The Orthodontic Treatment of Class III Malocclusion with Anterior Cross Bite and Severe Deep Bite

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INTRODUCTION

For correction of skeletal Class III malocclusion, Proffit states that there are three treatment options: 1) growth modification, use differential growth of the maxilla relative to the mandible; 2) camouflage of the skeletal discrepancy through tooth movements to correct the dental occlusion while maintain the skeletal discrepancy; or 3) orthognathic surgical correction. The treatment option is depending on the patient’s age, the facial profile, the skeletal pattern, the alveolar bone reaction on mandibular incisors, and the severity of malocclusion before treatment.

As for anterior cross bite, except some patients are truly skeletal Class III malocclusion, some others are pseudo-Class III malocclusion. These pseudo-Class III patients may present some characteristics as: 1) normal or mildly larger size of mandible; 2) normal or mildly smaller size of maxilla; 3) incisors could be guided to edge-to-edge in resting position; 4) difference between centric occlusion (CO) and centric relation (CR); 5) first molars may occlude in Angle’s Class III relationship.

The profiles of pseudo-Class III patients usually are concave, upper lips are less prominent due to insufficient support of upper incisors, while soft tissue menton and lower lips are more protrusive, but these Class III profiles...
The extraoral examination revealed that the patient had skeletal Class III malocclusion with midface deficiency, mandibular prognathism, acceptable lower facial height, insufficient display of upper incisors while smiling (Figure 1).

The intraoral examination revealed that the patient had Angle’s Class III malocclusion with anterior crossbite and deep bite with an accentuated curve of Spee in the lower arch and supra-eruption of lower incisors. The dental spaces in the lower arch resulted from the congenital missing of bilateral lower second premolars (Figures 1, 2). Besides, this patient was a pseudo-Class III malocclusion since her mandible could be guided to incisors edge to edge position (Figures 3, 4). The initial cephalometric analysis revealed that this patient was skeletal Class III malocclusion with normal mandibular plane angle, retroclined upper and lower incisors and retrusive upper lip (Figures 5, Table 1).

**CASE REPORT**

A 22-year-old female patient who had no history of illness or trauma, presented the following complaints including anterior crossbite and mandibular protrusion. The dental spaces in the lower arch came from congenital tooth missing.

Figure 1. Extraoral and intraoral photographs, before treatment.
Anterior Cross Bite with Deep OB

Figure 2. Study models, before treatment.

Figure 3. Intraoral photographs before treatment. The mandible could be guided to edge to edge bite.
Table 1. Cephalometric measurements before and after treatment.

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Pre-tx</th>
<th>Post-tx</th>
<th>Normal Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>SNA</td>
<td>79.0</td>
<td>80.0</td>
<td>79.8 ~ 83.2</td>
</tr>
<tr>
<td>SNB</td>
<td>80.0</td>
<td>78.5</td>
<td>75.7 ~ 78.7</td>
</tr>
<tr>
<td>ANB</td>
<td>-1.0</td>
<td>1.5</td>
<td>3.2 ~ 5.0</td>
</tr>
<tr>
<td>SN-MP</td>
<td>36.0</td>
<td>38.0</td>
<td>33.8 ~ 38.4</td>
</tr>
<tr>
<td>U1 to NA mm</td>
<td>4.0</td>
<td>7.5</td>
<td>4.3 ~ 8.1</td>
</tr>
<tr>
<td>U1 to SN°</td>
<td>92.0</td>
<td>104.5</td>
<td>103.85 ~ 108.75</td>
</tr>
<tr>
<td>U1 to NB mm</td>
<td>7.5</td>
<td>6.0</td>
<td>5.4 ~ 10.2</td>
</tr>
<tr>
<td>U1 to MP°</td>
<td>78.0</td>
<td>77.0</td>
<td>93.4 ~ 99.2</td>
</tr>
<tr>
<td>E-line: Upper</td>
<td>-3.5</td>
<td>-0.5</td>
<td>0.7 ~ 3.1</td>
</tr>
<tr>
<td>E-line: Lower</td>
<td>0.0</td>
<td>0.0</td>
<td>0.1 ~ 3.4</td>
</tr>
</tbody>
</table>
Anterior Cross Bite with Deep OB

Diagnosis
- Skeletal Class III jaw relation
- Orthodivergent facial pattern
- Angle’s Class III malocclusion
- Anterior crossbite and deep bite
- Congenital missing of #35, 45

Treatment objective
- To correct the anterior crossbite and deep bite, achieve normal overbite and overjet by upper anterior teeth proclination and lower anterior teeth retraction.
- To improve the facial profile and lip posture.
- To close the mandibular dental space.

