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Case report

Hybrid treatment of a skeletal class II malocclusion using aligners and sectional mechanics

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ABSTRACT

Aim: To describe the clinical management of an adult patient affected by skeletal Class II malocclusion treated through a hybrid orthodontic approach combining clear aligners and sectional mechanics, with the aim of improving sagittal correction and managing severe dental rotations while preserving the aesthetic and hygienic advantages of aligner therapy.

Materials and methods: A 25-year-old female patient presenting with skeletal Class II malocclusion, increased overjet and overbite, transverse maxillary constriction, moderate crowding, and severe premolar rotations (>35°) was treated with a hybrid protocol. Upper arch distalization and Class II correction were planned using clear aligners, optimized attachments and interarch Class II elastics. Severe lower premolar rotations were initially corrected using sectional NiTi mechanics combined with lingual traction chains. Once partial derotation was achieved, sectionals were removed, a new digital scan was acquired, and optimized attachments were incorporated to complete alignment and finishing using aligners alone.

Results: The hybrid protocol allowed efficient three-dimensional control of distalization, correction of severe dental rotations, alignment of both arches, reduction of overjet, and improvement of smile esthetics. Treatment goals were achieved without surgical intervention, maintaining high patient comfort and compliance.

Conclusions: The combined use of aligners, IZC screws, and sectional appliances represents an effective biomechanical strategy for managing complex Class II malocclusions and severe dental rotations when aligners alone may be insufficient.

1. Introduction

In recent years, orthodontic treatment with clear aligners has established itself as one of the most versatile and effective solutions for treating a wide range of malocclusions, thanks to continuous advances in materials, digital biomechanics and the customisation of tooth movements [1–4]. Today, even complex cases can be successfully treated using aligners, making them a viable alternative to traditional fixed appliances in many clinical settings [5–7].

However, despite their proven effectiveness, aligners have some inherent biomechanical limitations, especially when complex tooth movements are required, such as root control, correction of severe rotations and significant posterior distalisation [8–12]. In these scenarios, the integration of targeted auxiliary devices is often necessary to

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Fig. 1. Aesthetic analysis of the face.

Fig. 2. Intraoral photos.

Fig. 3a. Orthopantomography at time 0 before treatment.

optimise the biological response, reduce treatment time and limit the number of refinements [13–17]. It is in this context that the concept of a hybrid approach comes into play: the strategic combination of aligners with selected auxiliary means—such as Class II elastics, bonded buttons, elastomeric chains and sectional appliances for the direct management of resistant movements such as severe rotations—allows the biomechanical limitations of a single system to be reduced and clinical efficiency to be maximized [18–21]. This approach, which is increasingly common in contemporary clinical practice, allows clinicians to exploit the advantages of each technique while maintaining the aesthetic, functional and hygienic benefits typical of aligners [22–26].

The clinical case described here illustrates the practical application of these principles in an adult patient.

Fig. 3b. Teleradiography at time 0 before treatment.

2. Materials and Methods

2.1. Diagnosis and treatment plan

A 25-year-old woman came to us for an orthodontic consultation with the aim of improving her smile through the use of aesthetic braces. The patient has an oval, symmetrical face, with slight lip incompetence, a gummy smile and a facial midline centred with the upper interincisive midline. The profile appears convex, the mandible is retruded and the upper incisors are in an advanced anteroposterior position when smiling. When the mouth is closed, there is muscle hypertonicity in the lips and chin (Fig. 1).

Dentally, there is a Class II molar and canine malocclusion, more pronounced on the right, increased overjet and overbite, moderate crowding of the arches, and a mismatch between the midlines (deviation of the lower midline by about 2 mm from the upper midline, which is centred with the midline of the face).

The upper arch is contracted, has a V-shape and mesio-rotation of the upper first molars. Tooth 1.1 has undergone previous conservative treatment due to a traumatic fracture related to its excessively protruding position. In the lower arch, elements 3.5 and 4.5 have a mesial rotation greater than 35°. All teeth are present in the arch, including the third molars (Figs. 2, 3a and 3b).

Cephalometric analysis shows skeletal class II (ANB 7.04°) due to mandibular retrusion (SNB 76.92°), mixed with maxillary protrusion (SNA 83.96°), mesofacial subject (SN-GoMe 35.83°), increased overjet (10.90 mm), increased overbite (7.15 mm) (Fig. 4a and b).

