



Severe anterior open bite in a Class II hyperdivergent adult patient: A case report of clear aligner orthodontic camouflage treatment

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Keywords

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Summary

The aim of this study was to describe the successful treatment of an anterior open bite in an adult Class II hyperdivergent patient. A 31-year-old female presented for orthodontic treatment, seeking an aesthetic solution to correct her anterior open bite and lower crowding to enhance her smile. As an initial step, all third molars were extracted to facilitate the forward rotation of the mandible and the initial closure of the open bite. Subsequently, clear aligner therapy (F22 aligners, Due Carrare, Italy) was initiated, with aligners changed every 15 days in combination with Class II elastics. Bite closure was achieved through programmed interproximal reduction (IPR) and the retroclination of anterior teeth. At the end of treatment, the open bite was successfully closed, a Class I relationship was obtained on the right side, and an edge-to-edge Class II relationship persisted on the left due to underlying skeletal asymmetry. Additionally, incisor exposure during smiling was improved. This clinical case demonstrates that clear aligners can effectively compensate a functional anterior open bite by promoting mandibular forward rotation and incisor retroclination.

Introduction

The anterior open bite is a malocclusion characterized by a deficiency in the normal vertical overlap between upper and lower incisors when the posterior teeth are in occlusion. The indications for treatment are generally aesthetic and functional due to the lip incompetence [1].

The prevalence of anterior open bite is about 3% in an adult Caucasian American population, but it can range widely from 1.5% to 11% depending on ethnic group and dental age [2]. The aetiology of anterior open bite is generally multifactorial, involving a combination of genetic predisposition, hereditary influences, unfavourable facial growth patterns, as well as skeletal, dental, and breathing factors [3].

Open bite is classified into two main categories: dental open bite and skeletal open bite. Dental open bite is characterized by proclined incisors, under-erupted anterior teeth, and a normal or slightly excessive molar height. It results from a mechanical obstruction in the vertical development of the incisors and the alveolar component, while the skeletal relationships remain normal [4].

Dental open bite can also be caused by parafunctional activity when a splint does not cover all molars, leading to posterior extrusion and clockwise mandibular rotation [5].

Conversely skeletal open bite is characterized by increased lower anterior facial height and gonial angle, short mandibular ramus, and increased posterior dentoalveolar height [6].

The pathogenesis of the open bite will determine the type of treatment. In the case of a skeletal open bite, the gold standard is combined surgical and orthodontic treatment; in the case of a dentoalveolar open bite, orthodontic treatment is possible, either fixed or removable [7].

In recent years, clear aligners have gained popularity in orthodontics. They can be effectively used for open bite closure due to the double thickness of the clear plastic material on the occlusal surface, which exerts an intrusive force on the posterior teeth. On the other hand, achieving a positive overbite may require greater extrusion of the anterior teeth [8].

Diagnosis and aetiology

A 31-year-old woman presented at our observation requiring an orthodontic aesthetic treatment to resolve anterior her open bite and lower crowding in order to improve her smile.

The patient reported having never undergone orthodontic treatment in the past but is currently undergoing treatment with a night splint. In fact, she stated that her previous dentist had recommended the use of a bite splint to reduce muscular tension and treat nocturnal bruxism. This appliance was extended just to the second molars, causing the third molars to extrude.

The extraoral examination (*figure 1*) revealed a square-shaped face with a mandibular deviation to the left due to the skeletal asymmetry. The vertical analysis showed an augmented lower third with lip incompetence, open bite and excessive lower teeth exposure. The facial profile was convex with reduced labio-mental angle.

Intraorally, the patient displayed a right Class I molar and canine and a left edge-to-edge Class II molar and canine. The lower midline was deviated from the upper due to the mandibular asymmetry as frequently seen in Class II subdivision [9] (*figures 2 et 3*).

Intraoral records showed abrasions in all occlusal surfaces probably due to acid activity from the stomach or an external source [10].

