One-phase vs 2-phase treatment for developing Class III malocclusion: A comparison of identical twins

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Despite the known influence of early treatment on the facial appearance of growing patients with skeletal Class III malocclusion, few comparative reports on the long-term effects of different treatment regimens (1-phase vs 2-phase treatment) have been published. Uncertainty remains regarding the effects of early intervention on jaw growth and its effectiveness and efficiency in the long term. In this case report, we compared the effects of early orthodontic intervention as the first phase of a 2-phase treatment vs 1-phase fixed appliance treatment in identical twins over a period of 11 years. Facial and dental changes were recorded, and cephalometric superimpositions were made at 4 time points. In spite of the different treatment approaches, both patients showed identical dentofacial characteristics in the retention phase. Through this case report, we intended to clarify the benefits of undergoing 1-phase treatment against 2-phase treatment protocols for treating growing skeletal Class III patients. (Am J Orthod Dentofacial Orthop 2012;141:e11-e22)

In the treatment of skeletal Class III growing patients, it has become a common practice to intervene early with orthodontic or orthopedic treatment modalities as a part of a 2-phase treatment approach. This approach is claimed to provide early and significant improvement in the facial profile, require fewer surgical interventions in the future, and produce significant psychosocial benefits for the patient as well as the parents.1-3 Although orthopedic forces that attempt to control or alter the skeletal framework in skeletal Class III patients appear to be remarkably effective in the initial stages, the results are rarely maintained in the long term.4,5 Previously, we presented a clinical practice guideline for the treatment of developing Class III malocclusions (Fig 1).6,7 However, it is still difficult to decide whether a 2-phase treatment is actually better than a 1-phase treatment, especially in light of mounting evidence that patients with a skeletal Class III malocclusion show neither excessive mandibular growth nor deficient maxillary growth when compared with Class I subjects at any growth stage.8 Therefore, the key question is “what differences in jaw growth or treatment modality and outcome will there be between patients who undergo 1-phase treatment and those who don’t?” This twin study allowed us to elucidate some benefits of 1-phase treatment rather than waiting until the postadolescent period.

DIAGNOSIS AND ETIOLOGY

The patients, monozygotic twin sisters (Fig 2), were referred to our department at Tohoku University, Sendai, Japan, in 1996 when they were 9 years old for orthodontic treatment of anterior crossbites. Their medical histories showed no systemic diseases or developmental anomalies. Not surprisingly, both twins had almost the same orthodontic problems that included a prognathic profile, mild mandibular asymmetry, Class III denture bases, deviation of mandibular midlines, and occlusal interference of the incisors (Fig 3). Cephalometrically, their skeletofacial types were classified as Class III short-face types. The short-face tendency was more pronounced in Patient 2 (Fig 4).

TREATMENT OBJECTIVES

Class III short-face skeletofacial types are considered to have a good prognosis, because their mild jaw
Fig 1. Clinical practice guideline for the treatment of a developing Class III malocclusion. Obs, Observation.

Fig 2. Pretreatment facial photographs of the twins.
disharmony allows downward and backward rotation of the mandible for correction of the anterior crossbite and deepbite and, therefore, are good candidates for a treatment plan involving 2 phases. This includes correction of the anterior crossbite in the first phase followed by a period of growth observation and then a second phase of treatment with fixed appliances. In light of our previous discussion regarding early intervention on jaw growth, the treatment objectives for Patient 1 were established with the 2-phase treatment approach, whereas Patient 2 was managed with a 1-phase treatment concept. Informed consents were obtained for both patients from their parents.

The treatment objectives for Patient 1 were (1) phase 1 treatment involving dental correction of the anterior crossbite, (2) growth monitoring and oral health care until the postadolescent period, (3) fixed appliance treatment for correction of the remaining orthodontic problems, and (4) retention and long-term follow-up.

