

# Aligner hybrid orthodontic approach to treat severe transverse divergence in an adolescent girl: A case report

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## Keywords

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Palatal Expander  
Hybrid approach  
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## Summary

**Objective** > To resolve a complex Class II case with unilateral crossbite through an aesthetic approach, namely a hybrid orthodontic treatment combining aligners with miniscrews and auxiliaries.

**Materials and methods** > A 14-year-old hypodivergent female patient with dental Class II and posterior crossbite presented for orthodontic treatment. The patient refused conventional fixed multibracket treatment and was therefore prescribed aligners used in association with miniscrews and sectional lingual appliances. Pre- and post-treatment records and 2-year follow-up records are presented.

**Results** > Treatment objectives, namely ideal occlusion and improved profile, were achieved in 12 months. Post-treatment panoramic radiography showed good root parallelism, and no sign of either crestal bone height reduction or apical root resorption. The patient was satisfied with the functional and aesthetic outcomes, which were stable at 2 years.

**Conclusion** > This case report illustrates that a hybrid aligner approach may be used to treat posterior crossbite and class II malocclusion with reduced treatment times, optimal oral hygiene and excellent aesthetics.

## Introduction

Clinical and scientific evidence has now shown that aligners are able to resolve an ever-increasing number of malocclusions [1]. However, it has been widely documented that these devices have important biomechanical limitations that sometimes force the operator to change the type of equipment or subject the patient to very long treatments with non-optimal results [2]. Particularly problematic individual movements include the need for good root control and the rotation of conical teeth (premolars and canines), which remains one of the most difficult movements to achieve. In detail the clear aligner treatment seems not to be

effective in controlling rotation of rounded teeth. In fact, several studies suggest a mean accuracy for canine rotation of 36% which decreases to 29% for the mandibular canine. Considering these aspects, several authors recommended to plan overcorrections, especially if rotations exceed 15°, to use attachments, and to reduce staging to less than 1.5° per aligner [2-9]. Movements on the vertical plane are also poorly predictable, making aligners largely unsuited to cases featuring major extrusions or intrusions [10]. On the other hand, the literature agrees that aligners are particularly efficient and effective in vestibular/lingual tipping movements [3,11].

One of the movements on which research has focused the most in recent years is transverse expansion, which can be achieved by bodily movement of the posterior teeth. In this regard, skeletal anchorage can be used to offset aligners' reduced effectiveness in torque control, making it possible to treat increasingly complex malocclusions through a so-called hybrid approach [12-15].

Based on these observations, and awareness of the fact that a long series of aligners cannot be considered a reasonable solution for overcoming their limitations, the authors report on a case treated via a combination of aligners, skeletal anchorage and a sectional lingual appliance, a hybrid approach that provided satisfactory aesthetics and predictable clinical outcomes.

## Case report

The following case report provides an example of how hybrid treatments that combine the potential of aligners and 3D setup with the benefits of skeletal anchorage can enable us to treat complex cases featuring severe transverse discrepancy in a predictable manner and with an extremely reduced treatment time.

## Diagnosis and aetiology

The 14-year-old presented with a request to improve her smile aesthetics and resolve her crossbite. Functional examination revealed weak nasal breathing and snoring. Speech was correct, with proper masticatory muscle tone. The temporomandibular



FIGURE 1  
Pre-treatment extraoral and intraoral photographs

joints were asymptomatic, and maximum mandibular opening was normal. Examination of the records suggested a diagnosis of hypodivergent skeletal class I.

Extraoral analysis indicated a short-shaped face with lip competence and a pleasant profile. A correct nasolabial angle was appreciable from a lateral view. From the front, a skeletal mandibular deviation to the left side was evident; upon smiling, the incisor exposure was correct, but the upper lip was thin. The upper midline was centred with respect to the upper lip philtrum (*figure 1*).

