Non-extraction Orthodontics in Severe Open Bite with Disc Plication Surgery of the Temporomandibular Joint

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Abstract
Open bite malocclusion is among the most challenging orthodontic deformities to correct. Among the etiological factors of anterior open-bite, degenerative change in temporomandibular joints (TMJs) is the most difficult condition to manage. The most appropriate treatment modality for TMJ disorder with disc displacement remains controversial. Disc repositioning surgery is a treatment option when conservative treatment has failed to resolve symptoms. We presented a patient had history of gradual bite opening associated with joint stiffness and clicking. She received occlusal splint therapy for more than 10 years, and the occlusion was stable for 1 year before orthodontic treatment was initiated. Based on magnetic resonance images (MRIs), the diagnosis of the TMJ disorder was anterior disc displacement without reduction in the right joint but with reduction in the left joint. Disc plication surgery was performed to minimize the risk of post-treatment relapse. Molar intrusion in both arches with temporary anchorage devices resulted in a counterclockwise mandibular rotation and an improvement in open bite. Anterior teeth extrusion is an alternative approach for the management of open bite and smile esthetics in patients with insufficient incisor show. Furthermore, tongue and lip training are also crucial procedures for post-treatment stability.

Keywords
Malocclusion; Molar intrusion; Temporomandibular joint disorder; Anterior disc displacement; Temporary anchorage device (TAD)

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CASE REPORT

Non-extraction Orthodontics in Severe Open Bite with Disc Plication Surgery of the Temporomandibular Joint

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ABSTRACT

Open bite malocclusion is among the most challenging orthodontic deformities to correct. Among the etiological factors of anterior open-bite, degenerative change in temporomandibular joints (TMJs) is the most difficult condition to manage. The most appropriate treatment modality for TMJ disorder with disc displacement remains controversial. Disc repositioning surgery is a treatment option when conservative treatment has failed to resolve symptoms. We presented a patient with a history of gradual bite opening associated with joint stiffness and clicking. She received occlusal splint therapy for more than 10 years, and the occlusion was stable for 1 year before orthodontic treatment was initiated. Based on magnetic resonance images (MRIs), the diagnosis of the TMJ disorder was anterior disc displacement without reduction in the right joint but with reduction in the left joint. Disc plication surgery was performed to minimize the risk of post-treatment relapse. Molar intrusion in both arches with temporary anchorage devices resulted in a counter-clockwise mandibular rotation and an improvement in open bite. Anterior teeth extrusion is an alternative approach for the management of open bite and smile esthetics in patients with insufficient incisor show. Furthermore, tongue and lip training are also crucial procedures for post-treatment stability.

Keywords: Malocclusion; Molar intrusion; Temporomandibular joint disorder; Anterior disc displacement; Temporary anchorage device (TAD)

INTRODUCTION

Open bite malocclusion is among the most challenging orthodontic deformities to correct, and the correction is prone to relapse. The etiology of anterior open bite is usually attributable to an interaction between genetic, dental, skeletal, functional, soft tissue-related, and habitual factors. Among the etiological factors, degenerative change in temporomandibular joints (TMJs) is the most difficult-to-treat condition when it leads to loss of condylar height and shape, and alternation of surrounding structures, such as disc displacement. The most appropriate treatment modality for TMJ disorder with disc displacement remains controversial. Available modalities can be classified as the nonsurgical approach, minimal invasive surgery, and open surgical procedures to reposition the displaced disc.

A combination of orthodontic treatment and orthognathic surgery (OGS) can drastically improve both occlusion and facial appearance in a severe open bite. However, using a skeletal anchorage, an anterior open bite can also be corrected with orthodontic intrusion of posterior teeth.
et al. compared the treatment results obtained using a skeletal anchorage with those obtained through OGS. They suggested that molar intrusion with a temporary anchorage device (TAD) is simpler and more useful than two-jaw surgery in correcting the anterior open bite. Anterior teeth extrusion is an alternative approach for open bite management. However, a gummy smile may occur due to excessive anterior teeth extrusion, whereas insufficient incisal show might also compromise the smile esthetic. The adequate gingival display and incisal show should be evaluated before planning the amount of anterior tooth extrusion. We here present a case of anterior open bite with a history of TMJ disorder accompanied with disc displacement that was managed with pure orthodontic treatment and by using TADs. Related etiological factors and treatment modality are also discussed.

