Clinical Experience on a Case of Skeletal Openbite Treated with Lingual Bracket and Skeletal Anchorage System without Orthognathic Surgery

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Abstract: A 30-year-old Japanese female visited our office due to chief complaint of anterior openbite. After various examinations, the patient was diagnosed to be skeletal openbite case associated with mandibular clockwise rotation and tongue thrust. After the tongue thrust was improved by myofunctional therapy (MFT), her skeletal openbite was intended to improve by means of molar segments intrusion and upright by skeletal anchorage system. When alignment in the upper anterior teeth was made, lingual brackets were applied. As a result, the improvement of adult skeletal openbite was successfully achieved in a non-surgical treatment without necessity of premolar extraction and esthetic damage. This manipulation was thus suggested to be an effective, low-invasive therapeutic means with no esthetic damage in a border case between surgical orthodontic and non-surgical orthodontic treatments.

Key words: skeletal openbite, lingual bracket, skeletal anchorage system, molar intrusion

Skeletal anchorage system と舌側からの矯正治療の併用により改善を行った骨格性開咬症例

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要旨：本症例は30歳の日本人女性で前歯部開咬を主訴として来院した。詳細的な検査の結果、舌突出癖を伴い下顎の時計周りの回転を認める骨格性開咬症例との診断結果を得た。治療方針として myofunctional therapy (MFT) による舌突出癖の改善の後、skeletal anchorage system を用いた上下顎臼歯部圧下とアッブライトによる下顎のオートローテーションを図り骨格性開咬を改善することとした。また前歯部 alignment の際には、上顎に lingual bracket を使用した。

その結果、非外科的に下顎抜歯を行うことなく、かつ審美性に損なわずに開咬の改善が達成された。外科的矯正治療と矯正治療単独治とのブーダースケースに対する治療方針として同手法の適用は顎矯正手術併用と比べ低侵襲で審美性を損わない有効な一手段であることが示唆された。

引用語：骨格性開咬, lingual bracket, skeletal anchorage system,臼歯部圧下

Introduction

Since the publication of Fujita method\(^1\) in 1970s, various appliances have been developed for lingual bracket with the subsequent gradual advancement as a representative unnoticed orthodontic appliance\(^2\). In recent years, however, a lingual bracket appliance system characteristic of low friction, low force and low profile (STb light lingual system, Sybron Dental Specialties Japan Inc, Tokyo, Japan) was developed, per-
mitting efficient tooth-movement through a treatment with relatively minimum force.

On the other hand, a tooth-movement method using an implant as an anchorage has now been applied clinically in a lot of office since its introduction by Creekmore in 1983. By using an implant as an anchorage, such a tooth-movement as those of which direction and amount were considered difficult by conventional orthodontic treatment has become possible. In addition, a conventional concept concerning the orthodontic treatment has surely changed including non-surgical acquisition of optimal occlusion in patients so far deemed to be a candidate for surgical orthodontic treatment. Main implants now used for this method are roughly divided into two types, screw and plate types having a known different application mode each other. The implant of screw type is advantageous in its simplified procedure of use and predominantly used for reinforced anchorage at molar segment or intrusion of anterior teeth, but said to be inappropriate for active tooth-movement at molar segment because of potential dropout due to poor implantation. On the other hand, the implant of plate type can be invested into the jaw tightly although its surgical treatment at investment is relatively high. It is therefore considered to be most suitable as an implant for application intrusion or distal movement of molar segment.

In the past reports, the implant of screw type was mainly used as anchorage during lingual orthodontic treatment because of its simplified procedure and extended application. In addition, no report has concerned the application of plate-typed implant so far as we know. In those cases which require this implants intrusion or distal movement of molar segments, the plate-typed implant seems to be most appropriate, suggesting that the demand of its combination with lingual orthodontic treatment surely exists.

In the present report, therefore, the skeletal anchorage system of plate type was invested into the upper and lower molar segments in patients with skeletal openbite accompanied with anterior crowding. After treatment intrusion of upper and lower molars and distal movement, the lingual bracket system was applied to the maxillary arch. By using these mechanics, an esthetic damage could be minimally limited and the openbite was successfully improved through an effective non-surgically orthodontic treatment without extracting premolar teeth as reported below.

Case

Patient Histroy and Cause: The patient was a 30-year 3-month-old Japanese female with chief complaints of a lack of contact between the upper and lower incisors and difficulty in closing her lips together (Figs 1–3). Her medical history revealed no contraindications to orthodontic treatment. A tongue thrust habit and tongue interposition were present. The panoramic radiograph demonstrated that all the teeth were present and lower third molars were impacted. The cause of her malocclusion was a combination of

Fig 1  Facial photographs before treatment.