The panoramic X-ray showed good radicular parallelism and the presence of all third molars without sign of periodontal disease (*figure 4*). The pre-treatment cephalometry analysis showed a biretrusive skeletal Class II (SNA: 77.3°; SNB: 70.1°; ANB: 7.1°) and a hyperdivergent facial type (MP-SN: 45.3°) with proclined upper and lower incisors (UI-Apo: 8 mm; IMPA: 96°), *figure 4, table 1*.



FIGURE 1
Pre-treatment extraoral photos



FIGURE 2
Pre-treatment intraoral photos

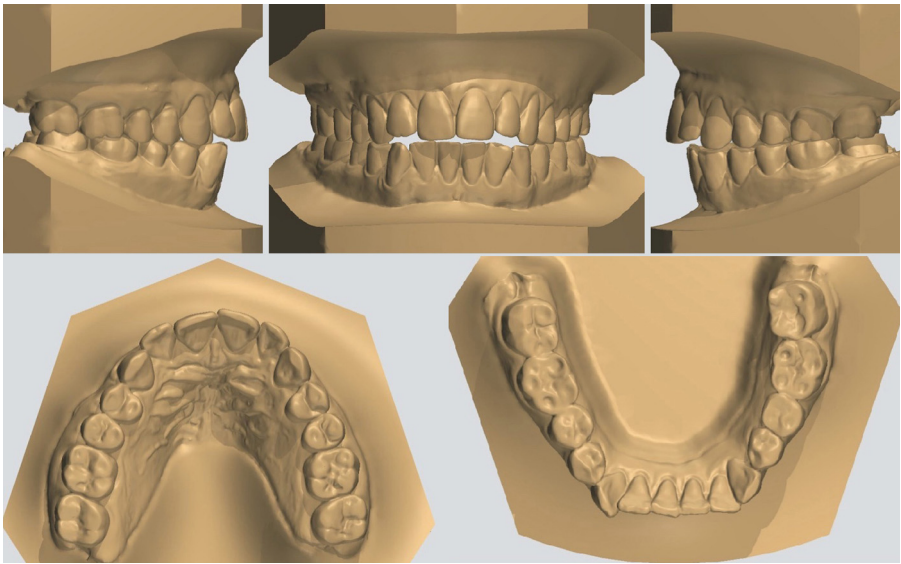


FIGURE 3
Pre-treatment digital models

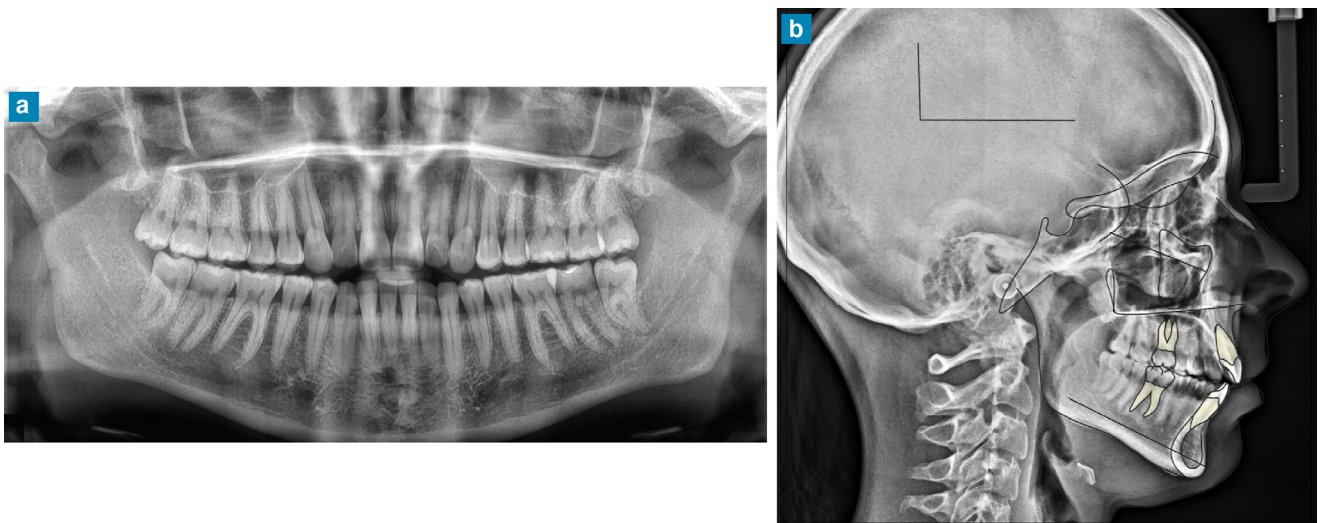


FIGURE 4
Pre-treatment panoramic X-ray and lateral cephalogram

TABLE I

Pre- and post-treatment cephalometric values

	Normal values	Pre-treatment values	Post-treatment values
Horizontal skeletal			
SNA (°)	82 ± 3.5	77.3	77.6
SNB (°)	80 ± 3.0	70.1	70.2
ANB (°)	2.0 ± 2.4	7.2	7.3
Maxillary skeletal (A-Na Perp) (mm)	1.0 ± 3.1	1.5	2.1
Mandibular skeletal (Pg-Na Perp) (mm)	-2.0 ± 5.3	-11.8	-10.3
Wits appraisal (mm)	-1 ± 1	0.1	1.2
Vertical skeletal			
FMA (MP-FH) (°)	26 ± 5.0	31.2	28.0
MP-SN (°)	33 ± 6.0	45.3	42.5
Palatal-mandibular angle (°)	28 ± 6.0	32.4	33.4
Palatal-occlusal plane (°)	10 ± 4.0	15.7	18.2
Mandibular plane to occlusal plane (°)	18.6 ± 5.0	16.7	15.2
Anterior dental			
U-Incisor protrusion (UI-Apo) (mm)	6 ± 2.2	8.2	6.5
LI-protrusion (LI-Apo) (mm)	1 ± 2.3	2.8	3.3
UI-palatal plane (UI-PI) (°)	110 ± 5.0	108.4	100.8
UI-occlusal plane (°)	59 ± 7.0	55.8	61.1
LI-occlusal plane (°)	72 ± 5.0	66.9	66.5
IMPA (°)	95 ± 7.0	96.4	95.0

SNA: angle between Sella-Nasion-A point, SNB: angle between Sella-Nasion-B point, ANB: angle between A point-Nasion-B point, MP-FH: angle between mandibular plane and Frankfurt Plane, MP-SN: angle between mandibular plane and Sella Nasion line, IMPA: lower incisor inclination.

