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A Fresh Look at Open Bite Malocclusion with Temporary Anchorage Devices: A Case Report

Geçici Ankraj Cihazları ile Open Bite Maloklüzyonuna Yeni Bir Bakış: Olgu Sunumu

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ABSTRACT

Anterior open bite is one of the anomaly types that is quite difficult to treat. Tooth extraction, posterior impaction, and orthognathic surgery are among the treatment options. Additionally, whole arch distalization with miniscrews can be considered as a treatment of choice. A male patient with a 17-year-3-month chronological age was admitted with the complaint of an opening in the anterior region when his teeth close. It was decided to perform bilateral distalization with a bilateral infrazygomatic miniscrew in the upper jaw and a bilateral buccal shelf miniscrew in the lower jaw. Total treatment lasted 18 months. At the end of the treatment, an ideal overbite and overjet were obtained with a Class I relationship. Distalization treatment, which is generally expected to have an adverse effect due to the increase in the maxillo-mandibular plane angle, provided successful results in anterior open bite cases and provided ideal aesthetic and functional results.
Keywords: Distalization; miniscrews; open bite.

ÖZ

Anterior open bite, tedavisi oldukça zor olan anomali çeşitlerinden birisidir. Diş çekimi, posterior gömme ve ortognatik cerrahi tedavi seçenekleri arasında bulunmaktadır. Ayrıca minividalar ile tüm çenenin distalizasyonu da bir tedavi seçeneği olarak düşünülebilir. Kronolojik yaşı 17 yıl 3 ay olan erkek hasta, dişlerini kapattığı zaman ön bölgede oluşan açıklık şikayetiyle başvurdu. Üst çeneye çift taraflı infrazigomatik minivida, alt çeneye ise çift taraflı bukkal shelf minivida ile bilateral distalizasyon yapılmasına karar verildi. Toplam tedavi 18 ay sürdü. Tedavi sonunda Sınıf I ilişki ile birlikte, ideal overbite ve overjet elde edildi. Maksillo-mandibular düzlem açısının artması nedeniyle genellikle ters etki yapması beklenen distalizasyon tedavisi, anterior açık kapanış vakalarında başarılı sonuçlar sağlayarak ideal estetik ve fonksiyonel sonuçlar elde edilmesini sağlamıştır.
Anahtar kelimeler: Distalizasyon; minividalar; açık kapanış.

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INTRODUCTION

The term open bite was introduced by Carevelli in 1842 as a separate classification of malocclusion (1). It is determined as a vertical contacts' insufficiency of the maxillary-mandibular antagonistic teeth, which can be categorized according to its location and etiology (2). Open bite can be divided into simple, compound, and infantile open bite, as well as posterior, anterior, and combined open bite, depending

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on its location. According to Moyer, it is categorized into simple and complex open bite. It is also classified as the skeletal and dental open bite (3). Anterior open bite has a multifactorial etiology, in which genetic, developmental, and environmental factors play a role (4). Today, genetic and epigenetic contributions to the anterior open bite etiology have gained attention. Genes associated with the craniofacial anomalies development also take part in the anterior open bite etiology. Especially, the FGFR2 gene is associated with Crouzon and Apert syndromes, which are characterized by hypoplastic midface, deep palatal bone, and malocclusion (5).

Habits like long-term teat use, tongue thrusting, and finger sucking in early childhood may lead to anterior open bite development by applying mechanical forces on the teeth and preventing their alignment. In addition, mouth breathing caused by airway obstruction due to allergies, a deviated septum, enlarged turbinates, and tonsillar hypertrophy may affect the facial growth pattern and increase the risk of anterior open bite (4,5). Alteration of these habits throughout early childhood aids in reducing the difficulties associated with open bite treatment later in life (5).

The severity of the malocclusion, functional impairments, the age and general health of the patient, and the etiology of the malocclusion all influence the treatment of open bite. In skeletal (true) open bite, developmental differences in the bone bases and dolichofacial features are observed, whereas in dental (false) open bite, the teeth and dentoalveolar processes are proclined and the bone bases remain unchanged (3). Fixed orthodontic treatment is often considered the first step and involves the use of braces, clear aligners, or other orthodontic appliances to properly reposition the teeth and close the bite. The underlying skeletal problem causing the open bite may also need to be corrected by surgically assisted treatment (6).

