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An Adolescent Case of Anterior Open Bite with Masticatory Muscle Dysfunction

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ABSTRACT

In adolescence an open bite is likely to be induced by various causes, and most patients with open bite show masticatory muscle dysfunction. The orthodontic correction of an open bite may lead to the recovery of harmonious stomatognathic function. This article reports treatment for a 12-year and 10-month-old female patient with an anterior open bite. She complained of occlusal disturbances due to an anterior open bite. Before the eruption of the upper second molars, she recognized the presence of occlusal contacts between the upper and lower anterior teeth. Before treatment, the activity of the masticatory muscles was relatively low during clenching. An upper lingual arch with an accessory spring to eliminate the premature contact and to improve the anterior open bite plus conventional fixed appliances for tooth alignment was selected as the treatment plan. Immediately after improvement of the open bite, the muscle activity became slightly greater than that at the initial stage. The total treatment time was 13 months. After treatment, an acceptable occlusion was achieved, the masticatory muscles were working harmoniously, and their activity was much higher than that at the initial stage. After a 2-year retention period, an acceptable occlusion was maintained without recurrence of the open bite, indicating a long-term stability of occlusion. The result of this treatment indicated that correction of open bite is of great importance for prevention of skeletal impairment and recovery of harmonious stomatognathic function lost by an unstable occlusion.

KEY WORDS: Open bite, Muscle activity, Orthodontic treatment.

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INTRODUCTION Return to TOC

In adolescence, the open bite with functional problem can be easily treated by eliminating inducing causes such as parafunctional habits. Meanwhile, skeletal open bites in adults are among the most complicated problems encountered.[1] Recently, a skeletal anchorage system was developed for treatment of severe open bite, and with the use of this system, the correction of skeletal open bite without unfavorable side effects became possible.[2] However, some patients with a severe open bite and a skeletal discrepancy require surgical correction.[3] Therefore, early orthodontic treatment is of great importance for open bite patients to eliminate the possibility of progressive impairment.

The etiology of open bite has been previously described, and functional and genetic problems are well known as inducing factors of open

bite.[4,5] In adolescence, open bite can also result from negligible events such as abnormal eruption of teeth and premature contacts at the molar region. In addition, the occlusal interferences induced by such events can change the coordination of muscular activity during mastication.[6,7] Irrespective of its causes, most patients with open bite show masticatory muscle dysfunction such as an imbalance in coordination of muscle activity and the reduction of elevator muscle activity.[8,9] However, the relationship between masticatory muscle function and the occlusal state has not been discussed.[8,9]

The purpose of this study is to present the treatment of a case of dentoalveolar open bite with masticatory muscle dysfunction.

Case report

The patient, a 12-year and 10-month-old Japanese female, exhibited a severe anterior open bite (Figure 1). She complained of occlusal disturbances due to an initial occlusal contact with pain on the upper right second molar. Before eruption of the upper second molars, she had recognized occlusal contacts between the upper and lower anterior teeth. The molar relationship on both sides was Class II, and the overjet and overbite were +2.0 and −2.5 mm, respectively (Figure 2). The occlusal contacts at maximum intercuspation were recognized only at the right second molars. The mandibular midline shifted to the right by two mm, although the maxillary midline was almost coincident to the facial one. Periodontal problems and temporomandibular joint disorders were not found.

The panoramic radiograph showed a congenital absence of the upper right first and second premolars and both the lower second premolars (Figure 3).

The cephalometric analysis showed that the gonial angle was smaller than that of the Japanese controls,[10] although the mandibular plane angle was within the normal range (Figure 3). The inclinations of the maxillary and mandibular incisors were within the normal range.

To examine masticatory muscle function, electromyographic (EMG) recordings for the masticatory muscles were made. Activities of both the anterior temporal and masseter muscles were measured using bipolar surface electrodes, which were 6-mm-diameter silver-silver chloride electrodes. The electrodes were placed in the direction of the muscle fibers with an interelectrode distance of 25 mm. The patient was instructed to clench with maximum effort three times with an intervening interval of 10 seconds. Although the activity of the left masseter muscle was normal, the activities of the other three muscles, especially of the left temporal muscle, were relatively low (Figure 4). A Dental Prescale System (Fuji Film Co., Tokyo, Japan) was used to measure the maximum bite force and occlusal contact area. Before recording, the patient was seated in the upright position and instructed to bite properly to exert the maximum clenching force. As a result, the total occlusal force at maximum clenching was 13.5 N with an occlusal contact area of 0.2 mm^2 (Table 1).

