

# Non-surgical adult class II high-angle treatment with an invisible appliance: A case report

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## Summary

This case report describes the complex situation of a young adult Class II hyperdivergent patient treated by premolar extraction with a straight wire lingual appliance. Despite the patient's refusal to undergo surgical treatment, the dual goals of ideal occlusal relationship and profile improvement were achieved through a well thought-out biomechanical strategy with appropriate extraction choice and anchorage control during space closure. This case report demonstrates the possibility of successfully resolving severe sagittal and vertical discrepancies in an adult patient without surgical treatment using a completely invisible technique. This report also highlights the need for careful planning during the diagnostic and treatment phases.

## Introduction

Treatment option for Class II malocclusion correction without surgery usually includes premolar extractions in order to compensate the sagittal discrepancy [1,2]. Nevertheless, this therapeutic choice represents one of the most challenging treatment strategies. This is even more true when the lingual appliance is used: on the one hand the control of the tip and torque is often critical [3], on the other hand the correction of class II by mandibular molar mesialization is difficult since the anchorage value of the mandibular molars in lingual orthodontics is particularly strong, making the biomechanics challenging [4]. It

should also be taken into account that there is an increasing demand for aesthetic treatment today, both in adults and adolescents [5,6]; the lingual appliance is the best choice, as aligners have limitations in performing bodily movements [7]. An appropriate extraction strategy and correct anchorage management, facilitated by the use of mini screws [8], are of primary importance for successful treatment.

## Diagnosis and aetiology

The patient presented at 20 years of age with a request to have her teeth aligned by means of an aesthetic appliance.



FIGURE 1  
Initial extraoral and intraoral photographs

The face, from a frontal view, evidenced an increased lower third; a significant mandibular symphysis deviation towards the right side was highlighted, combined with a different height of the mandibular angles.

From a lateral view the profile appeared convex, with a balanced nose, a 90° nose-labial angle, upper and lower lip protrusion with mentalis muscle strain and a retruded mandibular position.

On the frontal intraoral views, the midlines did not coincide (deviation of the lower midline to the left), a crossbite affected 34 and negative torque of the lateral and posterior sectors in both the upper and lower arches was noticeable; anterior deep bite and accentuated upper and lower curves of Spee were also present.

Lateral views showed bilateral Class II canines and molars, while occlusal views showed crowding in the upper and lower anterior areas with 11, 34 in buccal position and 22 and 42 in lingual position. The upper arch was very narrow and the lower arch asymmetric, while the upper and lower Wilson's curves were accentuated. The periodontal biotype was thin (*figure 1*).

The orthopantomography revealed the presence of all elements except 48. The latero-lateral telerradiography confirmed a skeletal class II (ANB = 7°) with a retruded mandible (SNB = 75°). The skeletal pattern was severely hyperdivergent (SN/MP = 40°), with a clockwise occlusal plane. The upper incisors were normo-inclined (110°) while the lower ones were slightly proclined (98°). (*figure 2*).