Dental and skeletal open bites, which are usually seen together with posterior dentoalveolar excess, occur due to downward and backward rotation of the mandible. Especially during the growth phase, appliances such as occipital headgear, posterior bite blocks, and acrylic-buttoned transpalatal arches can be used to intrude posterior teeth, or at least prevent molar eruption, to reduce or control anterior facial height. Active intrusion of posterior teeth using temporary anchorage devices can also help improve the anterior open bite by inducing counterclockwise rotation of the mandible (7).

Extraction of posterior teeth is another method used to correct an anterior open bite. In indicated cases, molar extractions due to caries or periodontal issues can effectively reduce facial height. The forward movement of the molars results in upward and forward rotation of the mandible. It has been suggested that 1 mm of molar intrusion can lead to a 2-3 mm closure of the anterior opening due to counterclockwise mandibular rotation (8).

Another method used in the treatment of an anterior open bite is distalization (9). Distalization of the maxillary posterior teeth contributes to the support of closure in the anterior segment, while the combined use of this approach with intrusion allows for a more stable correction of the open bite (10). Miniscrews provide a stable and non-invasive anchorage point, preventing unwanted movements during molar distalization and helping to restore occlusion of anterior teeth (11). In conclusion, miniscrew-supported distalization is considered an effective orthodontic treatment option and a non-surgical alternative in the treatment of anterior open bite (12).

Miniscrews have become an integral part of orthodontics due to their ease of application, small size, the possibility of immediate force loading in various areas of the mouth, and easy removal at the end of treatment. They facilitate faster and more efficient tooth movements of all types (13). In particular, the infrazygomatic crest (IZC) is considered a suitable site for miniscrews to achieve various orthodontic tooth movements, such as distalization, retraction, and intrusion. In the mandible, the buccal shelf region, located on the vestibular area of the first and second molars, is considered a suitable site for miniscrew application (14).

In light of this information, this paper aimed to present the results of the whole arch distalization treatment with miniscrews in a post-adolescent patient with an anterior open bite.

CASE REPORT

A male patient with a chronological age of 17 years and 3 months was admitted to the Selçuk University, Faculty of Dentistry, Department of Orthodontics with complaints of an opening in the anterior region when he closed his teeth, and an inability to close his lips. Extraoral examination revealed a convex soft tissue profile, mentalis and lip tension when the lips were brought together, and inadequate lip seal at rest (Figure 1). Intraoral examination revealed a 4.2 mm anterior open bite with tongue thrust, which resulted in difficulty in closing the lips. Additionally, a right molar Class I and canine Class II; left molar Class I and canine Class II angle classification was observed (Figure 2). There was no crowding or spacing in the lower arch, but 1.2 mm of excess space was detected in the upper dental arch (Figure 3).

It was determined that tongue thrust was the main etiological factor, and the patient was shown, using a mirror, how to position the tongue against the palate during swallowing. Correct swallowing technique was explained. The patient was instructed to perform this tongue exercise in front of a mirror 300 times daily in intervals, in an attempt to establish the habit.



Figure 1. Pre-treatment extraoral frontal and lateral photographs of the patient



Figure 2. Pre-treatment intraoral frontal, right, and left photographs



Figure 3. Pre-treatment occlusal photographs of the maxilla and mandible

Lateral cephalometric and panoramic radiographs were taken, and measurements were made (Figure 4). Lateral cephalometric analysis indicated the proclined and protruded maxillary and mandibular incisor teeth, and that the skeletal growth pattern was horizontal. Thus, it was determined that the anterior open bite was of dental origin. Sagittally, the maxilla and mandible were positioned properly relative to the cranial base (Table 1).

Although four-quadrant premolar extraction was initially considered due to the need for space in the arches, a different treatment plan was selected, taking into account the potential for facial profile collapse following extraction and the patient's horizontal growth pattern.

The aim was to achieve an Angle Class I molar and canine relationship by applying bilateral distalization in the maxilla and mandible, and by repositioning the protruded and proclined upper and lower incisors to their ideal angulation and position. Distalization was chosen to avoid collapsing the patient's facial profile, enhance incisor display to contribute to smile aesthetics, and preserve canine support at the corners of the lips.

First, all third molars were extracted to facilitate distalization. Then, upper and lower bonding was performed using 0.022-inch slot MBT system brackets (Mini Master, American Orthodontics, Washington, USA). At the beginning of fixed treatment, a 2 mm diameter, 12 mm long self-drilling miniscrew (Bomei, Taiwan) was applied to the right and left infrazygomatic regions in the upper arch and to the right and left buccal shelf regions in the lower arch.