Treatment objectives

The treatment objectives were to resolve the anterior open bite and inferior crowding, correct the Class II subdivision and improve facial aesthetics.

Treatment alternatives

The first treatment option was a surgical-orthodontic approach, consisting of a presurgical orthodontic phase aimed at coordinating the dental arches. This phase included the extraction of two lower premolars to normalize the inclination of the lower incisors. The surgical phase involved bimaxillary surgery with forward advancement of both the maxilla and mandible. Additionally, this approach would facilitate the rotation of the upper and lower occlusal planes to improve divergence.

The second option was a non-extraction approach, which involved the intrusion of the maxillary molars to promote clockwise rotation of the mandible, thereby facilitating the closure of the anterior bite. However, this option was deemed unsuitable due to the proximity of the maxillary molar roots to the maxillary sinus [11].

The third treatment option involved the extraction of teeth 1.4, 2.4, 3.5, and 4.4, followed by the application of a full fixed multi-bracket appliance and asymmetric elastics to correct the Class II relationship on the left side and realign the dental midline. However, this approach was excluded due to the risk of worsening the gummy smile.

Another potential approach was a conservative treatment, which would involve the use of a new bite splint covering all teeth to prevent third molar extrusion. However, considering the patient's initial request for an aesthetically driven treatment and the fact that all third molars were already extruded, we opted for an extraction-based approach. This included the removal of the third molars, followed by treatment with clear aligners and Class II elastics.