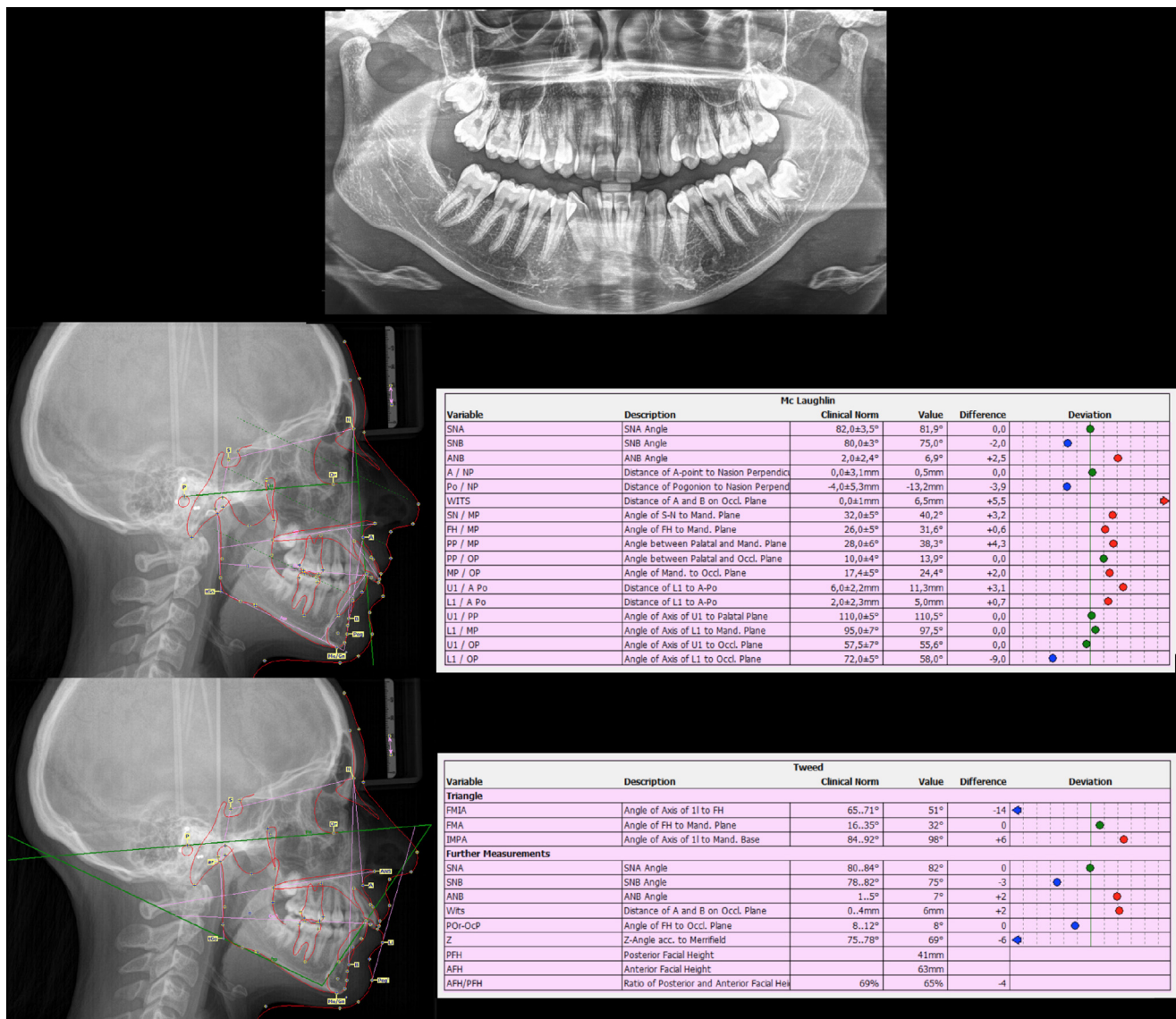


FIGURE 2  
Initial radiographs: orthopantomography, latero-lateral teleradiography with McLaughlin and Tweed cephalometric analysis

## Treatment objectives

The primary objectives were profile improvement, dental class II correction, vertical control. Additional goals were crowding correction, reduction of black buccal corridors during smile, ideal overjet and overbite achievement and periodontal improvement.

## Treatment alternatives

The ideal orthodontic-surgical treatment which would have allowed mandibular advancement and antero-rotation of the

maxilla-mandibular complex was illustrated to the patient without success.

Considering the profile features of the patient (convex profile, upper and lower lip protrusion, lower lip eversion), an extraction treatment was chosen. This choice was also motivated by the reduced Merrifield Z-angle (69°). [9]. The four first premolars could have been chosen in order to obtain easier anterior tooth retraction, considering also the cross-bite position of 34 that resulted also periodontally not ideal, with a very thin band of tissue and absence of keratinized gingiva. As a consequence of the severe class II, considering the mesial-inclination of 35 (with the root severely distally-inclined), lower second premolar



extraction was chosen in combination with upper first premolars. After 34-root relocation in the proper position, the periodontal situation could have been normalized with an adequate muco-gingival complex.

## Treatment progress

The orthodontic treatment was performed by lingual technique; that choice was determined by the patient's request for a completely invisible appliance; in addition, the lingual biomechanics is favourable to obtain a better control of the inclination of the lower incisors, due to their easier lingual repositioning during the closure of the premolar extraction spaces and less

proclination during levelling (due to the intrusion force passing closer to the lower incisors' centre of resistance) [4].