Intraoral investigation revealed a complete permanent dentition and a correct gingival biotype. A supernumerary incisor was present in the lower arch, between teeth 42 and 43. Accordingly, As a result, canine 43 was ectopic and buccally displaced. The transverse diameters of the upper arch were reduced, underlining skeletal maxillary contraction and unilateral crossbite with a severe midline discrepancy of about 4 mm. The right side displayed a molar and canine class I, while the left side exhibited cusp-to-cusp molar and canine class II. The class

II relationship on the left side was caused by the postural deviation of the lower jaw, itself due to maxillary contraction (*figure 1*).

Analysis of the pre-treatment dental casts revealed no crowding in the upper arch and mesiorotation of the maxillary first molars; however, in the lower arch there was a severe crowding due to the presence of the supernumerary incisor and an increased Spee curve. Overjet and overbite were normal (*figure 2*).

Panoramic x-ray confirmed the presence of all permanent teeth, the supernumerary incisor in the lower arch, and revealed the third molar germs (*figure 3a*). There was no sign of periodontal disease, and the condyles appeared intact. The cephalometric morphological assessment revealed hypodivergent (FMA:  $8.8^\circ$ ) skeletal class I malocclusion (ANB:  $1.5^\circ$ , Wits: 1.9 mm), and clockwise-oriented palatal, occlusal and mandibular planes. The upper incisors were greatly inclined with respect to the palatal plane (U1-pp:  $116^\circ$ ), while the lower incisors were proclined with respect to the mandibular plane (IMPA:  $105.5^\circ$ ), (*figure 3b*).

