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Abstract
This case report presents the outcome of atypical extraction and effect of Twin Block appliance on a growing adolescent. A 12-year-old boy who had complained about protrusive upper lips after being involved in a traffic accident. Tooth 11 was replanted at a local dental clinic, while tooth 21 was lost. In extra-oral examination, this patient had convex profile, obtuse nasolabial angle, and receded chin position. In intra-oral examination, bilateral Class II molar and canine relation were shown, the overjet was 11 mm between tooth 11 and 41; 7 mm between tooth 22 and 31; the overbite was 6 mm. Cephalometric analysis showed skeletal Class II jaw relationship with mandibular retrusion, and average mandible plane angle. The cervical vertebrae maturation stage was in late stage II to stage III. In the first stage of treatment, he received partial fixed orthodontic appliance to increase the overjet; then, Twin Block was used to facilitate mandibular growth. In the second stage, full-mouth fixed edgewise appliance was bonded and teeth 11 and 42 were extracted due to poor prognosis. After treatment, a harmonious profile was achieved. With proper case selection, good patient cooperation and appropriate appliance construction, distinct result with Twin Block appliance can be achieved. Early treatment using Twin Block appliance is effective in reduction of anterior-posterior discrepancy and severity of malocclusion.

Keywords
Growth modification; Twin block appliance; Asymmetric extraction; Class II malocclusion

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CASE REPORT

Class II Malocclusion and Traumatized Incisors in Adolescent with Twin Block and Fixed Appliance

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ABSTRACT

This case report presents the outcome of atypical extraction and effect of Twin Block appliance on a growing adolescent. A 12-year-old boy who had complained about protrusive upper lips after being involved in a traffic accident. Tooth 11 was replanted at a local dental clinic, while tooth 21 was lost. In extra-oral examination, this patient had convex profile, obtuse nasolabial angle, and receded chin position. In intra-oral examination, bilateral Class II molar and canine relation were shown, the overjet was 11 mm between tooth 11 and 41; 7 mm between tooth 22 and 31; the overbite was 6 mm. Cephalometric analysis showed skeletal Class II jaw relationship with mandibular retrusion, and average mandible plane angle. The cervical vertebrae maturation stage was in late stage II to stage III. In the first stage of treatment, he received partial fixed orthodontic appliance to increase the overjet; then, Twin Block was used to facilitate mandibular growth. In the second stage, full-mouth fixed edgewise appliance was bonded and teeth 11 and 42 were extracted due to poor prognosis. After treatment, a harmonious profile was achieved. With proper case selection, good patient cooperation and appropriate appliance construction, distinct result with Twin Block appliance can be achieved. Early treatment using Twin Block appliance is effective in reduction of anterior-posterior discrepancy and severity of malocclusion.

Keywords: Growth modification; Twin block appliance; Asymmetric extraction; Class II malocclusion

INTRODUCTION

Many methods have been developed for the orthodontic treatment of skeletal Class II malocclusion. However, when Class II malocclusion with retrognathic mandible occurs in a growing patient, growth modification is the most favored treatment modality. Among the armamentarium of the removable functional appliances, Twin Block appliance is preferred by many clinicians due to ease of use, and was first introduced by Clark in 1988, consists of two separate upper and lower removable plates with acrylic blocks, which were trimmed to an angle of 70° able to modify or redirect mandibular growth to correct a skeletal discrepancy. The following is a case report of a 12-year-old boy successfully treated with Twin Block appliance and fixed orthodontic treatment.

CASE REPORT

A 12-year-old boy came to our department having a chief complaint of protrusive lips. The date of first visit was Aug 25th, 2016. From extra-oral examination, the patient had a convex profile, receded chin, deep mentolabial sulcus and an average growth pattern (Figure 1A). From the intra-oral examination, the overbite was 6 mm. Since tooth 21 was missing, we used both teeth 11 and 22 as reference points for overjet measurement. Before treatment, the overjet was 11 mm between teeth 11 and 41, and 7 mm between teeth 22 and 31 (Figure 1B). The lower dental midline, compared to the facial midline, was shifted to his left side by 1.5 mm. Tooth 11 was avulsed and had undergone replantation, while tooth 21 was missing. The crown of tooth 42

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was fractured and tooth 36 was buccal version. Bilateral canines and molars showed Class II relationship. Anterior Bolton ratio was 92.3\% when the diameter of the mandibular six anterior teeth was divided by that of the maxillary five anterior teeth. Curve of Spee was 3 mm and 2 mm on the right and left sides respectively.

In panoramic film, there was no significant bony defect and the sinus was clear (**Figure 2A**). The shape and location of his temporomandibular joint were within normal limits. On posterior-anterior cephalometric analysis, his mandible had shifted to the left side 3.5° (**Figure 2B**). On lateral cephalometric analysis, the cervical vertebrae maturation (CVM) stage was in late stage II to early stage III (**Figure 2C**). He had skeletal Class II jaw relationship, the lower incisors were protrusive, while both upper and lower lips were protrusive to the E-line.

