Early orthodontic intervention followed by fixed appliance therapy in a patient with a severe Class III malocclusion and cleft lip and palate

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This case report describes the treatment of a girl, age 11 years 10 months, with a cleft lip and palate and a postsurgical scar. The clinical examination showed a concave profile, a retrusive maxilla, an asymmetric face, severe dental crowding, a Class III dental relationship, and a complete dental crossbite. Maxillary expansion and distraction, chincap, and high-pull headgear were used to moderate the skeletal discrepancy. These approaches, combined with tooth extraction and fixed orthodontic appliances, finally established a functional and aesthetic occlusal relationship, normal overjet and overbite, and a well-balanced facial appearance. (Am J Orthod Dentofacial Orthop 2013;144:726-36)

A skeletal Class III malocclusion has been acknowledged to be the most challenging problem confronting orthodontists, especially when it is associated with cleft lip and palate. 1 Primarily because of the unpredictable and potentially abnormal growth in patients with this skeletal pattern, treatment planning for most young patients with Class III malocclusion has been directed at growth modification. 2 Although early treatment of these patients commonly achieves a relatively more normal jaw relationship, there have been few case reports of early intervention for a Class III malocclusion in a patient with cleft lip and palate. 3

Most patients with cleft lip and palate have altered and deficient maxillary growth as a result of postsurgical scar contraction or anatomic anomalies, and even may have dental arch deformities. Our aims of orthodontic treatment for these patients are to solve or moderate these deformities and to establish an ideal maxillomandibular relationship. 4 This case report describes the treatment of a girl, age 11 years 10 months, with cleft lip and palate and a postsurgical scar, a Class III malocclusion, maxillary anterior crowding, and a complete dental crossbite.

DIAGNOSIS AND ETIOLOGY

The girl and her parents came for orthodontic treatment with chief complaints of a crossbite and an unesthetic smile. She had received surgery at the age of 4 years and had no contraindication to orthodontic therapy. The pretreatment examination (Fig 1) and the dental casts (Fig 2) showed a concave profile (suggesting maxillary retrusion) and an asymmetric face (suggesting mandibular deviation).

There was severe dental crowding (13 mm), and a left deciduous second molar remained in the maxilla; in the mandible, the deciduous second molars remained on both sides, with mild dental crowding. She had a Class III dental relationship on the left side and a Class I relationship on the right, as well as a complete dental crossbite. The maxillary midline deviated 3 mm to the right from the facial midline, and the mandibular midline was shifted 1 mm to the left.

The cephalometric tracing (Fig 3) and analysis (Table) showed a vertical skeletal pattern (MP-FH, 34°; PFH, 64.1°; AFH, 105.1°; FHI, 0.6°) and a Class III skeletal relationship with maxillary retrusion (SNA, 81.2°; SNB, 84.1°; ANB, −2.9°). The mandibular incisors were retroclined (IMPA, 77.5°; 1.NB, 20°; 1-NB, 3.8 mm). The concave...
Fig 1. Pretreatment photographs.

Fig 2. Pretreatment dental casts.
profile was due to a sagittally deficient maxilla (Z-angle, 79.6°; ULP, −2.8 mm; lower lip-E plane [LLP], 2.4 mm; nasolabial angle, 96°). Both the left and right second premolars were developing and could be seen on the panoramic radiograph (Fig 4). The right mandibular ramus length was slightly shorter than that of the left side.