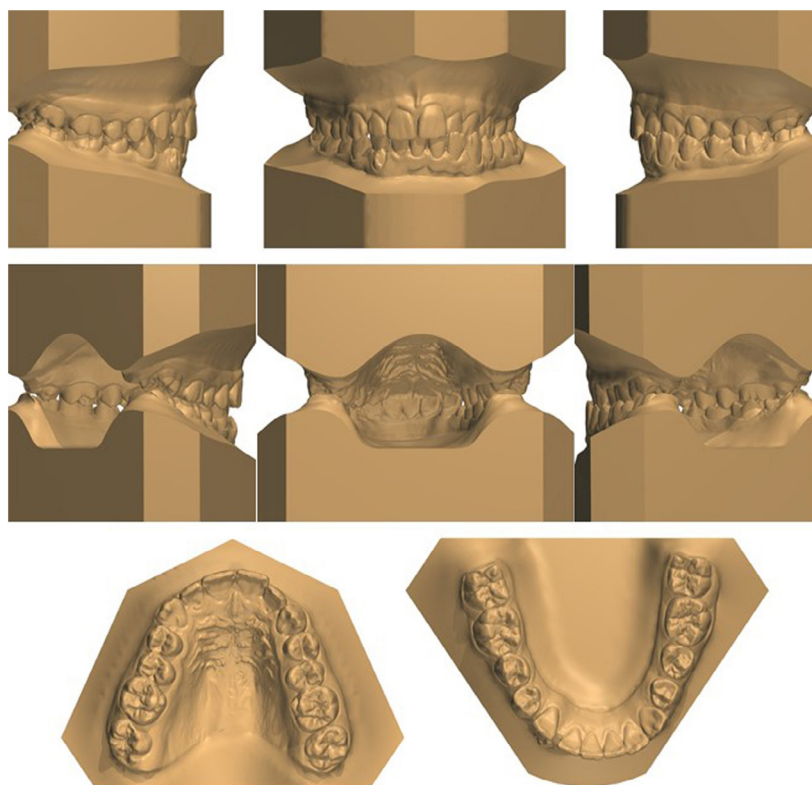


FIGURE 2  
Pre-treatment digital models

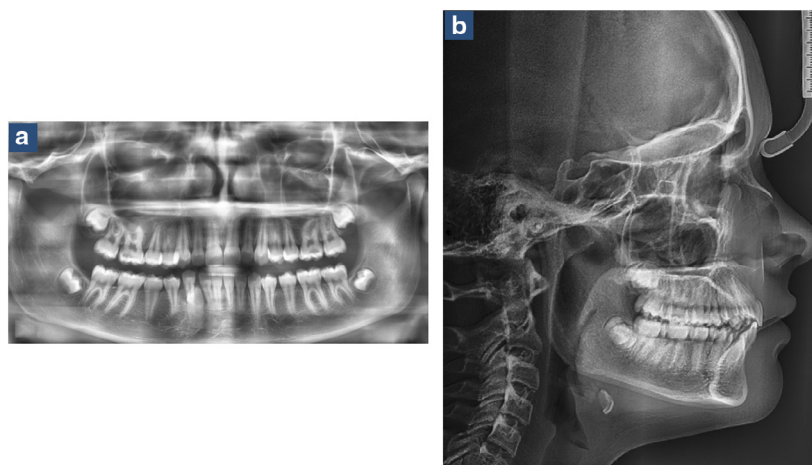


FIGURE 3  
Pre-treatment 2D radiographs. a: panoramic X-ray; b: lateral X-ray

### Treatment Objectives

The main goals of treatment were: skeletal expansion, crossbite correction, molar and canine class correction, and crowding resolution in the lower arch, in particular through the alignment of ectopic tooth 43, as well as midline discrepancy correction and improving the smile aesthetics. It was important to counter the risk of uncontrolled dental expansion, especially since the patient requested treatment with aligners.

### Treatment Alternatives

Among the treatment alternatives, the possibility of waiting for adulthood and performing surgical expansion was considered. However, this treatment option was refused by the patient, as she preferred an immediate, less invasive therapy. With this in mind, several treatment options were considered a view to achieving the above objectives. Given the severity of the malocclusion, attempting to perform (dental) expansion of the upper arch exclusively via aligners would have increased the risk of periodontal damage and likely resulted in non-optimal intercuspation due to the positive torque on the upper molars [13]. In fact, correction of the crossbite necessarily entailed skeletal expansion of the upper jaw. Given the age of the patient, who had been menstruating for about 2 years, skeletal anchorage was preferred to a traditional approach in order to minimize the dental compensation it could have made. The combination of skeletal anchorage and aligner treatment was supposed to provide a good final occlusion [14,15], facilitating transverse correction while controlling molar torque. To this end, it was decided to construct a hybrid skeletal anchorage device featuring two screws and bands on the first upper molars. This alternative to an exclusively skeletal anchorage device on four screws was guided by the patient's age and the degree of