**Diagnosis**

The diagnosis was divided into three parts. Firstly, skeletal Class II jaw relationship with mandibular retrusion, hyperdivergent facial pattern and mandible had shifted to the left side 3.5°; secondly,
dental Class II molar relationship exhibited neutral upper incisors but protrusive and proclined lower incisors; and thirdly, upper and lower lips were protrusive to the E-line.

Treatment objective and plan

For the skeletal part, the aims were to improve Class II jaw relationship. As the mandible deviation and facial asymmetry were acceptable to the patient during the whole treatment, there was no further active treatment intervention for skeletal asymmetry. For the dental part, we endeavored to achieve solid interdigitation relationship and acceptable overbite and overjet with well-alignment. Since teeth 11, 21 and 42 were extracted, the patient would have Class II molar relationship with 3 incisors finished at the end of treatment. As for the aesthetics, we wished to achieve a harmonious facial profile. In the first stage, we planned to bond maxillary canine to canine for leveling and alignments. If tooth 11 was found to be ankylosed, it
would be extracted. We also planned to use Twin Block appliance to modify the mandibular growth.

The treatment alternatives were one-stage fixed extraction treatment combined with orthognathic surgery or 2-stage non-extraction treatment. For the option of the one-stage extraction fixed extraction treatment, we planned to extract tooth 11 due to poor prognosis and extract teeth 34 and 44 for dental decompensation. For surgical option, bilateral sagittal split osteotomy with optional genioplasty will be planned for the patient. For the option of non-extraction treatment, high pull headgear and twin block with occlusal splint was initiated; subsequently, TADs might be used as backup plan if patient cooperation was poor.

Figure 5. A, extraoral and; B, intraoral photographs after a year of twin block treatment; C, lateral cephalometric film after twin block treatment showed CVM stage turned into stage IV.
Treatment progress: first stage

In May 2017, we bonded maxillary canine to canine with .022 slot OPAK system (TOMY, Japan) pre-adjusted fixed appliances and used 0.014” NiTi wire for initial leveling and alignment (Figure 3). After 5 months of correction, Twin Block therapy commenced (Figure 4). After a year of treatment, we re-evaluated the oral condition. The first stage serial photos showed overjet reduction (Figure 5).

After first-stage treatment, overbite was reduced to 4 mm. Overjet was 6 mm between teeth 11 and 41, and 6 mm between teeth 22 and 31 (Figure 5A and B). The molar relationship was corrected to Class I on the right side; nevertheless, anterior Bolton ratio was 89.4%, exceeding normal range, while crowded dentition and large Curve of Spee remained. The CVM stage was into stage IV when re-evaluated (Figure 5C).

By comparing the lateral cephalometric film between initial and re-evaluation; for the skeletal part, the SNA, SNB and SN-MP angles were increased and ANB angle decreased. For the dental part, the inclination and position of upper incisors were decreased, and position of lower incisors increased with both lips being improved. In regional superimposition, both maxilla and mandible grew (Figure 9); the upper incisors were retracted with extrusion; upper and lower molars extruded and moved mesially; and lower incisors were extruded.

Treatment progress: second stage

During the second stage treatment, teeth 11 and 42 were extracted, then rounded wire and rectangular NiTi wire were used for initial leveling and alignment (Figure 6). After five months, transpalatal arch was delivered for vertical control (Figure 7), while bilateral basal arch was used to flatten the curve of Spee and decrease overbite. Finishing and detailing took seven months. Second stage treatment took 11 months (Figure 8). Post-
Treatment panoramic film showed all root parallelisms were acceptable (Figure 8C).

**Treatment result**

The overall superimposition was performed according to Bjork anatomical landmarks on the basis of stability, including: 1) Anterior wall of sella turcica and its intersection with the inferior surface of the anterior clinoid process (Walker point); 2) Cribiform plate; 3) Ethmoidal crests; 4) Cerebral surface of the frontal bone orbital roofs. The maxillary superimposition was registered on the anterior surface of the zygomatic process. The mandibular superimposition registered on the anterior contour of the chin, the inner cortex of the mandibular symphysis, and the contour of the mandibular canal.

The cephalometric analysis was used for comparisons among pre-treatment, re-evaluation, and post-treatment. The SNA, SNB, and SN-MP angles increased, and ANB angle decreased (Figure 9 and Table 1). The inclination and position of upper incisors were decreased, while the position of lower incisors decreased. Both lips were improved. Regional superimposition before and after treatment demonstrated growth with retraction.
controlled tipping, and extrusion of upper incisors. The upper and lower molars were moved mesially and extruded, while lower incisors were proclined, retracted and extruded. The comparison of occlusal view showed well-aligned occlusion.

The lateral and frontal views showed bilateral maxillary lateral incisors replaced the central incisors well. Three incisors completed the mandibular part with acceptable overbite and overjet.

