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**Surgical-orthodontic Treatment with Molar Protraction in a Patient with Skeletal Class III Anterior Open Bite and Facial Asymmetry**

Yi-Hsuan Chen  
*Department of Craniofacial Orthodontics, Chang Gung Memorial Hospital, Taoyuan, Taiwan; Craniofacial Research Center, Chang Gung Memorial Hospital, Linkou, Taiwan; Graduate Institute of Craniofacial and Oral Science, Chang Gung University, Taoyuan, Taiwan*

Cheng-Hui Lin  
*Department of Plastic and Reconstructive Surgery, Chang Gung Memorial Hospital, Taoyuan, Taiwan; Craniofacial Research Center, Chang Gung Memorial Hospital, Linkou, Taiwan*

Ellen Wen-Ching Ko  
*Department of Craniofacial Orthodontics, Chang Gung Memorial Hospital, Taipei, Taiwan; Craniofacial Research Center, Chang Gung Memorial Hospital, Linkou, Taiwan; Graduate Institute of Craniofacial and Oral Science, Chang Gung University, Taoyuan, Taiwan, ellenko.wc@msa.hinet.net*

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INTRODUCTION

Facial asymmetry is one of the most common complaints for patients to seek surgical orthodontic treatment. Common features of facial asymmetry include more obvious in the lower thirds of the face than in the upper thirds, and associated cant of the maxillary occlusal plane.\(^1\) The frequency of facial asymmetry was reported as 5%, 36% and 74% in the upper, middle and lower thirds of the face respectively.\(^2\) In such cases, 2-jaw surgical orthodontic treatment was needed to achieve dramatic improvement of facial balance, including correction of the maxillary canting and chin deviation.\(^3\) Consequently, correction typically includes a combination of LeFort I osteotomy and bilateral sagittal split ramus osteotomy.\(^4\)

Case Report

A 20-year-old young male complained of his protrusive and deviated chin. He also presented occlusal plane cant, anterior open bite and unrestorable maxillary right first molar and mandibular left first molar. The severe maxilla-mandibular discrepancy was solved with surgery-first double jaw orthognathic surgery. The space of two extracted first molars was closed by protraction of the second and third molars after surgery. Two protraction techniques were used in this case, including closing maxillary right first molar space with reciprocal retraction, and closing mandibular left first molar with one miniscrew as an absolute anchorage. Careful biomechanical consideration was used during protraction to prevent worsening of the anterior open bite and jeopardizing midline control. Good occlusion, balanced facial symmetry and lateral facial profile were achieved within 2 years of treatment duration and have been well-maintained after 1 year of follow up. (Taiwanese Journal of Orthodontics. 29(4): 224-233, 2017)

Keywords: Class III malocclusion; facial asymmetry; molar protraction; Orthognathic surgery; miniscrew
This case report illustrates the treatment of Class III skeletal malocclusion with facial asymmetry. Surgery-first surgical orthodontic treatment was performed for re-establishing normal occlusion and adequate facial esthetics, and one miniscrew was placed in the buccal alveolar bone to protract the mandibular second and third molars into the atrophic ridge of the missing first molar.

**CASE REPORT**

A 22-year-old male visited our department with a chief complaint of protrusive and deviated chin. His nasal dorsum was mildly deviated due to previous facial trauma few years ago. He denied any major systemic disease and drug allergy. No signs and symptoms of temporomandibular joint dysfunction were noted. He has received general dental care at local dental clinic.

**DIAGNOSIS**

The patient had skeletal Class III relationship with normal divergent facial type and prominent chin. Pretreatment facial photographs demonstrated concave facial profile with paranasal depression, facial asymmetry with nose deviated toward right and chin deviated toward left. Bilateral eye corners were at noticeably different vertical levels. No maxillary incisal exposure was noted at rest. No functional shift was noted. Intraorally, he had Angle Class III malocclusion on both sides of the molars. Overjet and overbite were -4.0 mm and -1.0 mm respectively. The maxillary dental midline was coincident with the facial midline, and the mandibular dental midline had a 7.0 mm deviation toward his left side (Figure 1). The lateral cephalometric analysis...
Table 1. The comparisons of pre-treatment and post-treatment cephalometric analysis.

