Two-phase treatment of skeletal Class II malocclusion with the combination of the Twin-block appliance and high-pull headgear

Yan Lv, Bin Yan, and Lin Wang
Nanjing, China

The patient was a boy with a Class II skeletal and dental relationship, a large overjet, an impinging overbite, and a steep mandibular plane angle. Treatment started with the Twin-block appliance combined with high-pull headgear to promote growth of the mandible, restrain the maxilla in the anteroposterior and vertical planes, and improve his profile. This was followed by extraction of the maxillary second premolars and the mandibular first premolars. Then fixed appliances were used to align and level the dentition. Pretreatment and posttreatment records are shown, and the treatment results are stable 2 years after debonding. (Am J Orthod Dentofacial Orthop 2012;142:246-55)

Functional appliances have been used for many years in the treatment of Class II malocclusions. Alteration of maxillary growth, improvement in mandibular growth and position, and change in dental and muscular relationships are the expected effects of these appliances.1

The Twin-block appliance, originally developed by Clark,2 is a widely used functional appliance for the management of Class II malocclusion. It combines splints with extraoral force and functional orthopedic forces. The appliance can be worn most of the time, with the advantage of allowing nearly a full range of mandibular movement, easy acclimation, and reasonable speech. Its popularity also comes from its high patient acceptability and its ability to produce rapid results.

High-pull headgear is used in Class II patients with increased lower facial height. Teuscher3 suggested that forward and downward growth of the maxilla could be altered, and that the mandible could also change its growth direction to a more forward and upward position with condylar adaptation using the high-pull headgear.

Functional appliance therapy is followed by comprehensive fixed-appliance therapy with or without extractions. Extraction of 4 premolars is indicated primarily for dental crowding, cephalometric discrepancy, or a combination in growing Class II patients.4,5

This case report demonstrates the use of the Twin-block appliance and high-pull headgear in a skeletal Class II Division 1 patient with a retrognathic mandible, protruding maxillary anterior teeth, excessive overjet, and complete overbite. By means of extraction of the maxillary second premolars and the mandibular first premolars, a well-aligned and leveled dentition and an acceptable profile were achieved.

DIAGNOSIS AND ETIOLOGY

The patient, a Chinese boy aged 12 years 2 months, was in fair health and motivated for treatment with the chief complaint of protruded maxillary anterior teeth and a receding chin for 6 years. He had been biting his lip since eruption of the deciduous dentition. He was introverted and had poor self-esteem, despite his normal medical history. His father had a similar profile of protruded maxillary anterior teeth.

The facial photographs indicated a convex facial appearance, protruded lips, and moderate exposure of the maxillary incisors (Fig 1). He had a normal range of mandibular motion and no joint noise or pain. The midline of the mandible was shifted 2 mm to the right. Other intraoral findings included gingivitis of the incisors, a short lingual frenum, and swollen tonsils. He had a Class II Division 1 malocclusion (bilateral full Class II molars and canines) with a 15-mm overjet and...
an impinging overbite. Mild maxillary and moderate mandibular crowding as well as mesial inclination of mandibular posterior teeth were observed. The curve of Spee was severe (6 mm), and the Bolton analysis was 78% anteriorly and 88.4% totally. The cephalometric analysis confirmed a skeletal Class II jaw relationship with a retrognathic mandible and a steep mandibular plane angle. Additionally, the maxillary and mandibular incisors were labially inclined. The panoramic radiograph showed tooth buds of 4 third molars and symmetric bilateral joints. A hand-wrist radiograph showed that he was at the stage of a growth spurt (Figs 2 and 3).

The etiology of this patient’s malocclusion was probably a combination of his lip-biting habit and genetic factors.

**TREATMENT OBJECTIVES**

The treatment objectives were to correct the skeletal Class II malocclusion (retrognathic mandible), improve his overjet and overbite, solve the dental crowding, and improve his facial appearance. Cessation of the lip-biting habit was considered essential. Much attention would be given to controlling the vertical growth of his molars because of the steep mandibular plane angle.