CASE REPORT

Diagnosis

A 33-year-old woman visited our orthodontic department in December 2018. Her chief complaint was anterior open bite with difficulty in chewing and speech. She was a generally healthy woman who denied any systemic disease or history of trauma. However, she had a history of clicking sounds and stiffness in both her TMJs. Her bite was gradually opened before it was stabilized with occlusal splint therapy. This therapy was continued for 10 years, and her TMJ specialist referred her to our department for orthodontic treatment after one year of follow-up. Habits of mouth breathing, tongue thrusting, and clenching were recorded.

The extraoral photos of our patient revealed a convex profile and recessive chin (Figure 1). Lip incompetency and an acute nasolabial angle were observed. The upper lip coincident with the E-line and the lower lip 1 mm beyond the E-line in the profile view. The intraoral examination revealed an overjet of 5 mm and an overbite of negative 8 mm (Figure 2). There was only occlusal contact on the distal occlusal surface of the second molars. Both upper and lower dental midlines were shifted to the right, and bilateral canine and molar relationships were Class II. The posterior crossbites of teeth 16, 15, 14, 26, and 28 were noted. The panoramic film indicated mild flattening of the right condylar head, previous endodontic treatment of teeth 15 and 46, and absence of tooth 48 (Figure 3). In the cephalometric analysis, ANB and SN-MP angles were greater than the normal range, revealing a skeletal Class II relationship and a hyperdivergent facial pattern (Table 1 and Figure 4). The lower incisors were retroclined. The magnetic resonance images (MRIs) of the TMJs were also obtained during jaw closure and opening (Figure 5). When the jaw was closed, anterior disc displacement was observed in both joints. With the jaw opened, disc reduction was observed in the left but not in the right joint.

Our patient was diagnosed as having a skeletal Class II relationship with hyperdivergent facial pattern. Bilateral molar and canine relationships were Class II, with an open bite of 8 mm and a posterior lingual crossbite. Based on the MRIs, the diagnosis of the TMJs was anterior disc displacement.

Figure 1. Pre-treatment extraoral photos.
displacement without reduction in the right joint but with reduction in the left joint.

Treatment plan and progress

The patient was offered two treatment options. The first option was orthodontic treatment combined with OGS. Our oral surgeon suggested disc plication surgery of the TMJ before OGS to reduce the risk of postoperative relapse. The OGS plan was Le Fort I 3-piece in the maxilla for posterior impaction and widening, and bilateral sagittal splint for advancement in the mandible and genioplasty. The second option was non-extraction non-
surgical orthodontic treatment. Distalization and molar intrusion with TADs were planned in both jaws to achieve counterclockwise mandibular rotation. Tongue training, lip training, and TMJ monitoring were planned throughout the entire treatment process, and wraparound retainers were planned to be delivered for retention.

The patient originally selected the first OGS treatment plan. Then, disc plication surgery was performed in both joints to reduce the risk of postoperative relapse. Both articular discs were repositioned with bone anchors (DYNOMITE PK 2.0 anchors, Sheng-Hung Medical Co., Taiwan) inserted in the condyle and attached with sutures to secure the disc position (Figure 6). The relationship between the disc and the condyle was confirmed on the basis of mandibular movements. However, after the TMJ surgery was completed, the patient requested to change the treatment plan because of increased psychological concerns associated with the more invasive OGS. Hence, according to the revised treatment plan, pure orthodontic treatment with TADs was used to correct the 8-mm open bite. A transpalatal arch (TPA) and a lingual holding arch (LHA) were delivered. The TPA was widened, and the LHA was constricted for correcting the posterior crossbite. Segmental technique was used in the upper arch to avoid excessive extrusion of incisors. Maxillary and mandibular TADs were inserted near the midline of the palate and in the

