Conservative treatment for a growing patient with a severe, developing skeletal Class III malocclusion and open bite

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An 8-year-old Chinese girl sought treatment for a severe skeletal Class III malocclusion and open-bite skeletal pattern. Traditionally, patients with a skeletal Class III malocclusion are treated after they have stopped growing, and then they are treated with a combined orthodontic and orthognathic surgery approach. But the risks and expenses of this treatment plan are not acceptable to all patients. This young patient was treated with facemask therapy, a maxillary expansion device, and a molar occlusal splint for maxillary developmental stimulation with control of vertical jaw growth. After the completion of orthopedic therapy, \(2 \times 4\) technology was used to adjust molar positions. A bonded tongue crib was used in the early permanent dentition to help the patient break her bad tongue habits. Straight-wire appliances were used for 16 months to adjust the occlusal relationship. This achieved significant improvement in anterior tooth relationships and facial profile esthetics. At the 2-year post-treatment follow-up, the results were satisfactory. The success of the sagittal relationship correction between the maxilla and the mandible for a skeletal Class III malocclusion depends on the coordination of transverse and vertical relationships combined with the growth potential of each patient. (Am J Orthod Dentofacial Orthop 2014;145:807-16)

The treatment for a skeletal Class III malocclusion with an open bite is among the most challenging.1,2 These patients have vertical facial growth patterns that manifest clinically as length disharmonies between the maxilla and the mandible in the sagittal plane. Clockwise rotation occurs with the growth and development of the mandible in patients with bad tongue habits, which not only increase treatment difficulty but also increase the possibility of recurrence.3

Patients with a skeletal Class III malocclusion are often advised to wait until adulthood for combined orthodontic and orthognathic surgery, but the potential risks and expenses involved are not acceptable to all patients. Since its introduction in the 1960s, facemask therapy has made it possible to direct and stimulate maxillary protraction growth with extraoral force. Several studies have shown that the position and the dimensions of the dentofacial complex can be effectively changed with a facemask or a maxillary expansion appliance in the early period of growth and development of patients with a skeletal Class III malocclusion.4-6 Because of molar extrusion and the horizontal force exerted by the chincap, mandibular clockwise rotation is a typical result of facemask or maxillary expansion treatment.7-9 Therefore, facemask therapy is more suitable for patients with a skeletal Class III malocclusion and a horizontal growth pattern.10

The growth pattern of the maxillofacial region is set after birth, and it rarely changes in a person’s lifetime.11-13 In patients unwilling to undergo surgery, interference with the direction and quantity of jaw growth during the early growth period is the sole option. This can help to establish a favorable maxillofacial structure. To some
extent, the selection and success of treatment relies on the growth potential of each patient with a skeletal Class III malocclusion. In this case report, we present the treatment of an 8-year-old girl; her parents were unwilling to have her undergo surgical treatment for her skeletal Class III malocclusion. Instead, she was treated with a face-mask, maxillary expansion, and a molar occlusal splint for stimulation of maxillary development and control of vertical jaw growth. After the orthopedic therapy, 2 × 4 technology was used to adjust the molar positions. This case report highlights a treatment that used the patient’s physiologic skeletal, muscular, and dental movements to achieve the desired correction.

**DIAGNOSIS AND ETIOLOGY**

The patient was a girl aged 8 years with no relevant medical history of bone or dental pathology in her family, but she had bad tongue habits. The extraoral examination showed a midface deficiency along with a Class III profile (Fig 1). The intraoral examination showed a Class III maloclusion with posterior and anterior crossbites and with anterior open bite.

The dental casts (Fig 2) showed a transverse deficiency and an arch length deficiency in the maxillary arch. Moreover, molar and canine Class III relationships coexisted with the anterior and posterior crossbites and the anterior open bite of 3 mm. The panoramic radiograph (Fig 3) showed no hypodontia (and normal periodontal conditions).

The cephalometric analysis showed a skeletal Class III relationship (ANB angle, −5°) with mandibular excess (SNB angle, 85°). The maxillofacial region had a vertical growth pattern (S-Go/N-Me, 58.8%), but the y-axis angle was basically normal (y-axis, 60°). The mandibular body was long, and the ramus was obviously short (Go-Pg, 79 mm; Go-Co, 48 mm). The position and size of the maxilla were deficient (SNA angle, 80°). The mandibular

**Fig 1.** Pretreatment photographs.
incisors were lingually inclined ($L_1$-$NB$ angle, 27°). The maxillary incisors were labially inclined ($U_1$-$L_1$ angle, 119°; $U_1$-$SN$ angle, 62°; $U_1$-$NA$ angle, 37°). The eruption of the maxillary incisors and the mandibular molars was deficient ($U_1$-$PP$, 24 mm; $L_6$-$MP$, 26 mm) (Fig 4, Table).

