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Non-Surgical Orthodontic Treatment of Severe Open Bite Associated with Functional Treatment: A Borderline Case

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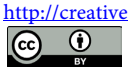

Abstract

This case report describes the treatment of a borderline case with severe skeletal open bite that was managed orthodontically. The patient presented an open bite from 16 to 25 associated with maxillary endoalveolia. She underwent lingual frenectomy and presented with the maxillary first premolars already extracted. Although surgery would have been the ideal approach, the chosen treatment plan consisted of an orthodontic option involving extraction of the first mandibular premolars. The open bite was managed by molar intrusion, anterior retraction and the use of vertical elastics. The functional lingual problem as well as the maxillary endoalveolia was corrected using a quad helix associated with palatal grid. Lingual exercises were also taught to the patient throughout the treatment period and during the 1-year follow-up period. The orthodontic compensation treatment enabled the correction of the severe open bite. Class I canine and molar relationships were restored and both smile and facial aesthetics were improved. The management of the functional lingual problem ensured treatment stability. Accurate diagnosis and identification of the etiological factors in open bite patients are essential for defining treatment objectives and determining the appropriate treatment plan for this type of malocclusion.

Subject Areas

Orthodontics

Keywords

Open Bite, Non-Surgical, Orthodontics, Functional Treatment, Stability

1. Introduction

Open bite is an orthodontic malocclusion defined by the absence of vertical contact between the maxillary and mandibular incisors, despite the presence of occlusal contacts in the posterior segments. The degree or severity of malocclusion may vary from a mild edge-to-edge relationship of the incisor teeth to a severe and handicapping malocclusion [1]. It is a complex vertical malocclusion, considered challenging to be treated due to its relapse rate [2].

The etiology of open bite is multifactorial, including unfavorable growth patterns, digit-sucking habits, enlarged lymphatic tissue, heredity and oral functional matrices [3]. Other factors may be involved such as tongue and orofacial muscle activity, mental retardation, imbalances between jaw posture, occlusal and eruptive force, and head position [1].

Treatment of open bite is complicated by the difficulty of differentiating among many possible dentoalveolar and skeletal etiologic factors, depending on the patient's growth pattern [1]. Several treatment options are presented in the literature, aiming to inhibit the mechanical factors that maintain the anterior open bite and limit the excessive vertical growth of facial skeletal components [3].

Given the complexity of open-bite management and the challenges related to long-term stability, achieving a successful outcome requires a thorough initial clinical assessment, an accurate diagnosis, a well-defined treatment plan, and a careful evaluation of contributing functional and behavioral risk factors. A high level of patient compliance with retainer wear is also a crucial factor [4].

The diagnosis and treatment planning of open bite are primarily determined by the severity of the malocclusion and the facial involvement. In non-growing young adult patients with severe skeletal open bite, the options are limited to compensatory orthodontics or surgical-orthodontic treatment [5].

The current case report describes a severe skeletal open bite that was managed orthodontically. It discusses the particularities of the non-surgical orthodontic treatment of borderline cases and highlights the importance of functional treatment to ensure treatment stability.

2. Case Description

2.1. Diagnosis and Etiology

A 15-year-old female was referred to the Department of Dentofacial Orthopedics at the Ibn Rochd University hospital of Casablanca with a chief complaint related to open bite. The patient reported no relevant medical history. However, a history of childhood thumb sucking was noted, and an abnormal tongue-thrust swallowing pattern was observed.

She had no previous history of orthodontic treatment; however, she reported a history of extraction of the maxillary first premolars. The patient reported having undergone a lingual frenectomy for her lingual problem.

The facial photographs showed flat profile, obtuse nasolabial angle and increased lower facial height. She presented lip incompetency and anesthetic smile

with buccal corridors (Figure 1(A)). Additionally, she was a mouth-breather.

Intraoral examination revealed a bilateral Class III canine and Class II molar relationships. The mandibular dental midline was deviated 1mm to the left. She had an extended open bite from 16 to 25 and transverse discrepancy of -3mm. She had maxillary constriction, characterized by a narrow V-shaped arch, and the absence of teeth 14 and 24. She presented moderate mandibular arch crowding (Figure 1(B)).

