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CASE REPORT

Angle Class I Malocclusion with Anterior Open Bite Treated with Non-Extraction Therapy

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ABSTRACT

This clinical case reports describes the orthodontic treatment of an Angle Class I malocclusion with anterior open bite and bimaxillary dentoalveolar protrusion in a 30-year-old female patient. The principle of orthodontic treatment is the occlusal plane change and intrusion mechanism of posterior teeth with miniscrews to make counter-clockwise rotation of mandible and close the negative overbite meanwhile. In addition, the case also demonstrated the method we used to correct gummy smile by intrusion of anterior teeth for better aesthetics.

Keywords: Anterior open bite; Hyperdivergent facial pattern; Gummy smile; Miniscrew

1. INTRODUCTION

An anterior open bite is considered to be one of the most challenged problems to treat in orthodontics since it may include sagittal, vertical and/or transverse problems. In conventional treatment methods, various treatment modalities for the correction of an anterior open bite have been proposed such as extrusion of the anterior teeth by using elastics,1,2 the uprighting of posterior teeth with multi-loop edgewise arch wire (MEAW),3,4 and inhibition of molar eruption with bite block and chin cap during growth.5,6

An alternative treatment option is surgical correction.7,8 Rotate the mandible for changing the occlusal plane is the key step in the treatment. It always achieves better results in a better vertical control. Although satisfactory outcomes can be achieved, the complexity, risks, and costs of surgery have initiated a search for other options.

In orthodontic treatment, there are many opportunities to apply forces to the molars. For example, inter-maxillary elastics, often used during the orthodontic treatment, which can improve the relationship between molars and canines; but the side effects of molar extrusion and/or dumping of anterior teeth of the maxilla may also take place, moreover, the occlusal plane may get worse.9 In recent years, the extensive application of miniscrews has made it easier to intrude molar, and the occlusal plane is therefore easier to control and change obviously to meet the treatment goal.10

It has been reported that intrusion mechanism provides a more stable treatment result than extrusion mechanism.11 The use of miniscrews are relatively simple and easy to insert, less traumatic, and make it possible to apply forces immediately after insertion.12,13 With the intrusion of the posterior teeth, it is possible to autorotate the mandible counter-clockwisely, achieve positive overbite, and reduce the anterior facial height without surgical intervention.

2. CASE REPORT

A 30-year-old female visited our orthodontic department complaining of an anterior open bite and obvious gum showing while smiling. She received orthodontic treatment previously when she was 11-year-old with 4 premolars extraction, but relapsed and protrusive lips with gummy smile still existed. In the frontal view, her chin deviation to the left side was found, it was accompanied with maxillary occlusal plane cant. In addition, the 4 mm
gummy smile was presented while she was smiling. In the lateral profile, a convex profile with a retruded chin was observed (Fig. 1).

The intra-oral examination presented a Class I molar relation on both sides with a 2 mm anterior open bite. The upper midline was coincident to the facial midline, while the lower midline was 2 mm off to her right side. There were two different occlusal planes between posterior and anterior teeth (Fig. 1). Cast analysis revealed 1.5 mm of crowding in the upper dentition and 0.6 mm of crowding in the lower dentition. There was no occlusal contact from the right-side premolar to the left side premolar area.

Cephalometric analysis revealed that ANB was $4.5^\circ$, indicating a Class II skeletal relationship (Fig. 2). The hyperdivergent facial pattern ($\text{SN-MP} = 43^\circ$) and the small facial height ratio (0.68) suggested clockwise rotation of the mandible, resulting in an increased lower anterior facial height. The upper molars were significantly extruded ($\text{U6-PP} = 32$ mm) compared with the normal range ($\text{U6-PP} = 23 \pm 1.3$ mm in female, Burstone analysis).

### 2.1. Treatment objectives

Four treatment objectives were identified: (1) open bite correction, (2) facial profile improvement, (3) establishment of a proper overjet and overbite, and (4) relief of crowding.