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Initial</th>
<th>Finish</th>
<th>Norm</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Skeletal</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SNA (°)</td>
<td>85.5°</td>
<td>86.0°</td>
<td>79.4 ~ 82.5</td>
</tr>
<tr>
<td>SNB (°)</td>
<td>87.0°</td>
<td>87.5°</td>
<td>74.6 ~ 77.8</td>
</tr>
<tr>
<td>ANB (°)</td>
<td>-2.5°</td>
<td>-0.5°</td>
<td>4.1 ~ 5.7</td>
</tr>
<tr>
<td>SN-MP (°)</td>
<td>37.0°</td>
<td>36.0°</td>
<td>34.2 ~ 38.6</td>
</tr>
<tr>
<td><strong>Dental</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>U1 to SN (°)</td>
<td>111.0</td>
<td>109.0</td>
<td>103.5 ~ 109.1</td>
</tr>
<tr>
<td>U1-NA (mm)</td>
<td>7.0</td>
<td>7.0</td>
<td>3.8 ~ 7.2</td>
</tr>
<tr>
<td>L1 to MP (°)</td>
<td>86.5</td>
<td>88.0</td>
<td>91.1 ~ 98.3</td>
</tr>
<tr>
<td>L1-NB (mm)</td>
<td>10.0</td>
<td>5.0</td>
<td>6.1 ~ 9.5</td>
</tr>
<tr>
<td><strong>Soft tissue</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upper lip – E line (mm)</td>
<td>-0.5</td>
<td>-2.0</td>
<td>0.8 ~ 3.2</td>
</tr>
<tr>
<td>Lower lip – E line (mm)</td>
<td>+5.0</td>
<td>-0.5</td>
<td>1.2 ~ 4.4</td>
</tr>
</tbody>
</table>

Figure 2. Pretreatment radiographs, including lateral and posterior-anterior cephalometric and panoramic radiographs.
indicated SNA angle of 85.5°, SNB angle of 87.0°, and ANB angle of -1.5°. The mandibular plane angle was 37.0°. The mandibular incisors were inclined lingually at an angle of 86.5° relative to the mandibular plane. The upper lip is retrusive and the lower lip is protrusive to the esthetic E-line (Table 1). The panoramic film radiograph demonstrated hopeless residual roots of the maxillary right first molar and the mandibular left first molars, and there was a large decay over the maxillary right second molar and the mandibular right third molar. Four third of the molars were fully erupted, and the periodontal tissues were healthy. Based on the cephalometric findings, the patient was diagnosed with a skeletal Class III malocclusion with mandibular prognathism and facial asymmetry (Figure 2).

**ORTHODONTIC TREATMENT ALTERNATIVES**

(A) Surgical orthodontic treatment is needed for severe skeletal discrepancy correction:

1. Only one-jaw orthognathic surgery for correction of mandibular prognathism and facial asymmetry. Upper occlusal plane cant 2 mm could be treated only with orthodontic treatment by inserting upper right posterior miniscrew for intrusion. The advantages were simplifying the surgical technique and reducing the risk and cost of Le Fort I osteotomy; However, the treatment duration is much longer due to lengthy presurgical orthodontics, including alignment of upper right posterior segment as well as protraction and intrusion of theses teeth. The patient should receive mandibular surgery after this orthodontic correction.

2. Surgery-first two-jaw orthognathic surgery could improve facial symmetry and lateral profile at the early stage of treatment, and accelerate the postoperative tooth movement, thus shorten the total treatment duration.