The panoramic radiograph revealed normal skeletal and alveolar structures, with the absence of teeth 14 and 24 (Figure 2(a)). The lateral cephalogram showed a hyperdivergent skeletal Class III pattern (33˚ of FMA and -5mm of Ao-Bo). The hyperdivergence was important (GoGn to SN of 48˚). The patient had retroclination of maxillary incisors (20˚ of I/Na) (Figure 2(b)) (Table 1).

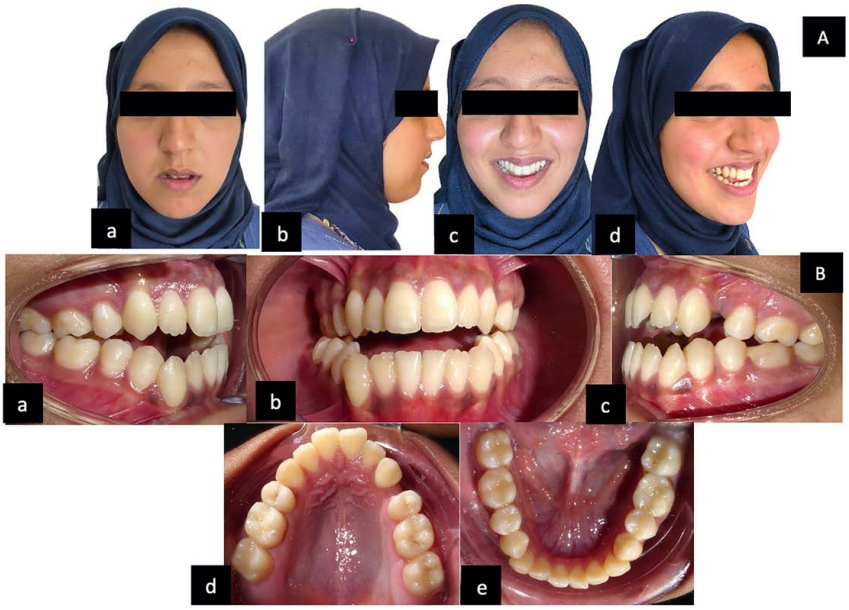

Figure 1. (A) Pretreatment extraoral photographs. (a) Frontal at rest; (b) Profile; (c) Frontal smiling; (d) Lateral smiling. (B) Pretreatment intraoral photographs. (a) Right lateral; (b) Frontal; (c) Left lateral; (d) Maxillary occlusal; (e) Mandibular occlusal.

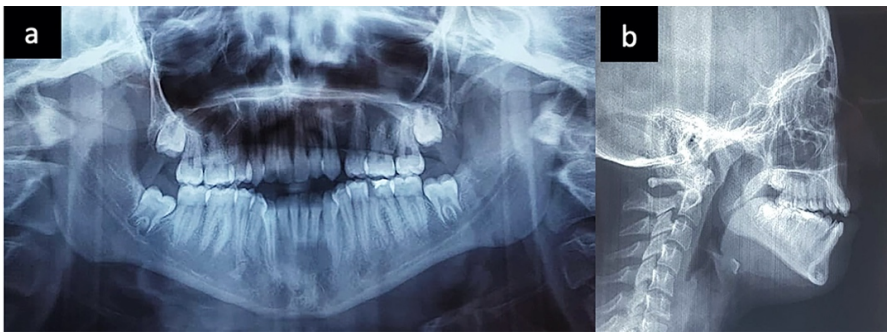

Figure 2. Pretreatment radiographs. (a) Panoramic radiograph; (b) Lateral cephalogram.

2.2. Treatment Objectives

The treatment objectives were to (1) correct the anterior open bite, (2) expand the

maxilla to resolve the transverse deficiency, (3) improve occlusion by establishing Class I molar and canine relationships, (4) achieve ideal overbite and overjet and establish appropriate anterior guidance, (5) correct the functional disturbances related to tongue dysfunction, and (6) improve the facial profile.