**Table. Cephalometric analysis**

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Average</th>
<th>Initial</th>
<th>Final</th>
<th>2 years after treatment</th>
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<tr>
<td><strong>Skeletal</strong></td>
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<tr>
<td>SNA (°)</td>
<td>82.3 ± 3.5</td>
<td>79.8</td>
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<td>SNB (°)</td>
<td>78.9 ± 3.5</td>
<td>81.6</td>
<td>82.8</td>
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<tr>
<td>ANB (°)</td>
<td>3.4 ± 1.8</td>
<td>−3.8</td>
<td>−0.7</td>
<td>−0.1</td>
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<tr>
<td>Convexity (°)</td>
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<td>−7.3</td>
<td>−3.5</td>
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<tr>
<td>MP-FH (°)</td>
<td>28.8 ± 5.2</td>
<td>31.9</td>
<td>37.2</td>
<td>38.3</td>
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<td>Gonial angle (°)</td>
<td>131.0 ± 5.6</td>
<td>133.6</td>
<td>133.7</td>
<td>133.4</td>
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<td>SL (mm)</td>
<td>41.9 ± 6.2</td>
<td>45.5</td>
<td>45.3</td>
<td>44.8</td>
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<td>SE (mm)</td>
<td>20.6 ± 2.7</td>
<td>15.7</td>
<td>14.5</td>
<td>14.9</td>
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<tr>
<td>NP-FH (°)</td>
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<td>89.4</td>
<td>86</td>
<td>85.7</td>
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<td>PFH (mm)</td>
<td>45.0</td>
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<td>AFH (mm)</td>
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<td>FHI (PFH/AFH)</td>
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<td>Y-axis (°)</td>
<td>65.4 ± 5.6</td>
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<td>66.5</td>
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<td><strong>Dental</strong></td>
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<td>U1-FH (°)</td>
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<td>U1-L1 (°)</td>
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<td>FMIA (°)</td>
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<td>IMPA (°)</td>
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<td>1 NB (°)</td>
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<td>1-NB (mm)</td>
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<td>1-NA (°)</td>
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<td>6.2 ± 1.9</td>
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<td><strong>Soft tissues</strong></td>
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<td>Z-angle (°)</td>
<td>69.11 ± 4.74</td>
<td>80.5</td>
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<td>Nasolabial angle (°)</td>
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<td>93</td>
<td>89</td>
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<tr>
<td>ULP (mm)</td>
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<td>LLP (mm)</td>
<td>2.6 ± 1.5</td>
<td>2.5</td>
<td>−1.7</td>
<td>−2.4</td>
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</table>

**TREATMENT OBJECTIVES**

Since this patient had a cleft lip and palate with a Class III malocclusion and a vertical skeletal pattern, the realistic and ideal treatment objectives were to (1) correct the maxillomandibular skeletal discrepancy; (2) obtain a normalized, functional, and stable occlusion; (3) create satisfactory overbite and overjet; (4) align the maxillary and mandibular dentitions and correct the midline; and (5) improve the dental esthetics and provide a favorable facial profile.

**TREATMENT ALTERNATIVES**

All alternatives made during the diagnosis were presented to the patient and her parents. Because she still had some maxillomandibular growth potential to accomplish ideal treatment goals, a nonsurgical approach was considered to be the best treatment option.

For an 11-year-old girl with cleft lip and palate, fixed orthodontic appliances alone had limitations, and the assistance of some other dental specialties was required to camouflage certain skeletal and dental factors of her
malocclusion and to help improve esthetics and function. The options considered included (1) maxillary and mandibular first premolar extractions, compensation mechanics, and further occlusal adjustment with Class III elastics; (2) rapid maxillary expansion and distraction as well as a high-pull chincap to moderate or correct the Class III skeletal relationship, with extraction of the maxillary and mandibular first premolars to correct the crowding, overjet, and anterior crossbite; and (3) combined therapy of orthodontic-orthognathic surgery after she reached 18 years old.

**TREATMENT PROGRESS**

Treatment began with maxillary expansion using a jackscrew expansion appliance soldered to 2 banded teeth per side [Fig 5, A]. The appliance was activated at a rate of 0.5 mm per day for 15 days, until the posterior crossbite had been moderated.

The facemask and the construction used for protraction were connected with anterior hooks in the canine region for elastics [Fig 5, B]. A 400-g to 500-g protraction force was transferred to the hooks per side, with the elastics adjusted to provide a forward and downward pull at 30° to the occlusal plane to minimize the side effect of counterclockwise rotation. The patient wore the facemask for at least 12 hours a day, and it was started after 4 weeks of maxillary expansion. The anterior crossbite was corrected 3 months later (Fig 5, C). The transverse expansion and protraction of the maxilla was maintained for 5 months to limit the relapse caused by the scar contraction and the increased muscle tension.

A chincap and high-pull headgear were used to limit the excessive mandibular anterior facial height, and Tip-Edge brackets (TP Orthodontics, La Porte, Ind) were bonded to the teeth (Fig 6). With sequential nickel-titanium archwires, dental alignment and leveling were observed in 3 months. We placed an 0.018–0.025-in stainless steel wire and an Australian wire, respectively, in the maxillary and mandibular dental arches. Then nickel-titanium coil springs (Fig 7, A) and Class III elastics (Fig 7, B) were used for space adjustment and distal movement of the mandibular dental arch.

