Mandibular Growth Stimulation Produced by Modified Twin-Blocks in Skeletal Class II Retrognathic Mandibular Patients

Arthit Sittipornchai* and Chairat Charoemratrote

Department of Preventive Dentistry, Faculty of Dentistry, Prince of Songkla University, Songkhla, 90112 Thailand
* E-mail: at_arthit@hotmail.com

Abstract

Objective: To determine the treatment effects of Modified Twin-Blocks (MTBs) on mandibular growth in skeletal class II retrognathic mandibular patients. Methods: Treatment group composed of 6 growing patients with skeletal class II retrognathic mandible and dental class II malocclusion. After leveling and aligning until upper and lower archwires were 0.022 x 0.025 inches stainless steel, MTBs was constructed on maxillary and mandibular first premolars for advance the mandible by 2 mm and then an additional 2 mm every 2 months until normal soft tissue chin position when compared to the forehead will be achieved. Treatment effects were identified with Pancherz’s analysis and conventional cephalometric analysis. Results: Results indicated that mandibular growth (Co-Pg) in the treatment group was on average 6.08 mm compared with the control group increase in Co-Pg of 2.25 mm, resulting in a net gain of 3.83 mm during the MBTs treatment period. The magnitude and direction of the skeletal changes were found to be quite favorable for correct skeletal class II relationship. Conclusions: Overall, this treatment technic, MBTs, can induce mandibular growth and correcting class II skeletal disharmony in growing patients.

Keywords: Modified Twin-Blocks, Growth Modification, Class II Malocclusion, Retrognathic Mandible, Functional Appliance

Introduction

The class II malocclusion is the skeletal facial disharmony that the position of mandible is posterior to the maxilla. This malocclusion can be result from maxillary prognathism, mandibular deficiency or a combination of both.

In growing patients, Stahl et al [1] reported that, patterns of craniofacial growth in patients with class II malocclusion essentially were similar to those of patients with normal occlusion, with the exception of significantly smaller increases in mandibular length. Growth modification with headgear or functional appliance during the circumpubertal period was recommended [2-4].

The Twin-Blocks appliance is removable functional appliance, which comprised of upper and lower bite-blocks that effectively modify the occlusal inclined plane. It induces favorably directed occlusal forces producing a functional mandibular forward displacement and change from class II to class I jaw relationship.

In comparison to other removable functional appliances, these occlusal inclined planes like appliance give greater freedom of anterior movement and lateral excursion and cause less interference with normal function [5].

The short-term treatment effects produced by the Twin-Blocks appliance evaluates the dentoalveolar and skeletal cephalometric changes, the results indicated that, the mandibular incisors were tipped labially and the maxillary incisors were retroinclined[3-9]. In comparison with the controls, however, the Twin-Blocks treatment produced a statistically increase in the total mandibular length [5, 10-12]. The increase in mandibular length could possibly be due to condylar growth stimulation as an adaptive reaction to the
forward positioning of the mandible. Thus, the change in the SNB angle may be a result of both an increase in mandibular length and forward displacement of the articular portion of the temporal bone[13-16].

Several studies [5, 11, 12], illustrated that in Twin-Blocks appliance group the ANB angle and overjet were significantly reduced. These were due to increase in the SNB angle. The lower incisors proclined considerably in the patients treated by Twin-Blocks appliance. The disadvantage of Twin-Blocks appliance is more dental movement than skeletal effects during the treatment, it may not be the most suitable for all types of malocclusion.

To maximize the orthopedic effect, in stainless steel crown Herbst appliance, unnecessary forward tipping of the lower incisors was avoided by using -10° torque brackets and maxillary arch was tied back to the molar tubes to prevent space from opening between the molars and the second premolars that prevented the distal movement of the maxillary molars [17, 18].

Step-by-step advancement of the mandible might enhance mandibular growth more than maximum jumping only. In previous comparison of treatment result over 12 months, it was shown that the improvement in the jaw base relationship produced by the headgear-Herbst appliance with step-by-step advancement of the mandible was twice as large as that of the conventional Herbst appliance with maximum jumping of the mandible. The results of an animal study [19] also indicated that the stepwise advancement produced more skeletal effects than single advancement and a more prominent effect with stepwise advancement was found in the glenoid fossa when compared with the condyle. Results of this study showed that forward mandibular positioning led to increase bone formation in the condyle and the glenoid fossa when compared with natural growth. Stretching of the posterior attachment of the fibrous capsule during mandibular advancement caused a series of cellular and molecular events that lead to bone formation in the condyle and the glenoid fossa [20].

The aims of this study were to develop a new mandibular advancement appliance, Modified Twin-Blocks (MTBs), under the same principle as Twin-Blocks appliance and to determine the treatment effects of (MTBs). The hypothesis of this study was mandibular growth of the class II growing patients treated with MTBs was more than that of untreated patients.