The treatment objectives are: to improve the smile, reduce the gummy smile, correct the misalignment, reduce the overjet.

The ideal treatment would be orthodontic therapy combined with orthognathic surgery, but the patient is not willing to accept this type of treatment, so orthodontic camouflage is chosen, which involves improving the class relationships by distalising the upper arch and aligning and levelling the arches. The patient requests cosmetic treatment with clear aligners.

2.2. Therapy

The clinical case in question was approached using a hybrid method based on distalization of the upper arch with clear aligners after extraction of all wisdom teeth and on temporary sectional mechanics for the management of severe rotations. Distalization was programmed in the aligner setup and assisted by interarch Class II elastics directed from the upper aligner slots to the lower molar tubes on both sides. In the lower arch, it was decided to combine the aligners with a mechanism inspired by the protocol proposed by Bowman: the correction of marked

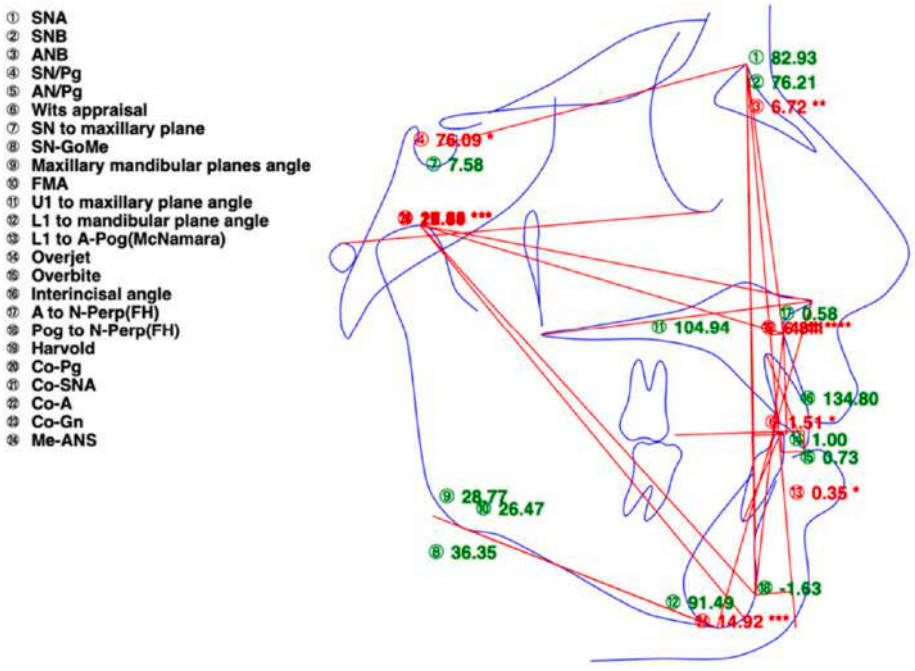


Fig. 4a. cephalometric measurements of the situation at time 0.