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genetic and environmental factors.

**Diagnosis**: Skeletal openbite case associated with mandibular clockwise rotation and tongue thrust.

**Skeletal problem**:
Skeletal class I. Skeletal openbite associated with mandibular clockwise rotation.

**Denture problem**:
Overjet $+1.5$ mm, overbite $-3.0$ mm. Angle class I with anterior openbite and crowding.
Narrowed maxillary dental arch.

**Functional problem**:
Tongue thrust.

**Esthetic problem**:
Convex profile, long face.
**Treatment Objectives**

The goals of treatment:
1. Correction of tongue thrusting by myofunctional therapy (MFT).
2. Correction of narrowed maxillary dental arch by lateral expansion.
3. Improvement of anterior openbite and anterior crowding by intrusion and distal movement of upper and lower molars (Fig 4).

**Treatment Progress**

The treatment was started to correct tongue thrusting by MFT, following expansion of maxillary arch by Quad-Helix. Lower third molars were extracted. Intrusion and distal movement of molars were attached with buccal sectional arches with U: Trans paratal arch, L: Lingual arch were first attempted by applying plate-typed implant to the upper and lower molar segment (Fig 5). Maxillary anterior tooth were aligned by lingual orthodontic treatment using lingual bracket (STb bracket). The wire sequence of the maxillary lingual orthodontic treatment used 0.012 inch, 0.014 inch NiTi, 0.016\(\times\)0.016 inch TMA (Figs 6, 7). Total treatment time with active appliances was 27 months. The fix appliances were removed, and maxillary Begg type retainer and mandibular spring retainer were placed.

**Results Achieved**

All treatment objectives were achieved. The photographs after the treatment demonstrate the correction of the openbite and the establishment of a normal posture.
Fig 6  Intraoral photographs: The maxillary tooth alignment was started.

Fig 7  With the progressed alignment of anterior teeth by using lingual bracket of low friction, the space between canine and premolar was closed naturally through lip sealed effect.
Fig 8  Facial photographs after treatment.

Fig 9  Intraoral photographs after treatment.

Fig 10  Panoramic radiograph after treatment showed no remarkable root resorption and acceptable parallel dental roots.
Class I occlusion (Figs 8, 9). The panoramic radiograph showed no remarkable root resorption and acceptable parallel dental roots (Fig 10). Cephalometric evaluation revealed successful retraction of the mandibular incisors and improvement of the soft tissue profile (Fig 11, Table 1).

**Discussion**

In the orthodontic treatment, an adult skeletal open-bite case is deemed as a case of malocclusion with high difficulty probably due to the mixed functional and morphological problems, both of which may affect each other. In such a case of malocclusion being a complicated state of disease, it seems important to clarify various problems and treat them adequately. For this reason, functional and morphological problems in an adult skeletal openbite are discussed in detail for elucidating the patient’s diseased state with
some consideration including the therapeutic planning employed in the present case and its result as described below.

As a functional problem that we, orthodontists, own jointly in an adult skeletal openbite, an otorhinologic factor such as closed nasal air way and/or prolonged unfavorable habit from the childhood are listed. As a morphological problem, on the other hand, mandibular clockwise rotation due to high mandibular plane angle and counter-clockwise rotation of palatal plane as well as skeletal anomalies including long face and denture anomalies including labial inclination of upper and lower anterior teeth and high molar positioning are listed. The following treatments can be listed as conventional countermeasures with respect to these problems. As an approach for functional problems, an otorhinologic treatment is of first choice in a suspected case of otorhinologic factor such as enlarged adenoid, while the treatment is targeted to exclude unfavorable habit, to make adequate tongue positioning and to acquire the swallowing function in a case without otorhinologic factor. In the present case, no swollen tonsils including adenoid were indicated from the clinical findings at first examination and spontaneous nasal respiration was possible. From the lateral cephalometric radiograph finding, no closed air way was suspected, indicating less influence due to otorhinologic factors. As for the customary tongue positioning, on the other hand, it was found that the apex of tongue located in the surrounding of upper and lower anterior incisor edge with tongue thrust at the time of swallowing. MFT was thus performed prior to the initiation of dynamic treatment in an attempt to obtain an adequate tongue positioning and swallowing function. As a result, the customary tongue positioning was improved so as to make the tongue tip located at the spot with successful acquisition of adequate swallowing function and the dynamic treatment was then initiated. After the initiation of dynamic treatment, MFT has been continued up to now, a retention period.