The orthodontic treatment was performed by lingual "Straight-wire" technique [10,11] with Ormco STb™ brackets, by means of a manual set-up. Extraction case tip and torque hypercorrections were included in the set-up prescriptions (figure 3):

- extra anterior labial crown torque to their maxillary incisors (+5° beyond the desired outcome);
- positive extra torque (+2°) on maxillary and mandibular canines in order to avoid cortical bone impaction;
- distal root tipping for maxillary canines (6°) and mesial root tipping for maxillary second premolars (6°) to facilitate the distal bodily movement during space closure;
- first and second molars backward tipping (2°) to increase posterior anchorage, to prevent vertical bowing effect during space closure mechanics and to achieve root parallelism;
- 2° distal root tip on maxillary central incisors and 3° distal root tip on maxillary lateral incisors to achieve root parallelism;
- in addition, 34 lingual root torque was increased (figure 3).

The brackets' bonding was carried out by "single jigs", following the "Komori system" technique, after the arch assembling was performed with "Kommon base" philosophy [12,13].

Upper and lower arch bonding was first performed (figure 4a). On 33 and 43, buttons were bonded due to lack of space for STb™ brackets. Occlusal build-ups were inserted on 16, 17, 26 and 27 in order to achieve vertical control through molar intrusion and to avoid excessive anterior precontact between lower incisors and upper brackets. Two weeks later, after 14, 24, 35, 45 extractions, 0.013 CuNiTi LSW Ormco STb™ Medium was



FIGURE 3  
Manual set-up

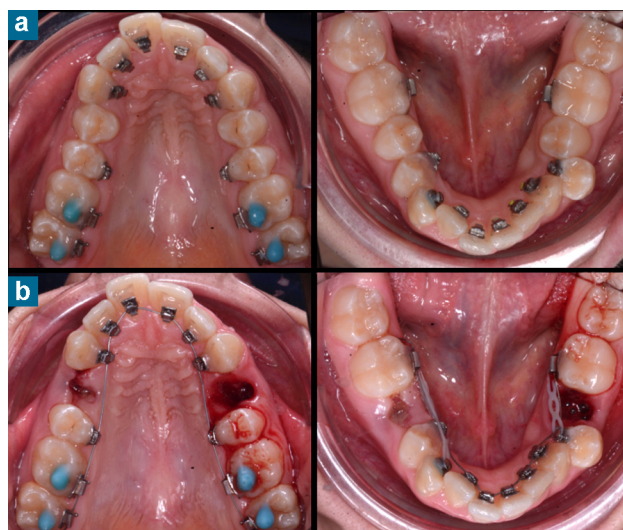


FIGURE 4  
a: Upper and lower bonding; b: Extractions of 14-24-35-45. Insertion of 0.013 CuNiTi on upper and lower arch



FIGURE 5

**a: Insertion of 0.018\*0.018 CuNiTi on upper and lower arches; b: Insertion of 0.019\*0.025 NiTi sectionals on 36-37, 46-47**

inserted on upper arch, 0.013 CuNiTi LSW Ormco STb™ Small on lower arch. 34-36 closed elastic chain was added in order to start 34 repositioning, 43-46 closed elastic chain in order to help 43 rotation (*figure 4b*).

After a period of two months a 0.018\*0.018 CuNiTi LSW Ormco STb™ Medium was inserted on the upper arch in order to start levelling and torque setting. A 13-23 open elastic chain was added in order to avoid spaces opening. Buttons on 34, 43 were removed and 34, 43 STb™ bracket bonding was performed (*figure 5a*).

One month later a 0.018\*0.018 CuNiTi LSW Ormco STb™ Small was inserted in the lower arch for levelling and torque setting. Buccal tubes on 36, 37, 46 and 47 were bonded in order to control second molar alignment and levelling. Tubes on lingual

side had not been bonded on these elements at treatment start as a consequence of their reduced clinical crown height. 0.019\*0.025 NiTi buccal sectional wires were inserted on both sides (*figure 5b*).