### 2.2. Treatment plan and progress

The patient required molar intrusion for occlusal plane correction, so as to rotate the mandible in a counter-clockwise direction. At the same time, total arch retraction for improving protrusive lips is essential. Therefore, third molar extraction was first applied before orthodontic treatment.

In order to give intrusive forces for occlusal plane cant correction and posterior teeth intrusion, 4 miniscrews were placed in the bilateral infra-zygomatic area and buccal shelves between the first and second molars after initial leveling and alignment. The TPA and LHA was maintained as a palatal/lingual splint to prevent buccal tipping of the posterior teeth while intrusive forces were applied from the buccal devices (Fig. 3). The LHA was removed earlier after we have intruded lower molars. Establishing the early vertical control of the posterior teeth and intrusive mechanism to deal with the occlusal plane. The inter-maxillary elastics which may cause molar extrusion and/or dumping of anterior teeth of the maxilla should be avoided.

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Fig. 1. The pre-treatment records of the patient. The extra-oral photographs showed that the chin deviated to the left side, occlusal plane cant, and convex lateral profile with lip protrusion. The intra-oral photographs presented Angle Class I molar relationship with 2 mm anterior open bite and two different occlusal planes between posterior and anterior teeth were presented.
As the occlusal plane cant problem was gradually solved, a miniscrew was placed between upper central incisors for gummy smile correction (Fig. 3). By using the 3 miniscrews on the upper jaw as a bone anchor, it helps to control the retraction, intrusion and torque of the upper incisors, and effectively improves the gummy smile and lip protrusion. Simultaneously, the traditional intrusive

Fig. 2. The pre-treatment x-rays of the patient. The missing 4 first premolars had been extracted due to the previous orthodontic treatment. The lateral cephalogram showed a mild skeletal Class II relation with hyperdivergent facial pattern. Bimaxillary dento-alveolar protrusion was also seen.

Fig. 3. The progress records of the patient. Four miniscrews were placed both upper and lower arches for molars intrusion. The lower left miniscrew was failed and removed earlier. An anterior miniscrew was inserted between 2 central incisors for gummy smile correction. The extra-oral photos and lateral cephalogram showed the improvement of the facial profile during treatment.
arch is used to control the inclination and vertical position of the lower incisors, preventing the interference with the upper front teeth during the counterclockwise rotation of lower jaw. After intrusion of upper incisors to correct tooth and gingival position, we established the harmony incisor display.

2.3. Treatment result

The total treatment time was 28 months. After treatment, the patient had a stable occlusion of normal overbite (1.5 mm), normal overjet (2 mm), and a Class I canine and molar relationship. The lateral cephalometric superimposition showed both of maxillary and mandibular molars intruded 2 mm and retracted 3.5 mm with counterclockwise autorotation of the mandible. As a result, the mandibular plane angle was reduced from 43° to 38.5°, and the lower anterior facial height was reduced from 82 mm to 75 mm; a forward-rotated chin greatly improved facial profile (Figs. 4–6).

In the dental part, the U1-SN was flared labially with 4 mm intrusion for gummy smile correction. The L1-MP was inclined to the lingual direction for compensating simultaneous counter-clockwise rotation of the mandible. In summary, the ANB was corrected to 2.5°, the mandibular plane angle was reduced by 4.5°, and the lips to E-line relation became harmonious. We used wrap-around Hawley retainers (daytime) and open bite activator (nighttime) as permanent retention.

3. DISCUSSION

In this case, we achieved molar intrusion and mandible counterclockwise rotation by using conventional orthodontic method with miniscrews to
correct long face and lip protrusion. Although miniscrews placement for molar intrusion is an effective treatment modality for open bite correction, it is not the universal method for all cases of open bite due to different clinical considerations.

3.1. Treatment considerations of anterior open bite

The first and the most important aspect we need to consider is the skeletal relationship including the 3D direction (vertical, transverse, and anterior–posterior relations). For example, a skeletal Class III open bite, the counterclockwise rotation of the mandible by an intrusion of the molars would worsen the Class III relationship despite the open bite correction. The approach of orthognathic surgery will become a better option. On the contrary, a skeletal Class II open bite with an increased lower anterior facial height can be treated successfully by the intrusion of the posterior teeth. The counterclockwise rotation of the mandible will shorten the lower anterior facial height and correct the anterior open bite. Thus, the intrusion of the molars is the most rational treatment for open bite patients that show long face types with skeletal Class I or mild skeletal Class II jaw relationships.

