

Case Report

# Management of Class III Extraction with the Miniscrew-Supported Orthodontic Pseudo-Ankylosis (MSOPA) Using Direct Tads

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**Abstract:** The aim of the present study is to represent the orthodontic treatment of a young patient with a skeletal Class III malocclusion (Wits Appraisal  $-9$  mm), in which the extractions of the first lower premolars were performed to obtain a class III camouflage using direct temporary anchorage devices (TADs). The patient reported a history of three years of orthodontic treatment at another clinic and the radiographic evaluation revealed an important impairment of the upper root incisors. A treatment was performed with a fixed appliance in the upper and lower arches using an archwire sequence of 0.16 CuNiTi,  $19 \times 25$  CuNiTi,  $19 \times 25$  SS and was carried out in 18 months. Post-treatment records of our patient show a control of facial esthetics from the frontal and lateral perspectives, with a harmonious soft-tissue profile. A Class I canine was achieved and her overbite and overjet were normalized by retracting the mandibular anterior teeth and carrying out a bodily mesialization of the posterior sector into the extraction space. In conclusion, the "pseudoankylosis system" used in this case allowed the desired result to be achieved with minimal change to the lower incisal inclination and without overloading the anterior upper and lower sectors, thus reducing the risk of further root resorption and patient compliance.

**Keywords:** skeletal anchorage; class III malocclusion; extraction treatment



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## 1. Introduction

Skeletal Class III is considered to be among the most challenging conditions in adult patients to treat. According to the literature, it can be treated either by orthodontic camouflage or orthognathic surgery, depending on the patient's characteristics: degree of skeletal discrepancy, skeletal pattern, M/M ratio, lower inclination and age [1,2].

The orthodontic camouflage treatment usually involves the retroclination of the mandibular incisors and the proclination of the maxillary incisors to achieve a positive overjet and correct the canine relationship [3].

Many strategies include the multiloop edgewise archwire (MEAW) technique, lower posterior distalization, non-extraction, or the extraction of a lower single incisor, premolars, or the first, second or third molars [4].

To avoid unwanted tooth movement of the anchorage unit during extraction, an absolute anchorage can be obtained by means of ankylosed teeth or dental implants, both of which rely on bone to inhibit movement. Anchorage protocols have been developed to avoid the undesirable effects of dental anchorage, including dental implants, surgical mini-plates and ankylosed teeth [5–8].

Despite the large spread of orthodontic miniscrews, their success rate can still be improved. According to the literature, the efficacy of sectional appliances in conjunction with TADs in managing complex post-extraction space closure has been demonstrated [9,10]. The clinical outcomes are influenced by many factors such as the miniscrew's characteristics, surgical technique, clinician experience, bone quantity and quality, primary stability, oral hygiene and biomechanics [11,12].

There are two principal methods of connecting miniscrews to the patient's dentition: one is the direct loading of the miniscrew, the "direct anchorage" approach, in which an elastic module is linked from the miniscrew to the tooth, or group of teeth, that are supposed to be moved; the other results from the indirect loading of the miniscrew to prevent tooth movement in the "anchorage segment." There is an extraordinary advantage to the rigid indirect setup when choosing the insertion site [13,14].

The miniscrew-supported orthodontic pseudo-ankylosis (MSOPA) is a procedure proposed in the literature in which orthodontic miniscrews link to a neighboring tooth with a rectangular stainless steel sectional wire for indirect anchoring. The connection between the teeth and the temporary anchorage device (TAD) locks the anchor unit in the pretreatment position thus providing the desired movements [15,16].

This article shows the orthodontic treatment of a young patient diagnosed as developing skeletal Class III in which the first lower premolar extractions were performed to obtain a class III camouflage.

The MSOPA technique has been shown to close extraction spaces by bodily mesialization of the posterior sector without the over-retraction of the lower incisors and with a significant reduction in compliance.

## 2. Case Report

A 21-year-old female attended our dental clinic and presented with good general health and no systemic or congenital disease. Her face, from a frontal view, appeared well-proportioned in the three thirds with an acceptable facial symmetry. From a lateral view, the profile appeared flat with a slightly close nose–labial angle, normal labiomental sulcus, lip competence and a protruding mandibular position. In spite of severe skeletal class III, she presented a good profile due to good soft tissue and the presence of a mandibular counterclockwise rotation, which masked her skeletal pattern. Panoramic, cephalic lateral X-rays and dental cast records were taken. The cephalometric analysis showed a skeletal Class III relationship (Wits Appraisal  $-9$  mm), maxillary retrognathism ( $SNA = 74^\circ$ ), skeletal openbite ( $ANS-PNS\hat{G}oGn = 30.6^\circ$ ), counterclockwise mandibular rotation ( $SN\hat{G}o-Gn = 39.3^\circ$ ) and a correct inclination of upper ( $I/ANS\hat{P}NS = 112.5^\circ$ ) and lower incisors ( $i/GoGn = 88.7^\circ$ ). Intraorally, the patient had dental Class III on the right side and Class I on the left side, reduced overbite and overjet, maxillary midline shift to the right side and moderate crowding in both arches. She reported a history of three years of orthodontic treatment in another clinic, moreover the radiographic evaluation revealed an important impairment of the upper root incisors at the beginning of the treatment (Figure 1).

