Introduction

The open-bite patient often presents with one of the most difficult and challenging malocclusions for clinicians to treat.\(^1,2\) The American Board of Orthodontics Discrepancy Index denotes two points per millimeter, per tooth for open-bites and two points for an SN-MP plane greater than 38 degrees, with an additional two points per degree beyond that. It is not hard to see that open-bite patients typically score very high on the discrepancy index, which is a measurement of case complexity.\(^3\)

The determination of whether an open-bite is truly skeletal or dental often requires analyses on multiple aspects. Skeletal profile divergence and increased lower facial height typically correlate with skeletal components, whereas anterior teeth proclination and incisal display at rest and smiling are parameters used to determine dental components. Often the open-bite has a combination of both skeletal and dental components. The etiology of the open-bite is yet another area of contention, with a vast myriad of “culprits” ranging from genetics, mouth-breathing and weak musculature to tongue-thrusting and thumb-sucking habits.\(^4,5\)

Open-bites are treated using a variety of methods. Extraction of teeth (such as premolars) to reduce the so-called wedge effect and close open-bites has been touted, although research has shown that the wedge-effect phenomenon is questionable, at best.\(^6\) Orthognathic surgery is also another popular option, but it is not without associated risks and possible complications. Long-term studies have also shown significant relapse, even after orthognathic surgery.\(^7,8\) In this case report, we will present and discuss the non-extraction treatment of a severe open-bite with the use of mini-screws and segmental mechanics.

Clinical diagnosis

An 11.5-year-old female patient presented to our clinic with the chief complaint of her front teeth not touching. Soft-tissue and facial analysis revealed a dolichofacial profile with a slight increase in anterior facial height—both lips were ahead of the E-line by about 2mm. Intraoral examination
revealed moderate crowding in the maxillary arch, a Class I molar relationship and an open-bite of 2mm, beginning at the first premolar and up to 6.5mm at the central incisors. Incisal display at smiling was ~70 percent and the patient did not exhibit any lip strain at rest and closure (Fig. 1). (See Fig. 1a for initial radiograph.)

Cephalometric diagnosis revealed a mild skeletal Class II with an ANB angle of 5.2 and a marked hyperdivergent pattern of growth with an SN-MP of 44.6 (Table 1). Her panoramic radiograph showed that all third-molar buds were present, but no other significant findings (Fig. 2).

Treatment plan

Both the patient and parent expressed their desire for the treatment to be as conservative as possible. Our analysis of her soft-tissue profile and facial pattern deemed that despite a dolicho facial pattern and slight increase in anterior facial height, the patient had otherwise harmonious and esthetic profile and facial planes, so we decided to treat this patient as follows:

1. Band maxillary and mandibular first molars and bond the remaining dentition (GAC DENTSPLY In-Ovation and VS Euro metal prescription brackets).

2. Level and align the maxillary and mandibular arches in segments from the second molar to the canine bilaterally, and the lateral incisor to lateral incisor anteriorly with round NiTi wires, eventually progressing to 16x22ss (GAC DENTSPLY AccuForm).

3. Once the segments are aligned, use a utility arch on the mandibular arch to upright and extrude the lower incisors and tip the occlusal plane in a counterclockwise direction.

4. Place mini-screws (PSM Medical Solutions, Quattro plus) in the maxilla to cranial base, and maxillary and mandibular arches in segments from the second molar to the canine bilaterally, and the lateral incisor to lateral incisor anteriorly with round NiTi wires, eventually progressing to 16x22ss (GAC DENTSPLY AccuForm).

5. Once the segments are aligned, use a utility arch on the mandibular arch to upright and extrude the lower incisors and tip the occlusal plane in a counterclockwise direction.

6. Place mini-screws (PSM Medical Solutions, Quattro plus) in the maxilla to cranial base, and maxillary and mandibular arches in segments from the second molar to the canine bilaterally, and the lateral incisor to lateral incisor anteriorly with round NiTi wires, eventually progressing to 16x22ss (GAC DENTSPLY AccuForm).