maturation of the suture [14]. After skeletal expansion, to facilitate upper incisor tip control and to make the correction of tooth 43 after extraction of the supernumerary incisor more predictable, lingual brackets and sectional archwires were to be fitted on teeth 12-11-21 and 44-43-42.

### Treatment Progress

First, an initial CBCT scan was performed (figure 4 a), followed by the intraoral scans (I-tero Element 2) required for virtual planning of the miniscrew positions (figure 4b). The supernumerary incisor in the lower arch was immediately extracted. Using the one-step protocol, two miniscrews were inserted with a surgical template (HDC Konic 2 × 12 mm), and in the same session, the hybrid expander was anchored to the two miniscrews and two bands, cemented onto teeth 16 and 26 (figure 4c). Skeletal expansion was performed for a total of 40 activations, at a rate of 1 activation/day.

Three months after completion of the skeletal expansion, the bands on teeth 16 and 26 were removed, with the expander remaining anchored to the palatal miniscrews. At this point, intraoral scans were taken for setup planning and subsequent orthodontic treatment. STb lingual brackets were positioned on teeth 12-11-21 and 44-43-42 of the malocclusion models, which were then scanned for setup to be performed. The F22 aligners (Sweden & Martina, Due Carrare, Padua, Italy) were printed taking into account the space that the archwire orthodontic would occupy in the inter-bracket spaces. In a single session, using a silicone transfer jig, the lingual brackets were bonded, then a 0.013 nickel-titanium (NiTi) archwire was inserted (figure 5), and the aligners were fitted; thanks to the digitizing process, the aligners completely enveloped the brackets, making the treatment more comfortable and more predictable.