**TREATMENT OBJECTIVES**

The proposed primary treatment objectives were as follows.
1. Stabilize the maxillary and mandibular vertical relationship.
2. Eliminate the functional limitation of the mandible by transverse expansion of the maxillary arch in the early period.
3. Coordinate the maxillary and mandibular sagittal relationships by correction of the dental malocclusion.
4. Obtain a normal posterior overjet and correct the anterior open bite and anterior crowding.

**TREATMENT ALTERNATIVES**

The first alternative was combined orthodontic and orthognathic surgery after the patient was an adult. In this proposal, presurgical decompensatory treatment could be used to relieve minor dental crowding. Meanwhile, a normal inclination angle of the maxillary and mandibular anterior teeth could be achieved. Through orthognathic surgery, the maxillary position could be reset to improve the midfacial concave profile. With backward and counterclockwise rotation of mandible, the open bite could be corrected to achieve a normal occlusion and an ideal soft-tissue profile, but the surgery was rejected by the patient’s parents.

The second alternative was to make use of the patient’s growth potential by directing the growth of the jaws in different development periods. With facemask therapy for maxillary protraction, the sagittal relationship of the maxilla and the mandible could be coordinated. Through maxillary expansion, the disharmony of the intermaxillary transverse relationship would be improved. With an occlusal splint, the excessive molar extrusion would be inhibited.

After the completion of treatment, a normal occlusal relationship would be established through orthodontic camouflage treatment so that the facial profile would be restored. The second treatment proposal was accepted by the patient and her parents.

**TREATMENT PROGRESS**

Stage 1 included orthopedic therapy that lasted for 2 years 3 months. The intermaxillary locked bite had to be eliminated as a priority for the adjustment of the sagittal relationship. Therefore, a rapid maxillary expansion (RME) appliance and an occlusal splint were placed in the maxilla. An occlusal splint for the posterior teeth was used to control molar extrusion. When proper
maxillary arch width was obtained after expansion, the RME appliance was still kept in place to prevent recurrence until the end of the mixed dentition period. When the maxillary expansion treatment started, maxillary protraction was performed with a 7-oz elastic traction force on each side and less than a 15° pulling angle in a forward and downward direction with continuous traction for 2 years until an overcorrected anterior overjet relationship was achieved. After orthopedic therapy, an anterior open bite still existed (Fig 5).

In stage 2, the orthodontic camouflage treatment was initiated. With the RME appliance for the maxilla in place, fixed vestibular brackets were bonded to the mandibular dentition with nickel-titanium wires for good alignment (Fig 6). After the RME appliance was removed, 2 X 4 technology was used for good alignment of the anterior teeth as the maxillary lateral incisors erupted, with the proper use of a tip-back bend for the adjustment of molar positions to stabilize the mandibular molars. During treatment, the movement of the teeth and the jaw fully depended on their growth adjustment, preventing the use of intermaxillary traction. A superficial overbite was established in the anterior teeth half a year later (Fig 7).

Stage 3 was the period for general fixed orthodontic treatment. A tongue crib was bonded to the lingual side of mandibular anterior teeth to correct the patient’s bad tongue habits. The maxillary and mandibular dentitions were well aligned and leveled for accurate adjustment of the occlusal relationships (Fig 8).
The fixed orthodontic appliance was removed after 18 months, and a modified Hawley retainer was used.

**TREATMENT RESULTS**

A good profile was obtained (Fig 9). The maxillary development deficiency was corrected, and the clockwise rotation of the mandible under orthopedic therapy did not worsen, so that the facial growth direction was well maintained. With regard to the teeth, an Angle Class I relationship was obtained for the molars with normal anterior overbite and overjet (Fig 10). No dental root resorption and alveolar bone loss were shown in the panoramic radiograph (Fig 11).

The results of the cephalometric analysis (Fig 12, Table) showed that the ANB angle was noticeably improved (from $-5^\circ$ to $2^\circ$) with the maxilla moving forward (SNA angle changed from $80^\circ$ to $83^\circ$). The extrusion of the mandibular incisors and the lingual inclination compensation were apparent (L1-NB angle, from $27^\circ$ to $19^\circ$; U1-L1 angle, from $119^\circ$ to $123^\circ$). With the use of an occlusal splint and a horizontal protraction force, counterclockwise rotation of maxilla was obtained (PP-FH angle, from $-9^\circ$ to $1^\circ$); this partially compensated for the mandibular molar extrusion (L6-MP, from 26 to 32 mm) and the mandibular rotation to stabilize the facial growth direction (y-axis, $60^\circ$; S-Go/N-Me, 59.3%). The records 2 years after the end of the treatment showed good and stable treatment results (Fig 13).