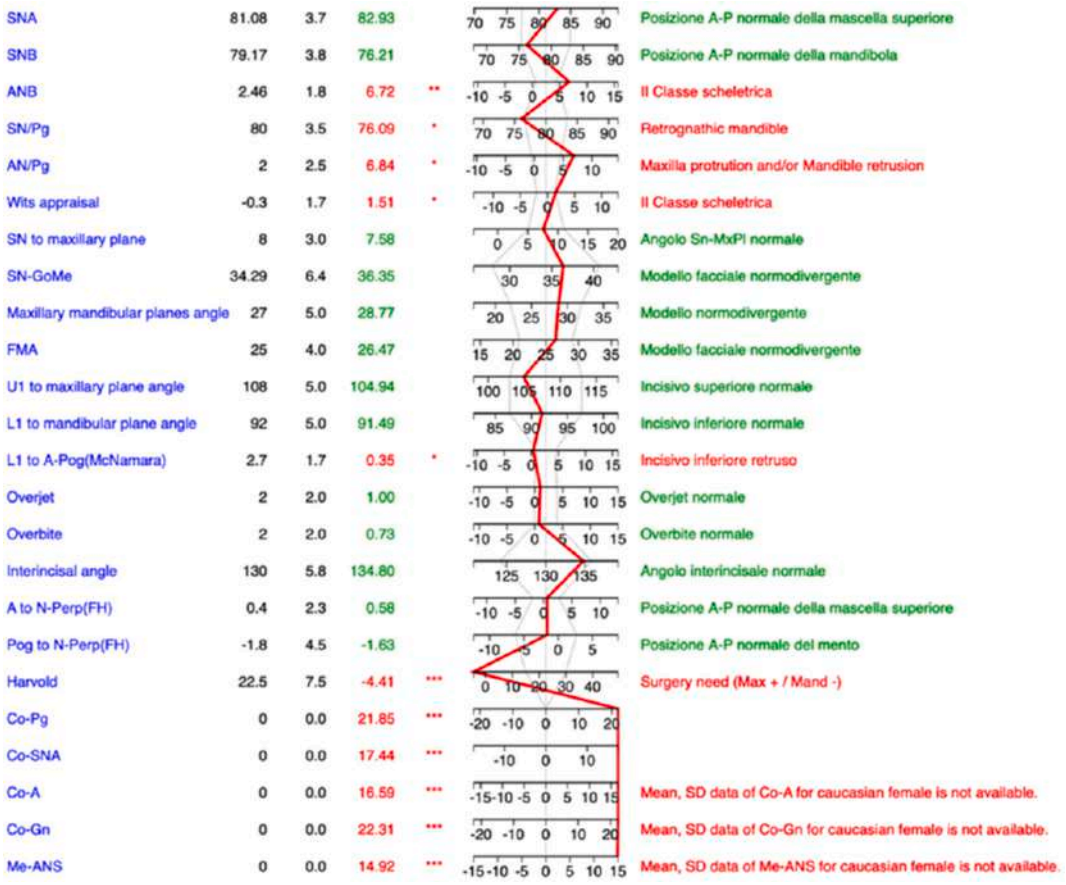


Fig. 4b. Cephalometric diagnosis of the situation at time 0.

dental rotations began with the application of two sectionals, the first in NiTi 0.018 inserted into the vestibular brackets on the premolars and molar tube, the second in NiTi 0.016 inserted into the bracket of the first premolar, onto a tube bonded to the occlusal surface of the second premolar and into the vestibular tube of the first molar. Small buttons were also applied to the lingual side of the premolars to attach support chains, and the aligners were appropriately unloaded to accommodate these fixed components applied to the teeth [27–30].

Once the rotation angle has been reduced to more manageable values, the brackets are removed, a new scan was performed, the digital set-up was updated and optimized attachments are inserted; staging is replanned to complete derotation and refine alignment with fully controlled three-dimensional movements [31–34]. Once the main movement was complete, the detailing phase began, using the same aligners. The entire process allowed the mechanical limitations of aligners to be overcome while maintaining their aesthetic, hygienic and comfort advantages, offering high predictability and a high level of patient satisfaction [35,36]. An essential element for the success of this procedure was the preliminary creation of adequate space adjacent to the premolar to be derotated: the severely rotated premolar occupies more transverse space than its correct position, and attempting derotation in a crowded context reduces the effectiveness of the applied couple, promotes interference with adjacent teeth and increases the risk of incomplete correction or relapse [37–39]. The space was created by mesial and distal interproximal stripping of the teeth affected by severe rotation. Only after clearing the necessary corridor could the combined force of sectionals, chains and aligners act efficiently, allowing rapid and stable derotation with optimal biomechanical control [40–42] (Fig. 5).

3. Results

In the clinical case presented, the adoption of a hybrid protocol allowed for effective three-dimensional control, efficient management of complex movements and high patient satisfaction, while