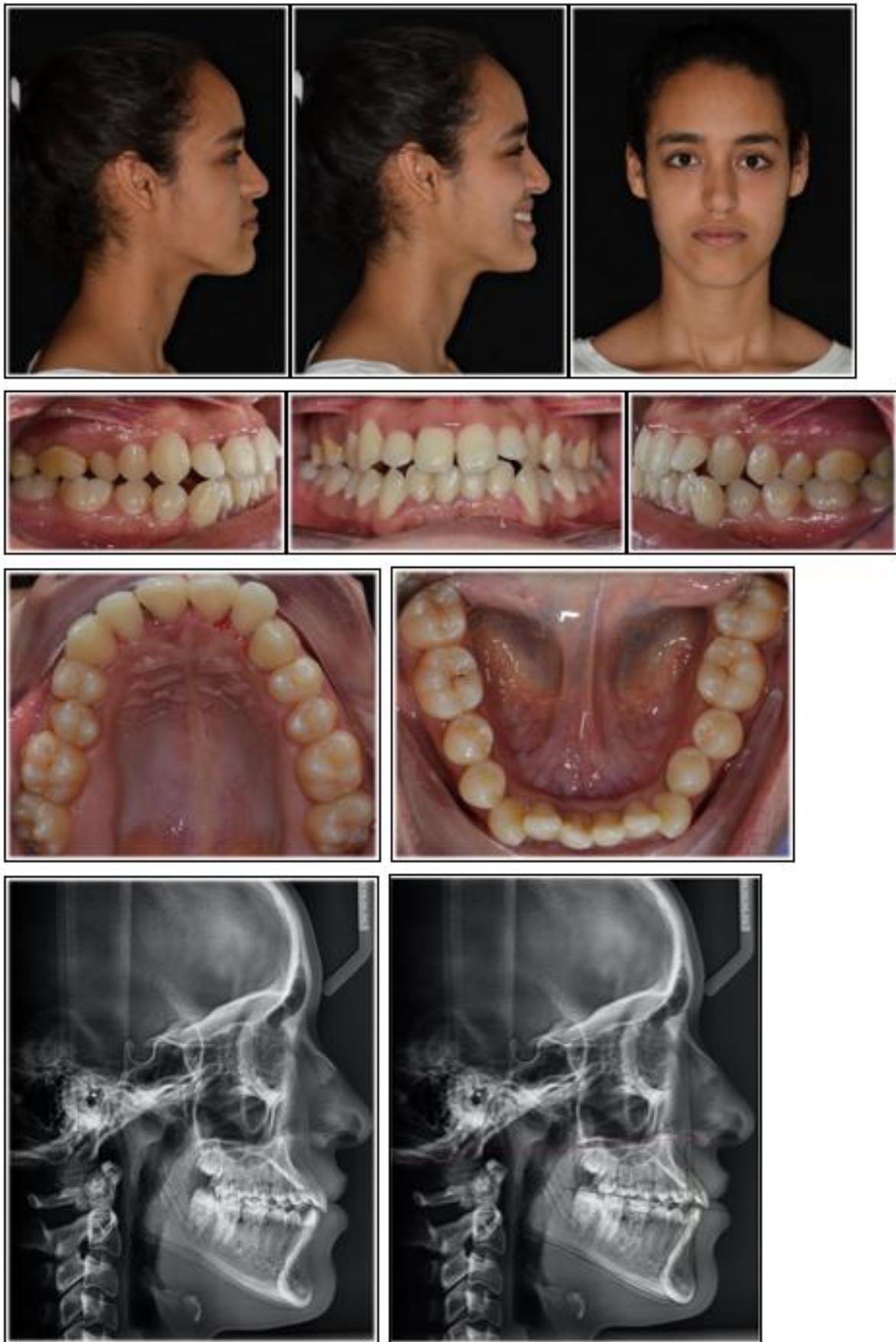


Figure 1. Cont.



