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CASE REPORT

The Non-surgical Treatment of Class II Jaw Relation with Anterior Open Bite

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ABSTRACT

This 19-year-old female presents anterior open bite with skeletal Class II jaw relation. The treatment modality was non-surgical treatment with 4-bicuspid extraction and molar intrusion by full-mouth fixed edgewise appliances and temporary anchorage devices. A favorable result of ideal overbite/overjet and improvement of profile change were achieved. The patient was satisfied with the improvement of function and esthetics after treatment. Taiwanese Journal of Orthodontics 2021;33(2):85–92

Keywords: Class II malocclusion; Anterior open bite; Molar intrusion; Temporary anchorage devices (TADs)

INTRODUCTION

Distinguishing the etiology of patients with anterior open bite is essential for effective treatment planning. Open bite malocclusion could occur due to either or both skeletal or dental origin. Skeletal open bite is characterized by hyperdivergent facial growth pattern resulting from specific gene expression and sometimes needs surgical intervention for better treatment outcome, while dental open bite usually occurs due to functional habit, macroglossia or upper airway obstruction. In combination with skeletal Class II jaw relationship, many challenges are presented in obtaining and retaining optimal treatment outcome for patients with anterior open bite.1–3

The main treatment mechanics for dental open bite include posterior teeth intrusion and anterior teeth extrusion. In patients with retrognathic profile, intrusion of posterior teeth could allow the mandible to autorotate and improve the chin appearance. Orthodontic temporary anchorage devices (TADs) nowadays provide a more minimally invasive way to achieve molar intrusion and potentially reduce the necessity of maxillary Le Fort I impaction surgery.4–6 Although the usage of TADs provides a more conservative way to reduce the hyperdivergent vertical dimension, considerable amount of posterior teeth relapse, or so-called “re-eruption”, have been found in previous studies, so retention protocol after comprehensive orthodontic treatment needs to be addressed.

The aim of this article is to present the treatment of dental open bite malocclusion combined with skeletal Class II growth pattern in an adult patient.

CASE REPORT

This case report describes a 19-year-old female with the chief complaint of difficulty when eating food with her front teeth. Extra-oral examination revealed a convex facial profile, while intra-oral examination showed anterior open bite with only second molars occluded. The cephalometric analysis revealed skeletal Class II jaw relation and hyperdivergent facial growth pattern.5 Both upper and lower anterior teeth were proclined and protruding from basal alveolar bone. After regular orthodontic analysis and consultation with the patient and her family, full mouth orthodontic treatment with four 1st-bicuspid extraction was planned. The treatment

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principle was to intrude the posterior teeth for improvement of hyperdivergent face and then to extrude the anterior teeth to construct a consonant smile arc (Figures 1–3, Table 1).

Diagnosis

1. Skeletal: According to ANB and SN-MP angle from cephalometric analysis and extraoral photographs, the patient was diagnosed with skeletal Class II jaw relation with hyperdivergent facial pattern.
2. Dental: From intraoral photographs and dental cast, the patient was diagnosed with Angle's Class I malocclusion with 4.5 mm overjet (from 21 to 31), −3 mm overbite (from 21 to 31) and dental crowding. Protrusion/Proclination over upper and lower incisors was also noted according to increased angle of U1-NA, U1-SN, L1-NB and L1-MP from the cephalometric analysis.
3. Soft tissue: From extraoral photographs, convex profile, protrusive lips with mentalis muscle strain were diagnosed.

Treatment objective

Improve the skeletal Class II jaw relation and hyperdivergent facial pattern by autorotation of mandible. Close anterior open bite by anterior teeth extrusion and posterior teeth intrusion. Correct the convex profile and protrusive upper lip to a more balanced profile. Anterior teeth retraction to relieve dentoalveolar protrusion. Flatten curve of Spee in mandibular dentition.