For Patient 2, the treatment objectives were (1) growth monitoring and oral health care until the postadolescent period, (2) correction of the malocclusion with fixed appliance treatment together with skeletal anchorage that would allow us to circumvent the need for mandibular premolar extraction, and (3) retention and long-term follow-up.
Fig 4. Skeleofacial types developed from the cephalometric analyses for the twins. They were judged as skeletal Class III short face. Note that the short-face tendency was more pronounced in Patient 2.

Fig 5. Timing intervals of the comparisons of treatment progress and results. MIP, Maxillary incisors protractor; MBS, multi-bracketed system; SAS, skeletal anchorage system.
TREATMENT ALTERNATIVES

Because the twins were skeletal Class III growing patients, growth modification treatments and functional appliances could be alternatives, but they were not included with our options for the reasons previously mentioned.

Treatment alternatives in the postadolescent phase could have included conventional camouflage treatment with a multi-bracketed system and premolar extractions together with Class III elastics. This approach would improve the Class III occlusion, but it would undermine esthetics, resulting in a more protruded chin and concave profile. Orthognathic surgery is also a viable option for improving function, occlusion, and esthetics; however, our patients rejected surgery as an option.

Fig 6. The twins at the initial time. Their dentofacial profiles were almost identical.
mild mandibular incisor crowding. At the same stage, Patient 2 demonstrated more severe orthodontic problems than her sister did at this age. She had a skeletal Class III malocclusion with a short-face tendency, premature contact at the incisors, a dental midline shift, an anterior crossbite, severe crowding of the maxillary anterior teeth, and retroclined mandibular incisors.

At this stage, we superimposed the cephalometric radiographs from 9 and 16 years of age based on the natural reference structures suggested by Skieller et al and Björk and Skieller. Cephalometric tracings were made in detail and superimposed carefully. In Patient 1, the superimposition showed correction of the anterior crossbite, with a significant amount of jaw growth. However, the amount of jaw growth from 13 to 16 years of age was negligible. In Patient 2, the cephalometric superimpositions showed that the maxilla and the mandible had significant amounts of downward and forward growth during the adolescent growth period. Her overbite had improved over time.

To correct the rest of Patient 1’s orthodontic problems, preadjusted fixed appliance treatment was started, and short Class III elastics were used to improve the Class III denture bases and prevent proclination of the mandibular incisors during leveling and aligning. Treatment for Patient 2 started with bonding brackets on the mandibular teeth and placing resin caps on the maxillary molars to open the bite for maxillary bonding. Open-coil springs were used to make space and procline the maxillary incisors. Simultaneously, distalization of the mandibular posterior teeth was started with the skeletal anchorage system, which uses an orthodontic miniplate as a temporary anchorage device. Within several months, her anterior crossbite was completely corrected, and the distalized mandibular posterior teeth were retained with the help of ligature wires connected to the miniplates.

After 12 months of active fixed appliance treatment, Patient 1’s malocclusion was corrected. She obtained a balanced profile, with adequate overjet and overbite, proper anterior guidance, and rigid posterior intercuspation of the teeth. On the other hand, Patient 2’s treatment with the skeletal anchorage system lasted 18 months. She also achieved an acceptable Class I occlusion and a satisfactory profile at debonding.

The dentofacial changes during the second phase of treatment were minimal in Patient 1; only the uprighting of the mandibular molars was observed. On the other hand, the cephalometric superimposition in Patient 2 before and after treatment with the skeletal anchorage system showed that her anterior crossbite was largely corrected by proclination of the maxillary incisors and clockwise rotation of the mandible, causing extrusion of her maxillary and mandibular molars. The mandibular molars were slightly distalized, and the retroclination of her mandibular incisors was improved purely by lingual root torque. After 30 months of retention, both twins have maintained a good occlusion except for a minor relapse of the maxillary right first premolar in Patient 2. Overall, satisfactory results were achieved.