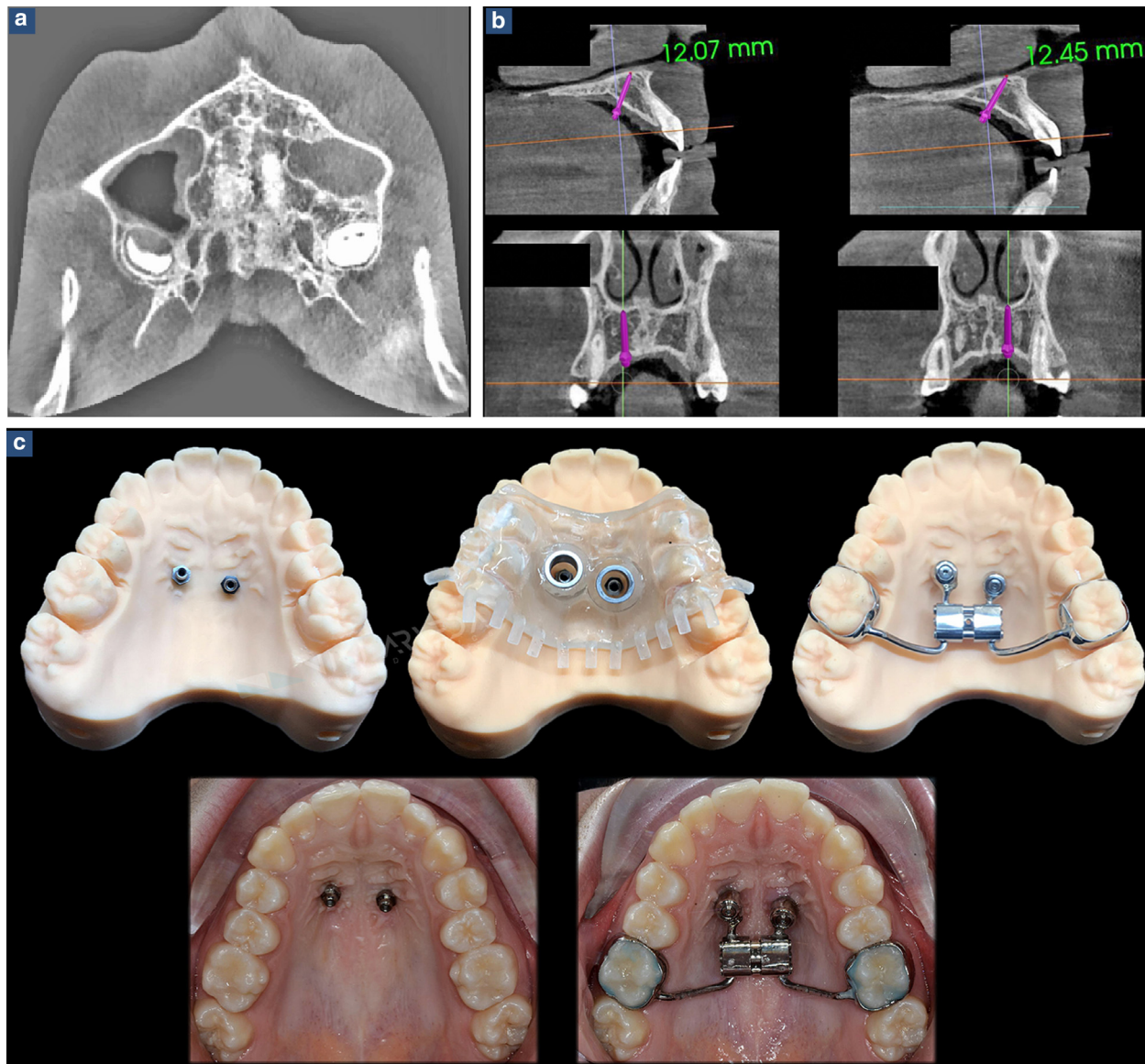


FIGURE 4

**Pre-treatment 3D radiographs. a: midpalatal suture morphology: stage C; b: selection of miniscrew insertion sites and their respective lengths; c: three-dimensional design and manufacturing of miniscrew-assisted palatal appliance surgical guide. Occlusal view of miniscrew and the bone-borne orthodontic appliance positioning**

A series of 25 aligners was planned, and the patient was instructed to wear them 22 h/day and replace them every 7 days. Scheduled stripping was performed accurately at each appointment. After about 2 months, the sectional orthodontic appliances were fitted with 0.016 nickel-titanium (NiTi)

archwires. Once the 25-aligner series had been completed, after about 6 months of orthodontic treatment, the brackets were removed and the scan repeated for creation of the finishing setup; this involved an additional series of five aligners, fitted with full-time class II elastics (3/16-inch, force 6 OZ). The

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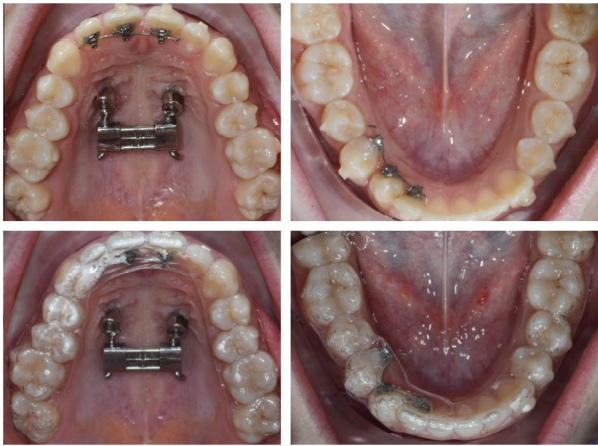


FIGURE 5  
Application of partial lingual fixed appliance and fitting of 0.013 inch Nickel-Titanium (NiTi) sectional wire

expander and orthodontic miniscrews were removed after about 10 months, just before the final orthodontic finishing phase.

At the end of the treatment, two PET-G Essix appliances were delivered for retention purposes, and the patient was instructed to wear them every night.

### Treatment Results

Thanks to the hybrid approach described above, the treatment was completed in just one year (figure 6). The miniscrew-supported skeletal expander corrected the severe transverse discrepancy and crossbite, limiting dental compensation, and making the malocclusion much easier to resolve using aligners. In the lower arch, extraction of the supernumerary incisor enabled a physiological improvement of the position of tooth 43. Finally, the lingual brackets and sectional archwire allowed good correction of the tip on teeth 11 and 21 and the position of tooth 43.