Materials and Methods
Sample selection
The patients were recruited from Orthodontic clinic, dental hospital, Faculty of Dentistry, Prince of Songkla University. The patient inclusion criteria for this study were: healthy patients, skeletal class II normodivergent pattern with retrognathic mandible, during MP₃ stage (maximal pubertal growth not yet reached) assessed by hand & wrist radiographic examination, complete eruption of the maxillary and mandibular permanent first premolars. All of patients were informed about step of treatment and willing to participate. The patients were divided into two groups

1. Control group: individuals were untreated during a time period of 6-8 months.
2. Experimental: individuals were treated with MTBs until achieved the normal soft tissue chin position when compared to the forehead.

Treatment technique
For treatment group, patients were treated with Preadjusted edgewise fixed appliances (0.022 x 0.028 inches slot size). Upper teeth were leveled, aligned and expanded. Lower teeth were aligned, kept both curve of Spee and lingual crown torque of lower incisors. Advancement done when upper and lower archwires were 0.021 x 0.025 inches stainless steel.

To construct the MTBs, Band-lok® were bonded on the maxillary permanent first premolars and mandibular permanent first premolars with the shape similar to Twin-Blocks appliance for 2 mm mandibular advancement. Every 2 months, the stepwise mandibular advancement was done by 2 mm
additional Band-lok®[21]. For the reason of chewing, the Band-lok® were constructed on the occlusal surface of lower molars. After normal facial contour angle had achieved (5°-13°), the treatment of MTBs was completed and the lateral cephalogram of each patient was recorded.

MTBs were designed to be used 24 hours a day that there was a continuous stimulus for mandibular growth. Due to no attachment connected between upper and lower teeth, better adaptation for normal functions such as mastication, swallowing, speech, and breathing would be created. Therefore the lower jaw was allowed opening and moving freely. Since the application of force was transmitted directly to the teeth through a supporting system, the main disadvantage may be encountered the dental movements during treatment. However, the unwanted dental movement could be avoided by good anchorage preparation [17, 18].

The analysis of treatment effects was derived from the lateral cephalogram tracing. The registrations from the lateral cephalograms were performed on acetate tracing paper. Linear measurements were made to the nearest 0.5 mm and angular measurements are made to the nearest 0.5°. The measuring points, reference points and reference lines[22] are defined in figure 2 A and B.

Before and after treatment records were analyzed by superimposition of tracings. Head film tracings were superimposed on NSL at S. The subject mean and standard deviation (SD) were calculated for all cephalometric variables. Means of cephalometric variable individuals at pre-treatment is T1, post-treatment is T2, pre-observe is C1, post-observe is C2. These data would be compared means in difference within sample group (ΔT) and control group (ΔC) by Mann-Whitney U test. The differences of probabilities of less than 5% (P<0.05) were considered statistically significant.

Figure 1. MTBs, with the shape similar to Twin-Blocks appliance for advance the mandible.

Figure 2. Cephalometric landmarks for investigated treatment effects: A, Horizontal measurements (Olp); B, Angular measurements.
Results and Discussion

Pretreatment equivalence

Table 1 showed the equivalence of the group for treatment before fitting the appliances and the control group at the start of the observation period. There was no significant difference between the two groups at the start of the study.

The treatment effects of the MTBs are shown in Table 2. Statistically significant differences are noted in 5 of the 11 variables examined in this study.

During the treatment period, the overjet was reduced 4.08 mm. Overjet reduction was accomplished by a favorable mandibular/maxillary growth difference of 3.1 mm, a 0.75 mm lingual movement of maxillary incisors and 0.51 mm lingual movement of mandibular incisors. The results could be calculated that was 7.74% orthodontic effect and 92.26% from orthopedic effect.

The mandibular unit length (measured from Co to Pg) increased by 6.08 mm in the MTBs group and 2.25 mm in control group. There was about three times as much as that experienced by the control subjects.

The forward growth of the maxilla was assessed by means of conventional angular measurement, little change in SNA was observed, thus indicating little maxillary restraint. These results did not suggest any significant headgear effects.

The correction of skeletal class II relationship could be accounted by the 1.92° decreased ANB angle in the treatment group, resulted from an increased of SNB angle as compared with almost no change in the control group.