**Figure 1.** A 21-year-old female with skeletal Class III, dental class III on the right side and Class I on the right side and severe crowding in the lower arch before treatment.

### 2.1. Treatment Planning

Four treatment options were considered: the first was ortho-surgery to correct the dento-skeletal discrepancies and improve the facial profile esthetics. Taking into account the patient's request to improve her smile without orthognathic surgery, the second option was to extract four premolars (i.e., 15, 25, 34, 44) to reach the molar and canine class I occlusion, which would require three-dimensional control of both the upper and lower incisors during space closure to maintain the correct inclination and torque. The third was to extract the lower third molars followed by distalization of the entire lower arch using auxiliaries such as miniscrews and class III elastics. Focusing attention on her clinical characteristics, a radiographic evaluation revealed particular impairment of the upper-incisor roots, so a treatment that did not include upper extractions would be the preferred option to avoid further root damage.

The last option, corresponding to our choice, was to extract two premolars (34, 44) for a camouflage treatment that included a final occlusion in molar Class III and canine Class I with better upper-incisor control and only minor stress to the roots.

Furthermore, the patient had already undergone three years of orthodontic treatment, so she would have had poor compliance with options that needed class III elastics during all therapy as a second choice.

### 2.2. Treatment Progress

Full-arch fixed appliances were bonded and extractions of 34 and 44 were done at the same appointment to avoid further incisor proclination and to start correcting crowding using the space created by the extractions (Figure 2). The first phase of orthodontic treatment involved leveling and aligning. During this stage, archwires of suitable stiffness are required to correct vertical and horizontal discrepancies. The following two archwires were used (0.016 CuNiTi and 0.019 × 0.025 CuNiTi) to reach the working archwire (0.019 × 0.025-inch SS). They were left in place until they were passively engaged in all bracket slots before we proceeded to the next in sequence. The positioning of a steel archwire (0.019 × 0.025 SS) allowed us to close the spaces through three-dimensional control of the teeth, thereby reducing the tipping movements and improving the bodily displacement of the tooth. Furthermore, through a rectangular steel archwire it was possible to control the torque of the lower incisors during the closing-space phase without creating excessive retraction of the lower-incisor sector.

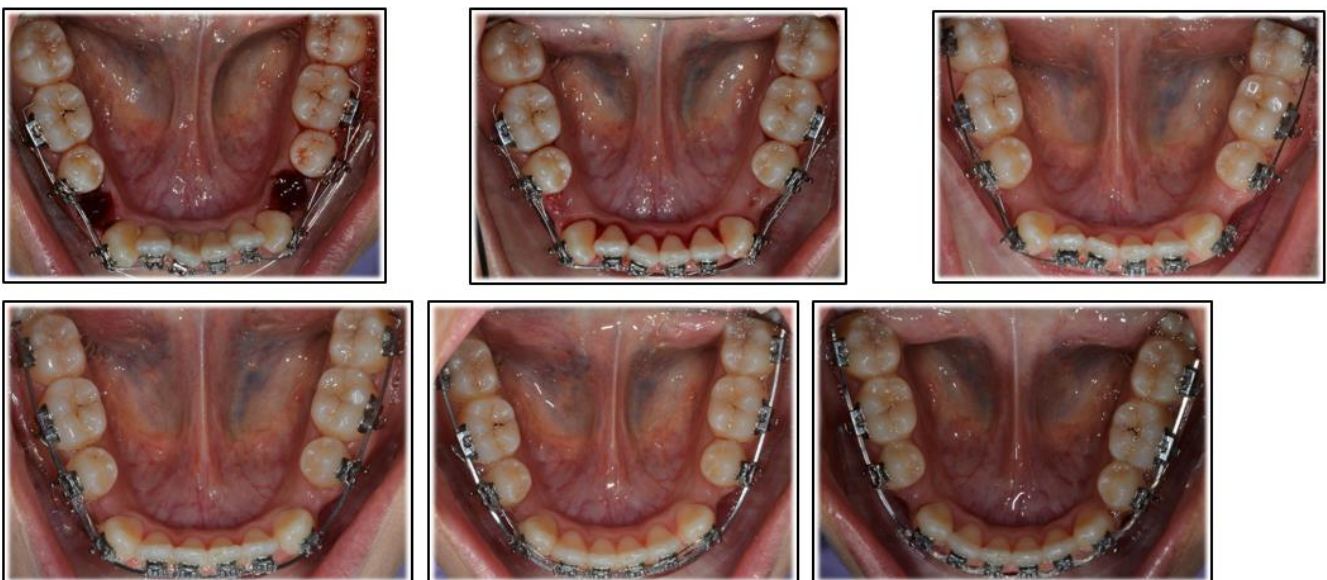


**Figure 2.** Extractions of 34 and 44 and initial leveling and alignment with 0.16 CuNiTi.

The mandibular third molars were to be preserved to allow for their eruption into occlusion following the anchorage loss of the first and second mandibular molars.