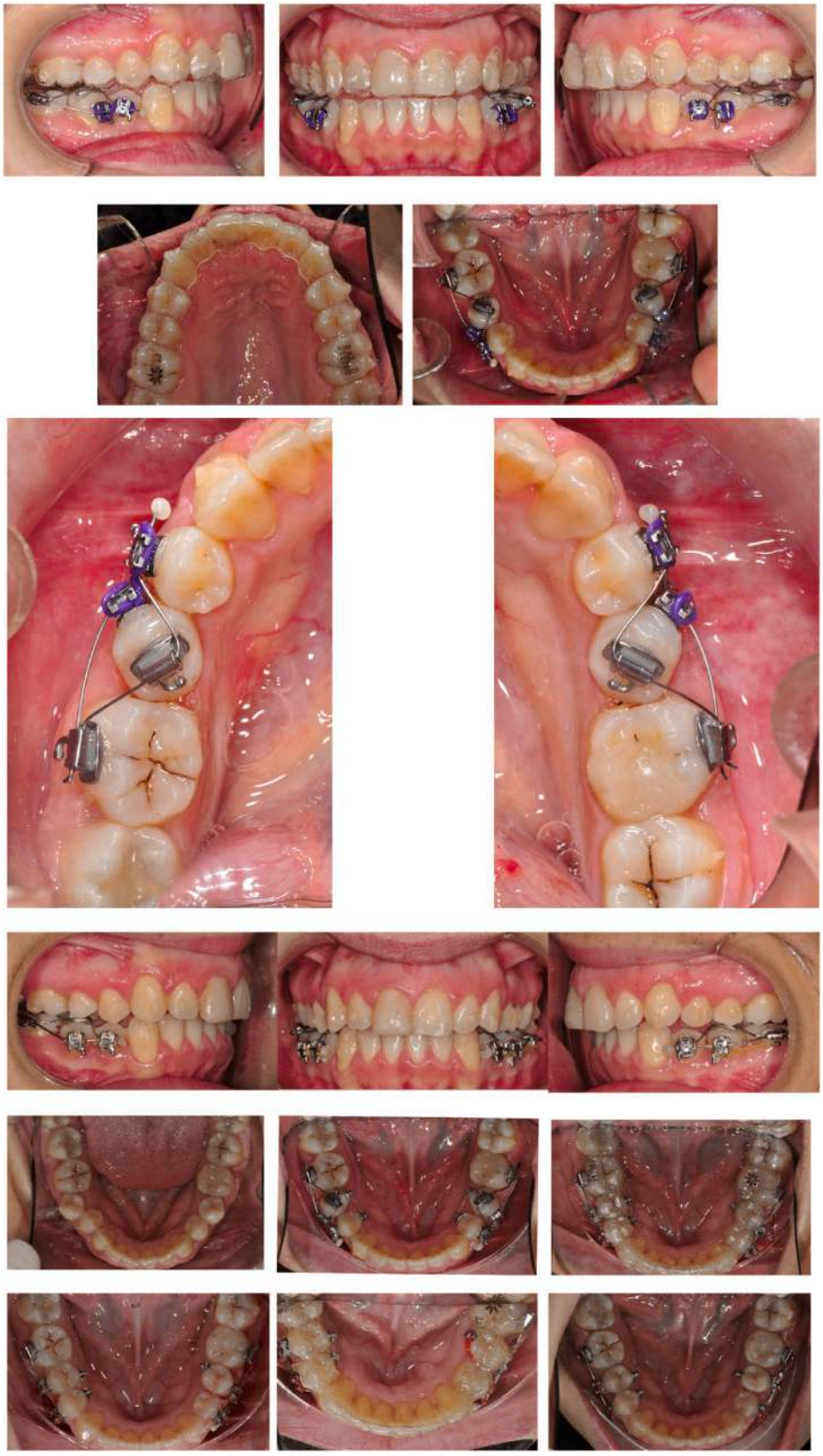


Fig. 5. Details of the biomechanics of derotation described in the text.

