
Class III malocclusion: a challenging treatment using miniscrews for extra anchorage

Mirian Aiko Nakane Matsumoto,* Patrícia Maria Monteiro,* Wendes Dias Mendes,† José Tarcísio Lima Ferreira,* Fábio Lourenço Romano* and Maria Bernadete Sasso Stuani*

Department of Pediatric Dentistry, Orthodontics, School of Dentistry of Ribeirão Preto – University of São Paulo, Ribeirão Preto, São Paulo, Brazil* Department of Basic and Oral Biology, School of Dentistry of Ribeirão Preto – University of São Paulo, Ribeirão Preto, São Paulo, Brazil†

Aims: This article presents the nonsurgical orthodontic treatment of a skeletal Class III malocclusion of an adult patient.

Methods: Because the patient refused an orthognathic surgical procedure, the mandibular first premolars were extracted and orthodontic camouflage using miniscrew anchorage was used to correct dental asymmetries and the occlusal relationship.

Results: The treatment strategy was successful and provided an acceptable aesthetic functional occlusion.

Conclusion: When appropriately indicated, the orthodontic camouflage of a class III malocclusion can avoid orthognathic surgery and, through the use of mini-implants as skeletal anchorage, enhance the results.

(Aust Orthod J 2021; 37: 227 - 236. DOI: 10.21307/aoj-2021.024)

Received for publication: March, 2021

Accepted: July, 2021

Mirian Aiko Nakane Matsumoto: manakane@forn.usp.br; Patrícia Maria Monteiro: ticiamonteiro@yahoo.com; Wendes Dias Mendes: wendes_veras@hotmail.com, wendesveras@gmail.com, wendesorto@usp.br; José Tarcísio Lima Ferreira: tarcisio@forn.usp.br; Fábio Lourenço Romano: fabioromano@forn.usp.br; Maria Bernadete Sasso Stuani: bernadete@forn.usp.br

Introduction

A Class III malocclusion invariably shows skeletal and dentoalveolar components. Genetic and environmental factors act as positive stimuli regulating mandibular growth, related to mandibular functional anterior deviation or mouth breathing.¹⁻⁴ A Class III phenotype is commonly associated with craniofacial characteristics displaying a sharp cranial base angle, a retrusive maxilla, and a protrusive mandible. Subjects with a retrusive maxilla are more likely to present with a hyperdivergent facial pattern, demonstrating vertical growth as a potential compensation mechanism.¹ Dentoalveolar compensations are frequently observed in Class III patients and, in addition to maintaining function, the compensations mask the underlying skeletal discrepancy.

Treatment is often challenging as the diagnosis and prognosis are complex and difficult to establish, especially

in malocclusions with associated asymmetries.² In the nongrowing Class III malocclusion patient, it is essential to evaluate the magnitude of skeletal involvement, the facial profile and the patient's goals. The treatment options are limited to either orthognathic surgery or a nonsurgical compensatory approach.¹⁻³ Nongrowing patients presenting with a mild to moderate Class III malocclusion with an acceptable facial profile can be successfully treated by dental extractions and dentoalveolar compensation. However, in order to achieve functional and facial aesthetic improvements, surgical orthodontic treatment is recommended for severe malocclusions.

The aim of the present article is to discuss an orthodontic treatment approach using miniscrews for anchorage, in an adult skeletal Class III malocclusion, who refused an orthognathic surgical procedure.

Case report

Diagnosis and etiology

A male (17 years 11 months) sought orthodontic treatment due to dissatisfaction with the aesthetics of his smile. The patient presented with a Class III malocclusion displaying an anterior cross bite, mild upper and moderate lower anterior crowding and an absent maxillary left canine.

The patient's face was oval and no facial asymmetry was detected. Paranasal depression and a relatively long lower face was noted. The facial profile was slightly concave due to a prognathic mandible, and featured a long anterior facial height and an obtuse nasolabial angle. Although the patient had a slightly protrusive chin and a mild midface deficiency, the facial appearance was accepted without aesthetic complaint (Figure 1).

The intraoral photographs and dental casts revealed a full unit Class III molar relationship on both sides, a lateral open bite, involving the left lateral incisors, canine and premolars, a negative overjet (0.5 mm), a transverse skeletal constriction and a reduced overbite. Posterior and anterior crossbites were evident. The upper dental midline was not coincident with the face and the maxillary and mandibular midline had shifted 1.5 mm and 1.0 mm to the left, respectively. The upper arch form was asymmetric, as the left upper first molar was 3.0 mm mesially displaced relative to the upper right first molar. There was a negative tooth-size discrepancy of 2.0 mm in the maxillary arch and 4.5 mm in the mandibular arch, and it was noted that a canine was absent in the upper arch. A mesial inclination of mandibular premolars and molars was also recorded (Figure 1).