**TREATMENT ALTERNATIVES**

Our plan was 2-phase treatment. To reduce the skeletal discrepancy anteroposteriorly by growth modification, a functional appliance (Twin-block with high-pull headgear) was planned for the phase 1 treatment in preadolescence. Even though the patient did not have a posterior crossbite, it was necessary to achieve compensatory lateral expansion of the maxillary arch with a maxillary expander. We aimed to inhibit the growth of the maxilla, promote that of the mandible, and control the eruption of his molars, thus to correct the skeletal Class II relationship and improve his profile. Meanwhile, cessation of the lip-biting habit, functional training of lip muscles, and psychological counseling were important parts in the phase 1 treatment.
Fig 2. Pretreatment dental casts.

Fig 3. Pretreatment radiographs and tracing.
The need for extraction was to be determined according to the profile, the molar relationship, and other results after phase 1 treatment. A straight-wire appliance was then applied to align and level the dentition and to achieve a neutral occlusion and a better profile.

**TREATMENT PROGRESS**

The Twin-block appliance was used with the maxillary expander activated once a week after an adaptation period of 2 weeks. Meanwhile, the high-pull headgear was worn for 9 months to restrict downward and forward growth of the maxilla. The patient was instructed to wear the Twin-block appliance 24 hours a day, especially during eating, and to wear the headgear at least 14 hours per day. During the phase 1 treatment, the Twin-block appliance was adjusted twice to guide the mandible forward. The patient was initially seen 10 days after the first visit, then monthly so that the blocks and the headgear could be adjusted for retention and stability as needed.

Based on the crowding and slightly convex profile after phase 1 treatment, we decided to extract the maxillary second premolars and the mandibular first premolars. Leveling and alignment progressed with nickel-titanium wires for 5 months. A lingual arch was applied to enhance anchorage during the early stage of phase 2 treatment.

An 0.018 × 0.025-in rectangular stainless steel archwire in the maxillary arch was used with T-loops to close space, and a 0.019 × 0.025-in rectangular stainless steel archwire with elastic chains was used in the mandibular arch. Meanwhile, intermaxillary traction was used to adjust the occlusion. After several adjustments of the occlusion, the fixed appliances were removed. The patient was given a pair of Hawley retainers with an inclined maxillary biteplane.

**TREATMENT RESULTS**

When the phase 1 treatment ended, the patient’s mandible was positioned forward, and the profile was
greatly improved (Fig 4). A skeletal anteroposterior reduction was significant with 3.8° change in the ANB angle (the SNA angle had decreased from 81.2° to 79.6°). The height of the maxillary first molar changed from 12.3 to 9 mm (Figs 5 and 6; Table). The intraoral examination showed an expanded maxillary arch, improvement of the deep overbite and large overjet, labially inclined maxillary anterior teeth, and a mesial relationship of the first permanent molars.

After active treatment, a normal occlusion with optimal overbite and overjet was achieved. The patient was satisfied with his facial profile, which had changed from convex to straight. Lip protrusion was also improved. Neutroclusion of the canines and the molars, good alignment and leveling of the maxillary and mandibular teeth, and correction of the dental midline were achieved (Fig 7). The posttreatment panoramic radiograph confirmed no apparent root resorption with the restored maxillary and mandibular left first molars. It was still necessary to extract the mesially inclined mandibular third molars. The posttreatment cephalometric radiograph showed an acceptable anteroposterior relationship with a slightly increased mandibular plane angle of 0.3°. The cephalometric superimposition depicted an increased mandibular length, a forward position of the mandible, and a good interincisal angle (Figs 8 and 9; Table).

After retention with Hawley retainers for 2 years, a stable occlusion and a coordinated facial profile were observed (Fig 10).

