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Rapid Maxillary Alveolar Expansion in Maxillary Severe Space Deficiency

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INTRODUCTION

Rapid maxillary expansion (RME) is a popular procedure for correction of transverse discrepancy in the past 2 decades. In 1990s, Adkins et al have demonstrated that 1 mm of trans-palatal width increase in the premolar region produces a 0.7 mm increase in maxillary arch perimeter.\(^1\) And in 2003, McNamara et al evaluated the short- and long-term changes in dental arch dimensions in patients treated with RME followed by fixed edgewise appliances; they concluded that a net gain of 6 mm was achieved in the maxillary arch perimeters as compared to the untreated controls.\(^2\) As a result, RME is a viable option to correct transverse discrepancies and create additional space in the dental arch, which offers the possibility of non-extraction treatment selection.

Previous study has indicated that rapid or slow expansion technique can achieve similar effects on maxillary arch expansion.\(^3\) If the skeletal transverse problem is severe, temporary anchorage device might be applied to join the expander to gain some orthopedic treatment effects. In this case report, a conventional expansion appliance (RME) was applied on a narrow maxilla was demonstrated.

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Case Report

RAPID MAXILLARY ALVEOLAR EXPANSION IN MAXILLARY SEVERE SPACE DEFICIENCY

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Although maxillary skeletal palatal expansion was efficient to correct the transverse dental deficiency, the conventional maxillary palatal expansion is still effective in some cases. This case report describes the orthodontic treatment procedure of a 15-year-old female patient who was diagnosed as Angle’s Class I malocclusion with severe space deficiency. The space deficiency of 11 mm was noted in maxillary arch in conjunction with severe overjet, blocked-in lateral incisors, high maxillary vault, posterior crossbite and V shape arch-form. The treatment plan presented non-extraction with rapid maxillary alveolar expansion in upper arch. The Hyrax expander was used in a rhythm of 2 turns/day. The treatment outcome demonstrated 5 mm transverse expansion after 3 weeks of activation. The fixed orthodontic therapy followed the maxillary expansion. The treatment result indicated harmonious facial profile with a normal overjet and overbite occlusion. It is suggested that correct diagnosis in transverse problems and proper selection of appliance contribute to the good treatment outcome. (Taiwanese Journal of Orthodontics. 30(4): 200-207, 2018)

Keywords: rapid maxillary expansion; Hyrax expander; edgewise therapy.
CASE REPORT

A 15-year-old female came to our department with her mother had a chief complaint of crooked teeth when smiling. The past medical history of the patient indicated allergic rhinitis. Other major systemic disease and drug allergy were denied. She has received dental care at local dental clinic regularly.

Extra-oral findings
The extra-oral examination demonstrated that she had a convex profile with mild incompetent lips and acute nasolabial angle. Her face was mild asymmetric. The maxillary incisal display was 9 mm (full crown height) on posed smile. The maxillary dental midline deviated to her left by 1 mm relative to her facial midline. No other oral habits were seen in the patient (Figure 1).

Intra-oral findings
The lower dental midline shifted to her left side by 1 mm relative to her upper dental midline. The molar relationship was Angle’s Class I, the canine relationship was Class II on both sides. The overjet was 8 mm and the overbite was 3.5 mm. Right posterior crossbite was noted from 14 to 17. Severe dental crowding in upper anterior region; there were 10 mm of space deficiency in the upper arch, and 4 mm space deficiency in the lower arch (Figure 1).

Radiographic examination
The radiographic examination included lateral and posterior-anterior (PA) cephalograms as well as panoramic film.

The panoramic radiography demonstrated deep caries at 46, presence of all third molars tooth germs and normal condylar head shapes with well-defined cortical margins. The lateral cephalometric analysis demonstrated skeletal Class I jaw relation with normodivergent facial pattern. Proclined upper incisal were also noted (Table 1). The PA cephalometric values are demonstrated in Table 2. The Ricketts analysis revealed the width differential of the maxilla to the mandible was less (68%), transverse deficiency could be found intraorally (Figure 2).

Figure 1. Pretreatment extra-oral and intra-oral photographs, and study model.
Table 1. The pre-treatment and post-treatment cephalometric measurements.

