A Modified Surgery-First Approach for Mandibular Prognathism with Proclined Maxillary Incisor and Mandibular Spacing

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This Case Report is brought to you for free and open access by Taiwanese Journal of Orthodontics. It has been accepted for inclusion in Taiwanese Journal of Orthodontics by an authorized editor of Taiwanese Journal of Orthodontics.
This case report describes the management of an adult patient presenting with a skeletal Class III malocclusion, mandibular protrusion, upper incisor proclination and mandibular arch spacing by a modified surgery-first approach. A 26-year-old man had skeletal Class III and dental Class III malocclusion with concave facial profile, midface deficiency and mandibular prognathism with chin deviation to left. His dental manifestation presented anterior crossbite, upper incisors proclination and spacing in his mandibular arch. Treatment was performed with a modified surgery-first approach, which included a short presurgical alignment phase. In the maxilla, the significant maxillary crowding was relieved by 14 and 24 extractions while partially retracting the maxillary incisors to reduce the incisal proclination. Then, the upper incisors inclination was furtherly corrected more by a 2-pieces LeFort I osteotomy and closure of the 14, 24 residual dental space during surgery. In the mandible, the lower dental spacing was caused by general tooth size/jaw bone discrepancy with relative upright incisal inclination. The presurgical preparation included consolidation the dental space distal to the bilateral mandibular canines. The bilateral sagittal split osteotomies were conducted for mandible setback and asymmetry correction. Additionally, the subapical osteotomy with Köle procedure was applied to close the dental space in the mandibular arch while keeping the anterior teeth in relative normal inclination. The excessive chin prominence caused by the Köle procedure was reduced by reduction genioplasty and surface contouring. Post-operative orthodontic treatment included overbite control and detailing of the occlusion. After treatment, the maxillary incisors proclination was corrected and all the dental spaces were closed. Patient’s profile was dramatically improved with well teeth alignment, angulation and interdigitation. The 2-pieces LeFort I and Köle osteotomy are the surgical procedures to address the correction in the dentoalveolar portion for efficiently control the inclination of the anterior teeth. Moreover, it also provides benefits for patients who require large amount of jaw setback with minimal effect at the posterior airway space. The treatment goals of the dentoalveolar portion and facial proportion should be contemplated for the staged procedures to improve the efficiency and effectiveness of the treatment outcome. (Taiwanese Journal of Orthodontics. 31(2): 86-94, 2019)
INTRODUCTION

A Class III skeletal pattern could lead to malocclusion and disharmony facial profile. From the systematic review and meta-analysis of Hardy et al. in 2012, the Angle Class III malocclusion had been found in Southeast Asian population with the highest rate of 15.80% compared to other populations. As well as the study from Soha et al. in 2005, the relationships of Class III incisor in Asian male army were 22.4% and Class III molar relationship were 24.2% at right side and 21.2% at left side. Tang also reported the prevalence of Class III malocclusion which was 14.8% in male dental student in Hong Kong. Most of the Class III malocclusion also presented a skeletal discrepancy (75.4%).

Although mild skeletal discrepancy can be treated by camouflage orthodontic treatment. To improve facial profile and dental occlusion in severe skeletal relationship, the treatment usually leads to orthognathic surgery. For conventional orthognathic surgery, the presurgical orthodontic treatment is needed to decompensate teeth alignment before surgery which provides benefits of changing the amount of surgical reposition procedure and gives the best surgical results. However, patients who received presurgical orthodontic treatment were found to have negative impact on their quality of life.

The surgery- first approach was introduced in 1988 by Behrman and Behrman with the advantages of short treatment period due to no presurgical orthodontics treatment stage. Patients also reported the improvement of quality of life immediately after surgery in surgery-first approach group. Yet in some cases, the degree of complexity exceeds the limitation for surgery-first approach.

A modified surgery-first approach has an advantage of using short period of presurgical orthodontic preparation simply for minor teeth adjustment. The aim of dental correction prior the surgery is to decrease the amount of severe dental discrepancy such as excessive or recessive inclination and major dental interference which could impact the setting of surgical occlusion, still there are some correction needed for postsurgical orthodontic treatment to be done.

Furthermore, surgical techniques to enhance dental correction can be benefit for patients who have atypical skeletal and dental pattern. Segmental osteotomy can be used to improve surgical outcome and help occlusal set up instead of strictly relying on orthodontic tooth movement. In the maxilla, the maxillary segmental osteotomy provided stable outcomes in sagittal plane. With the rigid fixation and interpositional bone grafting, the stability in horizontal plane of maxilla advancement in segmental group is the same as one-piece group and shows less relapse rate in vertical plane.

For mandible, main reason of skeletal Class III comes from mandibular prognathism (47.4%) or excessive growth, meanwhile the maxilla found to be retrognathism (10.5%) or micrognathia (8.8%). To deal with the excessive mandible, mandibular setback by bilateral sagittal split osteotomies (BSSO) is usually performed in our centre. Still the large amount of setback could affect the posterior airway space or could not fully correct patient’s problem. The mandibular anterior segmental subapical osteotomy was first introduced by Hullihen in 1849. After that many modification procedures by Köle was introduced in 1959. The subapical osteotomy at the anterior part of mandible provide more modification on lower jaw such as adjusting incisal position, incisal inclination and arch length.