2.3. Treatment Alternatives

An orthodontic-surgical approach, including maxillary advancement and counterclockwise autorotation of the mandible, would represent the most appropriate treatment option for correcting the anterior open bite in this patient, given the severity of her skeletal discrepancy. It may enable an establishment of an ideal occlusion as well as ensure treatment stability. However, the patient and her parents declined orthognathic surgery, and the patient expressed no concerns regarding her facial appearance.

As an alternative to orthognathic surgery, a compensatory orthodontic treatment involving extraction of the mandibular first premolars was proposed in order to establish proper anterior guidance. A functional phase was also planned in conjunction with orthodontic treatment to address the patient's lingual dysfunction. The patient was informed of the need for full cooperation with this treatment approach and agreed to the proposed treatment plan.

2.4. Treatment Progress

Both the maxillary and mandibular arches were bonded with 0.022 × 0.028-inch MBT appliances, and initial alignment was performed using 0.014-inch nickel-titanium archwires. A quad-helix appliance combined with a palatal crib was placed at the beginning of treatment to correct the transverse deficiency and to intercept the tongue-thrusting habit.

At each follow-up visit, the quad-helix appliance was activated to correct the posterior transverse discrepancy. Activation was continued for 4 months in conjunction with 0.016-inch, 0.016 × 0.022-inch and 0.017 × 0.025-inch nickel–titanium archwires. Maxillary expansion was discontinued once the edge-to-edge transverse discrepancy was overcorrected (**Figure 3**).

The patient was instructed to position her tongue against the palate during swallowing, and specific tongue exercises were taught. The patient was instructed to position her tongue against the palate during swallowing, and specific tongue exercises were taught. These consisted of placing the tongue against the palate to produce a "click," followed by positioning the tongue tip in the click position and applying an upward isometric force to retrain the tongue musculature. This exercise was performed in sets of ten repetitions, three times daily. A final exercise, known as the "three S's" (slurp, squeeze, and swallow), involves collecting saliva (slurp), bringing the teeth together and activating the elevator muscles (squeeze), and swallowing while maintaining the tongue in the click position. The patient demonstrated excellent compliance with the exercises, as she was highly motivated to accelerate the treatment process.

The lower first premolars were extracted to correct the initial Class III canine relationship. The mandibular arch was first aligned and leveled using a sequence of nickel-titanium archwires (0.014, 0.016, 0.016 × 0.022-inch and 0.017 × 0.025 inches).

Figure 3. Alignment and leveling photographs, the use of quad helix with palatal crib for correction of transverse deficiency and lingual dysfunction.

After correction of the mandibular arch form using 0.017 × 0.025-inch stainless steel archwire, en-masse retraction was performed using a 0.019 × 0.025-inch stainless steel archwire with bull loops (**Figure 4**).

In order to intrude molars, bite blocks with composite were bonded on first maxillary molars (**Figure 5**). With all spaces closed, and to ensure a correct anterior guide, an anterior interproximal reduction was performed on the mandibular arch. Vertical anterior intermaxillary elastics (3/16-inch), delivering approximately 150 g of force, were used to enhance vertical control and facilitate closure of the anterior open bite (**Figure 6**).

Figure 4. The use of bull loops for space closure in the mandibular arch.

Figure 5. Bite blocks bonded on first maxillary molars for molar intrusion.

Figure 6. Interproximal reduction on mandibular arch, Intermaxillary elastics (vertical elastics and class II elastics).

The Class II canine and molar relationships were corrected using Class II intermaxillary elastics (Figure 6). The patient demonstrated excellent cooperation, which contributed to the effectiveness of the applied mechanics. A finishing phase was subsequently performed by incorporating first- and second-order information on stainless steel archwires (Figure 7).

Figure 7. Open bite correction and finishing phase.

After 24 months of treatment and after fixed appliance removal, fixed retainers were bonded to both maxillary and mandibular arch. The patient was followed at 1month, 3 months, 6 months and 1 year after treatment. At each appointment, compliance with functional exercises was assessed. Follow-up evaluation at 1 year demonstrated a stable occlusion.