Initial leveling and alignment were carried out on 0.016 CuNiTi and  $0.019 \times 0.025$  CuNiTi in the upper and lower arch, and lacebacks were activated on the right and left side to start closing spaces. In the upper arch, alignment and leveling were performed by improving the arch shape and maintaining the incisal position.

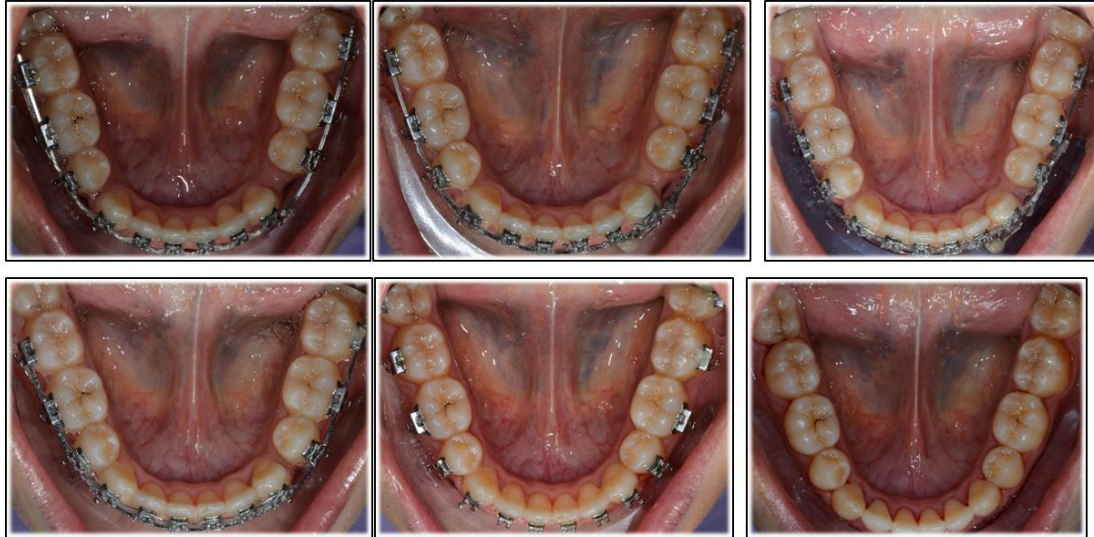
Six months later, after the alignment and leveling phases, the extraction space between the left lower canine and the left second premolar had not yet closed, and the lower-left hemi-arch was positioned distal to the contralateral side (Figure 3).



**Figure 3.** Alignment and leveling phases with 0.16 CuNiTi and  $19 \times 25$  CuNiTi.

To close the residual lower spaces using sliding mechanics and maintain a good incisor torque, a  $0.019'' \times 0.025''$  stainless steel archwire with a reverse curve of Spee was inserted.

The space obtained from the extraction of 44 was closed using a medium anchorage on the right side. On the left side, it was necessary to close the residual space by using a maximum anterior anchorage and mesialization of the entire posterior sector (Figure 4).



**Figure 4.** Intraoral treatment progress of the lower arch.

The MSOPA technique was used to close the space in the lower arch, reduce anchorage requirements and prevent excessive anterior retraction.

A  $1.5 \times 8$  mm K1 short neck titanium miniscrew (HDC Company, Sarcedo, Italy) was inserted buccally between the roots of the lower-left canine and lower-left second premolar. A  $0.019'' \times 0.025''$  stainless steel sectional wire was inserted in the TAD's cross-slotted head ( $0.022'' \times 0.025''$ ), bonded to the miniscrew and linked to lower-left canine, passively forming the "pseudoankylosis unit". A NiTi spring module of 150 g was connected from the lower-left canine to the lower-left second molar to promote the mesialization of the entire sector (Figure 5).



**Figure 5.** The "pseudoankylosis unit" created with an  $0.19'' \times 0.25''$  stainless steel sectional inserted in the TAD and linked to the lower left canine. A NiTi spring module connected from the lower canine to second molar to promote mesialization.

During the finishing stages, the patient overnight wore 6 oz class II elastics from the upper canine to the lower second molar for 24 h on the left side and 12 h on the right to improve the canine class relationship and to finalize lower-left space closure. Treatment was carried out over 18 months.

### 3. Results

The post-treatment records of our patient showed a control in facial esthetics from the frontal perspectives, with a harmonious soft-tissue profile and an improvement of the smile (Figure 6).