Treatment plan
No further tooth extraction was planned for this patient. Full-mouth fixed edgewise appliances were bonded for leveling and alignment in the upper and lower dentition. The mandibular space was closed by lower anterior retraction and intrusion. Class III elastic was also used to correct the anterior crossbite and rotate the mandible in clockwise direction. Thus, mild mandibular protrusive posture was improved by the Class III mechanics.

Treatment progress
Orthodontic treatment was carried out by using the pre-adjusted 0.022-inch slot self-ligation system, and lower anterior resin bite blocks were also added in the initial stage to disocclude the bite and facilitate the correction of anterior crossbite (Figure 6). It took about seven months to accomplish the leveling and alignment and correct the anterior crossbite. Reposition of some brackets to calibrate the position and root angulation after mid-term panoramic film taking. Continuing the crossbite correction and closing the residual mandibular spaces were accomplished in another nine months. After a total treatment duration of 32 months, the upper wraparound retainer and the lower fixed retainer were used for retention (Table 2).

Figure 6. Full mouth bonded with fixed appliance with light wire leveling and bite block in the lower anterior teeth.
second premolars. Canine relation was finished in Class I relationship by lower anterior retraction and Class III elastics. The superimposition of cephalometric tracings revealed that the upper incisors were proclined, and the upper lip also became more prominent after treatment. In addition, the upper first molar was mesialized; lower incisors were retracted and intruded while lower first

### Treatment results

The facial profile maintained in mild concave at midface (Figure 7). Normal overbite and overjet, Class I canine relationships as well as coincident facial and dental midlines were achieved (Figure 8). The molar relation was finished in bilateral Class III due to the dental space closure of congenital missing mandibular bilateral

<table>
<thead>
<tr>
<th>Table 2. Summary of treatment progress.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Upper</strong></td>
</tr>
<tr>
<td><strong>103 / 11 ~ 104 / 06</strong></td>
</tr>
<tr>
<td>• Bonding</td>
</tr>
<tr>
<td>• Leveling and alignment</td>
</tr>
<tr>
<td>• Crossbite correction</td>
</tr>
<tr>
<td>- short Class III elastics</td>
</tr>
<tr>
<td><strong>104 / 06 ~ 105 / 03</strong></td>
</tr>
<tr>
<td>• Keeping crossbite correction</td>
</tr>
<tr>
<td><strong>105 / 03 ~ 105 / 10</strong></td>
</tr>
<tr>
<td>• Releveling</td>
</tr>
<tr>
<td>• Keeping and detailing</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>105 / 10 ~ 106 / 07</strong></td>
</tr>
<tr>
<td>• Releveling</td>
</tr>
<tr>
<td>• Maintaining crossbite correction</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>106 / 07</strong></td>
</tr>
<tr>
<td>• Debonding</td>
</tr>
<tr>
<td>- wraparound retainer</td>
</tr>
</tbody>
</table>

![Figure 7. The facial and intraoral photographs, after treatment.](image)
Anterior Cross Bite with Deep OB

molar was mesialized and extruded; and the mandible showed clockwise rotation (Figure 9, 10). The root parallelism and root resorption were acceptable and within the normal range (Figure 11). The cephalometric analysis comparing the initial and final conditions indicted that the ANB angle increased from -1° to 1.5°, the SN line to mandibular plane angle (SN-MP) also increased from 36° to 38°. The distance between upper incisor to NA line increased from 4 mm to 7.5 mm, and the angle between upper incisor to SN plane increased from 92° to 104.5°. The lip posture was improved by increase the distance of upper lip to E-line from -3.5 mm to -0.5 mm (Table 1).

Figure 8. The study models, after treatment.

Figure 9. Superimposition of cephalometric tracings. Black line, before treatment; red line, after treatment.
Figure 10. Regional superimposition of cephalometric tracings. A, maxilla; B, mandible; black line, before treatment; red line, after treatment.

Figure 11. A, lateral cephalometric film; B, panoramic radiograph, after treatment.
DISCUSSION

For correction for skeletal Class III malocclusion, there are three main treatment options: growth modification, orthodontic camouflage therapy, and surgical-orthodontics. Growth modification by dentofacial orthopedic appliances is an effective method to resolve skeletal Class III jaw discrepancies in children.\textsuperscript{2-5} Proffit indicated the criteria of case selection to enhance the outcome of orthodontic camouflage therapy, including: (1) average or short facial pattern; (2) mild anteroposterior jaw discrepancy; (3) crowding less than 4-6 mm; (4) normal soft tissue features (nose, lips, chin); (5) no transverse skeletal problem. Tseng et al. used the receiver operating characteristic analysis of cephalometric variables to distinguish the skeletal Class III malocclusions who requiring orthognathic surgery. There should meet 4 of these 6 measurements that indicated for surgical treatment: (1) overjet, $\leq -4.73$ mm; (2) Wits appraisal, $\leq -11.18$ mm; (3) L1-MP angle, $\leq 80.8^\circ$; (4) Mx/Mn ratio, $\leq 65.9\%$; (5) overbite, $\leq -0.18$ mm; and (6) gonial angle, $\geq 120.8^\circ$.\textsuperscript{6} For this patient, only 2 of these 6 measurements (L1-MP angle=79$^\circ$; gonial angle=122$^\circ$) met the surgical indication. Besides, this patient had average facial pattern, mild anteroposterior jaw discrepancy with upper dentition crowding, no transverse skeletal problem; patient’s incisors could be shifted to edge to edge position with relative normal soft tissue features in this position; so, this patient was arranged for camouflage orthodontic treatment.