7. Once the segments are aligned, use a utility arch on the mandibular arch to upright and extrude the lower incisors and tip the occlusal plane in a counterclockwise direction.

8. Place mini-screws (PSM Medical Solutions, Quattro plus) in the maxilla to cranial base, and maxillary and mandibular arches in segments from the second molar to the canine bilaterally, and the lateral incisor to lateral incisor anteriorly with round NiTi wires, eventually progressing to 16x22ss (GAC DENTSPLY AccuForm).

9. Once the segments are aligned, use a utility arch on the mandibular arch to upright and extrude the lower incisors and tip the occlusal plane in a counterclockwise direction.

10. Place mini-screws (PSM Medical Solutions, Quattro plus) in the maxilla to cranial base, and maxillary and mandibular arches in segments from the second molar to the canine bilaterally, and the lateral incisor to lateral incisor anteriorly with round NiTi wires, eventually progressing to 16x22ss (GAC DENTSPLY AccuForm).

Table 1.

<table>
<thead>
<tr>
<th>Maxilla to Cranial Base</th>
<th>Initial Values</th>
<th>Final Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>SNA (degrees)</td>
<td>80.9</td>
<td>77.0</td>
</tr>
<tr>
<td>Mandible to Cranial Base</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SNB (degrees)</td>
<td>75.8</td>
<td>73.8</td>
</tr>
<tr>
<td>SN-MP (degrees)</td>
<td>44.6</td>
<td>44.8</td>
</tr>
<tr>
<td>FMA (degrees)</td>
<td>34.8</td>
<td>31.6</td>
</tr>
<tr>
<td>Maxillo-Mandible</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ANB (degrees)</td>
<td>5.2</td>
<td>3.2</td>
</tr>
<tr>
<td>Maxillary Dentition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>U1-NA (mm)</td>
<td>6.0</td>
<td>5.4</td>
</tr>
<tr>
<td>U1-SN (degrees)</td>
<td>114.8</td>
<td>94.8</td>
</tr>
<tr>
<td>Mandibular Dentition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L1-NB (mm)</td>
<td>7.6</td>
<td>7.5</td>
</tr>
<tr>
<td>L1-MP (degrees)</td>
<td>92.5</td>
<td>90.6</td>
</tr>
<tr>
<td>Soft Tissue</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower Lip to E-Plane (mm)</td>
<td>2.0</td>
<td>1.9</td>
</tr>
<tr>
<td>Upper Lip to E-Plane (mm)</td>
<td>1.9</td>
<td>-0.1</td>
</tr>
</tbody>
</table>

Often the open-bite has a combination of both skeletal and dental components. The etiology of the open-bite is yet another area of contention, with a vast myriad of “culprits” ranging from genetics, mouth-breathing and weak musculature to tongue-thrusting and thumb-sucking habits.
palate between the maxillary first and second molars, and start intrusion with elastomeric chains (GAC DENTSPLY) from the mini-screws to the lingual attachments on the maxillary first and second molars. Start lateral triangle elastics from the upper canines to lower canines and first premolars (GAC DENTSPLY).

5. Once the bite has started to close to almost edge to edge, go to continuous archwire in the mandibular arch and continue lateral triangle elastics as required.

6. Place maxillary anterior extrusion arch, and ligate the arch distal to the lateral incisors to control the retroclination of the incisors during extrusion.

7. Once the bite is sufficiently closed, go to continuous archwire on the maxillary arch, and finish with lateral and anterior vertical interarch elastics.

8. Place fixed upper and lower retainers and deliver overlay Hawley retainers (Perfect Finish Laboratory, New Jersey) for retention.

Treatment progress

1. Eight months from initial: After waiting for sufficient eruption of the upper-right canine and completing the leveling and alignment in segments, the patient is currently 17x25ss segments in the maxillary and mandibular arches with a 17x25 TMA anterior extrusion utility arch in the lower. The bite has closed significantly from the initial malocclusion, however, anticipated side effects are observed, such as the retroclination of the lower incisors from the extrusion arch and a slight increase in the lateral open-bites from the segmental leveling and aligning (Fig. 3).