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Initial</th>
<th>Finish</th>
<th>Norm</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Skeletal</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SNA (*)</td>
<td>79.5°</td>
<td>79.5°</td>
<td>79.4 ~ 82.5</td>
</tr>
<tr>
<td>SNB (*)</td>
<td>77.5°</td>
<td>77°</td>
<td>74.6 ~ 77.8</td>
</tr>
<tr>
<td>ANB (*)</td>
<td>2°</td>
<td>2.5°</td>
<td>2.2 ~ 5.8</td>
</tr>
<tr>
<td>SN-MP (*)</td>
<td>35°</td>
<td>37°</td>
<td>34.2 ~ 38.6</td>
</tr>
<tr>
<td><strong>Dental</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>U1-SN (*)</td>
<td>111.5°</td>
<td>101.5°</td>
<td>103.5 ~ 109.1</td>
</tr>
<tr>
<td>U1-NA (mm)</td>
<td>9.5 mm</td>
<td>7.5 mm</td>
<td>3.8 ~ 7.2</td>
</tr>
<tr>
<td>L1-MP (*)</td>
<td>94°</td>
<td>102°</td>
<td>91.1 ~ 98.3</td>
</tr>
<tr>
<td>L1-NB (mm)</td>
<td>5.5 mm</td>
<td>7.5 mm</td>
<td>6.1 ~ 9.5</td>
</tr>
<tr>
<td><strong>Soft Tissue</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upper lip-E line (mm)</td>
<td>0.5 mm</td>
<td>1.5 mm</td>
<td>0.8 ~ 3.2</td>
</tr>
<tr>
<td>Lower lip-E line (mm)</td>
<td>2.5 mm</td>
<td>3.5 mm</td>
<td>1.2 ~ 4.4</td>
</tr>
</tbody>
</table>

Figure 2. Pretreatment lateral, PA cephalometric and panoramic radiographs.
DIAGNOSIS

The patient was diagnosed as a skeletal Class I jaw relation with normodivergent facial pattern, Angle’s Class I malocclusion with severe space deficiency and posterior crossbite.

Treatment plan

The treatment plan included application of RME appliance at initial stage, following with non-extraction method by fixed orthodontic appliance to align the dental arch and correct the occlusion.

Treatment progress

At initial stage, only the mandibular fixed appliance was bonded. The Hyrax expander was inserted on the upper arch, with 2 turns per day (0.25 mm per turn) until the expansion screw reached 10.5 mm (in 21 days). The upper central diastema could be observed (Figure 3). The maxillary fixed appliance was bonded after RME. The Hyrax expander was kept in situ for another 2 months for retention. Since the patient’s poor oral hygiene, the expander was removed at the 3rd month. No further active expansion was observed during the phase of fixed appliance. After 24 months of treatment, a better overbite and overjet with good occlusion was achieved (Figure 4, 5).

Figure 3. Progressive intra-oral photographs (after expansion).

Treatment result

After a total 24 months of treatment, satisfactory dental alignment and acceptable overjet and overbite were achieved. The posterior crossbite were partially corrected (from 14 to 16) (Figure 4). The final radiographs indicated parallel roots, proper root alignment, and no obvious root resorption (Figure 5).

Superimposition of cephalometric tracings indicated that the sagittal relationship of basal bone was generally maintained, with slightly downward and backward rotation of the mandibular basal bone, which led to an increase in the mandibular plane angle of 2°. We also observed a mild mandibular growth during treatment (Figure 6).

From regional superimpositions, the maxillary incisors were palatally uprighted, retroclined by 10°; and the upper molar was extruded due to the maxillary expansion. On the mandibular arch, the lower incisors were extruded and became proclined, and the lower molar was extruded which might be caused by the mandibular growth.

PA comparisons indicated a substantial increase in skeletal width in the nasal, maxillary and inter-molar regions (Table 2). The skeletal expansion amount in these three regions was 2 mm, 1 mm, and 5 mm, respectively.
Figure 4. Posttreatment extra-oral and intra-oral photographs, and study model.

Figure 5. Posttreatment lateral, PA cephalometric and panoramic radiographs.
Figure 6. Superimpositions of pre-treatment (black line) and post-treatment (red line) cephalometric tracings.

Table 2. Pre-treatment and post-treatment postero-anterior radiograph transverse measurements.