<table>
<thead>
<tr>
<th>Table 1. Pre-treatment (Pre-Tx) and post-treatment (Post–Tx) cephalometric analysis data.</th>
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<tbody>
<tr>
<td><strong>Norm</strong></td>
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<tr>
<td><strong>Skeletal</strong></td>
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<td>SNA (°)</td>
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<td>SNB (°)</td>
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<td>ANB (°)</td>
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<td>SN-MP (°)</td>
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<td><strong>Dental</strong></td>
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<tr>
<td>U1-NA</td>
</tr>
<tr>
<td>U1-SN (°)</td>
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<tr>
<td>L1-NB</td>
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<tr>
<td>L1-MP (°)</td>
</tr>
<tr>
<td><strong>Soft tissue</strong></td>
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<tr>
<td>U-lip to E-line (mm)</td>
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<tr>
<td>L-lip to E-line (mm)</td>
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Figure 4. Pre-treatment lateral cephalometric film.
Figure 5. Magnetic resonance images (MRI) of the TMJ with mouth opened and closed. When the jaw was closed, anterior disc displacement was observed in both joints. With the jaw opened, disc reduction was observed in the left but not in the right joint. A, anterior; P, posterior; red line, position of condyle head; green, position of articular disc.

Figure 6. Photos taken during disc plication surgery.
buccal shelves, respectively. Molar intrusion was performed in both arches by using elastomeric power chains connected to the TADs (Figure 7). Tooth 18, 28, and 38 were extracted 4 months after orthodontic treatment began. After 21 months of treatment, molar intrusion in both arches was completed (Figure 8). Subsequently, the palatal TADs were moved to the buccal side for upper molar

Figure 7. Treatment progress. Palatal TADs with TPA in the upper arch and buccal TADs with LHA in the lower arch. Segmental technique was used in the upper arch to avoid excessive extrusion of incisors.

Figure 8. Treatment progress. Intraoral photos at 21 months of treatment, molar intrusion was completed, and open bite has been corrected.
distalization. Following midline correction in both arches, finishing and detailing was concluded with vertical elastics for occlusal settling. The total treatment time was 2 years and 7 months (Figure 9).

Treatment results

As noted in the post-treatment intraoral and extraoral photos, the 8-mm open bite was corrected, and Class I canine and molar relationships were achieved. Lip incompetency as well as the convex lateral profile were significantly improved (Figures 10 and 11). Post-treatment panoramic film showed good root parallel and no further resorption on condylar head (Figure 12). Head posture and oropharyngeal airway improved were also noted after comparison of pre-treatment and post-treatment lateral cephalometric films (Figure 13).

From the cephalometric superimposition and analysis before and after the treatment, we could observe 4 degrees of counterclockwise mandibular rotation and 3 mm advancement of the soft tissue menton. The upper lip was retracted, and lip incompetency was corrected (Table 1 and Figure 14). In the regional maxillary superimposition, 2-mm retraction with 2.5-mm extrusion of the upper incisors and 2-mm distalization with 1-mm intrusion of the upper molars were observed. In the mandibular superimposition, 1-mm retraction with 3-mm extrusion of the lower incisors and 2-mm distalization with 1-mm intrusion of the lower first molars, 2-mm distalization and 2-mm intrusion of the lower second molars were observed. Both posterior intrusion and anterior extrusion contributed to the correction of the anterior open bite (Figure 15).

At 1-year follow-up, the overbite presented a 0.5-mm decrease, but the overall occlusion was stable (Figure 16). In the superimposition of lateral cephalometric tracings, less than 0.5 degree of mandibular clockwise rotation was observed (Figure 17).