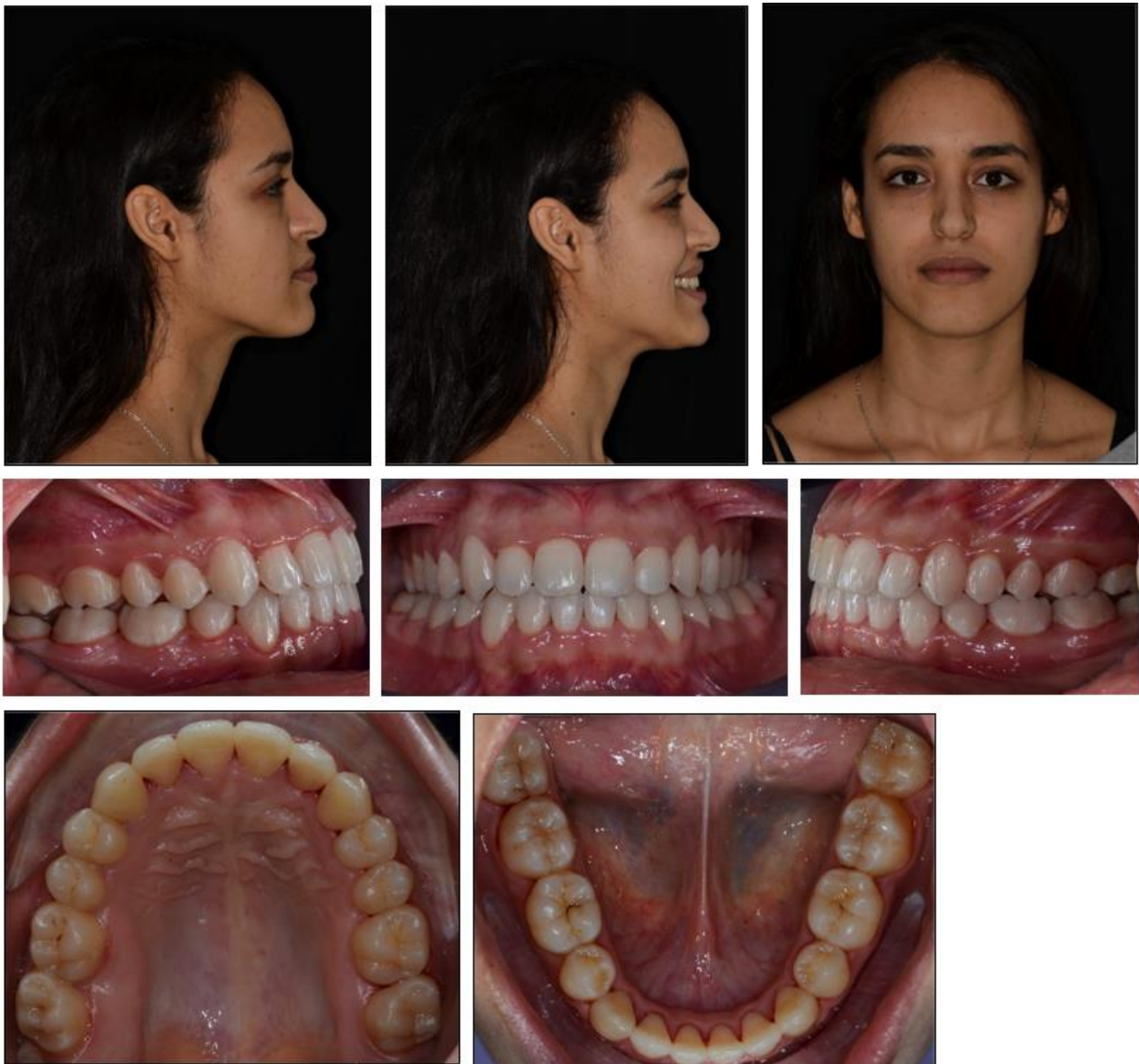
**Figure 6.** Pre and post treatment smile.

A class I canine was achieved and the overbite and overjet were normalized by retracting the mandibular anterior teeth and carrying out the bodily mesialization of the posterior sector into the extraction space. Coordination of the maxillary and mandibular midline and crowding correction were carried out although the patient's skeletal class III remained.

At the end of the treatment, cephalometric super-imposition and radiographs showed great control of the upper and lower inclination. The upper incisors to the palatal plane (PP) were retroclined  $3.5^\circ$  and the lower incisors kept a good sagittal and vertical control with a reduction of  $1.1^\circ$  to the mandibular plane (MP) (Figure 7) (Table 1).