<table>
<thead>
<tr>
<th>Measure</th>
<th>Initial</th>
<th>Finish</th>
<th>Norm (16yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nasal width (N-N, mm)</td>
<td>31</td>
<td>33</td>
<td>27.7 ± 3</td>
</tr>
<tr>
<td>Maxillary width (J-J, mm)</td>
<td>64</td>
<td>65</td>
<td>66.2</td>
</tr>
<tr>
<td>Maxillary intermolar width (mm)</td>
<td>32</td>
<td>37</td>
<td>35 ~ 39</td>
</tr>
<tr>
<td>Mandibular width (Ag-Ag, mm)</td>
<td>94</td>
<td>94</td>
<td>85.8</td>
</tr>
</tbody>
</table>
DISCUSSION

During the treatment, the patient’s arch-form was changed from V shape to ovoid arch-form. It represents that the transverse dimension has been enlarged. But for the patient’s age, the effect of maxillary expansion might mainly from the dental effect. Studies had shown that skeletal changes of RME include the forward and downward movement of the maxilla in conjunction with a backward and downward rotation of the mandible, and the dental effect in the upper molars was extrusion and buccal tipping mainly. Therefore, in addition to creating more space, its dental effect would improve patients with mild skeletal Class III tendency.

However, the long-term stability of RME is still uncertain. The timing of treatment were mostly in the period of growth spurt or late mixed dentition/early permanent dentition. The type of expander was mainly Hyrax or Hass-type.

In 1990, Adkins et al have demonstrated that every millimeter of trans-palatal width increase in the premolar region produces a 0.7 mm increase in available maxillary arch perimeter.\(^1\)

In 2000, Handelman et al studies the long-term efficacy of RME with a Hass-type expander followed by edgewise therapy. The treated sample included both adults (29 y) and children (9.5 y). The long-term evaluation was about 5 years after discontinuation of the maxillary retention. And the evaluation was from the dental cast assessment. From the long-term records, they found a net gain of 4.8 mm in maxillary and 0.7 mm in mandibular molar trans-arch width as compared with the control group.\(^5,6\)

In 2001, Bacceti et al evaluated the dental changes obtained before and after peak pubertal growth spurt using the Hass appliance.\(^5,7\) The evaluation was conducted with cephalometric radiographs assessment (frontal view). The average observation period was 8 years. The authors concluded that a patient treated with Hass expander produces a reproducible amount of expansion at the dentoalveolar level in any development stage. The dental changes are more skeletal in nature before pubertal peak and more dentoalveolar achievement after pubertal peak.

In 2003, McNamara et al evaluated the long-term changes in dental arch dimensions in patients treated with RME followed by fixed edgewise appliances.\(^2\) The subjects were about 12 years old at the beginning, and their average long-term observation period was about 8 years. They concluded that a net gain of 6 mm was achieved in the maxillary arch perimeters and 4.5 mm in the mandibular arch perimeter as compared to the untreated controls.

In 2010, Hakan Gurcan Gurel et al evaluated the long-term changes in maxillary arch widths, overjet and overbite in patients who were treated with RME followed by edgewise appliance.\(^8\) The subjects were about 13 years old at the beginning, and their average long-term observation period was about 7 years. They concluded that the treatment produced absolute increases in maxillary arch widths, but a significant amount of relapse occurred in the long term, the greatest relapse located in inter-canine width.

From the above previous studies, we can assure the treatment efficiency of RME and fixed appliance therapy. Though a significant amount of relapse in the long-term evaluation, it will still increase maxillary arch widths and gain additional dental arch perimeter.

In this case, the patient had skeletal transverse deficiency with her age exceeded the growth spurt, because her maxillary inter-molar width was about 32 mm, which was much smaller than the average 35~39 mm,\(^9\) as well as the upper molars were also lingually tipped, therefore Hyrax expander was used to take advantage of its dental effect. Besides, owing to the patient’s poor oral hygiene, the Hyrax expander was chosen rather than Hass expander. After 3 weeks of expansion and two months as a...
passive retainer, a significant additional increase of 5 mm in the maxillary inter-molar width was gained. The long-term evaluation of stability is required in future.

**CONCLUSION**

In this case report, we presented the case of 15-year-old female patient who was diagnosed as Angle’s Class I malocclusion with severe space deficiency. The treatment combined the non-extraction treatment and RME. Although the patient’s age was over the stage of maxilla mid-palatal suture ossification, the dental effect achieved by expanding the transverse arch could still achieve good treatment outcome.

**REFERENCE**