Nonsurgical Correction of Skeletal Class III Malocclusion with Evident Profile Change in an Adult Patient with Functional Shift and Low Mandibular Plane Angle

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INTRODUCTION

Class III malocclusion is the least prevalent type of Angle’s Classification of malocclusion in Caucasian, while it is more common in the Oriental. The prevalence of Class III malocclusion in a Chinese population can be as high as 12% \(^1,2\) as compared to the European (1.5% to 5.3%) and North American Caucasian (1 to 4%) populations.\(^3,6\)

Skeletal Class III malocclusion is defined by the sagittal relationship of the maxilla-mandibular complex, and often, it is associated with some complex problems, including functional shifts due to incisal interferences. Clinically, when dental interference is presented during intercuspation, the mandible may slide forward to avoid the premature contact, resulting in a larger negative overjet of the incisors.\(^7\)

For non-growing adult, the majority of the patients...
who have a severe skeletal Class III deformity are candidates for orthognathic surgery for its significant improvement of occlusion and facial esthetics. However, the dilemma we are confronted in some conservative patients who are not willing to accept surgical therapy. Since the facial profile of skeletal Class III deformities is always the main concern for patients who seek for treatment. This is a challenge for an orthodontist to develop a treatment plan that could estimate facial changes with the occlusal improvements along.

CASE REPORT

Diagnosis and etiology

This patient, 16 years 3 months of age, came with chief complaint of anterior crossbite. She was healthy with no specific medical problems. She had a prognathic mandible with mild facial asymmetry. Her chin was deviated to the left side. Besides, her facial profile was changed when estimated in the functional shift position (Figure 1). Intraorally, she showed a negative overjet and deep overbite with an accentuated curve of Spee. Her maxillary midline was coincided with the facial midline and her mandibular midline deviated to her left by 3 mm. The molar relationship was Class III on both sides. When her mandible was guided into centric relation, a functional shift was detected (Figure 2).

A panoramic radiograph showed multiple caries but no apical pathologies. Her maxillary third molars were developing, and the mandibular third molars were
erupting (Figure 3). The cephalometric radiograph showed that the mandible was significantly protruded (SNB angle, 91.5°) and the maxilla was in normal position (SNA angle, 83°), indicated a skeletal Class III (ANB angle, -8.5°) malocclusion with a low mandibular plane angle (SN-MP angle, 20°) (Figure 4, Table 1). The dental compensation masked the skeletal discrepancies, with severe lingual inclination of the mandibular incisors (mandibular incisor to mandibular plane, 82°) and labial inclination of the maxillary incisors (maxillary incisor to SN plane, 117°).

The malocclusion was caused primarily by the skeletal discrepancies and mainly because of the mandibular hyperplasia. Her father and grandmother also had protruded mandible. The etiology of her Class III malocclusion appeared to be a combination of heredity and environmental factors.
Table 1. Pretreatment cephalometric analysis.

<table>
<thead>
<tr>
<th>Skeletal analysis</th>
<th>SNA</th>
<th>SNB</th>
<th>ANB</th>
<th>SN-MP</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>83˚</td>
<td>91.5˚</td>
<td>-8.5˚</td>
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<td>33.8~38.4</td>
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<table>
<thead>
<tr>
<th>Dental analysis</th>
<th>Upper 1 to NA mm</th>
<th>Lower 1 to NB mm</th>
<th>Lower 1 to MP˚</th>
<th>E-line (mm)</th>
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<tr>
<td></td>
<td>6.5 mm</td>
<td>0 mm</td>
<td>82˚</td>
<td>Upper</td>
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<td>1 mm</td>
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<td></td>
<td>4.3~8.1</td>
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<td>93.4~99.2</td>
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<td>0.2~3.4</td>
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<table>
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<tr>
<th>Facial analysis</th>
<th>Upper E-line (mm)</th>
<th>0.7~3.1</th>
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<tr>
<td></td>
<td>Lower E-line (mm)</td>
<td>0.2~3.4</td>
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**Treatment objective**

The patient had a skeletal Class III relationship with transverse arch incompatibility and chin deviation; facial profile and symmetry correction was considered to be the primary option. Surgical-orthodontics was recommended to the patient and family, but they declined. Therefore, the treatment objectives were revised to only occlusion correction to achieve maximum improvement of occlusion and oral function, including speech and mastication. Revised treatment objectives were as follows.

1. Establish positive overjet and normal overbite
2. Eliminate the functional shift and correct the dental midline
3. Establish Class I molar and canine relationships
4. Level the curve of Spee and establish a stable occlusion
5. Improve the dentofacial esthetics

**Treatment alternative and treatment plan**

According to her growth cephalometric analysis and the age of menarche (11 years), the maxillomandibular growth potential was limited. The treatment goals with orthodontics alone could be clearly determined.

For the orthodontic camouflage treatment alternatives, 2 options could be considered. One alternative was mandibular premolar extraction. The mandibular incisors could be retracted by extraction space closure; positive overjet could be achieved. However, mandibular premolar extractions could cause severe lingual inclination of the lower incisors and bite deepening, also negatively affect the concave facial profile.

