibular rami, aiming at the osteosynthesis of 3 mandibular segments. We decided to use resorbable surgical plates and screws for the fixation of the jaw segments, so as to avoid potential complications that might appear if metal plates and screws were used instead, such as teeth sensitivity and sinusitis if plates and screws were placed too close to them, irritation due to palpability of the plates, pain and the need to surgically remove such materials later\(^\text{10-12}\).

Although metal plates provide stronger fixation than that provided by resorbable ones, research has shown that postoperative results are stable regardless of whether metal or resorbable plates have been used, particularly in cases where surgical shifts do not exceed 5 mm and when Le Fort I osteotomy and/or sagittal osteotomy of the mandibular rami are performed. It has also been reported that the increased rigidity of metal plates might cause excessive tension/stress to bone\(^\text{10-16}\), while absorbable materials allow faster occlusion and TMJ adaptation\(^\text{17}\). Turvey et al\(^\text{18}\) noticed increased maxillary mobility during the postoperative phase in cases where resorbable plates had been used, as compared to cases where metal ones had been used. This mobility was considered desirable because it facilitated postoperative adaptation of jaw segments and it did not inhibit bone healing. The same thing was also observed by Costa et al\(^\text{11}\) in their research.

Conclusions

The cooperation of both maxillofacial surgeons and orthodontists is very important in treating cases of skeletal asymmetries of the orofacial system in order to obtain predictable and best possible result. This cooperation involves treatment planning and coordination throughout the whole treatment phase.

In carefully selected cases, resorbable surgical plates and screws can be used for fixation, having predictable and similar results to metallic surgical plates and screws and, at the same time, avoiding disadvantages and complaints that accompany the later. This was demonstrated in the present case report, where 5 years following treatment the outcome of the treatment was stable and free of complications and complaints.

References


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