**Table 1.** Cephalometric Analysis.

	Pretreatment	Post-treatment
<b>Sagittal Skeletal Relations</b>		
<i>SNA</i>	$74.2^\circ$	$74.8^\circ$
<i>SNPg</i>	$77.2^\circ$	$77.5^\circ$
<i>ANPg</i>	$-3^\circ$	$-2.7^\circ$
<i>Wits</i>	$-9$ mm	$-9$ mm
<b>Vertical Skeletal Relations</b>		
<i>SN/ANS-PNS</i>	$5^\circ$	$3.6^\circ$
<i>SN/Go-Gn</i>	$39.7^\circ$	$38.8^\circ$
<i>ANS-PNS/GoGn</i>	$34.7^\circ$	$35.2^\circ$
<b>Dento-Basal Relations</b>		
<i>I/ANS-PNS</i>	$112.5^\circ$	$109^\circ$
<i>i/GoGn</i>	$88.7^\circ$	$87.6^\circ$
<i>i/APg</i>	$+4.3$ mm	$+4.4$ mm
<b>Dental Relations</b>		
<i>Overjet</i>	$+2$ mm	$+2$ mm
<i>Overbite</i>	$+1$ mm	$+2$ mm
<i>Interincisal Angle</i>	$128.3^\circ$	$131.8^\circ$



**Figure 7.** Final extraoral and intraoral views.

#### 4. Discussion

According to the literature, a Wits appraisal is considered an important discriminating factor in determining whether Class III malocclusion should be treated by camouflage treatment or surgery [17].

If the initial face profile seems to be pleasant and the patient does not submit a specific request to improve the proportions of the face (as in our case), compensatory treatment, using the most appropriate biomechanical methods, may produce satisfactory occlusal results, whereas orthodontic–surgical treatment causes more remarkable changes to the profile compared to camouflage orthodontic treatment alone [18].

This article shows the orthodontic treatment of a young patient with skeletal Class III in which the extractions of the first lower premolars were performed to obtain a class III camouflage.

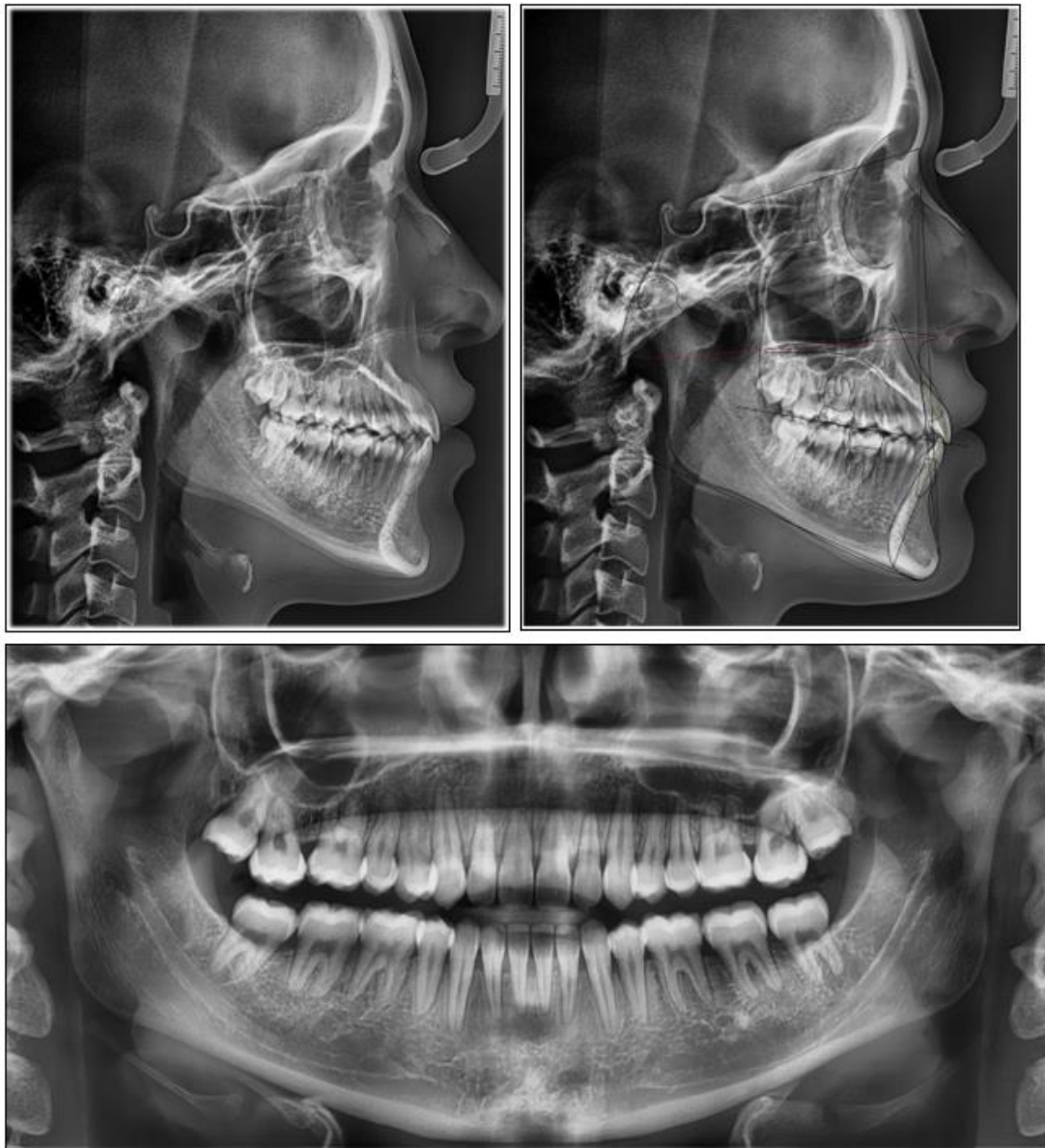
The refusal of our patient to undergo surgery and her good profile led to the development of a camouflage treatment with only lower extractions, thereby changing the upper and lower incisors inclination minimally. The post-treatment cephalometric superimposition and radiographs showed a great control of the upper and lower inclination. The