Treatment plan

Open bite malocclusion often corresponds with nasal airway problems such as hypertrophy of tonsils and adenoids, allergic rhinitis and nasal septum deviation. For in this case, we referred this patient to ENT department for nasopharyngeal airway evaluation before orthodontic treatment. Serial TMJ evaluation was also arranged to confirm that there was no active joint inflammation or condylar bone resorption before orthodontic treatment. After systemic checkup, a 4-bicuspid (upper right, upper left, lower right, lower left 1st premolars) extraction and non-surgical orthodontic treatment were planned for this patient; additionally, wisdom teeth were to be extracted before treatment to prevent interference during upper molar intrusion. Full-mouth fixed edgewise appliances were bonded for leveling and alignment while sectional leveling protocol was applied over the upper arch at initial treatment stage to facilitate molar intrusion. Maximum anchorage was designed for space closure and anterior retraction. After space closure and final...
finishing and detailing, fixed retainer and circumferential removable retainer with posterior bite block were used after debonding.

Treatment progress

After teeth 14, 24, 34, 44 extraction, orthodontic treatment was carried out on July 19th, 2018 by using the pre-adjusted 0.022-inch slot OPAK bracket system. It took about four months to accomplish the leveling and alignment in lower dentition. As for upper dentition, the dentition was sectioned into anterior (from R't canine to L't canine) and bilateral posterior parts (from 2nd premolar to 2nd molar, connected with transpalatal arch) and leveled by super-elastic wire respectively. Four TADs were

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Pre-tx</th>
<th>Post-tx</th>
<th>Normal Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>SNA</td>
<td>81</td>
<td>79.5</td>
<td>79.8 – 83.2</td>
</tr>
<tr>
<td>SNB</td>
<td>74</td>
<td>74.5</td>
<td>75.7 – 78.7</td>
</tr>
<tr>
<td>ANB</td>
<td>7</td>
<td>5</td>
<td>3.2 – 5.0</td>
</tr>
<tr>
<td>SN-MP</td>
<td>40</td>
<td>38.5</td>
<td>33.8 – 38.4</td>
</tr>
<tr>
<td>U1 to NA mm</td>
<td>8.5</td>
<td>2.5</td>
<td>4.3 – 8.1</td>
</tr>
<tr>
<td>U1 to SN</td>
<td>113.5</td>
<td>95</td>
<td>103.85 – 108.75</td>
</tr>
<tr>
<td>L1 to NB mm</td>
<td>12</td>
<td>6.5</td>
<td>5.4 – 10.2</td>
</tr>
<tr>
<td>L1 to MP</td>
<td>106</td>
<td>101</td>
<td>93.4 – 99.2</td>
</tr>
<tr>
<td>E-line: Upper</td>
<td>3</td>
<td>1.5</td>
<td>0.7 – 3.1</td>
</tr>
<tr>
<td>E-line: Lower</td>
<td>5.5</td>
<td>2</td>
<td>0.2 – 3.4</td>
</tr>
</tbody>
</table>
inserted over bilateral paramedian area (2*8 mm) and infrrazygomatic crest area (2*12 mm) to perform maxillary posterior segment intrusion after initial leveling. When overbite gradually reached positive value, plane arch releveling and bracket reposition proceeded by checking the panoramic film. Myo-functional therapy also commenced at this treatment timepoint. Tongue training (tongue lifting exercise, tongue popping sound exercise), lip training (plosive sound exercise, holding sticks between lips, blowing tissue paper exercise), nasal respiration training and clenching exercise were taught to patient to perform in the frequency range from 5 to 10 times per day (Figure 4).

It took another 7 months to close the extraction space and correct the inclination of the anterior teeth. After meticulous finishing and detailing, the patient was debonded on August 20, 2019 with a total treatment duration of 25 months. Fixed retainers were used to hold the anterior teeth in both upper and lower arches (Table 2).

**Treatment results**

The convex facial profile and anterior open bite were improved. A normal overbite, overjet, Angle’s Class I occlusion, and coincident facial and dental midlines were achieved (Figures 5, 6). The superimposition of cephalometric tracings revealed that the proclination of both upper and lower incisors were corrected, and the protrusive lips profile also became more harmonious (Figure 7). The root parallelism and root resorption were acceptable and within the normal range in the final results from the panoramic radiographic findings (Figure 8). From the cephalometric analysis comparison before and after treatment, the ANB angle decreased from 7° to 5° while the SN line to mandibular plane angle (SN-MP) also decreased from 40° to 38.5°. The changes of the ANB and SN-MP angle indicated the counterclockwise autorotation of mandible that alleviated the initial skeletal Class II pattern and retrognathic profile. The distance between incisor to NA line decreased from 8.5 mm to 2.5 mm in upper incisors and from 12 mm to 6.5 mm in lower incisors. While the angle between incisor to SN plane decreased from 113.5° to 95° in upper incisors and the lower incisors to mandibular plane decreased from 106° to 101°, reflecting the improvement of bimaxillary dental alveolar protrusion (Table 1). From regional superimposition, about 3 mm maxillary posterior teeth intrusion was achieved, but half the amount of corresponding extrusion over lower molar was also noted. About 3 mm of upper anterior teeth extrusion contributed to construction of the ideal overbite and consonant smile arc (see Figures 5, 8).
**Table 2. Treatment progress.**

