Abstract: For treatment of severe bimaxillary protrusion in adults, a condition known to be among the most difficult to manage, both the maxillary and mandibular anterior teeth must be fully retracted using all the extraction space available. This article reports the treatment of an adult with severe high-angle bimaxillary protrusion. To correct the protrusion of the anterior teeth, orthodontic anchor screws (OASs) were used to provide absolute anchorage during anterior retraction. Acceptable occlusion, facial profile, and balance were achieved. OASs appear to be very useful for treatment of severe bimaxillary protrusion in adults.

Keywords: orthodontic anchor screw; anchorage loss; bimaxillary protrusion.

Introduction
For orthodontic treatment of severe bimaxillary protrusion, a condition considered to be among the most difficult to manage, the anterior teeth must be maximally retracted using all the extraction space available. Therefore, stable anchorage is essential to avoid mesial movement of the molars. In such cases, headgear has conventionally been used to strengthen the molar anchorage. However, adult patients are less compliant with headgear use than children (1,2). Lack of headgear leads to an unsatisfactory treatment result with residual bimaxillary protrusion because the extraction space is closed by molar protraction. Recently, orthodontic anchor screws (OASs) have been developed, and these have been shown to provide an absolute anchorage, allowing en masse retraction without anchorage loss (3). Here we describe an adult with severe bimaxillary protrusion who was treated using four OASs instead of headgear, yielding excellent results in terms of occlusion and lateral profile.

Case Report

Present status
The patient was a 22-year-old woman with a chief complaint of severe bimaxillary protrusion. A review of the patient’s medical, dental, and family histories revealed no significant findings. The facial profile was convex, and difficulty with lip closure was evident (Fig. 1A), although no functional problems were apparent. Intraoral photographs showed an Angle Class I molar relationship with slight mandibular anterior crowding (arch length discrepancy: −2.5 mm) and maxillary anterior protrusion. Overjet was 7.5 mm, overbite was 3.5 mm, and the mandibular dental midline was shifted 2.5 mm left to the maxillary dental midline (Fig. 2A).

Panoramic radiography showed that the maxillary and mandibular third molars had erupted (Fig. 3A). The maxillary right first and second bicuspids, left second bicuspid and the first molars on both sides were treated with inlays. The mandibular left second bicuspid and first molars on both sides and the left second molar were treated with inlays, and root canal treatment was performed on the left first molar (Figs. 2A, 3A).
Lateral cephalometric analysis indicated a slight skeletal class 2 jaw base relationship with an ANB angle of 4.5° and a high Frankfurt mandibular plane angle (FMA) of 31.5°. The upper incisors were extremely flared (U1-FH: 128.0°). Protrusion of the upper and lower lips was observed, and the Z angle was 63.0°. Steiner analyses indicated that U1 to NA was 13.0 mm and that L1 to NB was 11.5 mm (Fig. 4, Table 1), indicating intense labial position of the maxillary and mandibular incisors.

Based on these data, the patient was diagnosed as having Angle Class I bimaxillary protrusion with mandibular anterior crowding.

Treatment plan and progress

The treatment objectives were to correct protrusion of the maxillary and mandibular anterior teeth and lip protrusion, and create ideal overjet and overbite with a Class I molar relationship and a good facial profile (4).

Considering the ANB angle, the goal value by Steiner analysis (5) was set as follows: U1 to NA, 2.5 mm; L1 to NB, 6.0 mm; total space deficit, −14.5 mm (relocation lower 1, [6.0-11.5] × 2 = −11.0 mm; arch length discrepancy, −2.5 mm; and Spee curve correction, −1.0 mm). All available extraction space (15.0 mm) was required for treatment. We planned to extract both the maxillary and mandibular first bicuspids and use OASs for stable anchorage to utilize all the extraction space for anterior retraction.

Treatment progress

After extraction of the first four bicuspids, the maxillary and mandibular buccal segment teeth were banded or bonded with a 0.022 × 0.028-inch standard edgewise appliance and leveled and aligned with 0.016- and 0.018-inch stainless steel (SS) wires for 2 months. After the 0.018-inch SS wires had been set in the maxillary and mandibular segment, four OASs (ISA: ø1.6 mm × 8.0 mm, Biodent Corporation, Tokyo, Japan) were implanted 5 mm below the gingival margin of the buccal alveolar bone between the maxillary and mandibular second bicuspids and first molars, and four canines were directly retracted by a powerchain worn canine bracket from the OASs. After 6 months of treatment, the incisors were bonded and both arches were releveled with 0.016- and

Fig. 1  Facial photographs

Fig. 2  Intraoral photographs
0.018-inch SS wires. Ten months later, 0.018 × 0.025-inch SS wires were installed to retract both of the anterior teeth using sliding mechanics, which involved distal movement of the arch wire using a powerchain from the hook soldered between the lateral incisors and canines to the OASs. An excessive curve of Spee was added so as not to extrude the anterior teeth in the maxillary arch.

After 2 years and 10 months of orthodontic treatment, a solid Class I molar occlusion with no rotations, crowding or spacing and acceptable overbite and overjet were achieved, with a well-balanced face. Occlusion without any occlusal interference during mandibular movement was acquired, allowing removal of all fixed appliances; Begg-type retainers were then applied on both arches.