Four months after treatment start, inter-radicular miniscrews were inserted for upper anterior tooth retraction (*figure 6a*). A 0.017\*0.025 SS posted Ormco STb™ was inserted in the upper arch with the addition of 12-22 root-palatal torque and a super Spee compensation curve. Occlusal build-ups on 17 and 27 were slightly increased in order to obtain vertical space for upper incisor retraction.

The insertion of the mini-screws was intended to reinforce the anchorage during the correction of Class II canine and molar, in



FIGURE 6

**Treatment progress views. a: Insertion of interradicular miniscrews; b: Insertion of 0.017\*0.025 SS on upper arch; of 0.018\*0.018 SS on lower arch; c: 0.014 Kobayashi on 13 and 23 for class II elastics**



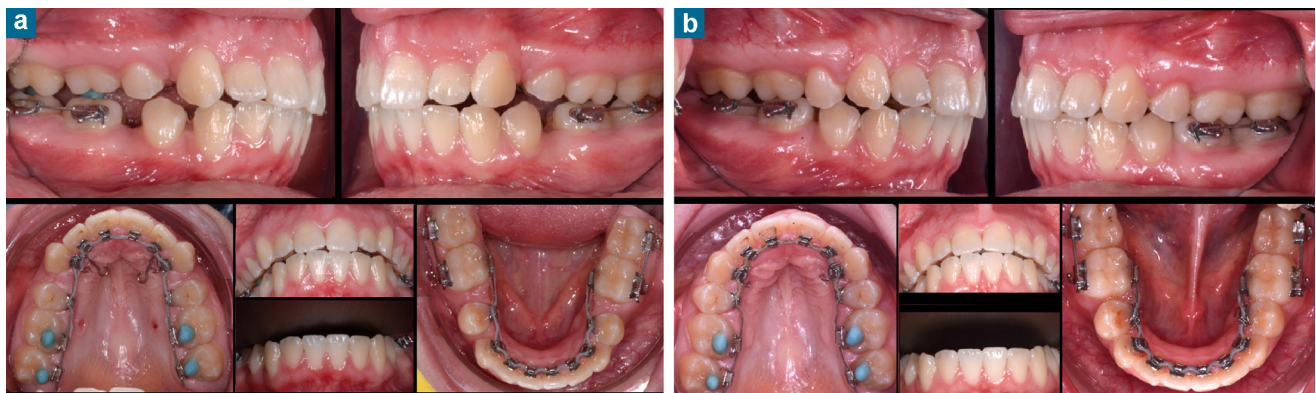


FIGURE 7

**Treatment progress views. a: Removal of interradicular miniscrews; b: Insertion of 0.0175\*0.0175 TMA on upper and lower arches for finishing bends**

combination with the intrusion of the posterior teeth to maintain the vertical dimension. One month later, a 0.018\*0.018 SS with anti-Spee and transverse anti-curvature lower compensation curves was inserted into the lower arch to continue space closure and levelling. (figure 6b). Six months after treatment start, 0.014 Kobayashi on 13 and 23 were added in order to prescribe full-time 3/16" 6 oz Impala Ormco class II elastics (figure 6c).

For the following months, the treatment continued with upper elastic chain reactivation for space closure and full-time class II elastics.

After 14 months of treatment, the upper miniscrews were removed and a 16-26 open elastic chain and a 36-46 closed elastic chain were inserted in order to continue upper and lower space closures (figure 7a). The removal of the miniscrews was performed 10 months after their insertion, once a bilateral class I canine and molar had been obtained. For the next five months, closure of the upper space was continued by open elastic chain from 16 to 26. Nineteen months after treatment start, a 0.0175\*0.0175 TMA LSW Ormco STb™ Medium was inserted on upper arch for finishing bends: 21 step-out and step-up, 13-15 step-out, 23-25 step-out. 16-26, 36-46 closed elastic chains were inserted to complete space closure. At the 21st month of treatment, a 0.0175\*0.0175 TMA LSW Ormco STb™ Small was inserted on the lower arch (figure 7b).

Finishing bends were performed: 42 rotation bend, 32 and 41 mesial step-in. 3/16" 6 oz Impala Ormco™ class II elastics were prescribed full-time on the right side, for night-time on the left side.

## Treatment results

After 30 months of treatment, upper and lower arch debonding was performed. Upper and lower essix were delivered and final treatment radiographies were prescribed.