FIGURE 6  
Post-treatment extraoral and intraoral photographs



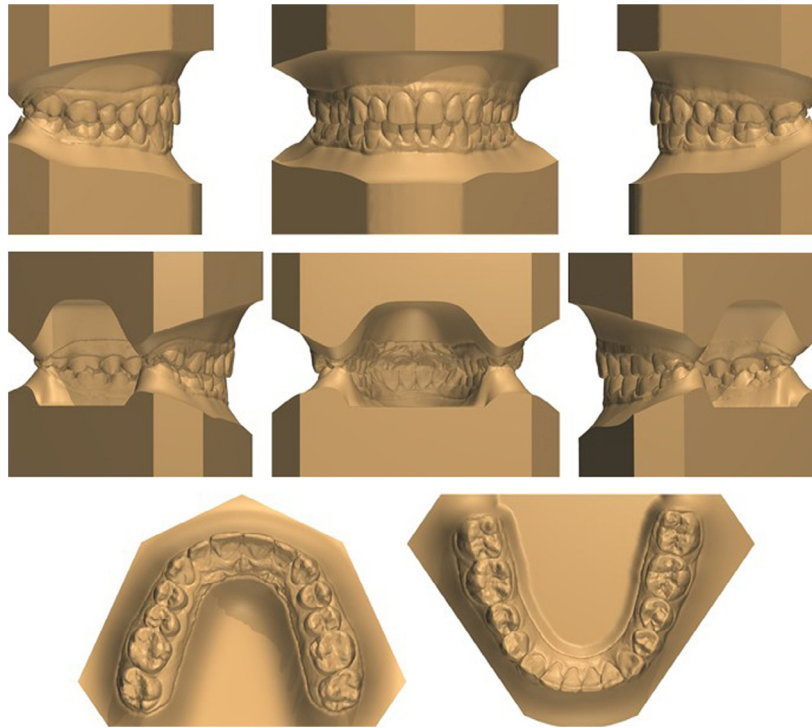


FIGURE 7  
Post-treatment digital models

Extraorally, facial symmetry had improved due to mandibular repositing. The resulting smile was pleasant and black corridors were absent. Upon smiling, the incisor exposure remained good, and the smile was in harmony with the face. Unfortunately, the upper lip remained very thin, and an excessive amount of gum was appreciable during smile, particularly at the lateral incisors and canines. On a lateral view, the profile

appears improved thank to the residual growth and improved light contacts.

The intraoral view shows good intercuspation, with bilateral class I molar and canine relationships (figure 6).

The midlines are centered with the facial midline, and the front sector shows good light contacts, even though the overbite could use slight improvement. The alignment appeared good,

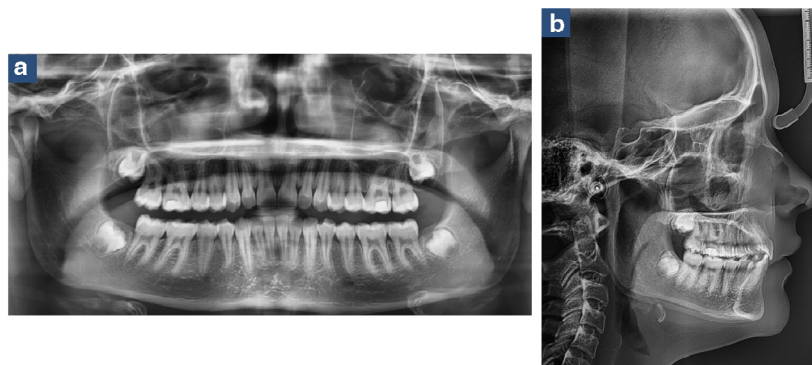


FIGURE 8  
Post-treatment 2D radiographs. a: panoramic X-ray; b: lateral X-ray

TABLE I  
Pre- and post-treatment cephalometric values.

	Pre-treatment value	Post- treatment value	Ref. Value	Standard deviation
SNA (°)	83.2	83.2	82.0	3.5
SNB (°)	81.7	81.9	80.0	3.0
ANB (°)	1.5	1.2	2.0	2.0
WITS appraisal (mm)	1.9	1.6	0.0	1.0
FMA (°)	8.8	8.5	26.0	5.0
MP-SN (°)	19.7	19.2	33.0	6.0
Palatal-Mand-Angle (°)	13.2	13.0	28.0	6.0
PP-OP (°)	1.3	2.5	10.0	4.0
Mand plane to Occ Plane (°)	11.9	13.1	18.0	5.0
U1-APo (mm)	5.4	3.8	6.0	2.2
L1-APo (mm)	3.0	1.3	2.0	2.3
U1-Palatal plane (°)	116	112.2	110.0	5.0
IMPA (°)	105.5	103.1	95.0	7.0
Overjet	1.0	1.0	3.5	2.5
Overbite	2.0	2.0	2.5	2.0