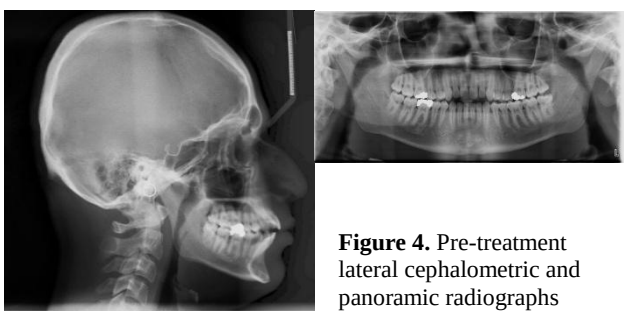


Figure 4. Pre-treatment lateral cephalometric and panoramic radiographs

In the first appointment, an elastomeric chain was installed from the miniscrews to the brackets of the canine teeth, applying 300 g of force for the maxilla and 350 g for the mandible (Figure 5). The patient attended routine control visits every four weeks, during which the elastomeric chain force was measured and renewed. Leveling and alignment

Table 1. The initial and final lateral cephalometric results

	Initial	Final
Skeletal Measurements		
SNA (°)	83.6	83
SNB (°)	80.6	80
ANB (°)	3	3
SN-GoGn (°)	29.4	30.9
FMA (°)	15.4	18.7
Y-Axis (°)	51.9	54.9
Maxillo-Mandibular Angle (°)	21.4	25.2
Dental Measurements		
Mx1-SN (°)	116.1	99.1
Mx1-NA (°)	32.5	16.1
Mx1-NA (mm)	9.9	4.7
Mx1-Pal (°)	124.1	104.8
IMPA (°)	111.8	95.7
Md1-NB (°)	41.8	26.6
Md1-NB (mm)	10.1	6.6
Interincisal Angle (°)	102.7	134.3
U1-PP (mm)	15.6	20.7
L1-PP (mm)	19.6	17
U6-PP (mm)	18.3	18
L6-PP (mm)	17.7	19
U1-PTV (mm)	52.3	47.7
L1-PTV (mm)	49.8	47.1
U6-PTV (mm)	29.1	24.2
L6-PTV (mm)	31.2	29.7

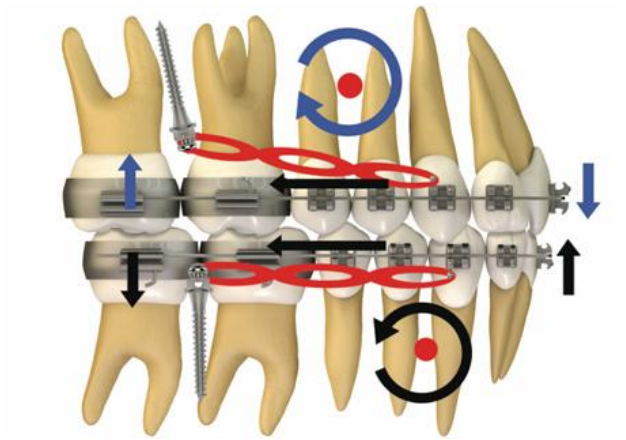


Figure 5. Biomechanics of tooth movements in the mandibular and maxillary arches caused by an elastomeric chain applied from infrazygomatic and buccal shelf miniscrews to canine brackets (9)

continued sequentially with 0.014 NITI, 0.016 NITI, and 16x22 NITI wires.

By applying the elastomeric chain directly to the bracket, rather than using a power arm, the intrusive component of the force was also utilized. This not only achieved distalization of the posterior segment but also prevented extrusion forces that could worsen the anterior open bite. The patient received tongue training at each appointment, and swallowing patterns were regularly monitored.

As the arches were distalized, gaps opened between the anterior teeth, and the teeth began to retrocline under the pressure exerted by the lips. The stability of the miniscrews was checked at every appointment, and no miniscrew loss occurred during treatment. For finishing, 17x25 stainless steel (SS) wires were placed in both arches, and a tight cinch-back was applied. The minor remaining spaces were closed by using a molar-to-molar elastomeric chain on both maxilla and mandible. The whole treatment time was 18 months. The anterior open bite was totally closed, proper overbite-overjet were achieved, and a Class I canine relationship was established (Figures 6, 7, and 8).