Treatment progress

First of all, all third molars were extracted to control occlusal plane allowing forward rotation of the mandible and initial open bite closure [12].

Then, we started clear aligner therapy (F22 aligners, Due Carrare, Italy) through a set of 16 aligners in each arch and 1 refinement of 8 aligners for maxillary arch and 6 aligners for mandibular arch to change every 15 days.

The bite closure was obtained programming IPR reduction and retroclination of anterior teeth thanks to the high predictability of tipping movement with clear aligners in conjunction with anterior extrusion.

An IPR of 0.1 mm was also programmed from 1.1 to 2.3 in the upper arch. On the contrary, for the lower arch, we performed an RPN of 0.2 mm from 4.6 to 3.4, except between 4.3 and 4.2, 3.2 and 3.3 where the RPN reduction was approximately 0.3 mm [13,14].

The extrusion movement in aligner technique has mechanical limitations for anterior teeth in that the buccal and lingual crown surfaces converge towards the incisal edge, facilitating dislodgement of the aligner and making this type of tooth movement virtually impossible without the use of additional composite attachments. As a result, a gingival-orientated attachment configuration with an inclined plane for the upper incisors, which provided a force system that improved predictability of this type of movement [15,16].

In contrast, in the lower arch, we used a single extrusion attachment in element 4.2 to level the incisal edge (*figure 5*). Finally, Class II elastics were used to obtain first class relationship in each side in conjunction with vertical grip point in upper premolars to correct the occlusion with bodily root movement. Patient was instructed to wear elastics all day and to replace them three times a day until he obtained a molar Class I on the most deviated side.