(B) The two un-restorable first molar spaces could be treated by implant prosthesis rather than molar protraction to simplify the orthodontic treatment and shorten the treatment duration. However, the patient wanted to preserve more of his natural teeth and to reduce the treatment expense. The treatment option of molar protraction was chosen.

**TREATMENT OBJECTIVES AND PLAN**

The following treatment objectives were planned: (1) harmonize the patient’s facial asymmetry; (2) correct the skeletal Class III anteroposterior jaw relationship; (3) remove the hopeless teeth and close the extracted molar space and (4) coordinate upper and lower dental arches. After discussion of all possible treatment alternatives, the 2-jaw surgical orthodontic treatment plan was set up as followings:

1. General dental care, including full mouth scaling, upper right first molar and lower right first molar extraction, and upper right second molar endodontic treatment with provisional prosthesis.
2. Bond full mouth edgewise fixed orthodontic appliance.
3. Limited pre-surgical orthodontic treatment, including initial leveling and alignment, and lower left miniscrew insertion.
4. Double jaw orthognathic surgery.
5. Post-surgical orthodontic treatment, including upper right molars space closure and lower left molars protraction, upper and lower arch coordination, dental and facial midline coordination, finishing and detailing.
6. Upper and lower wraparound retainers for retention.

**TREATMENT PROGRESS**

The orthodontic treatment initiated after hopeless molars were extracted (Figure 3). Preadjusted 0.022x0.028-in edgewise appliances were used for the treatment. The presurgical orthodontic treatment
<table>
<thead>
<tr>
<th>Upper arch</th>
<th>Lower arch</th>
</tr>
</thead>
</table>
| **0M**                             | Initial leveling & alignment  
- bonding & banding  
- .016 NiTi                                      |
| **2M**                             | Orthognathic surgery  
- Maxillary: Le Fort I osteotomy with superior repositioning  
- Mandible: Bilateral sagittal split setback  
- Chin: Genioplasty                                     |
| **3M**                             | Post-surgical orthodontic treatment  
- Molar protraction  
- Sliding mechanism: .016x.022 SSW                                      |
| **18M**                            | Finishing & detailing  
- .016x.022 SSW  
- Elastics                                                  |
| **24M**                            | Debonded & debanded  
- #12-22 fixed retainer delivery  
- Wraparound retainer delivery                       |

**Figure 3.** Treatment progress.

**Figure 4.** Extraoral and intraoral photographs in postoperative treatment progress, including lower left miniscrew placement.
Surgical-orthodontics in Class III Face Asymmetry

TREATMENT RESULT

After 2-year surgical orthodontic treatment, balanced facial symmetry and harmonized facial vertical proportion were achieved; paranasal depression and occlusal plane cant were also corrected (Figure 5). The maxillary dental midline coincided with the facial and mandibular midlines. An ideal occlusion was established with proper overjet and overbite, bilateral Class I canine and molar relationship and solid interdigititation (Figure 6). The major achievement was the closure of the dental space on an atrophic dental ridge. There was no periodontal complications and dental midline discrepancy. The post-treatment lateral cephalometric tracing illustrated 11.0 mm mesial protraction of the mandibular molar and 8.5 mm

included 1.5 month of initial leveling and alignment and insertion of the lower left miniscrew at the distal of the mandibular second premolar (Figure 4). In the second month, bimaxillary orthognathic surgery was performed, including LeFort I and bilateral sagittal split ramus osteotomies with maxillomandibular complex clockwise rotation. The occlusal plane canting was corrected by a 2.0 mm impaction at the region of maxillary right molar. The mandible had differentiated setback and side shifting to correct mandible deviation and prognathism. The surgical occlusion was setup as Angle Class I molar relationship with ideal overbite and overjet. Postsurgical orthodontic treatment carried on for further molar protraction, arch coordination, and finishing and detailing. Maxillary and mandibular wraparound retainers were delivered.