![Figure 3. Skeletal and dental changes (mean value in mm) in treatment group](image)

Table 1: Pretreatment comparison of MTBs and control groups

<table>
<thead>
<tr>
<th>Variable</th>
<th>Control</th>
<th>MTBs</th>
<th>Difference</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>12.27 ± 1.59</td>
<td>12.41 ± 1.54</td>
<td>0.14</td>
<td>NS</td>
</tr>
<tr>
<td>Overjet (mm.)</td>
<td>8.08 ± 2.69</td>
<td>7.50 ± 1.87</td>
<td>0.58</td>
<td>NS</td>
</tr>
<tr>
<td>Olp-SS (mm.)</td>
<td>79.25 ± 4.71</td>
<td>80.08 ± 4.67</td>
<td>0.83</td>
<td>NS</td>
</tr>
<tr>
<td>Olp-Pg (mm.)</td>
<td>77.83 ± 6.27</td>
<td>79.75 ± 6.03</td>
<td>1.92</td>
<td>NS</td>
</tr>
<tr>
<td>Olp-Ul (mm.)</td>
<td>89.83 ± 6.82</td>
<td>91.31 ± 5.64</td>
<td>1.48</td>
<td>NS</td>
</tr>
<tr>
<td>Olp-LI (mm.)</td>
<td>81.58 ± 3.06</td>
<td>83.83 ± 5.03</td>
<td>2.29</td>
<td>NS</td>
</tr>
<tr>
<td>Co-Olp (mm.)</td>
<td>10.17 ± 3.72</td>
<td>10.50 ± 3.66</td>
<td>0.33</td>
<td>NS</td>
</tr>
<tr>
<td>Co-Pg (mm.)</td>
<td>88.00 ± 5.26</td>
<td>90.25 ± 4.90</td>
<td>2.25</td>
<td>NS</td>
</tr>
<tr>
<td>SNA (°)</td>
<td>83.08 ± 2.67</td>
<td>83.33 ± 3.01</td>
<td>0.23</td>
<td>NS</td>
</tr>
<tr>
<td>SNB (°)</td>
<td>76.25 ± 2.75</td>
<td>76.75 ± 3.59</td>
<td>0.5</td>
<td>NS</td>
</tr>
<tr>
<td>ANB (°)</td>
<td>6.83 ± 1.21</td>
<td>6.58 ± 1.82</td>
<td>0.25</td>
<td>NS</td>
</tr>
</tbody>
</table>

*P < 0.05 level

Table 2: Posttreatment comparison of MTBs and control groups (T2-T1 changes)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Control</th>
<th>MTBs</th>
<th>Difference</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment times (years)</td>
<td>0.59 ± 0.23</td>
<td>0.71 ± 0.27</td>
<td>0.12</td>
<td>NS</td>
</tr>
<tr>
<td>Overjet (mm.)</td>
<td>-0.58 ± 1.96</td>
<td>-4.08 ± 1.82</td>
<td>3.5</td>
<td>*</td>
</tr>
<tr>
<td>Olp-SS (mm.)</td>
<td>0.83 ± 0.68</td>
<td>2.08 ± 1.77</td>
<td>1.25</td>
<td>NS</td>
</tr>
<tr>
<td>Olp-Pg (mm.)</td>
<td>1.92 ± 1.69</td>
<td>5.92 ± 3.54</td>
<td>4</td>
<td>*</td>
</tr>
<tr>
<td>Olp-Ul (mm.)</td>
<td>1.5 ± 2.51</td>
<td>1.33 ± 3.01</td>
<td>0.17</td>
<td>NS</td>
</tr>
<tr>
<td>Olp-LI (mm.)</td>
<td>2.25 ± 3.44</td>
<td>5.41 ± 4.07</td>
<td>3.16</td>
<td>*</td>
</tr>
<tr>
<td>Co-Olp (mm.)</td>
<td>0.33 ± 0.61</td>
<td>0.25 ± 0.88</td>
<td>0.08</td>
<td>NS</td>
</tr>
<tr>
<td>Co-Pg (mm.)</td>
<td>2.25 ± 2.19</td>
<td>6.08 ± 3.56</td>
<td>3.83</td>
<td>*</td>
</tr>
<tr>
<td>SNA (°)</td>
<td>0.25 ± 1.17</td>
<td>0.00 ± 0.32</td>
<td>0.25</td>
<td>NS</td>
</tr>
<tr>
<td>SNB (°)</td>
<td>0.5 ± 1.05</td>
<td>1.92 ± 1.11</td>
<td>1.42</td>
<td>NS</td>
</tr>
<tr>
<td>ANB (°)</td>
<td>-0.25 ± 1.17</td>
<td>-1.92 ± 1.12</td>
<td>1.67</td>
<td>*</td>
</tr>
</tbody>
</table>

*P < 0.05 level
Conclusions
The present study suggests that skeletal class II correction could be achieved with MBTs by stimulating growth of the mandible. It should be noted, however, this investigation was evaluated treatment effects by way of lateral cephalograms only. In addition the transverse and neuromuscular effects of treatment should be further evaluated.

References