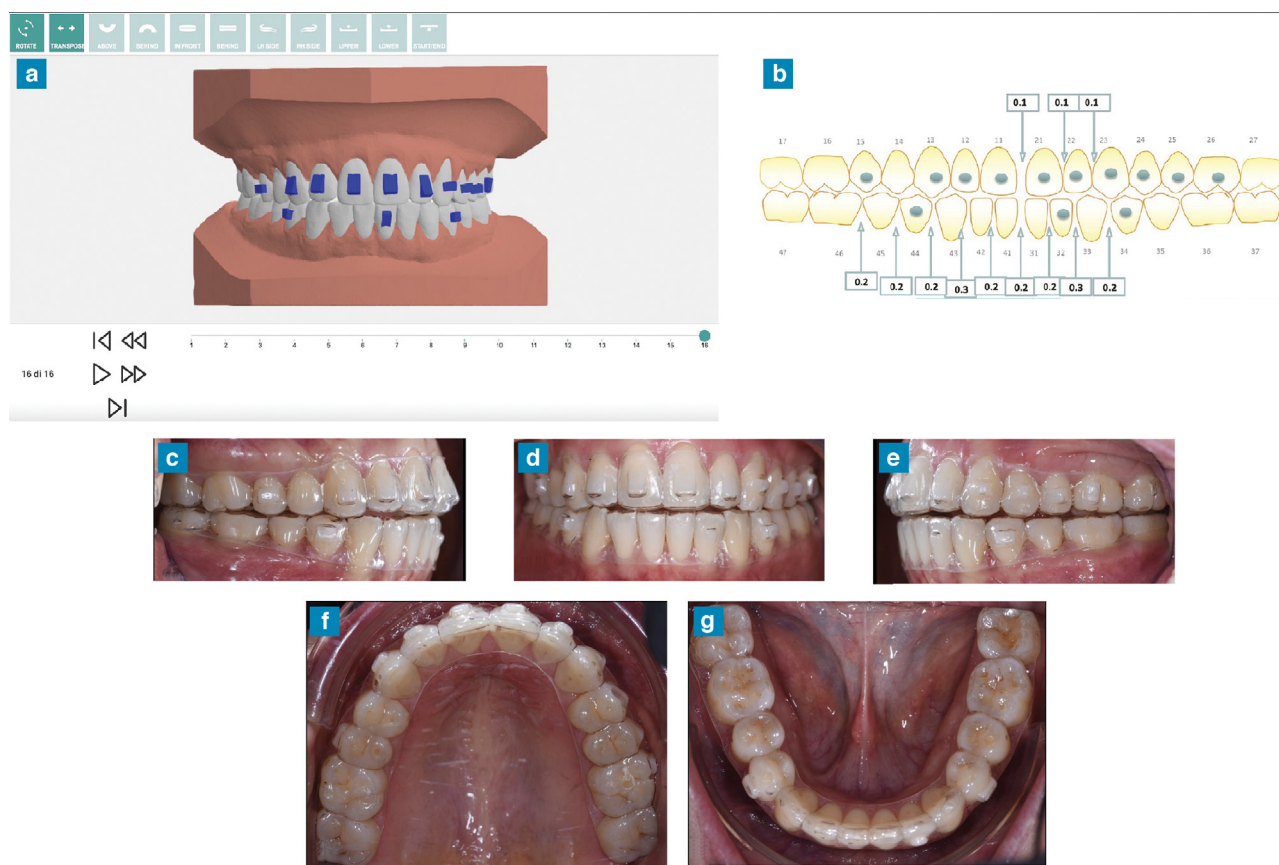


FIGURE 5

Treatment plan and progress: a: digital setup, initial malocclusion frontal view; b: interproximal reduction program; c-g: treatment progress with clear aligners

Treatment results

The extraoral analysis showed the open bite closure and a good exposure of the incisors during the smile (*figure 6*).

The intraoral analysis showed a slight coincidence of the dental midlines, a good right Class I and a small left Class II edge-to-edge relationship due to the persistence of skeletal asymmetry (*figures 7 et 8*).

The panoramic X-ray revealed good parallelism without signs of roots resorption (*figure 9a*).

The post-treatment cephalometry analysis confirmed a retroclination of upper incisors (U1-SN: 100), a slight proclination of lower incisors (IMPA: 98) and a forward rotation of mandibular plane (MP-SN: 42.5) (*figure 9b-f, table I*).

Records one year after the treatment confirm the great stability of the results and the improvement of the occlusion (*figure 10*).



FIGURE 6
Post-treatment extraoral photos



FIGURE 7
Post-treatment intraoral photos: a: light contact; b-g: lateral, frontal and occlusal views