**DISCUSSION**

It is difficult to establish and maintain normal overbite and overjet relationships in orthodontic treatment for patients with a skeletal Class III malocclusion combined with an open bite caused by jaw growth patterns and bad tongue habits. We believe that in the early orthodontic therapy for a patient with a skeletal
malocclusion, every step of the treatment should follow the biomechanism of the dentomaxillary system. Only when the physiologic compensatory mechanisms of the dentomaxillary system are stimulated, use of the simplest approaches to acquire long-term and stable orthotherapy results is possible.

In the treatment planning for such patients, overall growth direction (y-axis) of the maxillofacial region should be maintained to control its vertical growth. In the sagittal direction, the length and the position of the maxilla and the mandible should be coordinated through orthopedic force. Finally, normal occlusal relationships can be established by directing the movement of the dental arch and the dentition with orthodontic camouflage treatment.

There are 3 typical effects of facemask therapy: maxillary protrusive movement, maxillary molar mesial movement, and clockwise rotation of the mandible. The first and second effects were the results we wanted to achieve, whereas the third one negatively impacts the malocclusion by making treatment more difficult and damaging the jaw growth direction. Therefore, the direction of traction force is crucial in facemask therapy. For our patient, an angle of less than 15° in the
infra-anterior direction was obtained; it did not go through the center of resistance of the maxilla and the dental arch. Thus, counterclockwise rotation of the maxilla occurred. Since the molar occlusal splint was in place simultaneously with the facemask, a counterclockwise rotation with the molar region (as a rotation center) was established during the maxillary protrusive movement, partially compensating for the mandibular clockwise rotation and improving the lower facial height. With an orthopedic force in this direction, satisfactory protrusive movements of the maxilla and the maxillary arch could also be acquired.

Since the orthotherapy concept is in compliance with the biomechanism of the dentomaxillary system, it is ideal to coordinate the jaw relationship by the patient’s own physiologic adjustment. With protractive orthopedic therapy, the intermaxillary locked bite was eliminated using the RME appliance and the molar occlusal splint. With these approaches, a new mandibular physiologic position could be established under the balance of internal and external myodynamics of the lingual and labial muscles. After orthopedic therapy, the overjet was overcorrected. Although there was still minor clockwise rotation in the mandible, the ratio of the lower facial height to the overall face was maintained at the pretreatment level.

In the retention stage of orthopedic therapy, the mixed dentition was not finished. The RME appliance and the occlusal splint should be kept in place for about 1 year after completing the maxillary expansion treatment. The critical factor in the treatment for this stage was to guide the teeth to normal positions and establish relatively normal occlusal relationships. Continuous Class III or intermaxillary vertical traction is commonly used to treat patients with a skeletal Class III malocclusion by protracting and inclining the teeth, but treatment stability is doubtful. Fixed vestibular brackets were bonded to the permanent teeth (partially erupted) without using complicated orthodontic technology and intermaxillary traction; we only aimed for simple

![Posttreatment photographs.](image)

Fig 9. Posttreatment photographs.
alignment and leveling. With natural growth of maxillary and mandibular incisors, superficial overbite and overjet relationships have been established in the permanent dentition.

The major issues of this patient’s malocclusion had already been tackled in the first 2 stages of the treatment. A Class I molar relationship and superficial anterior overbite and overjet were obtained. In the next orthotherapy in the early period of the permanent dentition, a tongue crib was bonded to the lingual side of the mandibular incisors to change the bad tongue habits. In addition, the premolar open bite had been corrected. After treatment, the occlusion, the smile, the lateral profile, and the ratio of frontal soft tissues were obviously improved.

CONCLUSIONS

The orthodontic approach in compliance with the biomechanism of the dentomaxillary system has great success in obtaining cosmetic and stable results. As far as a teenage patient with a skeletal Class III malocclusion is concerned, the jaw growth direction must be maintained without change during treatment, while the orthopedic force is needed to adjust the sagittal jaw relationship. Changes of the balance of internal and external myodynamics are also necessary to establish a dental compensatory relationship.
Fig 12. Posttreatment cephalometric superimposition (black lines, pretreatment; dotted green lines, after facemask treatment; red lines, posttreatment).

Fig 13.Retention photographs.
REFERENCES