As an approach for morphological problems, on the other hand, a lot of therapeutic method have so far been devised and clinically applied by many orthodontists according to various concepts. As a conventional treatment strategy, upper and lower anterior upright by multi-bracket approach combined with vertical elastics was attempted after premolar extraction in order to improve an openbite. At that time, it was reported that the 2nd premolar extraction is desirable for preventing the mandibular clockwise rotation. In 1980, Kim devised MEAW technique for treating an openbite and subsequently reported that the reconstitution of occlusal plane by molar upright was effective for the treatment of openbite with the aid of multiloop edgeto-arch wire and vertical elastics. In his case reports, an adequate over bite was attempted to acquire by using this technique without tooth extraction as far as possible. In such a case of only orthodontic treatment, however, no skeletal improvement can be expected and the dental compensation is served as a main purpose. When a skeletal improvement was targeted in an adult skeletal openbite case, on the other hand, Sagittal Splitting Ramus Osteotomy (SSRO) or Two-jaw surgery by means of combined Le Fort I osteotomy and SSRO have been applied following establishment of treatment strategy for deformed jaw in many institutions with good outcomes. However, a surgical orthodontic treatment may have some risk not only from the medical but also social aspects including relatively large surgical invasion or necessity of prolonged hospitalization as compared with non-surgical orthodontic treatment. In recent years, therefore, a skeletal anchorage system of plate type has been used in a border case between orthodontic and surgical orthodontic treatments to have an improved openbite through mandibular counter-clockwise rotation by molar intrusion in order to avoid such a risk as reported by Sugawara et al. An application of orthodontic treatment combined with skeletal anchorage system to such a case as sited above is expected to reduce a patient’s burden from various aspects in the therapeutic content. In addition, its need seems to have increased as a means for avoiding a orthognathic surgery because of possible intentional and effective tooth movement.

In the present case, it was revealed from the test data at first examination that the mandibular plane an-
gle was found to be relatively large as 36.5° and ANS-Me was excessively large as 81.0 mm. Application of 2nd premolar extraction or of surgical orthodontic treatment was thus discussed thoroughly. Finally, given the patient’s desire to avoid both orthognathic surgery and premolar extraction, a skeletal anchorage system of plate type was applied to the right and left mandibular molars, and the upper and lower molar intrusion and upright were attempted without tooth extraction to improve the patient’s openbite by mandibular autorotation. As a result, a distal movement of 3 mm under 3 mm intrusion at the 1st maxillary molar as well as a distal movement of 2 mm under 1 mm intrusion at the 1st mandibular molar were achieved. Furthermore, the mandibular plane angle was reduced by 1.5° through the mandibular counterclockwise rotation and the maxillary anterior region was aligned and the mandibular front teeth were uprighted. Through the therapeutic effects mentioned above, the anterior openbite and crowding as well as the upper and lower labial protrusion was improved without necessity of premolar extraction. Based on the evidences described above, an application of skeletal anchorage system to an openbite case was considered to be of effective means for avoiding a surgical orthodontic treatment. In addition, as compared with a conventional orthodontic treatment, a potential variation in the therapeutic effects under the presence or absence of the patient’s cooperation could be reduced by the decreased necessity of using elastics and the tooth movement was thus suggested to be performed efficiently and securely according to the pretreatment prediction.

In the present case, the anterior alignment after distal movement of maxillary molar was further performed by using a lingual bracket system. By using this lingual bracket system, a dynamic treatment was successfully performed without causing esthetic deterioration due to appliance setting. In addition, the treatment-targeted tooth with lingual bracket setting was successfully limited to the anterior segment and the tooth movement was achieved efficiently and relatively at ease because the vertical control in the molar segment was performed by combining an implant for orthodontics. Furthermore, as for the degree of patient’s comfortability, no marked speech defect or lingual laceration due to the appliance setting was observed during the treatment course because a lingual bracket of minimum size was used in the present case. The degree of comfortability was thus evaluated to be good. Based on the present results, a clinical study by using a similar therapeutic strategy in openbite cases is planned to be further accumulated in the future.

Conclusion

A tooth-movement approach using the implant system of plate type as an anchorage combined with the innovative lingual orthodontic treatment was revealed to have successfully limited possible esthetic damages, ultimately leading to an improved openbite efficiently and non-surgical orthodontic treatment without premolar extraction.

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