2.5. Treatment Results

Excellent facial and occlusal outcomes were achieved with this non-surgical approach. The facial profile esthetics were enhanced, while the lower facial height was maintained. Intraorally, both arch length and transverse discrepancies were corrected. Proper dental alignment and a functional anterior guidance were established, with Class I molar and canine relationships and ideal overjet and overbite (Figure 8). The patient's high level of cooperation played a key role in the success of the treatment.

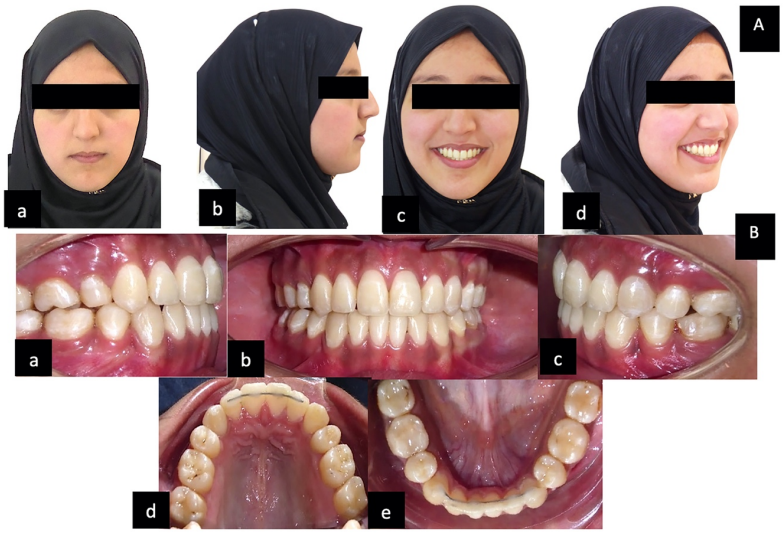

Figure 8. (A) Final extraoral photographs. (a) Frontal at rest; (b) Profile; (c) Frontal smiling; (d) Lateral smiling. (B) Final intraoral photographs. (a) Right lateral; (b) Frontal; (c) Left lateral; (d) Maxillary occlusal; (e) Mandibular occlusal.

In the panoramic radiograph, suitable root parallelism was noted (Figure 9). We planned to extract the 18 right after the treatment. Final cephalometric analysis showed that the mandibular plane has almost not changed (FMA = 34˚). Cephalometric superimposition confirmed the maintenance of the vertical dimension and the correction of the anterior open bite. In addition, both maxillary and mandibular incisors were extruded, whereas the maxillary and mandibular molars were intruded (Figure 10) (Table 1).

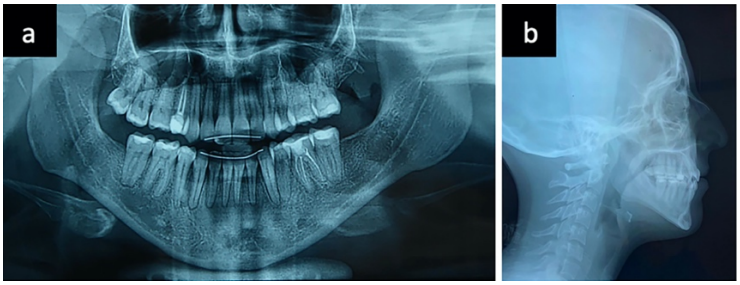

Figure 9. Posttreatment radiographs. (a) Panoramic radiograph; (b) Lateral cephalogram.

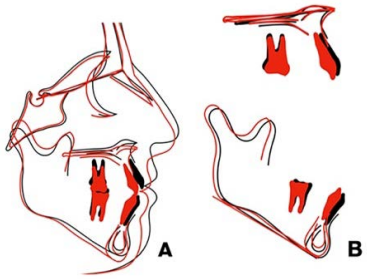

Figure 10. Total superimposition (A), maxillary and mandibular superimpositions (B) of initial (black) and final (red) cephalometric tracing.