**DISCUSSION**

Because the patient had a skeletal Class II pattern with a retrognathic mandible at the preadolescent stage, indicated by the hand-wrist radiograph, it was necessary to use a functional appliance and extraoral forces to correct the skeletal anteroposterior and vertical discrepancies. There were some problems during early treatment, including psychosocial, behavioral, and financial factors, risks of tissue damage, treatment complexity, duration, and stability.6-10 However, early treatment can bring...
many benefits.11,12 In this patient, early intervention by functional appliances resulted in using his growth potential, improved compliance and self-esteem, and stable results, as described in several studies.11-14

With regard to functional intervention, some articles confirmed that more correction was accomplished through dentoalveolar changes than by skeletal changes.15,16 In this patient, the restrained maxilla and the advanced mandible confirmed the skeletal changes. Meanwhile, the dentoalveolar changes included movement and inclination of the molars and incisors (Fig 6).

Several studies show that a Twin-block, an activator, or a Herbst appliance can induce significant favorable modifications in growing subjects with Class II malocclusions.1,17-19 Compared with the Herbst and activator appliances, the Twin-block appliance has 2 obvious advantages.17 One advantage is greater mandibular growth because of the duration and timing when the appliance is worn. Another advantage was the apparent elongation of the mandibular ramus in our patient; this could be attributed to a greater vertical activation of the appliance (bite-blocks must be at least 5 to 7 mm thick vertically). In our patient, the

---

**Table.** Cephalometric analysis from lateral radiographs

<table>
<thead>
<tr>
<th>Variables</th>
<th>Normal</th>
<th>Pretreatment</th>
<th>After phase 1</th>
<th>After phase 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Skeletal variables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SNA (°)</td>
<td>83.77 ± 2.85</td>
<td>81.2</td>
<td>79.6</td>
<td>80.3</td>
</tr>
<tr>
<td>SNB (°)</td>
<td>79.98 ± 2.98</td>
<td>73.5</td>
<td>74.7</td>
<td>76.1</td>
</tr>
<tr>
<td>ANB (°)</td>
<td>3.79 ± 1.88</td>
<td>7.7</td>
<td>4.9</td>
<td>4.2</td>
</tr>
<tr>
<td>Ptm-A (mm)</td>
<td>46.3 ± 2.78</td>
<td>44</td>
<td>43.7</td>
<td>44.6</td>
</tr>
<tr>
<td>Ptm-S (mm)</td>
<td>16.87 ± 2.84</td>
<td>15.8</td>
<td>15.8</td>
<td>14.2</td>
</tr>
<tr>
<td>PP-FH (°)</td>
<td>5.26 ± 3.70</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>PP-GoGn (°)</td>
<td>20.72 ± 4.11</td>
<td>30.6</td>
<td>29.8</td>
<td>29.8</td>
</tr>
<tr>
<td>OP-SN (°)</td>
<td>19.42 ± 3.99</td>
<td>12.5</td>
<td>18.6</td>
<td>20.6</td>
</tr>
<tr>
<td>Go-Pg (mm)</td>
<td>74.20 ± 5.11</td>
<td>64</td>
<td>62.8</td>
<td>67.6</td>
</tr>
<tr>
<td>Go-Co (mm)</td>
<td>59.34 ± 5.62</td>
<td>52.1</td>
<td>55</td>
<td>53</td>
</tr>
<tr>
<td>SN-MP (mm)</td>
<td>34.85 ± 4.09</td>
<td>37.4</td>
<td>37.9</td>
<td>37.7</td>
</tr>
<tr>
<td>Y-axis (°)</td>
<td>65.03 ± 3.89</td>
<td>72.6</td>
<td>73.3</td>
<td>73</td>
</tr>
<tr>
<td><strong>Dental variables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>U1-L1 (°)</td>
<td>120.62 ± 9.12</td>
<td>114</td>
<td>116.8</td>
<td>123</td>
</tr>
<tr>
<td>U1-SN (°)</td>
<td>72.54 ± 5.89</td>
<td>60.6</td>
<td>71.8</td>
<td>77.4</td>
</tr>
<tr>
<td>U1-NA (mm)</td>
<td>4.44 ± 2.36</td>
<td>3.7</td>
<td>4.5</td>
<td>1.8</td>
</tr>
<tr>
<td>LL-NB (mm)</td>
<td>23.69 ± 5.74</td>
<td>38.2</td>
<td>29.6</td>
<td>22.3</td>
</tr>
<tr>
<td>U1-NB (°)</td>
<td>6.84 ± 2.65</td>
<td>5</td>
<td>6.1</td>
<td>3</td>
</tr>
<tr>
<td>FMIA (°)</td>
<td>31.90 ± 6.09</td>
<td>33</td>
<td>37.6</td>
<td>36.1</td>
</tr>
<tr>
<td>U6-Ptm (mm)</td>
<td>51.81 ± 7.26</td>
<td>56.3</td>
<td>49.2</td>
<td>48.9</td>
</tr>
<tr>
<td>U6-Ptm (mm)</td>
<td>15.33 ± 2.98</td>
<td>12.3</td>
<td>9</td>
<td>17.5</td>
</tr>
</tbody>
</table>