2. Twelve months from initial: The patient currently has had three months of intrusion from the palatal mini-screws placed between the maxillary first and second molars; additionally, bite buttons were placed on the second molars to aid in our intrusion

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vector and clockwise rotation of the segments. On the mandibular arch, she is in a continuous 16x22ss wire; interproximal reduction of 0.2mm was performed between the lower canine-to-canine segment, and an elastomeric chain was placed from first molar to first molar to maintain the inclination of the lower incisors. Lateral triangle elastics from the upper canines (lingual on the right and labial on the left) to lower canines and first premolars were starting to close the lateral open-bites, and also tipping the mandibular plane and maxillary segment toward each other (Fig. 4, p. 34).

3. Fifteen months from initial: With the intrusion of the maxillary posterior segment, the patient’s bite is now edge to edge. At this point we delivered a maxillary anterior extrusion arch. We ligated the arch distal to the lateral incisors to avoid excessive retroclination of the anterior segment. Significant maxillary posterior intrusion, especially in the premolars, is observed (Fig. 5, p. 34).

4. Eighteen months from initial: Utilizing just a combination of the maxillary extrusion arch and the mini-screws to intrude the posterior maxillary segments, we have now achieved positive overbite. At this point we decided to continue the previous mechanics, but also augment them with an anterior vertical elastic from the upper to lower central incisors, to be worn only at night (Fig. 6, p. 34).

5. Twenty-two months from initial: At this point we have achieved an overbite of about 3mm. The maxillary premolars have intruded so much we had to place a NiTi wire over their gingival bases to re-extrude them into occlusion. The patient is currently on anterior and lateral vertical elastics at night only (Fig. 7).

6. Twenty-six months from initial: We are now in 17x25ss maxillary and 16x22ss mandibular archwires. The mini-screws have been removed and elastomeric chains are placed from first molar to first molar on both arches to tighten all contacts. The patient is still on the current vertical elastics protocol. Fixed upper and lower retainers were also placed (Fig. 8).

7. Twenty-eight months from the initial: Patient is debonded and final photographs, panoramic and cephalometric radiographs are taken. Upper and lower Hawley retainers are delivered for night wear only (Fig. 9).
Treatment review and conclusion

Both the patient and her parents were very satisfied with the overall outcome of treatment. Soft-tissue and profile analysis showed that we did not detrimentally affect her profile and facial planes. Smile analysis showed marked improvement in her smile and incisal display (Fig. 9). The final panoramic radiograph showed that the root length and parallelism were satisfactory (Fig. 10). (See Fig. 1b on page 33 for final radiograph.)

The cephalometric analyses comparing the initial malocclusion and finished treatment showed an improvement in the ANB angle and reduction of the lip protrusion. Upper and lower incisors were also uprighted with more uprighting evident in the maxillary incisors (Table 1, p. 33). From the cephalometric superimpositions, we can see that despite a continual vertical pattern of growth, the open-bite was predominantly resolved by a combination of retroclination and extrusion of the anterior dentition, intrusion of the maxillary posterior dentition and rotation of the maxillary and mandibular planes toward each other (Fig. 11).

The treatment of the open-bite patient has often proven to be difficult and complicated, and further challenged in this day and age—it is also not uncommon for patients to request treatment with the option of avoiding extractions and/or orthognathic surgery, if possible. This case report shows one example of how the use of mini-screws, segmental mechanics and the employment of favorable force systems may create a satisfactory outcome within a reasonable amount of treatment time to treat a severe open-bite malocclusion without the need for extractions or orthognathic surgery.

References

Author Bio

Dr. Edmund Khoo is an orthodontist certified with the American Board of Orthodontics. He teaches orthodontics and dentofacial orthopedics full time at his alma mater, New York University. Dr. Khoo has been published in several journals and has been invited to chair numerous scientific sessions. His awards and achievements include the American Association of Orthodontists Charley Schultz Scholar Award; Academy of Distinguished Educators Faculty Award; and the Faculty Council Teaching Recognition Award.

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