Another alternative was to extract the lower left third molar and right second molar and then upright and distalize the mandibular dentition and correct the midline...
deviation. The arch wires exerting light continuous tip-back force along with Class III elastics could be used to correct the negative overjet. The maxillary incisor proclination was permitted with Class III elastics for protruding the upper lip. Because she had a concave profile accompanied with low mandibular angle, clockwise rotation of the mandible could improve the profile and also contribute to the correction of the Class III molar relationship.

We thoroughly discussed these camouflage alternatives and explained that the skeletal disharmony and chin deviation would not be completely corrected, as well as the gingival recession would occur. She still preferred the nonsurgical approach of the lower molar extractions (right: 2\textsuperscript{nd} molar; left: 3\textsuperscript{rd} molar), and she agreed to cooperate in wearing intermaxillary elastics as instructed. The definitive plan was listed as followings.

1. Camouflage treatment
2. Extraction of tooth 38,47
3. Full mouth bonding fixed preadjusted bracket system
4. Stage I: Leveling and alignment

Stage II:

1. Close the extraction space and tooth 48 substituted for tooth 47
2. Correction of reverse overjet
3. Class III elastics for tip-back lower molars and protract upper teeth
4. Bite opening by lower wire bending of reverse curve of Spee
5. Midline correction
6. Achieve canine and molar Class I relationship

Stage III:

1. Correction of torque and tip angles for each tooth individually
2. Detailing and finishing

Stage IV: Retention

1. Upper wraparound retainer
2. Lower fixed retainer and wraparound retainer

Treatment progress

Tip-Edge Plus brackets with 0.022 x 0.028-in slots were bonded on both arches for leveling and alignment. The maxillary and mandibular arch were leveled with continuous arch wires, starting with 0.014-inch NiTi wires. We use lower anterior bite turbo to disocclude posterior teeth for posterior teeth extrusion (Figure 5).

Figure 5. Use the 0.014-inch NiTi wires in both arches and lower anterior bite turbos to disocclude the posterior teeth.
After 2 months, the mandibular arch distalization were performed over a maxillary 0.016 x 0.022-inch stainless-steel arch wire and a mandibular 0.016-inch Australia arch wire. Bilateral class III elastics was used for lower arch distalization (Figure 6).

In the 14th month, all the space was closed and the canine and molar relationship were almost in Class I relationship. During the finishing stage, final detailing of the occlusion was accomplished with bimaxillary 0.021 x 0.025-inch stainless-steel arch wires for torque and angulation correction in conjunction with right side Class II elastics for 0.5 mm midline correction (Figure 7).

After 23 months of orthodontic treatment, the brackets were removed. The 0.0175-inch tripleflex wire were bonded from canine to canine in the lower arch, meanwhile, wraparound removable retainers were also delivered to secure the stability of both arches.

Treatment result
The patient cooperation throughout the treatment was excellent, and ideal overjet and overbite with Class
I molar and canine relationships were achieved, and the dental midline was aligned with the facial midline (Figure 8). The concave facial profile improved apparently with a clockwise rotation of the mandible (Figure 9).

The posttreatment panoramic radiograph showed acceptable root parallelism with no significant signs of bone or root resorption (Figure 10). Posttreatment lateral cephalometric analysis and superimposition showed skeletal changes (ANB angle, -8.5°→-7°). The mandible rotated downward and backward, and there was a slight increase in the mandibular plane angle (SN- MP, 20°→23°). The proclination of the maxillary incisors (U1-SN, 117°→126°) compared with pretreatment was observed, and the angle of mandibular incisors had a slight improvement (L1-MP, 82°→83°) (Figure 11, 12; Table 2). The patient’s facial profile, especially the position of upper and lower lip and soft-tissue pogonion, were improved (Figure 8, 12). The patient was satisfied with the functional and esthetic results.
Figure 10. Posttreatment panoramic radiograph.

Figure 11. Posttreatment cephalometric radiograph.

Table 2. Posttreatment cephalometric analysis.

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<tr>
<th>Analysis</th>
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<th>POST TX</th>
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<td>Lower 1 to NB mm</td>
<td>0 mm</td>
<td>-0.5 mm</td>
</tr>
<tr>
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<td>83˚</td>
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<td><strong>Facial analysis</strong></td>
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<td>Lower</td>
<td>-3 mm</td>
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DISCUSSION

Although treatment of severe Class III skeletal relationships usually requires a combination of orthodontic treatment and orthognathic surgery to achieve desirable results in adults. Treatment of some Class III dental malocclusions can be accomplished by camouflage treatment with various extraction combinations, depending on the severity of the malocclusion. Camouflage treatment usually includes some unwanted side effects as extrusion of the maxillary molars and proclination of the maxillary incisors because of the Class III elastics, but those only happen to patients with a low mandibular plane angle and a deep bite occlusion. Class III elastics extrude the maxillary molars and cause clockwise mandibular rotation that results in increased lower anterior face height. It is important to consider these potential undesirable treatment outcomes, especially in hyperdivergent patients, whose molar extrusions could produce unpleasant esthetic facial changes.