For correction of the anterior crossbite, disoccluding the bite for unrestricted pathway in the initial tooth movement is essential. Various treatment methods have been proposed to correct anterior dental crossbite, such as tongue blades, reversed stainless steel crowns, fixed acrylic planes, bonded resin-composite slopes and removable acrylic appliances with finger springs.\textsuperscript{7-10} The aforementioned appliances might be huge, uncomfortable, and only applicable in young patients. For adult patients, fixed appliances with Class III elastics and bondable resin bites for disocclusion was effective to correct the anterior crossbite. The anterior resin bites also help to intrude the supra-eruptive lower anterior teeth. The upper teeth show was insufficient before treatment. By flaring of upper anterior incisors, the crowding in upper dentition was relived and the pleasing smile curve was also achieved. The patient’s upper lip rests on the gingiva margin of upper incisors when smile. The tooth show exceeds the proposed minimum of 0 to 2 mm of upper lip coverage of the anterior teeth for posed smile in Asian female standard.\textsuperscript{11}

In treating anterior crossbite with camouflage orthodontic treatment, lingual tipping of lower anterior teeth may result in wash-board appearance and periodontal damage. The cephalometric analysis indicated the change of lower incisor inclination was few (L1-MP: 78$^\circ$ to 77$^\circ$). The reasons for the few change in the lower incisors may be attributed to: (1) light force and short distance of Class III elastics (\textsubscript{3/16”} 2 oz) were applied when small-sized initial working NiTi wires (0.013 / 0.014 inch) were used to avoid unwanted side effect of over-retraction in lower anterior teeth; (2) gradually increase the size of working wires with appropriate amount of buccal crown torque in lower anterior teeth when closing lower dental space; (3) the combination of pre-torque NiTi wire (.017 x .025 NiTi with 20 degree lingual root torque) for torque control of lower anterior teeth.

The mandibular second premolars are the most frequent congenitally missing teeth followed by mandibular and maxillary lateral incisors.\textsuperscript{12} The etiology of tooth agenesis is considered to involve the disturbance of dental development by genetic factors, environmental factors, or combination of both. Many researchers have reported that tooth size is often smaller in patients with tooth agenesis than in patients without tooth agenesis.\textsuperscript{13-18} Two treatment approaches are available to solve the missing tooth space: (1) close the spacings and allow the permanent first molar drift mesially and then complete
the space closure orthodontically; (2) retain or regain the spaces for prosthesis. As for this patient, the dental spacings were small (< 3mm) and the lower anterior teeth retraction was required for the cross bite correction, the space was closed for camouflage treatment and no further prosthesis. To finish in Class III molar occlusion, the occlusion should be evaluated for the existence of mandibular third molars to make sure that there are antagonist teeth to occlude the maxillary second molars. Some adjustment might be required to occlude the mandibular first molars with maxillary premolars in finishing a good Class III molar relationship, including positioning the mandibular first molars lingually than normal; no offset in mandibular first molar; more offset in the maxillary premolars and molars; no toe-in in maxillary molars; lingual crown torque in mandibular molars; reduced palatal crown torque in maxillary premolars and molars. Some contouring or occlusal adjustment was required for better intercuspation, such as reduction of the palatal cusps in the maxillary premolars and molars or the augmentation of the buccal cusps of the mandibular molars with restoration.

When reviewing the long treatment duration (32M) for this patient, the main time was spent on correction of anterior crossbite. The length to use the lower anterior resin bite blocks was not long enough, so the patient still could move the mandible forward as the upper anterior teeth were still locked within the lower anterior teeth while biting or eating. The anterior crossbite was further corrected after the use of .017 x .025 pre-torque NiTi (20-degree, buccal crown torque) combined short Class III elastics. When remove the resin bite block, the mandible position should be re-evaluated and confirmed for stability.

CONCLUSION

Class III malocclusion may be a difficult task in orthodontic treatment, since we need to differentiate between skeletal or dental Class III malocclusion. The factors in identifying the patient as dental or skeletal Class III malocclusion and the factors in achieving good results of camouflage treatment were reviewed. The patient with dental Class III malocclusion can be well treated with proper evaluation and camouflage treatment.

REFERENCE