Then the Tip-Edge brackets were replaced by preadjusted 0.022-in brackets (MBT; 3M Unitek, Monrovia, Calif). Australian wire and 0.18 × 0.025-in stainless steel archwires were used to align the teeth more precisely. At
**Fig 6.** Combination of high-pull chin cap and Tip-Edge brackets.

**Fig 7.** Treatment progress: 

A, nickel-titanium coil springs for space adjustment;  

B, Class III elastics for mandibular dental retraction;  

C, Tip-Edge brackets replaced by MBT brackets and mini-implant for midline correction.
the third stage, to correct the maxillary midline, a mini-
implant (1.6 × 9 mm; Medicon, Tuttlingen, Germany)
was placed between the roots of the maxillary right
lateral incisor and canine, 3 mm occlusally to the vestib-
ular groove (Fig 7, C). The treatment lasted 3 years 2
months. It took over 12 months to establish Class I molar
relationships, including maxillary expansion, protraction,
and tooth movement, and 6 months to correct
the midline.

TREATMENT RESULTS

The posttreatment facial photographs (Fig 8) and
dental casts (Fig 9) indicated a noteworthy improvement
in the lower facial profile from the pronounced retrac-
tion of the mandibular anterior teeth. The lower lip
moved backward, shown by LLP, resulting in an opti-
mized lip relationship. Because of the better mandibular incisor and lower lip positions, the soft-tissue profile
became more convex, the Z-angle decreased signifi-
cantly, and the nasolabial angle also decreased slightly.
Meanwhile, the crossbite had been corrected, and Class
1 canine and molar relationships were achieved with
normal overbite and overjet.

The lateral cephalometric tracing and analysis (Fig
10, Table) were consistent with the clinical results. Verti-
cally, lower facial height increased as shown by MP-FH,
PFH, and AFH, yet the facial height ratio was main-
tained. Sagittally, the skeletal discrepancy between the
maxilla and the mandible was remarkably moderated,
as confirmed by the SNA, SNB, and ANB angles. The mandible tilted down and backward because of the pres-
sure exerted on the chin. Although the treatment for this patient was a compromise, satisfactory results were ob-
tained. In addition, her facial convexity was significantly
improved as shown by NP-FH and y-axis. The mandib-
ular incisors moved backward to a more acceptable
position as shown by 1.NB, 1-NA, FMIA, IMPA, and
the interincisal angle. The maxillary incisors were also
retracted as shown by U1-FH and 1-NA.

The soft-tissue profile changes between pretreatment and posttreatment, as well as the skeletal profile
improvement and tooth movement, were clearly evident
on the superimposition of the cephalometric tracings
(Fig 11). It also shows that no change was observed in
the position of the condyle relative to basion and the go-
nial angle; this was confirmed by the cephalometric anal-
ysis. The level of interradicular bone was relatively stable
after treatment as seen on the panoramic radiograph (Fig
12). There is a bony apophysis appearing obviously along
the lower border of the mandible, close to the chin.

The treatment plan was a satisfactory nonsurgical
alternative, and a functional and esthetic occlusal
relationship was established. The more favorable
mandibular incisor inclination resulted in normal overjet
and overbite, and a well-balanced facial appearance was
achieved. Correction of the malocclusion and improve-
ment of her facial profile were accomplished with both
dentoalveolar and skeletal changes.

After 2 years of retention, the posttreatment occlu-
sion and anterior overjet continued to be stable (Fig
13). The skeletal (Fig 14) and soft-tissue (Fig 15) facial
profile were also satisfactory, and there was no signifi-
cant change shown on the panoramic radiograph
(Fig 16).

DISCUSSION

Midface retraction and malocclusion are concerns for
patients with operated cleft lip and palate. Because of
the possible influence of cleft severity on the growth
of the maxilla, cleft lip and palate patients can have a
relatively retruded maxillary position with a tendency
for a Class III malocclusion, even after palatoplasty.1,5,6
The tension of the scar contraction resulting from the
palatal repair could adversely affect maxillary growth.
Most cleft lip and palate patients require a LeFort I
osteotomy after completion of skeletal growth to
reposition the maxilla. This type of surgery might also
require rigid fixation, bone grafting, and mandibular
setback.6,7 However, these treatments are quite invasive.