The frontal and lateral extraoral photographs show the facial balance obtained with less muscular strain, a correct smile arc and a well-balanced profile. A good Class I canine and molar was achieved on both sides, with resolution of the crowding, levelling of the Spee curve and correction of the deep bite. Maximum intercuspation contact points were ideal at this stage (figure 8). The final panoramic radiograph did not show any significant signs of bone or root resorption. Root parallelism, even in the area of the extracted premolars, was correct. Lateral-lateral telerradiography revealed improved facial and dental relationships. The torque of the upper incisors was slightly reduced (99°) and the inclination of the lower incisors showed an increase (98° to 106°). Ricketts' E-line [14] and Merrifield's Z-line [9] were consistent and confirmed the correct extraction decision. General and local structural superimpositions according to the method of Arne Björk [15,16] showed that the correction was mainly dento-alveolar. Upper molars were slightly mesialized and intruded while lower molars were significantly mesialized and slightly extruded. At the level of the incisors, the superimposition confirmed that good light contact. No increase in the lower face height was encountered and lip competence was improved (figure 9).

Two months later, upper 12-22 and lower 33-43 fixed lingual retainer were directly bonded. At this point, new upper and lower essix were delivered. The control photographs performed one year later, show the stability of the treatment (figure 10).



FIGURE 8  
Final extraoral and intraoral photographs



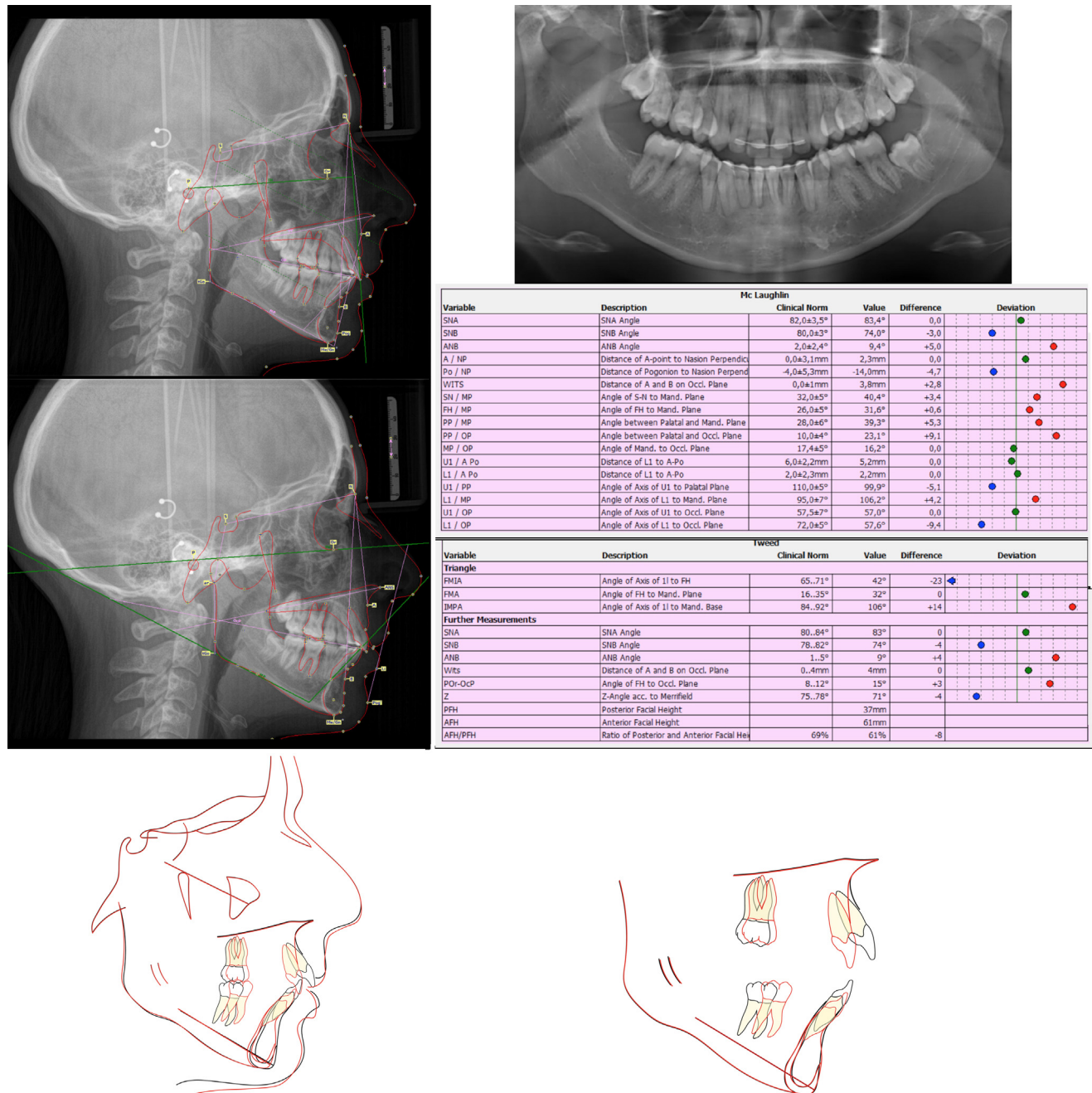


FIGURE 9  
Final radiographs, McLaughlin/Tweed cephalometric analysis, structural general and local superimpositions



FIGURE 10  
Extra-oral and intra-oral follow-up photographs one year after treatment

## Discussion

In the present case report, a full cusp Class II malocclusion in a high-angle adult patient was corrected with a lingual straight wire appliance by premolar extraction compensation.

Despite the fact that the case would have benefited from orthognathic surgery for profile improvement, the patient declined this option and the best camouflage treatment was chosen.

Treatment options to correct Class II malocclusions without orthognathic surgery usually include selective extraction of permanent teeth, with subsequent tooth compensation to mask the skeletal discrepancy. The choice of the premolars to extract is based on many factors such as: anchorage needs [17,18], periodontal and dental condition (teeth with poor prognosis) [19–21], Bolton Index [22].

In lingual orthodontics, anchorage value of mandibular molars is particularly strong. When mandibular premolars are extracted, it is difficult to obtain a mandibular molars mesialization [4].