<table>
<thead>
<tr>
<th>Date</th>
<th>Upper arch</th>
<th>Lower arch</th>
</tr>
</thead>
<tbody>
<tr>
<td>2018.07.19–2018.11.05</td>
<td>Bracket bonding&lt;br&gt;Sectional Leveling and alignment&lt;br&gt;0.014&quot; NiTi&lt;br&gt;0.016&quot; NiTi&lt;br&gt;0.016 × 0.022&quot; NiTi&lt;br&gt;0.016 × 0.022&quot; SSW</td>
<td>Bracket bonding&lt;br&gt;Full mouth scaling and oral hygiene instruction&lt;br&gt;Extraction 34, 38, 44</td>
</tr>
<tr>
<td>2018.11.05–2019.03.18</td>
<td>IZC/paramedian miniscrew placement&lt;br&gt;TPA delivery&lt;br&gt;Posterior segment intrusion&lt;br&gt;0.017 × 0.025&quot; SSW</td>
<td>Anterior teeth retraction&lt;br&gt;0.017 × 0.025 SSW</td>
</tr>
<tr>
<td>2019.03.18–2019.10.04</td>
<td>Plane arch re-leveling and alignment&lt;br&gt;0.016 × 0.022&quot; NiTi&lt;br&gt;0.016 × 0.022&quot; SSW&lt;br&gt;Anterior teeth retraction&lt;br&gt;0.017 × 0.025&quot; SSW</td>
<td>Plane arch re-leveling and alignment&lt;br&gt;0.016 × 0.022&quot; NiTi&lt;br&gt;0.016 × 0.022&quot; SSW&lt;br&gt;Anterior teeth retraction&lt;br&gt;0.017 × 0.025&quot; SSW</td>
</tr>
<tr>
<td>2019.10.04–2019.11.25</td>
<td>Check root parallelism (Panorex)&lt;br&gt;Bracket reposition&lt;br&gt;Re-leveling and alignment&lt;br&gt;0.016 × 0.022&quot; NiTi&lt;br&gt;0.016 × 0.022&quot; SSW</td>
<td>Check root parallelism (Panorex)&lt;br&gt;Bracket reposition&lt;br&gt;Re-leveling and alignment&lt;br&gt;0.016 × 0.022&quot; NiTi&lt;br&gt;0.016 × 0.022&quot; SSW</td>
</tr>
<tr>
<td>2019.11.25–2020.08.13</td>
<td>Finishing &amp; detailing&lt;br&gt;0.017 × 0.025&quot; SSW</td>
<td>Finishing &amp; detailing&lt;br&gt;0.017 × 0.025&quot; SSW</td>
</tr>
<tr>
<td>2020.08.13</td>
<td>13-23 palatal fixed retainer&lt;br&gt;35-45 lingual fixed retainer</td>
<td>De-bonding&lt;br&gt;Circumferential retainer</td>
</tr>
<tr>
<td>2020.08.20</td>
<td>De-bonding&lt;br&gt;Circumferential retainer</td>
<td>De-bonding&lt;br&gt;Circumferential retainer</td>
</tr>
</tbody>
</table>

**Figure 5. The facial and intraoral photographs, after treatment.**
Etiology of open bite malocclusion

Open bite malocclusion is a multifactorial manifestation where it is difficult to distinguish which
factor plays the major role. The etiology of anterior open bite could mainly be divided into three parts: skeletal, dental and habitual. A hyperdivergent growth pattern, steep mandibular plane with low posterior facial growth could cause skeletal open bite; as it might derive from heredity and gene expression. Mandibular condyle pathology such as traumatic condylar resorption, rheumatoid condylar resorption, degenerative arthritis or idiopathic condylar resorption (so-called Cheerleader syndrome) could shorten the condylar length and manifest as anterior open bite.