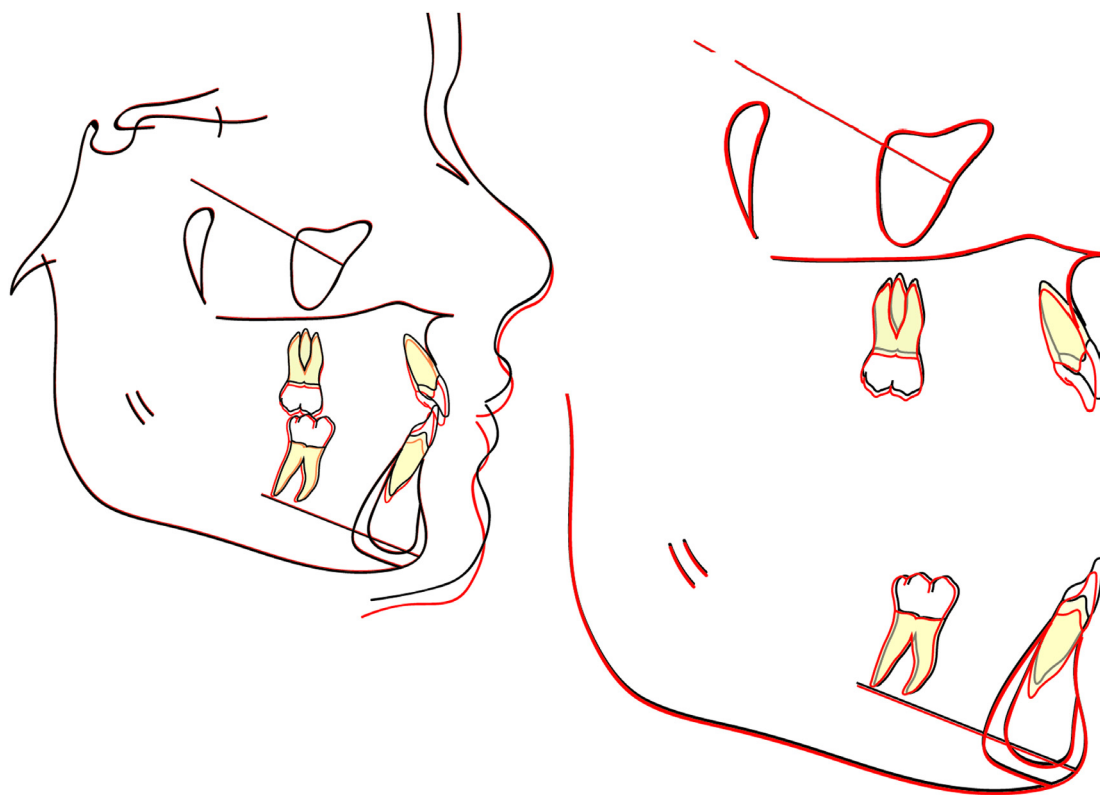


FIGURE 9  
Cephalometric structural superimpositions (black, pre-treatment; red, post-treatment)





FIGURE 10  
Intraoral photos at 2 years

as did the coordination of the arches and the torque on the rear sectors (figure 7).

Panoramic radiograph showed acceptable root parallelism, although a slightly greater distal root tip could have been achieved on tooth 44, 43, 42 and 15 (figure 8).

Post-treatment cephalometric analysis (table 1), revealed good control of the upper incisors with a slight reduction in inclination (U1-Palatal Plane from  $116^\circ$  to  $112^\circ$ ) and an improvement in the final position of the lower incisors (IMPA from  $105.5^\circ$  to  $103^\circ$ ), (figure 9).

Records taken at two years (figure 10) show unaltered occlusion and proper case stability thanks to the upper and lower removable retainers (PET-G Essix).