**Table 1** Summary of cephalometric measurements

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Pre-treatment (22Y 7M)</th>
<th>Post-treatment (25Y 10M)</th>
<th>Post-retention (28Y 10M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SNA (°)</td>
<td>81.3 ± 2.69</td>
<td>83.5</td>
<td>83.5</td>
</tr>
<tr>
<td>SNB (°)</td>
<td>78.75 ± 2.71</td>
<td>79.0</td>
<td>78.0</td>
</tr>
<tr>
<td>ANB (°)</td>
<td>2.56 ± 1.08</td>
<td>4.5</td>
<td>5.5</td>
</tr>
<tr>
<td>FMA (°)</td>
<td>26.34 ± 4.07</td>
<td>31.5</td>
<td>33.0</td>
</tr>
<tr>
<td>IMPA (°)</td>
<td>96.77 ± 6.41</td>
<td>91.5</td>
<td>85.0</td>
</tr>
<tr>
<td>FMIA (°)</td>
<td>56.90 ± 6.39</td>
<td>57.0</td>
<td>62.0</td>
</tr>
<tr>
<td>Occ. Plane to FH (°)</td>
<td>9.90 ± 3.84</td>
<td>8.0</td>
<td>10.0</td>
</tr>
<tr>
<td>U1-FH (°)</td>
<td>112.08 ± 4.23</td>
<td>128.0</td>
<td>100.0</td>
</tr>
<tr>
<td>U1 to NA (mm)*</td>
<td>Mean: 4.1 Goal value: 2.5</td>
<td>13.0</td>
<td>2.0</td>
</tr>
<tr>
<td>L1 to NB (mm)*</td>
<td>Mean: 4.7 Goal value: 6.0</td>
<td>11.5</td>
<td>6.0</td>
</tr>
<tr>
<td>Z-angle (°)**</td>
<td>Mean: 66.6 ± 7.1</td>
<td>63.0</td>
<td>72.0</td>
</tr>
<tr>
<td></td>
<td>Ideal: 73-75</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Standard by: Iwasawa et al., Nihon Kyosei Shika Gakkai Zasshi 28, 105-112, 1969; * Uesato et al., 1978 (5); **Ioi et al., 2005 (4).

**Fig. 3** Panoramic radiographs: (A) Pre-treatment, (B) Post-treatment, (C) Post-retention

**Fig. 4** Superimposed lateral cephalometric tracings: Pre-treatment (22Y 7M), solid line; Post-treatment (25Y 10M), dotted line; Post-retention (28Y 10M), dot-and-dash line

**Treatment results**

The facial photographs demonstrated an acceptable facial balance with improved lip protrusion and an acceptable smile without gingival exposure (Fig. 1B). Intraoral photographs showed acceptable occlusion and proper overbite and overjet, and solid Class I molar and canine relationships (Fig. 2B). Lateral cephalometric analysis indicated that U1 to NA was improved from 13.0 mm to 2.0 mm and that L1 to NB was improved from 11.5 mm to 6.0 mm. These values were very close to those identified in treatment planning. The Z-angle was changed from 63.0° to 72.0°, which was around the ideal value (4). FMA changed from 31.5° to 33.0°, resulting in clockwise rotation of the mandibular plane angle. The occlusal plane to FH was also increased from 8.0° to 10.0° (Fig. 4, Table 1).
For 3 years after retention, an acceptable occlusion was maintained without relapse of maxillary protrusion or mandibular anterior crowding, indicating stability of the occlusion (Figs. 1C, 2C). Panoramic radiography after treatment showed satisfactory root paralleling and no pathological findings; there has been no change in retention after 3 years (Fig. 3B, C).

**Discussion**

In patients with a high mandibular plane angle and a large space deficit, such as the present patient with bimaxillary protrusion, it is important to use all available extraction space without molar mesial movement (6). OASs are used for absolute anchorage. In this case, after treatment, the patient showed an acceptable facial profile balance through improvement of lip protrusion, due to retraction of the maxillary and mandibular anterior teeth. U1 to NA was changed from 13.0 mm to 2.0 mm and L1 to NB from 11.5 mm to 6.0 mm; these results were very close to those identified in treatment planning. The Z-angle was changed from 63.0° to 72.0°, which is the value of the facial profile favored by Japanese (4). Conventionally, headgear has been used for additional anchorage, but adult patients are often unable to use headgear because of social concerns, or reject its use because of esthetic problems. This lack of compliance results in insufficient treatment results. Recently, OASs for orthodontic treatment have been developed, and these have a number of advantages for orthodontic treatment (3,7). The treatment of this patient with severe bimaxillary protrusion demonstrated the effectiveness of OASs for absolute anchorage. During maxillary anterior retraction, an excessive curve of Spee was added to prevent extrusion of the anterior teeth, which can result in gingival exposure. Therefore, gingival exposure was acceptable in the facial smile photographs taken after treatment. However the values of the occlusal plane and mandibular plane to FH were increased. This might have been the result of insufficient maxillary anterior teeth intrusion and maxillary molar extrusion during anterior retraction. Better results would have been obtained by adding a further excessive curve of Spee for anterior teeth intrusion and by ligating the arch wire with maxillary OSAs by a ligature wire to prevent molar extrusion.

In conclusion, OASs appear to be useful for anterior full retraction in comparison to headgear, thus lessening the burden on patients.

**References**