### Table I. Lateral cephalometric measurements (initial, age of 9) with standard deviations from norms

<table>
<thead>
<tr>
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<th>Patient 1</th>
<th>Patient 2</th>
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<tbody>
<tr>
<td>SNA</td>
<td>79.6° (−0.4)</td>
<td>79.0° (−0.6)</td>
</tr>
<tr>
<td>SNB</td>
<td>79.8° (1.3)</td>
<td>80.0° (1.3)</td>
</tr>
<tr>
<td>ANB</td>
<td>−0.2° (0)</td>
<td>−1.0° (0)</td>
</tr>
<tr>
<td>Mandibular plane to SN</td>
<td>34.6° (−0.8)</td>
<td>35.4° (−0.8)</td>
</tr>
<tr>
<td>Gonial angle</td>
<td>127.0° (−0.5)</td>
<td>125.2° (−0.8)</td>
</tr>
<tr>
<td>U1 to SN</td>
<td>93.6° (−1.7)</td>
<td>89.4° (−2.4)</td>
</tr>
<tr>
<td>L1 to mandibular plane</td>
<td>85.8° (−1.4)</td>
<td>79.1° (−2.5)</td>
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<tr>
<td>L1 to U1</td>
<td>149.9° (2.8)</td>
<td>156.1° (4.0)</td>
</tr>
<tr>
<td>Wits</td>
<td>−6.5 mm</td>
<td>−7.7 mm</td>
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<tr>
<td>N-Me</td>
<td>105.1 mm (−1.1)</td>
<td>104.0 mm (−1.4)</td>
</tr>
<tr>
<td>N-ANS</td>
<td>47.5 mm (−0.7)</td>
<td>46.0 mm (−1.3)</td>
</tr>
<tr>
<td>ANS-Me</td>
<td>58.2 mm (−1.4)</td>
<td>58.6 mm (−1.3)</td>
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**TREATMENT PROGRESS**

Although a 1-phase treatment protocol was chosen for Patient 2, there was no definitive treatment until growth completion was confirmed. In Patient 1, the first phase of treatment began with facemask therapy and 2 × 4 appliances. The aim was to correct her anterior crossbite dentally, not skeletally. The crossbite and maxillary dental midline shift were corrected in 6 months.

At the age of 10 and after the first phase of treatment, Patient 1’s prognathic profile and dental malocclusion had improved significantly. At the same time, growth observation in Patient 2 showed that all her orthodontic problems were exactly as they had been at the initial examination. At age 13, both twins had completed their permanent dentitions. Patient 1 had maintained a positive overjet and overbite until 16 years of age as per our clinical practice guidelines. Before the second phase of treatment, Patient 1 still had a prognathic profile, with some minor dental problems, particularly in the mandibular dentition. She had a lateral crossbite on the right side, a mild Class III denture base, and mild mandibular incisor crowding. At the same stage, Patient 2 demonstrated more severe orthodontic problems than her sister did at this age. She had a skeletal Class III malocclusion with a short-face tendency, premature contact at the incisors, a dental midline shift, an anterior crossbite, severe crowding of the maxillary anterior teeth, and retroclined mandibular incisors.
The cephalometric and clinical comparisons of the twin sisters took place at 4 time intervals (Fig 5).

Fig 7. Significant dentofacial differences were observed at the age of 10. After the first phase of mechanics in Patient 1, her anterior crossbite was corrected after the flaring of her maxillary incisors, the forward displacement of the maxilla, and the clockwise rotation of the mandible. Consequently, her skeletal facial type became much closer to a Class I average face.

COMPARISON OF TREATMENT PROGRESS AND RESULTS IN THE TWINS

The cephalometric and clinical comparisons of the twin sisters took place at 4 time intervals (Fig 5).

1. The initial examination was at age 9 years. Because they are monozygotic twins, it is no surprise that even their dentitions were almost identical. Cephala-
was a little more pronounced than her sister’s, their dentofacial profiles were almost identical (Fig 6; Table I).