Therefore, this case report describes the management of an adult patient presenting with a skeletal Class III malocclusion with mandibular protrusion, upper incisor proclination and mandibular arch spacing by a modified surgery-first approach. The surgical technique included segmental LeFort I osteotomy in maxilla and BSSO combined with subapical osteotomy in mandible.
CASE REPORT

A 26-year-old man had chief complaint of a long lower jaw. He denied any major systemic diseases or drug allergies.

Clinical Findings

The clinical examination presented skeletal Class III relationship, retrognathic maxilla, excessive lower facial height and prognathic mandible with chin deviation to the left 3 mm. He had non-consonant smile arch without gummy smile. His lateral facial profile was concave with paranasal depression, acute nasolabial angle and shallow mentolabial fold (Figure 1).

His dental manifestation presented Angle’s Classification III malocclusion with a negative overjet of -2 mm and overbite of 2.5 mm. The upper dental midline was 2 mm right to facial midline while the lower dental midline was 2 mm left to facial midline. For the maxilla, upper incisors were proclined (U1/SN=128.5°), mild crowding and right-side up occlusal plane canting. In contrast, the mandible presented spacing between canine and first premolar at both side with slightly retroclined lower incisors (L1/MP=85°) (Figure 2, Table 1).

From radiographic examination, all permanent teeth were erupted with 24 endodontically treatment. Average retropalatal and retroglossal and airway space, which was 9 mm and 12 mm respectively, were observed (Figure 3).

Figure 1. Pre-treatment facial photographs.

Figure 2. Pre-treatment intraoral photographs.
Treatment goals and treatment plan

From the examination, the treatment goals were set.

<table>
<thead>
<tr>
<th>Soft Tissue</th>
<th>Skeletal</th>
<th>Dental</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Correct facial proportion</td>
<td>• Correct midface deficiency and mandibular</td>
<td>• Correct dental inclination and relationship</td>
</tr>
<tr>
<td>• Correct lip posture</td>
<td>prognathism</td>
<td>• Achieve Class I canine and Class II molar relationship</td>
</tr>
<tr>
<td>• Improve smile arch</td>
<td>• Correct maxilla canting</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Correct chin deviation</td>
<td></td>
</tr>
</tbody>
</table>

From the diagnosis and treatment goals together with patient’s expectation, the treatment plan was performed with a modified surgery-first approach as following steps.

1. General dental care: Full mouth scaling and polishing
2. Presurgical orthodontic treatment: 14, 24 extraction for reducing incisal proclination, alignment and levelling.
3. Orthognathic surgery: Maxilla: 2-pieces LeFort I osteotomy
                            Mandible: Köle procedure and BSSO for mandible setback and asymmetry correction.
                            Genioplasty: chin contouring
4. Post-surgical orthodontic treatment
5. Retention
Treatment Progress

In the maxilla, the significant maxillary crowding was relieved by 14 and 24 extractions while partially retracting the maxillary incisors to reduce the incisal proclination. Then, the upper incisors inclination was furtherly corrected more by a 2-pieces LeFort I osteotomy and closure of the 14, 24 residual dental space during surgery.

In the mandible, the lower dental spacing was caused by general tooth size and jaw bone discrepancy with relative upright incisal inclination. The presurgical preparation included consolidation the dental space distal to the bilateral mandibular canines. The presurgical orthodontics preparation took 7 months before surgery.

Then, the pre-operative records were taken included dental radiographs, cone beam computed tomography (CBCT) and surgical models. For surgical plan, a 2-pieces LeFort I osteotomy were performed which was cut at the area between 13-15 and 23-25. Anterior maxilla portion was clockwise rotated which resulted in upper incisor setback 4 mm, downward 1 mm and decreasing their inclination. The posterior portion of maxilla was moved forward for space closure and posterior impacted for further dental occlusion.

The bilateral sagittal split osteotomies (BSSO) were conducted for mandible setback and asymmetry correction. The mandible was set back 8mm at the right side and 5mm at the left side. Additionally, the subapical osteotomy with Köle procedure was applied with 2mm setback at the right side and 4mm setback at the left side. This procedure helped closing the dental space in the mandibular arch while keeping the anterior teeth in relative normal inclination. The excessive chin prominence caused by the Köle procedure was reduced by reduction genioplasty and surface contouring (Figure 4).

Post-operative orthodontic treatment took about 19 months included overbite control and detailing of the occlusion and interdigitation.
Treatment Results

After treatment, patient’s profile was improved to straight facial profile, symmetry and good facial proportion. All surgical segments were stable. Class I canine relationship and Class II molar relationship were achieved with 2 mm overjet and 2 mm overbite. The maxillary incisors proclination were improved, all the dental spaces were closed and well interdigitation (Figure 5, Table 1).

From the superimposition, the mandible was setback and the maxilla was clockwise rotated by impaction of posterior segment upward 3 mm. The pogonion point was moved backward by 7 mm along with posterior airway reduction to 8 mm at retropalatal and retroglossal area (Figure 6).