Lingual retainers were bonded for retention and reinforcement. Additionally, removable retention appliances were fabricated, and the patient was warned to wear a Hawley appliance during the day and a Positioner at night. The patient, who had an initial anterior open bite of 4.3 mm, had an overbite of 3 mm after treatment. No root resorption was observed in the panoramic and lateral cephalometric radiograph taken after treatment (Figure 9). However, advanced imaging techniques are required for a more detailed evaluation.

The patient came for follow-up one month later, and it was observed that there was no relapse and the dental Class I occlusion relationship was preserved with ideal overjet and overbite. However, due to the high relapse potential of



Figure 6. Post-treatment extraoral frontal and lateral photographs



Figure 7. Post-treatment intraoral frontal, right, and left photographs



Figure 8. Post-treatment occlusal photographs of the maxilla and mandible

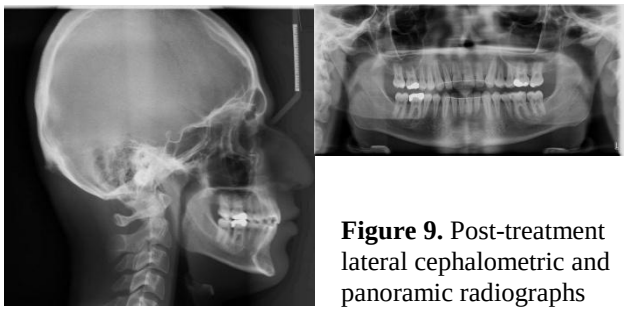


Figure 9. Post-treatment lateral cephalometric and panoramic radiographs

an open bite, long-term monitoring is essential. Follow-up evaluations at the 3-month, 6-month, and annual intervals have been scheduled and communicated to the patient.

Written informed consent was obtained from the patient's legal guardian for publication and image use.

DISCUSSION

When determining the treatment plan for an anterior open bite in individuals with complete growth and development, the skeletal or dental origin should be determined very well. In general, open bite malocclusions of dental origin can be solved only by fixed orthodontic means, while open bite cases of skeletal origin require surgical interventions (15). In the fixed orthodontic treatment of anterior open bite cases where there is no space requirement and the axial inclinations of the anterior teeth are normal, extraction of the maxillary and mandibular first premolars is a frequently preferred method by orthodontists. It is thought that if the premolars are mesialized into the extraction cavity, the mandible will undergo anterior rotation (16). Some studies have shown that there will be no reduction in the vertical dimensions as a result of the extraction of

premolars. For this reason, the spaces created as a result of premolar extraction are used for the correction of anterior open bite by complete retrusion and retroclination of the incisors (17). Since the patient's growth pattern presented here was horizontal (Y-Axis Angle: 51.9°, FMA: 15.4°, SN-GoGn: 29.4°), it was not appropriate to close the space completely by mesialization of the molars (minimum anchorage) with four premolar extractions. In addition, due to the positions and axis inclinations of the maxillary and mandibular incisors (Mx1-SN: 116°, Mx1-NA: 9.9 mm, IMPA: 111.8°, Md1-NB: 10.1 mm), even if premolar extraction is considered, the gaps should be corrected to completely retract the anterior teeth. However, as a result of this excessive backward movement of the lips that have lost their incisor support, an unaesthetic appearance will appear in the patient's lip area. Therefore, fixed treatment with the extraction of four premolars was contraindicated in our patient.

Another method of the open bite treatment is the posterior region intrusion with miniscrews or miniplates. In many studies, posterior intrusion with skeletal anchorage has been successfully applied (18,19). Deguchi et al. (20) compared the results of traditional fixed treatment and treatment with a miniscrew in adult patients with skeletal anterior open bite malocclusion. It was determined that the anterior open bite was closed by extrusion of the maxillary and mandibular incisors in the group in which the miniscrew was not applied, resulting in a clockwise rotation of the occlusal plane. In the miniplates group, it was observed that the occlusal plane rotated counterclockwise with the intrusion movement of the maxillary and mandibular molars. The counterclockwise rotation of the mandible appears as a horizontal effect in the growth pattern (20). Since our patient's growth pattern was horizontal, posterior intrusion treatment with skeletal anchorage was not preferred because it would exacerbate the skeletal anomaly.

Another method of obtaining space in the arch is the distal movement of the upper and lower teeth. Molar distalization can be performed with extraoral and intraoral methods. However, skeletal anchorage devices have been the most preferred distalization method since their introduction. Chang et al. (21) performed En Masse retraction with a 12 mm long IZC miniscrew in their study. Hsu et al. (22) used 12 mm long miniscrews in a study in which they examined the IZC miniscrews' success rate in 386 patients bilaterally. El-Dawlatly et al. (23) used miniscrews with a diameter of 1.8 mm, while Hsu et al. (22) used miniscrews with a diameter of 2 mm. In accordance with these studies, miniscrews with a diameter of 2 mm and a length of 12 mm were chosen to be placed in the infrazygomatic region in our patient.