**DISCUSSION**

We presented a 12-year-old boy with Class II malocclusion treated with Twin Block followed by fixed appliance. The treatment course was totally 37 months, comprised of five months of initial leveling and alignment, eight months of Twin Block active phase, 4 months of Twin Block support phase, and then the fixed appliance phase commenced in the second stage. The outcome was favorable. The reason of 5-month leveling and alignment before initiating the Twin Block therapy was to increase sufficient overjet for mandible advancement. The considerations for this atypical extraction in the patient after tooth trauma injuries were as follows: firstly, teeth 11 and 42 had poor prognosis; and secondly, after assessment of Bolton ratio, the overjet and overbite would be acceptable after extraction.

Among tooth-borne functional appliances such as Bionator, Herbst, Twin Block appliance, and mandibular anterior repositioning (MARA) modalities; Twin Block showed better control of vertical dimension.\(^8\) The plan of Twin Block treatment was to expect more horizontal than vertical growth; however, as shown in Table 1, the SN-MP angle increased 0.6° between initial and 1st stage treatment, which meant the mandible had been growing more vertically than horizontally. According to Ricketts analysis, facial axis angles are used to evaluate growth, and in this patient, the facial angle was less than 90° during each treatment phase. The vertical growth pattern might outweigh the horizontal growth generated by the Twin Block effect.

The skeletal effect of Twin Block is controversial because the inherent growth cannot be neglected. If accurate skeletal and dentoalveolar effect produced by Twin Block is desired, CBCT would be the better modality for evaluation. Besides, the case lacks the X-ray after initial leveling would lead to incomplete calculation of dental effect. If the patient had lateral cephalometric film images taken before Twin Block therapy, the actual effect of the Twin Block could be better seen.

As previously mentioned, the initial average overjet was 9 mm (11 mm between teeth 11 and 41, 7 mm between teeth 22 and 31). After the complete treatment, the overjet was 2 mm, by 7 mm reduction. In regional superimposition, upper incisors retracted by 5 mm. In overall superimposition, B point prostracted by 2 mm. Consequently, the ratio of skeletal to dental effect was approximately 2 to 5.

Twin Block has advantages such as patients’ tolerance and compliance, ease of repair and applicable in both permanent and mixed dentition.\(^9\) Although the Twin Block effect can be compromised by poor patient compliance. Also, clinician experience and age of the patient are important factors. This patient had retracted mandible and orthodivergent facial pattern with hyperdivergent tendency. His dental development was in mixed dentition and had good compliance. Therefore Twin Block was considered as an option. It should be cautious that Twin Block might cause proclination of

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**Table 1. Summary of Cephalometric Analysis.**

<table>
<thead>
<tr>
<th>Norm</th>
<th>Pre-treatment</th>
<th>Post-1st stage</th>
<th>Post-treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Skeletal</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SNA</td>
<td>79.9–85.5</td>
<td>85.8</td>
<td>85.9</td>
</tr>
<tr>
<td>SNB</td>
<td>76.7–82.7</td>
<td>75.8</td>
<td>76.9</td>
</tr>
<tr>
<td>ANB</td>
<td>1.2–4.8</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td>SN-MP</td>
<td>28.9–38.1</td>
<td>37</td>
<td>37.6</td>
</tr>
<tr>
<td><strong>Dental</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>U1-NA</td>
<td>3.7–7.3</td>
<td>5</td>
<td>3.5</td>
</tr>
<tr>
<td>U1-SN</td>
<td>100.2–114.6</td>
<td>106</td>
<td>93</td>
</tr>
<tr>
<td>L1-NB</td>
<td>5.0–8.6</td>
<td>11</td>
<td>12</td>
</tr>
<tr>
<td>L1-MP</td>
<td>92.6–103.4</td>
<td>102</td>
<td>102</td>
</tr>
<tr>
<td><strong>Soft tissue</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>U-lip to E-line</td>
<td>0.8–3.2</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>L-lip to E-line</td>
<td>1.2–4.4</td>
<td>11</td>
<td>8</td>
</tr>
</tbody>
</table>
lower incisors and posterior open bite as shown in this case.

In previous studies, Twin Block effect achieved 5.6 mm-6.4 mm of overjet reduction.\textsuperscript{10,11} Our case showed 5 mm of overjet reduction between teeth 11 and 41, and 1 mm of reduction between teeth 22 and 31 after Twin Block treatment, less than the amount that shown in previous studies.

For the bite registration of Twin Block, single activation to an edge-to-edge incisor relationship with 2 mm interincisal clearance was recommended for the overjet less than 10 mm. When overjet is more than 10 mm, an initial advancement of 7 or 8 mm should be followed by reactivation of the appliance after occlusion has been corrected to the initial bite registration.\textsuperscript{4}

As for the optimal treatment age, one study showed that early treatment starting from adolescence is better, with less treatment time and costs.\textsuperscript{11} The optimal timing is around the pubertal peak. Our patient started from 12.5 years of age, which was a timely intervention as supported by previous studies.

CONCLUSION

In this case, initially, the patient was ortho-divergent with hyper-divergent tendency. He was in CVM late stage II to early stage III, indicating an active grower. He had uncrowded Class II division I dentition with deep overbite, so Twin Block was used, with more dentoalveolar than the skeletal effect.

Conflicts of interest statement

The authors declare that there is no conflict of interest.