As for the dental aspect, under-eruption of anterior teeth or overeruption of posterior dentoalveolar complex could also cause anterior open bite. Persistent problems like tongue thrusting, digit sucking or biting on a pencil or pipe habitually could develop an anterior open bite, and is often manifested as under-eruption over anterior teeth.

In this case, the patient had a hyperdivergent facial pattern with dentoalveolar protrusion, and tongue thrusting was also noted at initial examination. As for condylar examination, the shape and cortical border of her condyle remained oval and intact. Serial cephalometric film showed no linear change of mandibular length within a year of follow-up, so condylar resorption in this case appeared to not play a role.1,2

**Stability between surgery and non-surgery treatment for anterior open bite**

Regarding the stability between surgical treatment or non-surgical treatment for anterior open bite, a systemic review from University of Washington revealed that the total overbite relapse was 0.3 mm in the surgery group and 0.6 mm in the non-surgery group.7 The percentage of patients who had positive overbite during follow-up period was 82% in the surgery group and 75% in the non-surgery group. The outcome of surgery treatment seemed to be more stable at the conclusion of this research.8,9 In this case, surgery was not planned because of two reasons: firstly, the patient's tooth-to-lip relationship and tooth show were favorable to correct the anterior open bite by extrusion of upper incisors during anterior retraction; and secondly, her chief complaint at the beginning was protrusive lips, and her chin prominence was acceptable.10 Also, she had an Angle's class I molar relationship before treatment, so in this case, four bicuspid extractions with adequate vertical control seemed to be more reasonable than surgical treatment.

**Stability between extraction and non-extraction treatment for anterior open bite**

According to a systemic review by Dr. Foosiri et al., the mean stability rates were 93.53% and 73.68% in extraction and non-extraction cases respectively.11,12 This research indicated no significant relapse (0.07–0.77 mm) in extraction cases, but there was a significant relapse (0.7–1.35 mm) in non-extraction cases.

**Stability and limitation of molar intrusion**

Molar intrusion is an efficient way to simultaneously correct anterior open bite and improve retrognathic facial profile. According to the envelopment of tooth movement by Dr. Profitt, the maximal intrusion amount is around 2–4 mm by miniscrew.2 A millimeter intrusion could decrease the overbite by 1.5–2.5 mm based on different arch length.

The relapse percentage after active intrusion is around 22%–30% according to different studies with 80% of total relapse occurring within one year after treatment.4,13,14 As for long term follow-up, Dr. Profitt's research stated that with more than 2.3 mm of upper molar intrusion, the intruded teeth would re-erupt by 0.5–1.5 mm.15 Although soft-tissue analysis showed more favorable changes in the molar intrusion group, the relapse tendency after intrusion was still significant. In the present study, 3 mm M intrusion was achieved proximately, so retention reinforcement was important for long-term stability, thereby circumferential retainer with posterior bite block was used to apply "anti-re-eruption" force over posterior dentition. On the other hand, about 1.5 mm of lower molar compensated extrusion was noted in our case after treatment. According to Dr. Hart's research,16 about 1.1 mm compensated lower molars eruption was noted after 2.3 mm upper molars intrusion on average. Dr. Profitt also found a 0.6 mm compensated extrusion after 2.3 mm upper molars intrusion. Consequently, in this study, vertical control of lower dentition by lingual holding arch or TADs should be applied to reinforce the mandibular autorotation effect.

**CONCLUSION**

Treatment of anterior open bite is always challenging due to complicated etiology and questionable post-treatment stability. In our case, clockwise rotation of occlusal plane after intrusion of posterior teeth and extrusion of anterior teeth could facilitate the construction of smile arc, and counterclockwise auto-
rotation of mandible could improve retrognathic facial profile. After anterior teeth retraction, the anterior overbite and overjet was within the normal range, and the smile arc became more consonant. Superimposition of cephalometric film revealed ANB angle and SN-MP angle decrease, and lip protrusion was also reduced. After meticulous finishing and detailing, an efficient occlusion and improvement of esthetics were achieved after treatment.

Conflict of Interest Statement

The authors declare no conflicts of interest.

REFERENCES