An elastomeric chain was installed from the infrazygomatic miniscrews to the bracket of the canine teeth by applying 300 g of force. El-Dawlatly et al. (23) used a zygomatic miniscrew and applied 300 g of distalization force unilaterally for distal movement of the molar tooth. In this study, they applied 300 g of force to both segments for distalization.

The region between the buccal frenulum and the anterior edge of the masseter muscle is called the buccal shelf. In his study, Ghosh (24) applied 300-350 g of force to the buccal shelf region using a 2 mm diameter 12 mm long miniscrew. In our patient, 350 g of force was applied to the canine teeth with a buccal shelf miniscrew in accordance with the literature information. The probable reason for applying more force in the mandible than in the maxilla is the more compact structure of the mandible.

In studies on molar distalization, Ghosh et al. (25) reported that lower facial height increased after molar distalization in vertically growing individuals. Angelieri et al. (26), Byloff et al. (27), and Polat-Özsoy et al. (28) reported that the maxillo-mandibular plane angle would increase after molar distalization due to extrusion of the maxillary first molars. In our patient, SN-GoGn angle increased by 1.5°, Y Axis angle by 3°, and FMA angle by 3.3°. The increase in these values is compatible with the literature data.

The pterygoid true vertical (PTV) plane was used as a reference to compare the sagittal movement of the teeth. The perpendicular line drawn from the pterygoid point to the Frankfurt horizontal plane is referred to as the PTV plane. Measurements were made by drawing struts from the mesial edges of the first molars to the PTV plane. The amount of distalization was determined by comparing pre- and post-treatment measurements. Additionally, measurements were made by drawing perpendiculars from the incisal edges of the upper and lower incisors to the PTV plane. This determined the extent to which the upper and lower incisors had moved backward. In our patient, the upper first molars had approximately 4.9 mm of distalization, and the lower first molars had 1.5 mm of distalization.

The palatal plane (PP) was used to compare the vertical movement of the teeth. The PP is the plane formed by the junction of the ANS and PNS points. The perpendiculars drawn from the mesial cusp tops of the first molar teeth to the PP were compared. Thus, the amount of intrusion in the molars was determined. The amount of intrusion in the incisors was determined by comparing the perpendiculars drawn from the incisal edges to the PP. Cephalometric measurements revealed that the upper incisors were extruded by 5.1 mm and the lower incisors were extruded by 2.6 mm. It was also observed that the upper first molars were intruded by 0.3 mm, and the lower first molars were intruded by 1.3 mm. The anterior open bite was closed as a result of incisor retraction accompanied by relative extrusion and molar intrusion. Correction of the anterior open bite is usually achieved by extrusion of the incisors.

In the cephalometric superimpositions, the movements of the molar and incisor teeth can be observed (Figure 10).

CONCLUSION

Significant retrusion and retroclination were observed in the maxillary and mandibular anterior teeth. Although molar distalization was performed, there was a very little

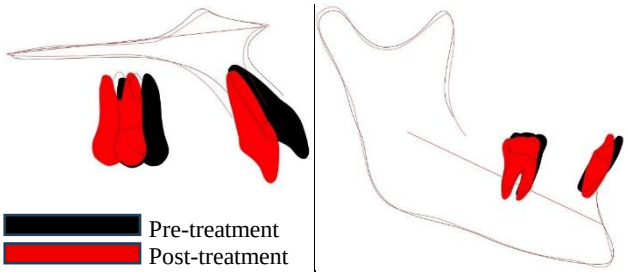


Figure 10. Cephalometric local superimpositions of the maxilla and mandible

increase in vertical values. The anterior open bite was completely corrected. Ideal overjet and overbite were obtained. Aesthetic and functional improvement was achieved in the patient. It has been shown that anterior open bite cases can be successfully treated with distalization treatment, which is thought to be contrary to the open bite treatment mechanics due to the increase in the maxillo-mandibular plane angle, and ideal aesthetic and functional results can be obtained.

While successful outcomes were obtained in this case, further studies involving a larger cohort of patients, more comprehensive study designs, and extended long-term follow-up are warranted.

Informed Consent: Written informed consent was obtained from the patient for publication and accompanying images.

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