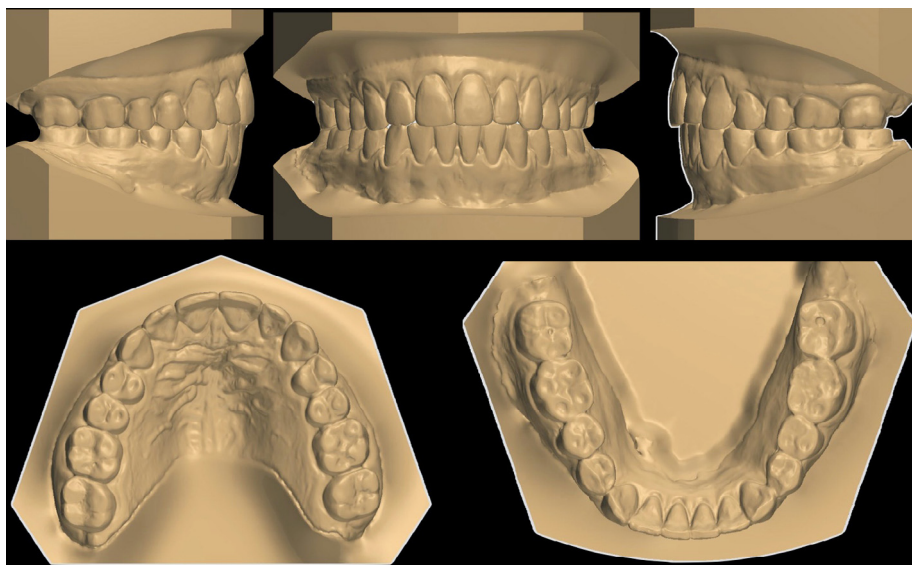


FIGURE 8
Post-treatment digital models

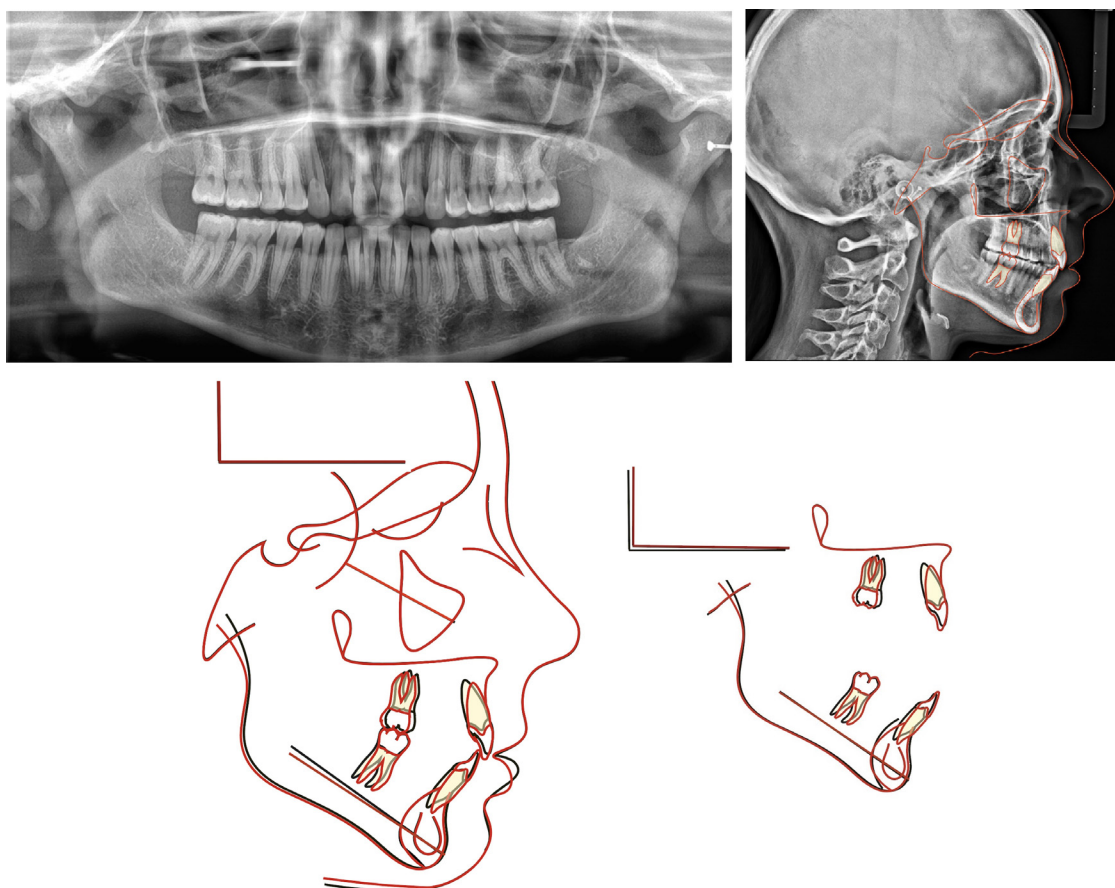


FIGURE 9
Post-treatment X-rays and Björk's structural superimpositions: a: panoramic X-ray; b: lateral cephalogram; c: superimposition on the cranial base; d: superimposition on the stable maxillary structures; e: superimposition on the stable mandibular structures



FIGURE 10
Extraoral and intraoral photos 1 year after the treatment

Discussion

In this case report we have described a successful clear aligner treatment of a skeletal Class II malocclusion with an anterior open bite.