Table 1. Cephalometric analyses before and after treatment.

(a)			
		Before TRT	After TRT
Cephalometry	Objective		
SNA	82˚	75˚	74˚
SNB	80˚	73˚	72˚
ANB	2˚	2˚	2˚
I/NA	22˚	20˚	20˚
I/NA mm	4 mm	4 mm	3 mm
i/NB	25˚	23˚	21˚
i/NB mm	4 mm	6 mm	4 mm
Pog/NB		0 mm	1 mm
GoGn/SN	32˚	48˚	50˚

Continued

(b)			
		Before TRT	After TRT
Cephalometry	Objective		
FMA	25˚ ± 3	33˚	34˚
FMIA	67˚ ± 3	62˚	66˚
IMPA	88˚ ± 3	85˚	80˚
AoBo	−2 mm à + 2	−5 mm	1 mm
Occl to PF	10˚	11˚	7˚
Angle Z	75˚ ± 5	71˚	76˚
Upper Lip	/	10 mm	8 mm
Total Chin	/	11 mm	9 mm
FHI	0.69	0.60	0.59

TRT: Treatment.

3. Discussion

Open bite remains a challenging malocclusion for orthodontists in terms of both treatment and long-term stability, owing to its complex and multifactorial etiology. Its causes include genetic predisposition, orofacial dysfunctions, deleterious oral habits, and abnormal skeletal or alveolar bone development. Identifying the underlying etiology is essential, as it directly influences the choice of the treatment approach and the long-term stability of the results [6].

In the management of complex and severe malocclusions, orthodontists must carefully evaluate all available treatment options, taking into account their respective advantages and limitations. In cases as severe as the present one, characterized by a skeletal open bite and a hyperdivergent facial pattern, a combined orthodontic–surgical approach is generally considered the most appropriate treatment modality. However, the patient declined orthognathic surgery. Considering this, a well-designed and meticulously implemented orthodontic method could be a viable alternative to surgical correction [7].

Although there are a variety of orthodontic treatment modalities used to correct open bite, there is still no consensus on what methods are most successful [8]. Many therapeutic protocols have been presented such as high-pull headgears, dental extractions, posterior bite-blocks, etc.

In nongrowing patients, the most effective treatment strategy generally consists of intruding or limiting the vertical eruption of the posterior teeth. Indeed, correction of the anterior open bite is mainly achieved through counterclockwise rotation of the mandible induced by intrusion of the maxillary posterior teeth [4] [9]. Conversely, extrusive mechanics applied to the anterior teeth can establish overlap between the maxillary and mandibular incisors; however, this approach may increase gingival display and is associated with a high risk of relapse [8].

Several orthodontic appliances have been specifically designed to achieve posterior tooth intrusion. Headgear, multiloop edgewise archwires (MEAW), and vertical elastics are commonly used to manage overerupted maxillary molars [7]. With the introduction of skeletal anchorage, posterior tooth intrusion using titanium miniplates or monocortical bone screws has become a feasible therapeutic option. The effects of skeletal anchorage have been reported to be, to some extent, comparable to those obtained with maxillary impaction performed during orthognathic surgery [10]. In this current borderline case, however, camouflage treatment without any skeletal anchorage was chosen. Synchronizing expansion with posterior intrusion using bite blocks was beneficial.

Premolar extractions, and in some cases molar extractions, may be indicated for the correction of open bite, particularly in the presence of dental crowding. Premolar removal provides space for enhanced incisor retraction and uprighting, facilitating closure of the open bite through the so-called "drawbridge" effect [8] [9]. Foosiri *et al*. [11] investigated the stability of open-bite treatment using extraction and non-extraction approaches. Their results showed no significant relapse in the extraction group, whereas a statistically significant relapse was observed in the non-extraction group. In the present case, cephalometric analysis indicated that correction of the anterior open bite was achieved through retraction, uprighting, and extrusion of both the maxillary and mandibular incisors, consistent with the so-called "drawbridge" effect.