In our case, the patient had a mild skeletal Class II relation with increased lower anterior facial height. After the intrusion of the molars, the mandible has better chin projection by counterclockwise rotation.
Secondly, the periodontal condition is another aspect that we should concern about. For the intrusion of molars with periodontal disease, Melansen et al. reported that the periodontal tissue recovers by forming new attachment during intrusion. In patients with slight periodontal disease, periodontal treatment is indispensable before any orthodontic treatment. Without doubt, the recall for periodontal maintenance and followed-up radiographs should be taken during orthodontic therapy. On the other hand, molar intrusion is not recommended in problems of low sinus floor and reduced periodontal bony support. Surgical intervention will be suggested for open bite correction if the periodontal condition is unsuitable for molars intrusion.

In our case, the periodontal condition is acceptable before orthodontic treatment by the evaluation of periodontal charting data, X-ray films and intraoral condition. After the orthodontic treatment, the periodontal condition of the patient was maintained.

Third, the facial aesthetics is the key issue that every patient shows concern about. To correct open bite cases, molar intrusion and incisor extrusion are both effective for different situations. Considering of incisor show at rest and smile, patients who do not expose sufficient incisor should not be treated by molar intrusion. By extruding incisors to reestablish the smile arch and incisor show may be a more suitable option. In most cases, the combination of these two methods can be applied simultaneously for efficient treatment.

In our case, on account of the 4 mm gummy smile was presented, she was treated with both incisors and molars intrusion. As shown by the results, this method was successful.

3.2. Differential diagnosis of gummy smile and its treatment strategy

The etiologies of gummy smile may include hard tissue, soft tissue or dentition. Orthognathic surgery is traditionally needed to solve the skeletal problem. Such patients usually have increased lower anterior facial height with excessive vertical maxillary excess, but not all patients need to receive orthognathic surgery. In 1996, Garber et al. divided the excessive vertical maxillary excess into three levels according to its severity; if gummy smile was about 2–4 mm, it was classified to mild level, which can be improved by orthodontic treatment only or combined with periodontal or restorative treatment to improve the aesthetics. If the extent of gummy smile was 4–8 mm, it was classified to moderate level, which can be improved by extensive orthodontic treatment in conjunction with periodontal and restorative treatment. Orthognathic surgery might be required for cases with unfavorable facial pattern and severe skeletal discrepancy in this category. The severe level is gummy smile shows more than 8 mm. At this time, orthognathic surgery was suggested for definitive correction.

Designing a treatment plan based only on the extent of gum exposure may easily overlook other causes, such as hyper-mobile or short upper lip (average for adult women = 20–22 mm, average for adult men = 22–24 mm), gingival hyperplasia, or altered passive eruption. If there are not sufficient upper incisor show when the patient is relaxed in the facial muscle (average value = 2–4 mm), the hyper mobile upper lip when smiling was suspected. If the clinical crown height of upper incisors are too short, the evaluation should include gingival hyperplasia, incisor delayed passive eruption (altered passive eruption), or compensatory eruption caused by incisor wear.

Patients with excessive vertical growth of the maxilla are common with long face syndrome. The occlusal plane of the maxillary dentition is often found to be consistent, and the clinical crown length of incisors and molars are normal but over-erupted in the lateral cephalometric analysis. If there are more than one occlusal plane of the maxillary dentition, the anterior teeth area will be inclined downward. As the situation, we could diagnose as upper incisors excessive eruption. The correct diagnosis of gummy smile will help us to formulate a treatment plan. Usually patients have multiple factors, so we should provide patients with different treatment plans according to different causes.