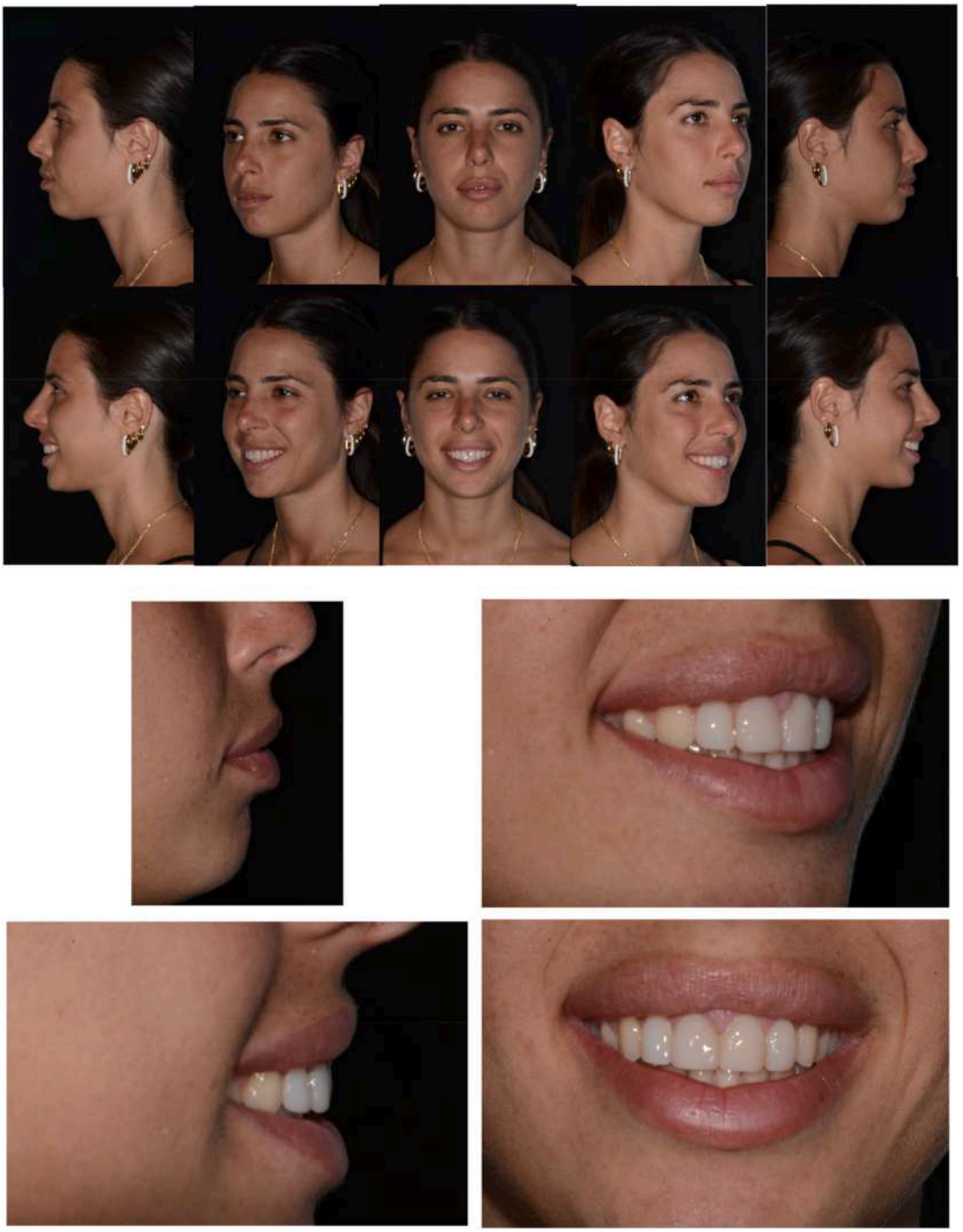


Fig. 6. Aesthetic analysis of the face after the treatment.

Fig. 7. Intraoral photo after the treatment.

demonstrating how synergy between techniques—rather than their isolated use—is the key to success in complex cases (Figs. 6–9).

4. Discussion

Sequential distalization of the upper arch with clear aligners is now an established technique for the non-premolar-extraction management of Class II malocclusions in selected patients. The typical sequence involves starting distalization from the first upper molar, continuing with the second premolar, the first premolar, the canine and finally the front teeth, according to a treatment plan defined using dedicated software. Several studies have shown that, in the absence of third molars and with good compliance control, it is possible to achieve distal movements of approximately 2–3 mm per half-arch, with limited side effects. This approach is particularly suitable in cases of dental Class II with a mild or compensated skeletal component [43–46].