## Discussion

In recent years, the use of digital technology in orthodontics has become increasingly widespread, on the one hand allowing the programming of treatments using aligners, on the other hand permitting the design of skeletal anchorage devices customized to the patient.

In this case report, skeletal anchorage made treatment more predictable, eliminating several of the undesirable effects of dental anchorage, in particular the collateral periodontal effects associated with tooth-borne expansion devices [16-18]. At the same time, the use of the palatal vault as a site for miniscrew placement in cases of transverse maxillary deficit is considered safe and reliable [13].

A surgical guide (MAPA) was used to safely guide the insertion of two self-drilling miniscrews, ensuring both bicortical anchorage and good angulation enabling them to counteract strong orthopaedic forces [19]. The miniscrews were inserted and

appliances were fitted in a single sitting, as immediate loading seems to be advantageous for both treatment efficiency and miniscrew stability [20].

Despite some reports of complications after the use of a bone-borne rapid maxillary expander (i.e., facial asymmetry, orbital microfracture, eye impairment, etc.) [21,22], the risk of these undesired phenomena was reduced by planning a dedicated screw activation protocol (1 turn/day). In addition, the patient was young, and those complications are usually related to greater skeletal maturity and increased bone density [23].

This approach provided resolution of the left crossbite and opened the median suture, as evidenced by the formation of a clinically evident interincisal diastema, testament to a skeletal response to the orthopaedic forces exerted.

The second phase of treatment was performed with aligners, owing to fact that the patient requested an aesthetically pleasing and comfortable alternative to conventional fixed orthodontics. However, considering the aligners' biomechanical limitations [2-11], a hybrid approach with partial fixed lingual appliances was required for the management of the interincisal diastema and the correction of the lower right canine position, following extraction of the supernumerary tooth [14,15,24-26]. In fact, as several studies have amply demonstrated, rotation movements, especially of rounded teeth like canines and premolars, are notoriously difficult to achieve with aligners; in particular, rotation of lower canines is an extremely unpredictable movement [2-11]. Considering these limits, such a strategy (lingual brackets on teeth 12-11-21 and 44-43-42) achieved both rapid correction of rotation and correction of root tip of the upper central incisors, as the expected spontaneous closure of the diastema during the expansion phase led to coronomesial

migration of the anterior teeth [14]. Using aligners alone would have necessarily resulted in a substantial increase in treatment time, with a high probability of having to resort to a mid-course correction [6].

The class II correction was then completed thanks to the constant force of the class II elastics (6 oz), which were applied from the first finishing aligner and completed with the last aligner. To prevent unwanted extrusion and/or rotation and to further enhance aesthetics, we created notches in the aligners at the upper canines and lower first molars to attach the intermaxillary elastics, rather than buttons bonded directly onto the teeth [27]. Careful planning of the stripping not only helped improve the molar and canine class, but also preserved the inclination of the lower incisors, obviating the risk of further proclination due to the use of class II elastics; the lower incisor tip changed from 105.5° to 103° with respect to the mandibular plane. Class II correction was also mainly obtained thanks to the mandibular repositioning.

Such an approach combines the advantages of both fixed lingual appliances (i.e., aesthetics and biomechanical efficiency) [28] and aligners (i.e., aesthetics, reduced risk of emergencies,

increased comfort and unobstructed oral hygiene procedures) [29–31], thereby reducing treatment times and ensuring an aesthetic and comfortable treatment. The case was concluded in only 1 year, without unwanted movements or side effects such as resorption or gum inflammation, and with good root parallelism.

Check-up at year two demonstrated the excellent stability of results.

## Conclusions

The successful resolution of this clinical case shows the double advantage of the hybrid approach: on the one hand, by meeting the demand for an aesthetic treatment even in the management of complex cases, and on the other hand, by enabling treatment planning with great predictability, capable of achieving a pleasant facial aesthetic and good root parallelism in only 12 months of treatment.

**Disclosure of interest:** The authors declare that they have no competing interest.

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