In our case, excessive gummy smile was found when smiling. When the facial muscles are relaxed, too many upper incisors are exposed, but her upper lip length is within normal range. The occlusal plane of the maxillary arch is consistent, and the muscles of the upper lip are not too active when smiling. According to the above findings, we can conclude that the diagnosis of gummy smile in our patient is vertical maxillary excess. To improve the gummy smile with traditional orthodontic devices, intrusive arch wire or combined with miniscrews can be used to apply the forces of intrusion. Intrusive arch wire is a simple and effective one couple system device. It can intrude the anterior teeth, but it tip-back the molars at the same time. In addition, to prevent unnecessary eruption of molars during treatment, miniscrews in the posterior area can be used to connect to the main wire or molars, or to the distal end of the intrusion arch wire. The connection for vertical control is effective to prevent the molars from tipback rotation and extrusion.
The patient in this case shows the appearance of upper and lower bimaxillary dento-alveolar protrusion in anteroposterior direction and the negative overbite in vertical direction. It’s necessary to rotate mandible counterclockwise for reducing the protractive lips and improve the facial aesthetics. In order to avoid interferences during the treatment, we need to reach excellent vertical control or even intrusion of both upper and lower incisors. The interdental miniscrew between the middle of upper incisors effectively delivered sufficient upper incisors intrusion force for gummy smile correction and minimize interferences during the mandibular counterclockwise rotation. At the same time, the lower anterior teeth were also well maintained vertically by using of the intrusive arch. The key to this treatment process is to improve the torque of the upper incisors prior to intrusion, otherwise the upper incisors would become too proclined during the intrusive mechanism.

3.3. Stability of molar intrusion for treating anterior open bite

The deformity of anterior open bite is caused by combined influences from skeletal, dental, functional, and habitual factors; various treatment modalities have been suggested. Kuroda et al. and Sugawara et al. used miniscrews to treat the patients with anterior open bite by intruding the molars, but they did not report the long-term stability of the treatment. Lee and Park used miniscrews to intrude the upper molars and reported a 10.36% relapse rate for the intrusion at 1 year posttreatment. The relapse rate of 22.88% for the maxillary molars intrusion at 3 years posttreatment in the study of Baek et al. The success rate from previous studies had some disparity, such as Denison et al. reported a 79% success rate at 3 years posttreatment; and Lo and Shapiro reported 75% success at 5 years follow-up. They had provided a basis for intruding posterior teeth to solve the problems of mild to moderate skeletal anterior open bite.

In anterior open bite cases, the retention protocols such as high pull headgear or open bite activator have been proposed for preventing the eruption of the posterior teeth after intrusion. In general, the majority of the relapse occurs in these cases are within the first year after treatment. Hence, the suggestion of effective retention protocols must be done during this time period. For example, a retainer covering the occlusal surfaces of the molars with elastics to the buccal mini screws could be used and has shown to be a successful method. In our case, after achieving molar intrusion with mini screws, we provided an open bite activator at nighttime during retention phase, which covered the occlusal surfaces of the posterior teeth and let the soft tissue deliver a force opposing to tooth eruption; the conventional retainers should be wore at daytime.

4. CONCLUSION

For patients with anterior open bite, the principle of receiving non-surgical therapy is to control the occlusal plane, and guide the patient’s lower jaw to have counterclockwise rotation. Generally, intrusion of molars in one jaw is quite effective for open bite correction, but facial profile improvement is not obvious because unwanted extrusion of molars may occur in the opposite jaw due to curve of Spee elimination and space closure.

In our case, we intruded both upper and lower molars; as a result, the mandible was significantly rotated in a counter-clockwise direction. Two-jaw molar intrusion accomplished major skeletal changes and better facial profile. Therefore, we suggest the intrusion of molars in both jaws while the anterior open bite cases caused by extrusion of the posterior teeth. Our treatment results were acceptable and similar to those in mild to moderate skeletal Class II relation with gummy smile open bite cases. Moreover, treatment using miniscrew anchorage is minimally invasive and requires a shorter treatment time period as compared to orthognathic surgery. This method could be an effective alternative treatment to orthognathic surgery.

Conflicts of interest statement

The authors declare that there is no conflict of interest.

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