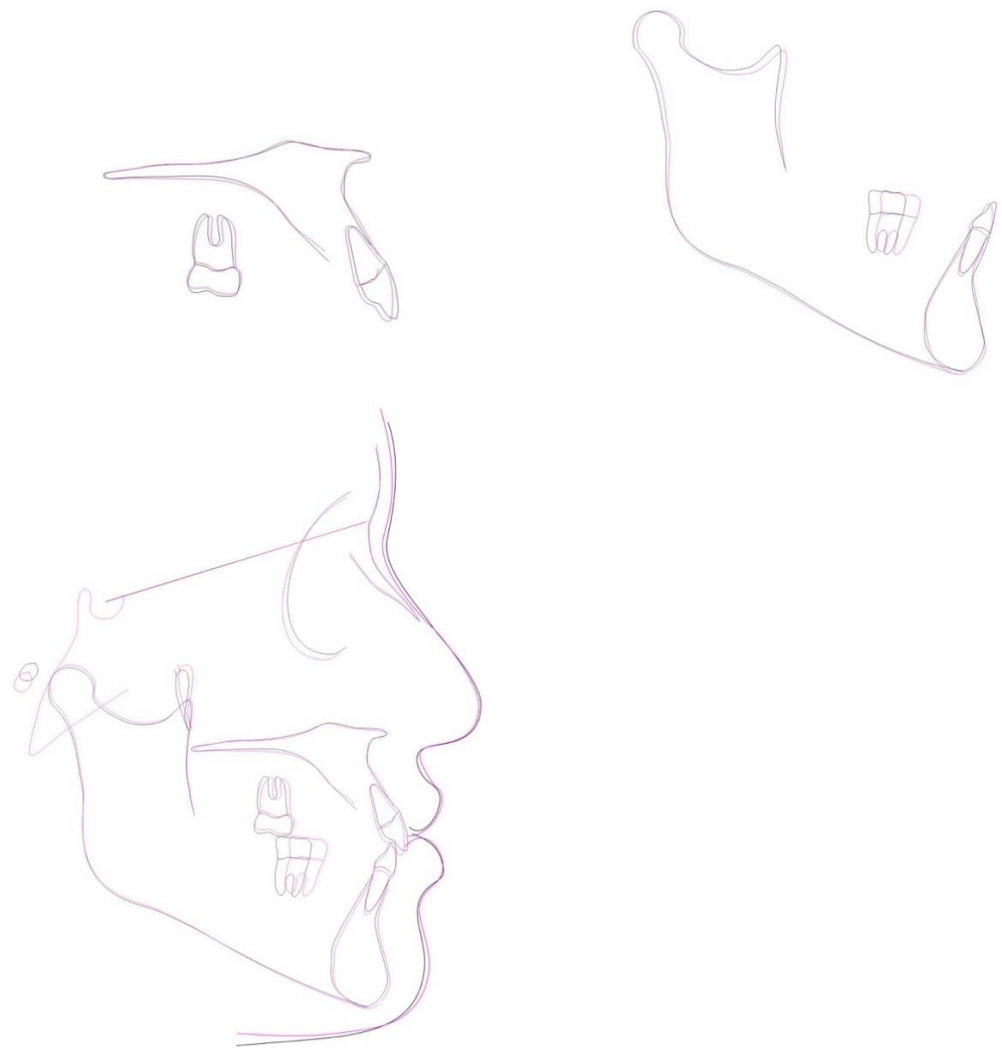
upper incisors to the PP were retroclined  $3.5^\circ$  and the lower incisors kept good sagittal and vertical control with a reduction of  $1.1^\circ$  to the MP (Figures 8 and 9).