Moon et al. indicated that Class III patients with a more hypodivergent skeletal pattern generally respond better to treatment. Franchi et al. stated that a lower palatal plane to mandibular plane angle, is a predictive
indicator of good outcomes in early Class III treatment. They demonstrated that a patient with an angle of 23.0°±4.1° was treated successfully, but a patient with an angle of 29.4°±5.6° had unpleasant treatment outcome. Although these 2 previous studies dealt with early treatment of Class III patients, the conclusions can be also applied to adult patients. The case has hypodivergent skeletal pattern (SN-MP, 20°) indicated that she would be more receptive to camouflage treatment.

Combining the use of lower anterior bite turbo and the vertical component of the Class III traction on the upper molar contributed to the posterior extrusion of bimaxillary molars. Mandibular plane angle at the end of the treatment increased, related to the clockwise rotation of the occlusal plane. It was optimal to the improvement of the profile in the Class III dentition. All these were beneficial in the correction of skeletal Class III malocclusion with a low mandibular plane angle.

Another important consideration for patients with Class III malocclusion is the discrepancy between centric relation and centric occlusion in the sagittal plane as reference. Diagnosis of “pseudo” Class III, defined as a Class III occlusal situation due to the functional shift of the mandible to avoid premature contact and interferences, is compared and differentiated from the true skeletal Class III accompanied by maxillary deficiency and/or mandibular excess. However, Class III patients in adulthood often have enough mandibular excess to lead to a premature contact of the incisors, creating a functional shift of the mandible. Clinically, the functional shift worsens the relatively straight profile to a hypodivergent and chin prominent profile with deep negative overjet at maximum intercuspation and excessive exposure of the mandibular teeth when smile, similar to the case in this report. Thus, proper diagnosis, treatment planning, and retention are critical in achieving the most desirable outcomes for patients with a Class III malocclusion and a functional shift. In this case, the patient’s pretreatment and posttreatment cephalometric superimpositions showed that the mandible moved back approximately 1.5 mm; this helped to correct the anterior crossbite, improve the posterior occlusion, and eliminate the functional shift by making centric relation coincident with centric occlusion. The dental camouflage of Class III malocclusion with non-extraction became possible.

There are a few factors that should be taken into consideration and inform patient before determining the treatment plan. Dental extraction of lower premolars usually involves a large amount of lower incisors retraction to improve the overjet. Nevertheless, the incisors would move easily beyond the alveolar bone or boundary limitations. In addition, patient’s chin may appear more protrusive, and subsequently result in an unaesthetic chin contour. Moreover, mandibular premolars extractions would lead to “Class III molar relationship,” which make the upper second molar have no antagonist and consequently overerupt into the lower distal molar space. In this case, the jaw discrepancies became less severe after eliminating the mandibular functional shift, which allowed the clinicians to perform non-premolar extraction treatment instead of large amount of retraction. The final treatment plan was the extraction of lower left third molar and lower right second molar for the minor mandible retraction and midline correction as well. Meanwhile, it’s important to assess the position and morphology of the adjacent third molar. In this patient, the lower right third molar was partially erupted and the pathway of eruption was appropriate, neither buccolingually nor mesiodistally.

The effective distalization of mandibular teeth and positive overjet were easily obtained with the aid of the differential tooth movement mechanism. That is to say, the net result of crown tipping followed by root uprighting is bodily movement (Figure 13). Tip-Edge Plus brackets followed by Begg light wire technique is known as its cutting edge and low frictional resistance (Figure 14), and contributed to the arch distalization with the light force of the Class III elastics about 50-60 g. A tipping movement
of teeth is much easier than a bodily movement and, therefore, the range of movement is larger.\textsuperscript{19-21}

Combining the forward movement of the upper teeth, mandible clockwise reposition, and the increase of anterior lower facial height contributed to the correction of the anterior crossbite and achievement of Class I molar relationship.\textsuperscript{22-23} Above all, there was a successful camouflage treatment to have a satisfying profile in cases with such a prognathic mandible. It’s worth mentioning that no screw was used in this patient.

Figure 13. Differential tooth movement.
\(\text{A} \) crown tipping; \(\text{B} \) root uprighting; \(\text{C} \) bodily movement.

Figure 14. The cutting edge of Tip-Edge Plus brackets.
CONCLUSION

Several orthodontic camouflage treatment modalities could be used to treat Class III malocclusion patients, provided by an appropriate initial examination and diagnosis. In this case, we detected the diagnosis of functional shift and the character of low mandibular plane angle which prompted clinicians to review the feasibility of non-surgical treatment to improve the dental and facial esthetics simultaneously. More importantly, the benefits and disadvantages, and the limitations of camouflage treatment should be explained carefully to the patient before the initiation of treatments.

REFERENCES