Nonsurgical orthodontic management of adult patients with anterior open bite can also be achieved through the use of vertical intermaxillary elastics [4]. In the present case, anterior vertical intermaxillary elastics (3/16-inch), delivering 150 g of force, were applied to enhance vertical control and facilitate closure of the anterior open bite. The patient's cooperation in wearing the elastics was essential for achieving successful correction.

The management of open bite malocclusion generally requires a comprehensive approach that targets not only the dentition, but also the jaws and the orofacial musculature [7]. Tongue-thrust swallowing is a recognized contributing factor to post-treatment relapse and should therefore be controlled during both the active treatment and retention phases [12] [13]. Several therapeutic strategies have been proposed to manage abnormal tongue posture, including functional orthodontic appliances, vestibular shields, lingual spurs, tongue cribs, and myofunctional therapy, with variable levels of reported effectiveness [14] [15].

Bonded lingual spurs on the maxillary and/or mandibular incisors, as well as fixed or removable palatal cribs, help eliminate tongue interference within the open-bite space and promote a more appropriate tongue posture, thereby facilitating correction of the anterior open bite [5] [12] [14]. A quad-helix appliance combined with a palatal crib is also an effective appliance for intercepting sucking habits. In addition, it contributes to the correction of posterior crossbite, promotes downward rotation of the palatal plane, and improves intermaxillary vertical relationships [16] [17].

In the present case, the patient demonstrated an adaptive anterior tongue-thrust pattern, characterized by forward positioning of the tongue in response to the underlying malocclusion. The use of a quad-helix appliance with a palatal crib allowed simultaneous correction of the posterior crossbite through transverse expansion and improvement of tongue posture, thereby contributing to the correction of the anterior open bite.

To ensure treatment stability, it is also important for the patient to undergo orofacial myofunctional therapy (OMT), which aims to raise awareness of improper tongue posture and to promote the acquisition of physiological orofacial functions through specific exercises. The effectiveness of this approach depends primarily on the patient's compliance [12] [15].

Several tongue exercises can be prescribed for patients with a tongue-thrust pattern. These include placing the tongue against the palate to produce a "click," followed by positioning the tongue tip in the click position and applying an upward isometric force to retrain the tongue musculature. This exercise should be performed in sets of ten repetitions, three times daily. A final exercise, known as the "three S's" (slurp, squeeze, and swallow), involves collecting saliva (slurp), bringing the teeth together and activating the elevator muscles (squeeze), and swallowing with the tongue maintained in the click position [13].

In the present case, the patient was instructed in tongue-training exercises throughout treatment to correct tongue posture and was periodically reviewed after treatment to monitor possible recurrence of the tongue-thrust habit. The risk of relapse was considered minimal, as a stable occlusion was achieved and a more physiological muscular pattern—particularly with respect to tongue function—was re-established.

Given the variable reports regarding the stability of open bite correction, overcorrection of the overbite is strongly recommended to minimize the risk of relapse in such malocclusions [4] [13]. Maintenance of the achieved occlusion is often challenging due to uncontrolled tongue posture and function, which increases the risk of relapse and necessitates both patient cooperation and the implementation of myofunctional therapy [18]. Treatment stability also requires an appropriate retention protocol. Consequently, several retention strategies have been proposed for anterior open bite cases, such as fixed retainers, functional appliances in combination with posterior bite plane and TAD'S [16].

4. Conclusions

To achieve successful treatment and long-term stability in open bite cases, a thorough evaluation of the etiological factors and an accurate diagnosis are essential. A multidisciplinary approach can help prevent post-treatment relapse in many patients.

The present clinical case is a borderline non-surgical case whose therapeutic success was ensured thanks to well-controlled orthodontic mechanics as well as the management of the functional lingual problem. The open bite was successfully

corrected, with the establishment of Class I canine and molar relationships and the improvement in smile and facial esthetics. The well settled anterior guide and functional normalization allowed post-therapeutic stability.

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Conflicts of Interest

The authors declare no conflicts of interest.

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