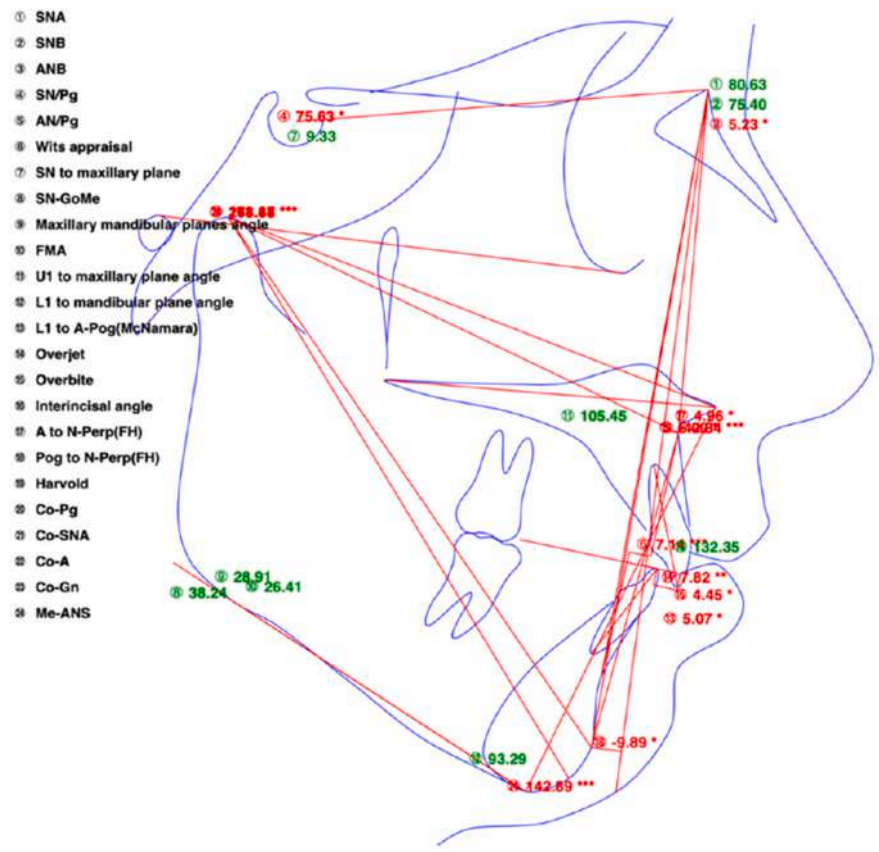
However, the main limitations lie in the difficulty of controlling root inclination during distal movement, the risk of undesirable effects such as distal tipping of the molars, mesial tipping of the premolars and loss of vertical control. [47–51]. The use of specific attachments, adequate staging and Class II elastics can improve clinical control, although the response remains influenced by tooth morphology, aligner fit, activation design and patient compliance [52–55]. The correction of severe tooth rotations, particularly those exceeding 35°, represents one of the most significant biomechanical challenges in clear aligner therapy. Clinical and experimental studies have shown that the effectiveness of aligners in derotating elements such as premolars is drastically reduced as the initial rotation angle increases, especially in the presence of ovoid-shaped crowns or reduced vestibular surfaces. Although the use of optimized attachments and slower staging can improve movement control, the clinical response often remains partial in the most complex cases. For this reason, in cases of marked rotations, hybrid strategies, such as the use of sectionals, buttons and elastic auxiliaries, are recommended to improve the rotational couple and achieve faster and more effective derotation [56–62].

5. Conclusions

This clinical case report highlights how a hybrid orthodontic strategy can effectively expand the therapeutic potential of clear aligner treatment in the management of complex malocclusions characterized by sagittal discrepancies and mechanically challenging dental movements. Upper arch distalization and Class II correction were managed through a digital aligner protocol supported by interarch elastics, while the temporary use of sectional mechanics proved essential for the correction of severe premolar rotations exceeding the biomechanical limits of aligners alone. This staged approach enabled rapid initial derotation and created favorable conditions for subsequent aligner-driven finishing.

This synergistic approach demonstrates that combining selected auxiliary techniques with digital aligner protocols does not compromise the aesthetic, hygienic, and patient-friendly advantages of clear aligner therapy, while substantially improving movement efficiency and reliability. Moreover, individualized biomechanical planning and staged interventions were key to addressing site-specific challenges without resorting to fixed full-arch appliances or orthognathic surgery, which were not acceptable to the patient.

Although the evidence provided by a single case cannot be generalized, the present report supports the growing concept that modern orthodontic success relies on the intelligent integration of treatment modalities rather than on any single system alone. Hybrid protocols therefore represent a valuable option for clinicians seeking predictable outcomes in the treatment of moderate to complex Class II malocclusions.