The possibility of being able to use the miniscrews made good incisal control simpler, thus avoiding excessive retraction of the lower incisors. Mesialization of the lower hemiarch, carried out with miniscrew anchorage, showed a bodily movement of the first molar.

The “Pseudoankylosis System” allowed us to maintain excellent control of the lower incisors without over-retraction, and then control of the lower midline, which limited the risk of shifting and kept it centered during the space closure phase in the mandible, when we had to pay attention to the thickness of the buccal plate to avoid excessive lingual inclination during retraction [19]. Furthermore, this approach required less compliance from the patient who had to wear the Class II elastics for much less time than for a traditional treatment. This method allowed direct biomechanical traction from the molar to the canine, which, with a reverse curve of Spee inserted in the lower arch, promoted a bodily mesialization without causing vertical bowing, thus maintaining good control of lower incisor torque. Finally, the extraction of the lower premolars allowed the eruption of the third molars, which were inserted into the fixed appliance and aligned.



**Figure 8.** Final radiographs.



**Figure 9.** Superimposition of cephalometric tracings before treatment (black) and at the end of treatment (pink).

The choice of extracting only the two lower premolars arose from the high risk of causing further damage to the roots of the upper incisors, which had a degree of resorption, most likely caused by the previous treatment, which lasted 3 years.

In orthodontic retreatments, as in our case, it is the orthodontist's responsibility to investigate risk factors carefully before starting tooth movements, especially when the patient has a long history of previous treatment. In addition to the initial clinical exam and anamnesis, a pretreatment radiographic evaluation can often identify root resorption as in our patient at the beginning of the treatment.

The treatment that included the four extractions would have been the easiest and more rational choice considering the occlusal and biomechanical features, and it would probably have avoided the use of the skeletal anchor.

As shown by recent research, the extraction of the upper premolars would have definitely required more accurate upper-incisor root control during the space closures, thereby resulting in a greater risk of worsening apical root resorption of the upper incisors [20–23].

The need for orthodontic treatments that maximize anchorage control, minimize patient compliance requirements, limit treatment time and promote healthy teeth has led to the development of a fourth option of therapy with implant-assisted orthodontics.

The alternative treatment for a camouflage Class III was to extract two lower third molars and distalize the lower arch. This kind of treatment would have led to a first-class

molar and canine occlusion but would still have required a skeletal anchorage and would have increased the biomechanical difficulties significantly [24,25].

As demonstrated in the literature, these lower distalization methods mainly lead to a coronal distal-tipping movement rather than a molar bodily movement with counterclockwise rotation of the occlusal plane [26,27]. Finally, this treatment would have required the extraction of 38 and 48 and considerable compliance for the use of class III elastics.

Generally speaking, extraction of the third molars and lower distalization require a good patient's compliance for the use of intermaxillary elastics and miniscrews as anchorage [28]. Although these techniques can provide an acceptable incisor relationship and occlusion, they mostly produce distal tipping with the rotation of the molars rather than a bodily distal movement. Furthermore, the quality of treatment depends on patient cooperation [29,30].

This compensatory approach can apply to a patient who declined orthosurgery or any other orthodontic treatment with extreme anchorage requirements and less compliance.

## 5. Conclusions

Post-treatment records of our patient showed control in facial esthetics from the frontal and lateral perspectives with a harmonious soft-tissue profile that reflected the typical traits of the patient's race and pleased her.

The coordination of the maxillary and mandibular midlines and correction of crowding improved the smile esthetics although the patient's skeletal class III remained. A Class I canine was achieved and the overbite and overjet were normalized by retracting the mandibular anterior teeth and carrying out the bodily mesialization of the posterior sector into to the extraction space.

The "Pseudoankylosis System" used in this case allowed the desired result to be achieved in 18 months without changing the lower incisal position and without overloading the anterior sector, thereby reducing the risk of further root resorption and the patient's compliance.

### Limitations

With respect to the final intraoral records, the patient did not present a perfect canine guide on either side; moreover, the final torque on the first upper premolars could have been more precise.

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