---

**Fig 6.** Superimposed pretreatment and postphase 1 treatment cephalometric tracings. The overall superimposition was registered on SN at sella. The maxillary superimposition was registered on the palatal plane at ANS. The mandibular superimposition was registered on the lingual aspect of the symphysis. **Black line**, Pretreatment; **green line**, postphase 1 treatment.
forward movement of the mandibular molars by the Twin-block appliance was significantly obvious (Fig 6).

Although the Twin-block appliance could provide relative distalization of the maxillary molars, high-pull headgear was used because of the steep mandibular plane angle. The headgear also helped to restrain maxillary growth, distally tip the maxillary teeth, and restrain the eruption of the posterior maxillary teeth (Fig 6). Superimpositions showed that the maxillary first molars moved distally without extrusion after phase 1 treatment, followed by moving mesially with eruption after the phase 2 treatment (Figs 6 and 9). The eruption, which could have been due to the patient’s growth, was acceptable. This kind of eruption had little influence on the mandibular angle and the vertical facial height, since the first molars moved mesially when the spaces were being closed.

Furthermore, most researchers agree that the Twin-block produces retroclination of the maxillary incisors and proclination of the mandibular incisors. The maxillary incisors of this patient approached the goal of retroclination by 15.9° (U1-NA), whereas the mandibular incisors were proclined from 33° to 37.6° (L1-NB). Because of the subsequent fixed appliance treatment, the excess proclination of the mandibular incisors was improved from 37.6° to 36.1°. Because of the overcorrection of the mesial molar relationship after phase 1 treatment, 1 approach was proposed to move the mandibular second molars mesially into neuetroclusion with implants after removing the third molars. However, the crowded mandible, deep curve of Spee, proclined mandibular incisors, and slightly convex profile led to the decision to extract. Therefore, the alternative plan of removing the maxillary second premolars and mandibular first premolars was used to reach neuetroclusion, resolve crowding, align the mandibular incisors, and improve the profile. Another important reason for extracting the maxillary second premolars was the steep mandibular plane angle, because moving posterior teeth mesially would be more favorable for treatment stability. In this patient, there were no apparent differences between the T-loops and elastic chains when the extraction spaces were closed.
Fig 8. Radiographs and tracing after phase 2 treatment.

Fig 9. Superimposed postphase 1 treatment and postphase 2 treatment cephalometric tracings. The overall superimposition was registered on SN at sella. The maxillary superimposition was registered on the palatal plane at ANS. The mandibular superimposition was registered on the lingual aspect of the symphysis. Green line, Postphase 1 treatment; red line, postphase 2 treatment.
REFERENCES


Fig 10. Facial and intraoral photographs after 2 years of retention.