From these findings, this case was diagnosed as a dentoalveolar open bite with masticatory muscle dysfunction. The treatment plan for this case was as follows:

- An upper lingual arch with an accessory spring on the right second molar with a sectional arch in both the upper molar regions was to be used to eliminate the premature contact.
- Place the conventional fixed appliances on both dental arches.
- Place a Begg-type retainer on the upper arch and a spring retainer on the lower arch.
- With respect to the congenital missing permanent teeth, the deciduous teeth present were kept.

Treatment progress

A lingual arch appliance was placed on the maxillary first molars. A 0.5-mm-diameter auxiliary spring was soldered to a base wire of the lingual arch and provided a long range of action to bring the right second molar laterally. Simultaneously, a segmental arch wire of 0.016- × 0.022-inch stainless steel with tip back bends was applied at the left molar region. Two months after initiating the orthodontic treatment, the anterior open bite was almost corrected (Figure 5). However, the occlusal pain on the upper right second molar remained. Thus, endodontic treatment was conducted, which resulted in removing the occlusal pain. EMG recordings showed that the activities of the left anterior temporal and right masseter muscles became slightly larger than those at the initial stage, but were smaller than those of the left masseter muscle (Figure 6). The total occlusal force was 91.4 N with an occlusal contact area of 2.2 mm^2 (Table 1).

At this point, orthodontic treatment with conventional fixed appliance was initiated. After leveling both dentitions, anteriorly placed short Class II elastics were applied to move the mandibular dentition forward. Through the treatment, no bracket was placed on the right deciduous first molar to avoid any progressive root resorption induced by orthodontic forces. Total treatment time was 13 months with 14 adjustments. Immediately after debonding, the patient was provided with a wraparound-type retainer on the upper arch and a spring retainer on the lower arch.

RESULTS Return to TOC

Facial photographs showed that the profile itself was not changed from the initial views (Figure 7). Acceptable occlusion was achieved, and the overbite and overjet were improved to +1.0 and +1.5 mm, respectively (Figure 7). The Class II molar relationship was maintained on the both sides because of the presence of the deciduous teeth. A panoramic radiograph showed a slight progression of root resorption on both lower deciduous second molars (Figure 8). Cephalometric analysis indicated a counter-clockwise rotation of the mandible (Figure 9).

Activities of both the anterior temporal and masseter muscles were much higher than those at initial stage, and they were working harmoniously during clenching (Figure 10). The total occlusal force at the maximum clenching was 533.8 N with an occlusal contact area of 11.8 mm^2. After two years of retention, an acceptable occlusion was maintained without the recurrence of an open bite, indicating a long-term stability of the occlusion (Figure 11).

DISCUSSION Return to TOC

Skeletal open bite is characterized by various morphological features, ie, negative overbite, a high mandibular plane angle, mesially inclined teeth, a narrow maxillary dental arch, short ramus height, and a downward and backward tipping of the palatal plane.[1] This characteristic morphology may appear gradually with craniofacial growth and development. Although the present case exhibited severe anterior open bite, no such characteristic morphology was found except for a negative overbite. Furthermore, she had recognized occlusal contacts between the upper and lower anterior teeth before eruption of the upper second molars, and the anterior teeth exhibited a slight attrition at the initial stage. Worms et al[11] reported a cross-sectional study of open bite in 1408 children ranging in age from 7 to 21 years and stated that open bite appeared to increase at 13 to 15 years of age. They, furthermore, demonstrated that one possible explanation for this increase was the complete eruption of the permanent teeth. Therefore, we diagnosed the patient as having anterior open bite induced by premature contact at the second molars accompanying their abnormal eruption.

Masticatory muscle function has a considerable influence on craniofacial growth.[12–14] Ringquvist[14] showed that the size and shape of the mandible, especially the gonial angle and ramus height, were correlated with bite force. Kiliaridis[15] recorded the influence of masticatory muscle function on craniofacial growth in a series of experimental animal and clinical studies and found that the elevator muscles of the mandible influenced the transverse and vertical dimensions of the face.

With respect to the influence of muscles and occlusal disturbances, it has been reported that a small occlusal interference in the intercuspal position can change the coordination of muscular activity.[6] Christensen and Rassouli[7] investigated masseteric EMG responses to experimental occlusal interference and reported that myoelectric clenching activity was significantly reduced on the side opposite the interference.