This case report was approved by the Institutional Review Board and Medical Ethics Committee of Chang Gung Memorial Hospital (No. 201900284B0).

Figure 5. Post-treatment photographs at the time of debond (19 months after surgery).
Table 1. The cephalometric analysis in before and after treatment.

<table>
<thead>
<tr>
<th>Skeletal</th>
<th>Pretreatment</th>
<th>Debond</th>
<th>Norm</th>
</tr>
</thead>
<tbody>
<tr>
<td>SNA</td>
<td>85.0</td>
<td>84.0</td>
<td>79.4 - 82.5</td>
</tr>
<tr>
<td>SNB</td>
<td>92.0</td>
<td>84.0</td>
<td>74.6 - 77.8</td>
</tr>
<tr>
<td>ANB</td>
<td>7.0</td>
<td>0.0</td>
<td>4.1 - 5.7</td>
</tr>
<tr>
<td>SND-MP</td>
<td>30.5</td>
<td>35.0</td>
<td>34.2 - 38.6</td>
</tr>
</tbody>
</table>

Dental Analysis

| Upper-NA (mm) | 13.0 | 8.5   | 3.8-7.2 |
| U1/SN⁰       | 128.5| 114.0 | 103.5-109.1 |
| L1-NB (mm)   | 28.0 | 27.0  | 6.1-9.5  |
| L1/MP⁰ (Me-Go)| 85.0 | 87.5  | 91.1-98.3 |

Facial Analysis

<table>
<thead>
<tr>
<th>E-line (mm)</th>
<th>Upper</th>
<th>Lower</th>
<th>Upper</th>
<th>Lower</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper</td>
<td>0.5</td>
<td>1.0</td>
<td>0.8-3.2</td>
<td></td>
</tr>
<tr>
<td>Lower</td>
<td>6.0</td>
<td>1.0</td>
<td>1.2-4.4</td>
<td></td>
</tr>
</tbody>
</table>

Figure 6. 2D and 3D Superimposition of before and after treatment.
DISCUSSION

With the modified surgery-first technique, the presurgical orthodontic treatment was performed to reduce severe incisal inclination, minor levelling and alignment but didn’t aim for fully dental alignment, space closure or occlusal interdigitation. Thus, this patient took only 7 months for presurgical orthodontic treatment preparation. The 2-pieces LeFort I and Köle osteotomy then addressed the correction in the dentoalveolar portion for efficiently control the inclination of the anterior teeth.12

For the surgical design, the clockwise rotation of maxilla could help reducing the incisal inclination.5 From the study of Gandedkar et al., the range of 4-8 mm setback surgery in bimaxillary surgery showed no change in risk factors scores for obstructive sleep apnea (OSA).15 However, for this patient, a big amount of rotation was needed for fully correction which could affect the amount of bone reduction and could affect the posterior airway space.10,11

On the other hand, the discrepancy between tooth-size and arch length in this patient resulted in large amount of spacing in mandibular arch especially at distal of lower canine at both sides. If the spacing would be closed by only orthodontic movement before surgery, a large amount of incisors retraction or molar protraction were needed which could lengthening the presurgical orthodontics treatment. On the contrary, if spacing were kept for prostheses or planned for space closure after surgery, the large amount of mandibular setback more than 8 mm could not be avoided.

Therefore, the combination of the clockwise rotation of maxillary anterior segment from 2-pieces LeFort I osteotomy and Köle osteotomy combined with BSSO was chosen to reduce incisors angulation and space closure.16 The posterior segment of maxilla was moved forward to close extraction space and Köle osteotomy was helped to close the excessive mandibular spacing which resulted in less amount of total mandibular set back by just BSSO technique alone. They generate a better result with less effect on posterior airway space and provided good skeletal stability.9,17

Although, upper anterior incisors showed severe proclination, an excessive amount of rotation at anterior segment of maxilla could not be done. The large bony step between anterior and posterior segment should be considered. It also could cause the periodontal problem at distal of canine where the surgical cut and extraction space closure take place which could lead to periodontal problem such as gingival recession (1.5%).18 Therefore, with the limitation above, the upper incisors still show some proclination at the end of the treatment (U1/SN = 114⁰), but no periodontal problem was founded. The side effect of Köle osteotomy set back is bony prominence and excessive chin contour.19 The genioplasty could help contouring the bony prominence and correct remaining asymmetry.

Finally, a proper surgical result not only concern about facial profile and dental occlusion, but also airway space should be appropriate considered. Some maxillary incisors proclination and minor reduction of airway space were observed, however, patient reports no change in sleep quality and feels pleasing with the treatment result.

CONCLUSION

The treatment goals of the dentoalveolar portion and facial proportion should be contemplated for the staged procedures to improve the efficiency and effectiveness of the treatment outcome. Soft tissue including airway space also should be carefully evaluated to avoid the unwanted side effects and provided the most suitable treatment for patient.

REFERENCE

1. Hardy D, Cubas Y, Orellana M. Prevalence of angle class III malocclusion: A systematic review and meta-