Orthodontic force vectors imposed on the anterior teeth through the lingual orthodontic appliance are directed not exactly toward the resistance centre of the teeth, but are deviated lingually so as to produce lingual crown torque in the anterior teeth. As a result, an upright force is imposed distally on the posterior teeth through the archwire and there is more resistance to anchorage loss in the posterior teeth [4].

In the lingual technique, in Class II cases with slight crowding, if premolar extractions are planned, closing the extraction spaces may result in major retraction of the mandibular anterior teeth with considerable risk of overjet remaining after treatment [4]. This was particularly important to prevent in this case as it would have been difficult to achieve a Class I canine-molar relationship at the end of the treatment with a nice profile. Although extraction of the lower first premolars seemed indicated due to the cross-bite occlusion of the 34 and its periodontal fragility with the absence of keratinised gingiva, the lower second premolars were in fact extracted in combination with the upper first premolars. The mesial inclination of 35 (with a large root surface) would have strengthened the anchorage, make it difficult to correct the class II by mesialization. For this reason, the extraction of lower first premolars was not considered advisable. Furthermore, the insertion of interradicular skeletal anchorage in the lower arch would have been complicated by the presence of frenums and by the irregular anatomy in the area of 34 [23]. The patient's cooperation with the intermaxillary elastics was excellent and allowed the closure of the lower arch space. Ideal root parallelism was achieved without the need for additional finishing bends.

The use of a skeletal anchorage in the upper arch enabled the correction of sagittal divergence by retraction of the anterior teeth, as well as vertical control by intrusive effect of the posterior teeth [24–26].

34 at the start of treatment was ectopic with a very thin band of tissue and an absence of keratinised gingiva. Its periodontal situation improved with a correct mucogingival complex due to its displacement to a better bone support [27,28].

## Conclusions

The successful resolution of this clinical case shows the double advantage of the lingual appliance: on the one hand, the

effectiveness in resolving severe sagittal and vertical discrepancies in adult high angle class II patients with camouflage; on the other hand, the possibility of satisfying the needs of a complete aesthetic treatment even in the management of complex cases.

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

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