Figure 9. Intraoral photos showing progression of treatment. A, initial; B, upper arch expansion completed and posterior crossbite corrected; C, maxillary molar intrusion completed and alignment of anterior and posterior segment started; D, post-treatment.
The stability of the treatment results after 1 year was deemed acceptable, and the patient was very satisfied with the results.

DISCUSSION

In the treatment of anterior open bite cases, identifying and managing related etiological factors is a challenging yet essential procedure. Multiple etiological factors such as skeletal, dental, respiratory, neurologic, and habitual factors may be associated with the anterior open bite.  

Among the etiological factors, degenerative change in the TMJs is the most challenging condition to treat. 

Condylar degeneration, which is caused by various types of arthritis, could result in condylar osseous resorption and gradual bite opening. Therefore, a comprehensive review of related medical and dental history through clinical and radiographic examinations of the TMJ is crucial before orthodontic treatment. Orthodontic treatment in patients with the TMJ disorder should not be initiated until the joints are proven stable for 6–12 months and the patient's condyle is in a reproducible and reliable reference position for mandibular movement.

The most appropriate treatment protocol for the management of TMJ disorders, including internal derangement of the articular disc, remains
controversial. Conservative treatment methods include stabilization splints, medication, and control of parafunction.\textsuperscript{10} Disc repositioning surgery is another treatment option when conservative treatment has failed to resolve symptoms.\textsuperscript{4} However, some authors reserve TMJ surgery as a last resort,\textsuperscript{16,17} whereas others prefer TMJ surgery at the earliest.\textsuperscript{18,19} Several methods are available for securing the displaced disc in TMJ surgery. On evaluating the long-term postsurgical outcome after using sutures to tie the disc to the retrodiscal tissue and condylar capsule, studies have found that TMJ plication surgery successfully relieved the patients of TMD symptoms.\textsuperscript{4,20} Bone anchors allow the optimization of the attachment between the disc and bone, ensuring that the disc remains in position in relation to the condyle during movement.\textsuperscript{21,22} A study revealed the superior performance of bone

Figure 12. Post treatment (finish) panoramic film.

Figure 13. Comparison of pre-treatment and post-treatment lateral cephalometric film. Yellow – the pre-treatment oropharyngeal airway space, red – the post-treatment oropharyngeal airway space.
anchors compared with conventional techniques. However, in the same study, postsurgical pain was greater for patients treated with bone anchors in the immediate postoperative period due to bone injury than for those who underwent conventional discopexy. A study also indicated that disc repositioning using the Mitek anchor could minimize the risk of post-OGS relapse. Aberrant development of the craniofacial structure is associated with anterior open bite. Significantly greater eruption of maxillary molars, excessively steeper mandibular planes, and greater lower anterior facial dimension have been observed in open bite cases. In Isaacson’s study, the distance from the occlusal to palatal plane (palatal height), anterior dental height, and height of mandibular molar were increased in the group with high mandibular plane angles. During the initial analysis, our patient had increased lower anterior facial height and increased SN-MP angle. We compared the palatal height, anterior dental height, and ramus height with the values in Isaacson’s study. Both the palatal height and anterior dental height were above average, suggesting vertical maxillary excess (Table 2).

A surgical orthodontic procedure can drastically improve both occlusion and facial appearance, thereby correcting severe open bite. In addition to OGS, posterior intrusion with TADs or extrusion of incisors have been proposed. Various reports have shown that molar intrusion in both arches with TADs can result in a desirable improvement in facial esthetics due to counterclockwise mandibular rotation. A study comparing the treatment results of open-bite correction using TADs or OGS suggested that molar intrusion with TAD is simpler.
and useful than two-jaw surgery. Several mechanisms have been proposed for the intrusion of the posterior teeth. Using TADs combined with a TPA and LHA to maintain the intermolar width during intrusion or placing TADs on both the buccal and palatal sides, has been proven to be an effective method. This is corroborated by a previous study by Kim et al., in which 1 mm of maxillary molar intrusion resulted in a 2.6 mm decrease in overbite, a 1.7 mm reduction in anterior facial height, a 2.3 mm forward movement of pog. and a $2^\circ$ decrease in the mandibular plane angle.