Skeletal open bite is one of the most difficult problems to treat in orthodontics. In severe adult cases, treatment usually requires a combination of orthodontics and orthognathic surgery [17].

Many aetiologies can explain this malocclusion: high anterior facial height according to a skeletal vertical excess, dysfunctional (lingual interposition, mouth breathing), and parafunctional habits [18]. Many patients are reluctant to undergo surgical procedures and therefore opt for orthodontic camouflage therapy using fixed or removable appliances. Orthodontic treatment may involve anterior extrusion combined with

posterior intrusion to achieve a forward rotation of the occlusal plane. However, anterior extrusion is one of the least predictable movements with aligners. Studies indicate that aligners exhibit the highest accuracy for buccolingual tipping (56%), while maxillary molar intrusion reaches at least 35%, and maxillary incisor extrusion only 18%. Consequently, open bite closure is more predictably achieved through the retroclination of anterior incisors. Furthermore, it has been reported that the bite closure prescribed in ClinCheck software often overestimates the actual bite closure achieved clinically [8,13]. However, it has been demonstrated by the study of Talens-Cogollos et al. that a nonplanned molar intrusion of 0.94 mm was observed in 74.2% of patient especially hyperdivergent patients with low tone of muscular activity [19].

In this case, the patient had a parafunctional activity. An occlusal splint limited to the second molars has been used for over a year to reduce muscular tension. Unfortunately, a third molar extrusion was seen as a side effect. A partial occlusal splint should be avoided because of the risk of irreversible tooth migration (extrusion, intrusion). In fact, we resolved the anterior open bite by the extraction of third molars allowing the mandible to achieve an anterotation, accompanied by the clear aligner therapy, programming open bite closure through both retroclination and extrusion of upper incisors [18,20–22]. Ojima et al. study [23] reported that the efficacy of the open bite closure with clear aligners is about 58.4% and these results are in agreement with the results of Haouilj et al. who showed incisor extrusion accuracy between 47.1–56.4% compared to predictions [13]. Nonetheless, significant retroclination of the upper and lower incisors, good vertical control and no significant extrusion of the posterior teeth are the main mechanisms for correcting open bite with clear aligners. Thus, in Garnett et al. study, no statistical difference in open bite closure can be found in comparison with a fixed appliance [24]. Ojima et al. reported that the bite closure is more predictable using extrusion attachment in anterior incisors [23]. In this case, vertical grip points in the upper arch were added to achieve the Class II correction through bodily root movement. At the end of treatment, the upper incisors were retroclined to correct the open bite and the Class II relationship, while the lower incisors experienced a slight proclination due to the effects of Class II elastics and the lower alignment. However,

the combination of clear aligners with Class II elastics can better control proclination of lower incisors, which would be worsened with Class II elastics alone without additional anchorage [25]. However, the dental midlines remained slightly deviated. They would probably have been completely corrected with orthognathic surgery. But the patient refused.

An occlusal restoration treatment for the molar cusps affected by abrasion and erosion lesions had been suggested, but again the patient refused. She is satisfied with the closure of the open bite and the good aesthetic appearance achieved with the treatment using aligners.

Conclusions

This clinical case shows that clear aligners can effectively compensate a skeletal anterior open bite by correcting maxillary incisor protrusion and achieving bite closure through mandibular counter-clockwise rotation. Accurate diagnosis and meticulous treatment planning are essential in selecting the most appropriate approach to address both orthodontic and aesthetic concerns while meeting the patient's expectations.

Contribution of authors: Lombardo Luca, Cremonini Francesca: concept and study design.

Cremonini Francesca, Falconi Virginia, Carazzato Lisa, Palone Mario: analysis and/or interpretation of data.

Cremonini Francesca, Falconi Virginia, Carazzato Lisa, Palone Mario: drafting the manuscript.

Lombardo Luca, Cremonini Francesca, Palone Mario: revising the manuscript critically for important intellectual content.

Lombardo Luca, Cremonini Francesca, Falconi Virginia, Carazzato Lisa: approval of the version of the manuscript to be published.

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