2. After Patient 1’s first phase of treatment (age, 10 years), the clinical pictures clearly show the efficiency of early intervention for her. Cephalometric superimposition shows significant dentofacial differences between the sisters at this stage. Patient 1’s crossbite was corrected by proclination of her maxillary incisors, forward displacement of the maxilla, and

Fig 8. Skeletal differences between the sisters at 10 years old gradually disappeared during the pubertal growth period, and almost no difference was observed between their skeletal profiles at age 16 years. The only difference was in the position of Patient 1’s maxillary incisors; this was an orthodontic effect from the facemask. Before 2nd Phase Tx, After the first phase of treatment (ie, facemask therapy); Before ortho. Tx, after growth observation only (no interceptive treatment was done).
clockwise rotation of the mandible. This gave her an orthognathic facial profile compared with Patient 2 (Fig 7).

3. Before fixed appliance treatment (age, 16 years), the skeletal differences between them at 10 years gradually disappeared during the pubertal growth spurt, and almost no difference could be observed between their skeletal profiles at 16 years. The only difference perhaps was in the position of the maxillary incisors. The orthodontic effect of the facemask could still be seen on Patient 1’s maxillary incisors (Fig 8).

4. During the retention period (age, 20 years), we superimposed the twins’ final records. Interestingly,
although they underwent orthodontic treatment
with completely different treatment regimens
(1-phase vs 2-phase), their dentofacial morphol-
ogies were identical (Fig 9; Table II).

DISCUSSION

The advantage of using monozygotic twins in such
a comparative case report is that all differences in skeletal
growth, beyond the error of measurement, can be assumed
to be nongenetic and, therefore, the result of the environ-
ment.12,13 The most powerful oral environmental influ-
ence for the twins was the treatment itself. Mandibular growth
can be controlled with chincup therapy, by altering the
skeletal framework of growing Class III patients. Our
studies on the short-term and long-term effects of chin-
cup force indicated that the skeletal framework is greatly
improved during the initial stages of chincup therapy.4,5
However, these changes are rarely maintained during the
pubertal growth period; when growth is over, any
treatment with the chincup appliance seldom alters the
inherited prognathic characteristics of Class III profiles.

The second relevant area to review is jaw surgery. Our
longitudinal studies have given us every reason to believe
that surgical orthodontic treatment is the most effective
modality to obtain a favorable profile and a stable occlu-
sion for severe adult skeletal Class III patients.14,15 Third,
we need to look back at what we knew then about jaw
growth. Our group had conducted some longitudinal
studies with untreated Class III subjects.16-20 It was shown
that those with skeletal Class III malocclusion showed
nevertheless, when a patient is diagnosed with severe
skeletal Class III, phase 1 treatment is recommended. Ac-
cording to the clinical practice guidelines that we have
set for managing Class III malocclusions, we believed
that 2-phase treatment was the most beneficial for
growing patients diagnosed with mild to moderate Class
III jaw relationships, such as the twins.

Table II. Lateral cephalometric measurements (final,
age of 20) with standard deviations from norms