Figure 5. Posttreatment extraoral and intraoral photographs.
Figure 6. Posttreatment radiographs, including lateral and posterior-anterior cephalographic and panoramic radiographs.

Figure 7. Superimposition of pre-treatment and post-treatment cephalometric tracing. Black line, pre-treatment; red line, post-treatment.
mesial protraction of the maxillary molar (Figure 7). After 1-year follow-up, the results were still well maintained (Figure 8).

**DISCUSSION**

To evaluate the presence and extent of facial asymmetry, the first step is to determine the midsagittal plane. Double cross grid method in posteroanterior (PA) cephalogram combined with facial photograph is a common and effective tool in 2-dimensional image. However, the double cross grid method needed to be modified in this case, due to the opposite directions of the patient’s nose deviation and chin deviation. A three dimensional (3D) midfacial plane must be determined first to assess the facial symmetry more comprehensively. The 3D midfacial plane is typically constructed based on the skeletal structures along the facial midline (e.g., the sella, basion, and anterior nasal spine), or based on the vertical plane perpendicular to the Frankfort plane and passing through a midfacial structure (e.g., the nasion).

In patients with facial asymmetry, this skeletal midfacial plane may slightly differ from the midfacial plane based on the reference points relative to the soft tissue structures along the facial midline (i.e., the soft tissue nasion, nasal tip, subnasale). Thus, surgical reconstruction of the midfacial plane should align those reference points located on external soft tissue structures, which means that the 3D midfacial plane should be selected based on the position of external facial structures and internal skeletal structures.

According to the general guidelines for surgery-first surgical orthodontic cases (mild crowding, small curve...
of Spee, little decompensation of the inclination of both upper anterior teeth and lower anterior teeth, this case should be categorized as a simple case for surgery-first approach. However, the facial asymmetry with missing molars on the opposite sides of the two arches increased the difficulty of coinciding the dental and facial midline. 

Both the maxillary right first molar and the mandibular left first molar were missing in this case, so the maxillary right second and third molars and the mandibular lower left second and third molars needed to be protracted. Considering the structural differences between the posterior maxilla and the posterior mandible, it is more challenging to avoid anchorage loss in the mandible than in the maxilla. The posterior mandible consists of a thicker cortical bone and dense, radially oriented trabeculae, while the posterior maxilla is composed of uniformly thin cortices, interconnected by a network of spacious trabeculae. Thus, reciprocal mechanism was applied to protract the upper right molars, and absolute anchorage with miniscrew was applied to protract the lower right molars.

In the molar region, the average maxillary buccal cortical thickness is 1.5 mm, and the average in the mandible is 2 mm. Roberts et al. found that the rate of molar mesialization was inversely proportional to the alveolar bone density and the rate of mandibular molar protraction using implant anchorage was approximately 0.34-0.60 mm per month. With this rate, 10 mm of edentulous mandibular first molar space closure will take 2–3 years in adults. In our case, protraction of the upper right posterior molars was finished in 15 months and protraction of the lower right posterior molars was finished in 22 months. The average extent of molar protraction is more than 0.5 mm per month, which could be attributed by the regional acceleratory phenomenon (RAP). To prevent mesial tipping during molar protraction, uprighting lever arms were placed and a 30 degree of tip back bend was performed in 0.016x0.022-inch stainless steel wire.

The RAP, the acceleration of the bone remodeling process after osteotomy, was first described by Frost in 1993. Liou et al. 2011 first showed that orthognathic surgery could also trigger 3 to 4 months of higher osteoclastic activities and metabolic changes in the dentoalveolus post-operatively, and which could possibly accelerate post-operative orthodontic tooth movement. Jeong et al. 2017 presented that the surgery-first orthognathic approach can dramatically reduce the total treatment time, with similar postoperative stability and no major complications. Patients undergoing the surgery-first approach could also benefit from immediate improvement in facial aesthetics, oral function, and self-confidence.