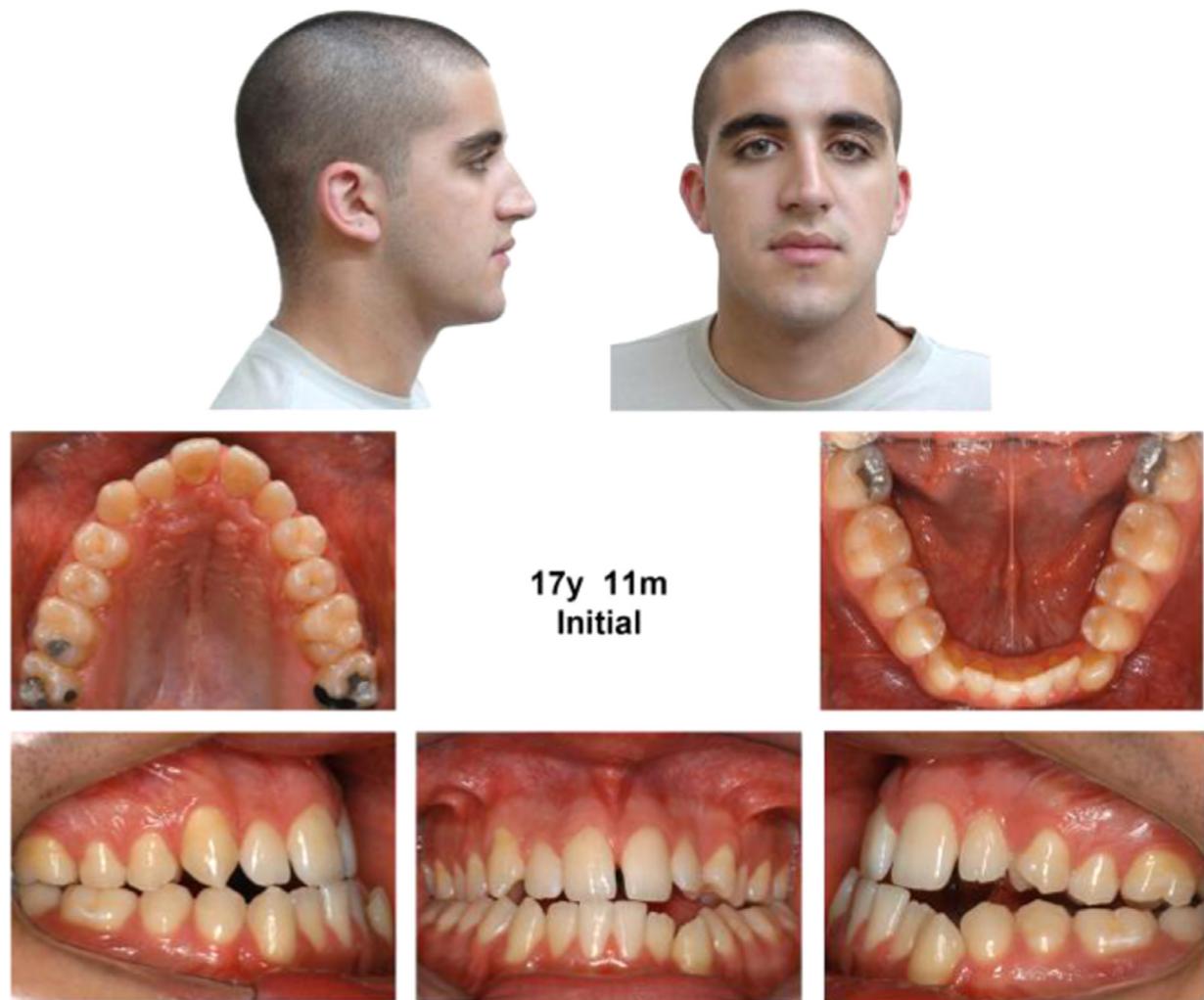


Figure 1. Extra- and intra-oral pretreatment photographs.

Dental radiography showed no root length abnormalities and alveolar bone loss was not detected. The third molars were unerupted and impacted (Figure 2).

The pretreatment lateral cephalometric tracing and analysis (Figure 2 and Table I) indicated a maxillary deficiency (SNA, 78.0°) and mandibular protrusion (SNB, 81.0°), indicating a skeletal Class III malocclusion (ANB, -3.0°, Wits, -5.0 mm). The mandible exhibited a downward and backward rotation characteristic of a hyperdivergent skeletal pattern (SN. GoGn, 36.0°; FMA, 34.0°; SN.Y-axis, 57°; Facial angle, 87°). The maxillary incisors were proclined (U1 to NA, 28°; 1-NA, 8.0 mm), the mandibular incisors were upright (FMIA, 68.0°; IMPA, 78.0°; L1 to NB, 16.0°; 1-NB, 3.0 mm) and the interincisal relationship was 139.0°. Conventional orthodontic therapy was possible as there was good

alveolar bone support. The skeletal and facial profile were concave (NA-Pog -9°, S-LS, -3.0 mm; S-LI, -2.0 mm) therefore the diagnosis was a Class III skeletal malocclusion due to mandibular protrusion in company with a hyperdivergent skeletal pattern and an upper and lower midline deviation.