<table>
<thead>
<tr>
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<th>Patient 1</th>
<th>Patient 2</th>
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<tbody>
<tr>
<td>SNA</td>
<td>81.1° (−0.7)</td>
<td>82.0° (−0.4)</td>
</tr>
<tr>
<td>SNB</td>
<td>78.8° (−0.3)</td>
<td>80.2° (0.3)</td>
</tr>
<tr>
<td>ANB</td>
<td>2.3° (−0.3)</td>
<td>1.8° (−1.2)</td>
</tr>
<tr>
<td>Mandibular plane to SN</td>
<td>37.1° (0.1)</td>
<td>36.4° (−0.1)</td>
</tr>
<tr>
<td>Gonial angle</td>
<td>122.0° (−0.8)</td>
<td>122.9° (−0.6)</td>
</tr>
<tr>
<td>L1 to SN</td>
<td>107.8° (0.6)</td>
<td>112.6° (1.5)</td>
</tr>
<tr>
<td>L1 to mandibular plane</td>
<td>91.7° (0.2)</td>
<td>92.7° (0.4)</td>
</tr>
<tr>
<td>L1 to U1</td>
<td>123.4° (−0.6)</td>
<td>118.2° (−1.2)</td>
</tr>
<tr>
<td>Wits</td>
<td>−1.4 mm</td>
<td>−2.7 mm</td>
</tr>
<tr>
<td>N-ANS</td>
<td>123.3 mm (1.0)</td>
<td>121.8 mm (0.4)</td>
</tr>
<tr>
<td>N-ANS</td>
<td>52.8 mm (−0.8)</td>
<td>52.1 mm (−1.0)</td>
</tr>
<tr>
<td>ANS-Me</td>
<td>71.4 mm (2.8)</td>
<td>70.4 mm (2.3)</td>
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Fig 10. A, Maxillary growth changes of the twins from
ages 9 to 18. Patient 1, who had the first phase of treat-
ment, showed more maxillary growth than did Patient 2
until they turned 14, but no difference in maxillary lengths
was observed at 18 years of age. B, Mandibular growth
changes of the twins from ages 9 to 18. Obviously, there
was almost no difference between them in mandibular
growth throughout the various growth periods. (Green
and yellow lines represent the average growth changes
of untreated Class I and Class III Japanese teenagers
from ages 9 to 14 years taken from longitudinal data.16-21)
We also looked at the maxillary growth changes that occurred from ages 9 to 18 years for the sisters. Patient 1, who had 2-phase treatment, showed more maxillary growth than did Patient 2 until they turned 14. However, no difference in maxillary lengths was observed at 18 years of age. Consequently, early correction of the anterior crossbite had no impact on maxillary growth. Similarly, there was almost no difference between the twins in their mandibular growth throughout the observation period (Fig 10).

Recent clinical trials have suggested that in the long-term the improvement in the skeletal malocclusion obtained after a first phase of treatment is not significant when compared with a control group that had no growth modification treatment. It has also been suggested that early intervention does not seem to confer a significant psychosocial benefit. The first phase of treatment for Patient 1 was effective, in that her dento-facial and functional problems were improved considerably, and were much better than her sister’s. Significant differences were observed between their skeletal profiles at age 10. Nevertheless, their skeletal differences gradually diminished during the pubertal growth period to the point that there was almost no difference in their skeletal profiles at age 16. It was obvious that the early correction of the anterior crossbite did not make a positive impact on jaw growth. It seems that morphogenetic factors are still stronger and much more dominant than environmental factors in the matter of jaw growth.

Interestingly, despite the differences of treatment timings and modalities, the twins achieved almost identical dentofacial profiles, and both had favorable occlusions at age 18. Patient 2 who was managed with a 1-phase treatment, had to undergo treatment with the skeletal anchorage system. The skeletal anchorage system is a viable modality for distalizing mandibular molars. It enables en-masse movement of the mandibular buccal segments and even the entire mandibular dentition with only minor surgery for placing the anchor plates at the anterior border of the mandibular ramus or the mandibular body. It is particularly effective for correcting Class III malocclusions, mandibular incisor crowding, and dental asymmetries, and rarely requires the extraction of premolars. Without the skeletal anchorage system, this twin study would not have been possible, and such results could not have been obtained.

CONCLUSIONS

1. In spite of the differences in treatment timing and modalities (1-phase vs 2-phase treatment), both twin sisters achieved almost identical dentofacial results. This implies that early treatment had no impact on jaw growth in the pubertal growth period.

2. Although phase 1 treatment had no impact on jaw growth, it made the phase 2 treatment simpler and easier. Therefore, 2-phase treatment might be more suited for mild to moderate Class III patients than 1-phase treatment.

3. The criteria for the selection of 1-phase or 2-phase treatment depend entirely on the patient’s requirements. Because the biologic outcome is the same, the basis for opting for a particular treatment regimen can be complicated. Cultural, environmental, and psychosocial factors need to be considered more carefully.

REFERENCES