Anterior teeth extrusion is an alternative approach for open bite management. However, a gummy smile may occur due to excessive anterior teeth extrusion, whereas insufficient incisal show results in an older appearance. Therefore, smile esthetics must be considered when planning the amount of anterior teeth extrusion.

In addition to the skeletal factor, related muscular activity plays a crucial role. Once the maxillary complex translates downward, there is only contact in the posterior teeth to create an open bite. The anterior mimic muscles, including the orbicularis oris, mentalis, depressor and levator anguli oris, and buccinator muscles help to adapt the mandible. Because of weak anterior mimic muscles, the mandible cannot adapt through rotation movement.
Figure 17. Superimposition of cephalometric tracings after treatment and one-year follow-up.

Table 2. Comparison of ramus height, palatal height, and anterior dental height between Isaacson’s average group and our patient. The measurements are indicated by a green box in the figure on the right.

<table>
<thead>
<tr>
<th>Measurements</th>
<th>Isaacson’s average group (±1 SD)</th>
<th>Our case</th>
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<tr>
<td>Ramus height (RH, mm)</td>
<td>56.30 (±3.92)</td>
<td>57.5</td>
</tr>
<tr>
<td>Palatal height (OP-PP, mm)</td>
<td>19.63 (±1.73)</td>
<td>22.0</td>
</tr>
<tr>
<td>Anterior dental height (ADH, mm)</td>
<td>28.70 (±1.87)</td>
<td>33.0</td>
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SN, Sella to Nasion; PP, palatal plane; OP, occlusal plane; MP, mandibular plane; TFH, total facial height; UFH, upper facial height; LFH, lower facial height.
To control this etiological factor and improve long-term stability, attention must be paid to the respiratory, tongue posture, and perioral muscle activity.27,28

Our case patient had a history of gradual bite opening associated with joint stiffness and clicking. She received occlusal splint therapy for more than 10 years, and the occlusion was stable for 1 year before orthodontic treatment was initiated. Based on MRIs, the diagnosis of the TMJ disorder was anterior disc displacement without reduction in the right joint but with reduction in the left joint. Orthodontic treatment combined with OGS was originally planned, and hence, the oral surgeon performed disc plication surgery of the TMJ to reduce the risk of post-OGS relapse. However, the treatment plan was changed as the patient was increasingly concerned of the invasive OGS. The renewed plan was to perform nonsurgical orthodontic treatment using TADs in conjunction with a TPA and LHA. In the pretreatment photos of this patient, no incisal show was observed at rest (Figure 1). Thus, both incisor extrusion and molar intrusion were planned to the open bite correction. For this patient, the correction of an 8-mm open bite contributed to a 1-mm intrusion of the maxillary molars and a 2-mm intrusion of the mandibular second molar, which in turn resulted in a 5-mm decrease in overbite. The open bite correction also rectified a 2.5-mm extrusion of the upper incisors and a 3-mm extrusion of the lower incisors. Furthermore, tongue and perioral muscle training was performed throughout the treatment.

CONCLUSION

In a patient presenting with a severe anterior open bite, molar intrusion in both arches with TADs can result in counterclockwise mandibular rotation and an improvement in open bite. Anterior teeth extrusion is an alternative approach for the management of open bite and smile esthetics in patients with insufficient incisor show. Furthermore, in patients who conjunctively have TMJ disorder and anterior disc displacement, disc repositioning with plication surgery may minimize the risk of post-treatment relapse. Tongue and lip training are also crucial procedures for eliminating the etiological factors.

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ETHICAL APPROVAL

Not required.

PATIENT CONSENT

Provided.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

REFERENCES