In this case, the activities of the anterior temporal and masseter muscles were checked three times with an EMG through the orthodontic treatment: before treatment, immediately after correction of open bite, and after treatment with conventional fixed orthodontic appliances. Before treatment, the activities of both right muscles were relatively low, and the left anterior temporal muscle exhibited less or no activity during clenching. At the initial stage, the patient had not only an occlusal disturbance but also an occlusal pain on the upper right second molar and was unable to clench in a normal fashion. However, even after elimination of the occlusal pain and incomplete correction of the open bite there was only a little change in the muscle activity. Bakke and Michler[8] studied activity in temporalis and masseter muscles and traits of facial morphology and occlusal stability in 22 patients with anterior open bite and temporomandibular disorders. Bakke and Michler[8] concluded that reduced occlusal stability and long-face morphology were associated with weak elevator muscle activity. Lowe[9] also suggested a significant association between anterior open bite and reduced masseter muscle activity. In the present case, after orthodontic treatment for achievement of an acceptable occlusion, the elevator muscles worked harmoniously, and their activity became markedly higher than that at the initial stage. In addition, the muscles exhibited an acceptable coordination of elevator muscle activity. Bakke and Michler[8] indicated from their results that an increase of occlusal stability might lead to increased muscle strength and possibly a reduced risk of physical strain. Therefore, early diagnosis of problems in individual cases and individual management of these problems are of great importance for the prevention of skeletal impairment and the recovery of harmonious stomatognathic function.

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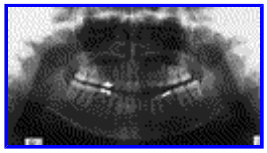
TABLE 1. Changes of Occlusal Contact Area, Force, and Mean Pressure Through Orthodontic Treatment

	Contact Area (mm^2)	Mean Occlusal Pressure (MPa)	Occlusal Force (N)
Before treatment	0.2	71.8	13.5
During treatment	2.2	41.8	91.4
After treatment	11.8	45.2	533.8

FIGURES Return to TOC

Click on thumbnail for full-sized image.

FIGURE 1. Facial and intraoral photographs before treatment (12-year and 10-month old).



Click on thumbnail for full-sized image.

FIGURE 2. Panoramic radiograph before treatment (12-year and 10-month old).

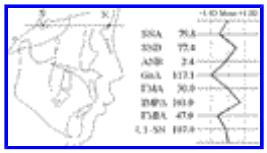


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FIGURE 3. Cephalometric tracing before treatment

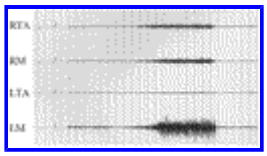

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FIGURE 4. Muscle activities during clenching checked by EMG before treatment. Calibration bar indicates 200 mV. RTA indicates right temporalis anterior; LTA, left temporalis anterior; RM, right masseter; LM, left masseter

Click on thumbnail for full-sized image.

FIGURE 5. Intraoral photographs after elimination of occlusal pain and interference on the right second molar (13-year and 1-month old)

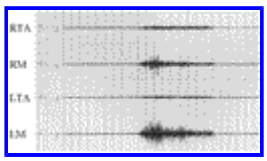

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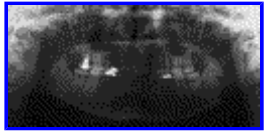
FIGURE 6. Muscle activities during clenching checked by EMG during treatment. Calibration bar indicates 200 mV. For the abbreviations, see Figure 4

Click on thumbnail for full-sized image.

FIGURE 7. Facial and intraoral photographs after treatment (14-year old).

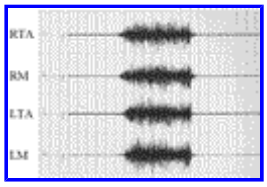


Click on thumbnail for full-sized image.

FIGURE 8. Panoramic radiograph after treatment (14-year old).

Click on thumbnail for full-sized image.

FIGURE 9. Superimposition of cephalometric tracings before (solid line) and after (dotted line) treatment



Click on thumbnail for full-sized image.

FIGURE 10. Muscle activities during clenching checked by EMG after treatment. Calibration bar indicates 200 mV. For the abbreviations, see Figure 4

Click on thumbnail for full-sized image.

FIGURE 11. Facial and intraoral photographs 2 years after treatment.

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