	Media	S.D.	Risultato	Gravità	Grafico poligonale	Significato
SNA	81.08	3.7	80.63		70 75 80 85 90	Posizione A-P normale della mascella superiore
SNB	79.17	3.8	75.40		70 75 80 85 90	Posizione A-P normale della mandibola
ANB	2.46	1.8	5.23	*	-10 -5 0 5 10 15	II Classe scheletrica
SN/Pg	80	3.5	75.63	*	70 75 80 85 90	Retrognathic mandible
AN/Pg	2	2.5	5.00	*	-10 -5 0 5 10	Maxilla protrution and/or Mandible retrusion
Wits appraisal	-0.3	1.7	7.14	***	-10 -5 0 5 10	II Classe scheletrica
SN to maxillary plane	8	3.0	9.33		0 5 10 15 20	Angolo Sn-MxPl normale
SN-GoMe	34.29	6.4	38.24		30 35 40	Modello facciale normodivergente
Maxillary mandibular planes angle	27	5.0	28.91		20 25 30 35	Modello normodivergente
FMA	25	4.0	26.41		15 20 25 30 35	Modello facciale normodivergente
U1 to maxillary plane angle	108	5.0	105.45		100 105 110 115	Incisivo superiore normale
L1 to mandibular plane angle	92	5.0	93.29		85 90 95 100	Incisivo inferiore normale
L1 to A-Pog(McNamara)	2.7	1.7	5.07	*	-10 -5 0 5 10 15	Incisivo inferiore protuso
Overjet	2	2.0	7.82	**	-10 -5 0 5 10 15	Overjet aumentato
Overbite	2	2.0	4.45	*	-10 -5 0 5 10 15	Morso profondo
Interincisal angle	130	5.8	132.35		125 130 135	Angolo interincisale normale
A to N-Perp(FH)	0.4	2.3	4.96	*	-10 -5 0 5 10	Mascella superiore protrusa
Pog to N-Perp(FH)	-1.8	4.5	-9.89	*	-10 -5 0 5	Punta del mento retrusa
Harvold	22.5	7.5	-42.34	***	-40 -20 0 20 40 60 80	Surgery need (Max + / Mand -)
Co-Pg	0	0.0	213.48	***	-200 -100 0 100 200	
Co-SNA	0	0.0	171.14	***	-100 0 100	
Co-A	0	0.0	163.67	***	-150 -100 -50 0 50 100 150	Mean, SD data of Co-A for caucasian female is not available.
Co-Gn	0	0.0	218.35	***	-200 -100 0 100 200	Mean, SD data of Co-Gn for caucasian female is not available.
Me-ANS	0	0.0	142.89	***	-100 -50 0 50 100	Mean, SD data of Me-ANS for caucasian female is not available.

Fig. 8. Cephalometric analysis at the end of the therapy.

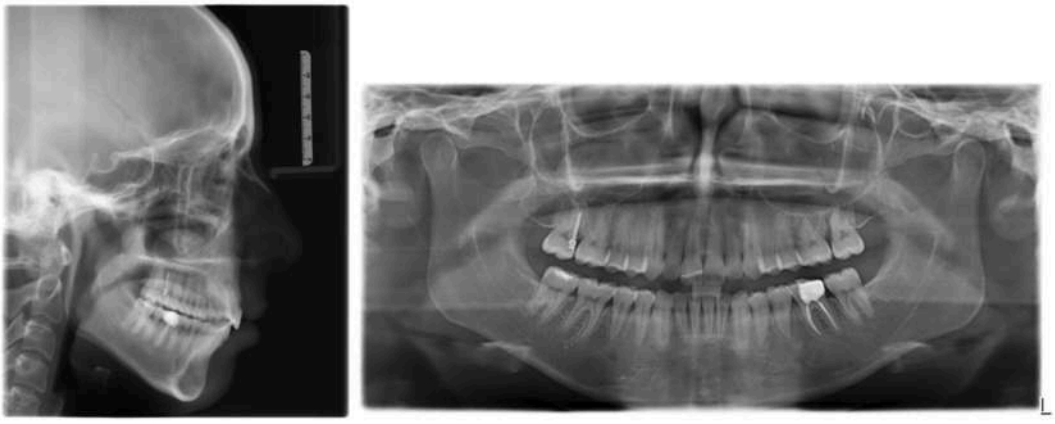


Fig. 9. X-rays at the end of treatment.

Informed consent statement

Written informed consent was obtained from the patient for the publication of this case report, including clinical data, photographs, radiographs, cephalometric records, and the description of the treatment. The patient consented to the use of this information for scientific research and publication. All identifying information has been removed to protect patient confidentiality.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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