Maxillary expansion and distraction osteogenesis are
considered an attractive alternative to correct the maloc-
closure in cleft lip and palate patients,6,8,9 although a chincap and high-pull headgear have also been advo-
cated in the treatment of Class III malocclusion.10 Labial
tipping of the maxillary incisors could not be avoided
because the maxillary anterior teeth were used as an
anchor for the distraction forces. Because of the first pre-
molar extraction, proclination of the maxillary anterior
teeth had been slightly decreased. The pronounced
improvement of the patient’s facial profile and occlusal
relationship suggested that orthognathic surgery was
unnecessary for correcting her skeletal discrepancies.
In addition, because of her unesthetic facial appearance
and unattractive smile, the patient and her parents did
not want to wait another 10 years to have surgical treat-
ment. Also, the malocclusion could have become worse
with time if it were not corrected. Therefore, orthog-
nathic surgery was finally abandoned after careful
consideration.

The esthetic improvement obtained in this cleft lip
and palate patient was impressive as a result of favorable
maxillary advancement and mandibular incisor retru-
sion, which were achieved by maxillary protraction,
mandibular growth inhibition, and premolar extraction.

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Fig 8. Posttreatment photographs.

Fig 9. Posttreatment dental casts.
Early intervention by protracting the maxilla was intentionally controlled. One side effect of facemask protraction is unexpected proclination of the maxillary anterior teeth; this would cause undesirable profile changes (concave facial profile with maxillary incisor proclination). Hence, premolar extraction was necessary to keep her maxillary incisors upright. Although most Class III patients have retroclined anterior mandibular teeth, retraction of the mandibular incisors still helps to deepen the labiomental fold, which is flat in most Class III patients. This further contributes to the improvement of the facial profile. Our results are similar to those of Lin and Gu, who suggested that by treating Class III patients with compensatory mechanics, remarkable soft-tissue changes can be observed when the facial profile changes from concave to straight. However, other factors such as the patient’s age, skeletal growth pattern, individual growth potential, and cooperation are also important in producing the entire treatment effect.

The age of the skull is an essential element that affects the mechanical property of the skeletal suture. So, timing is crucial to achieve successful orthodontic treatment. Beginning treatment at the correct time in a patient with growth potential has a significant influence on correcting the discrepancy in the sagittal, vertical, and transverse planes. It is recommended that treatment directed at promoting or inhibiting maxillary or mandibular growth should be performed before the pubertal growth spurt. Normally, midface growth up to the age of 7 years is attributed to the increasing size of the anterior cranial base, orbits, and nasal septum. All facial bones move forward and downward from growth of the synchondroses. However, normal
forward and downward growth was not expected because of the underdeveloped maxilla, especially in this patient with cleft lip and palate. Consequently, expansion and protraction therapy was considered for her. But the space provided by the rapid maxillary expansion was not enough to correct the dental crowding;
therefore, tooth extraction was a reasonable solution. Luckily, the patient's cleft deformity was not unilateral. Thus, the risk of a nonaverage distribution of heavy orthodontic force caused by the asymmetric structure of the skull was greatly reduced.

Chincap, high-pull headgear, and maxillary protrusion appliances have been reported to achieve favorable changes in patients with Class III malocclusion. Yet whether it is possible to alter the congenital growth pattern significantly and permanently requires further investigation. Interestingly, the apophysis along the lower border of the mandible shown in the posttreatment profile was not found on the cephalometric tracing before the chin cap was applied. The effects of the chin cap were more concentrated on backward repositioning of the mandible, the direction and inhibition of mandibular growth, and the stress distributions on the condyle. Remodeling of the mandibular shape and morphologic changes have been rarely reported. Although similar bone apophysis might also be observed in other clinical cases in which the chincap was used, further study related to its mechanical properties should be conducted.

The posttreatment results show good stability after more than 2 years. The prevention of posterior and anterior crossbite by maxillary expansion and distraction, and the long-term chin growth inhibition with the chin cap seemed to contribute to this stability.

CONCLUSIONS

A definitive analysis and treatment plan should be made for each patient. In those with cleft lip and palate who are undergoing a growth spurt, orthodontic treatment objectives should be restoratively realistic, economical, and low risk. In this case report, the final occlusion was esthetic, functional, healthy, and stable. The early orthodontic intervention combined with the second phase of treatment (fixed orthodontic appliances) efficiently achieved a satisfactory result, and the patient benefited by gaining self-esteem and improved esthetics.

REFERENCES


Fig 15. Superimposed tracings of posttreatment and 2 years after treatment. Red lines, posttreatment tracing; black lines, 2 years posttreatment tracing.

Fig 16. Panoramic radiograph 2 years after treatment.