Treatment objectives

The treatment goals intended to (1) establish an acceptable overbite and overjet; (2) correct the dental posterior crossbite by expanding the maxilla; (3) improve the dental and smile aesthetics; (4) correct the mandibular arch crowding and the lateral open bite; (5) correct the dental midline deviation; (6) achieve acceptable and a stable occlusal relationship with a favourable functional occlusion; and (7) maintain the pre-treatment facial profile.

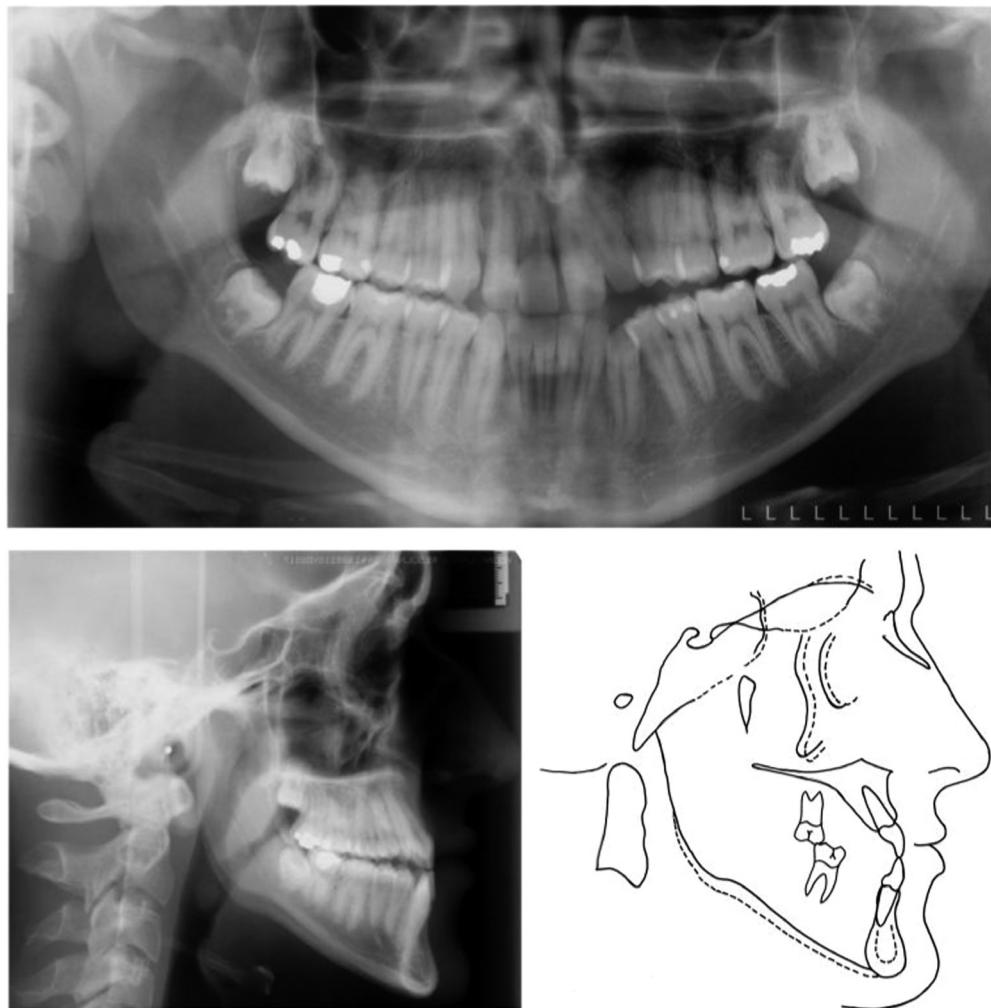


Figure 2. Pretreatment records.

Table I. Initial and final cephalometric measurements.

| Measurements | Average | Initial pretreatment | Final posttreatment |
|---------------------------------|---------|----------------------|---------------------|
| Sagittal skeletal relationships | | | |
| SNA (°) | 82.0 | 78.0 | 78.0 |
| SNB (°) | 80.0 | 81.0 | 81.0 |
| SND (°) | 76.0 | 80.0 | 80.0 |
| ANB (°) | 2.0 | -3.0 | -3.0 |
| Wits (mm) | -1.0 | -5.0 | -5.0 |
| SNPg (°) | | 83.0 | 84.0 |
| ANPg (mm) | | -9.0 | -13.5 |
| Vertical skeletal relationships | | | |
| SN.GoGn (°) | 32.0 | 36.0 | 40.0 |
| SN.y-axis (°) | 59.0 | 57.0 | 58.0 |
| FMA (°) | 25.0 | 34.0 | 35.0 |
| Facial angle (°) | 87.9 | 87.0 | 89.0 |
| Dental relationships | | | |
| 1. NA (°) | 22.0 | 28.0 | 27.0 |
| 1-NA (mm) | 4.0 | 8.0 | 7.0 |
| 1. NB (°) | 25.0 | 16.5 | 11.0 |
| 1- NB (mm) | 4.0 | 3.0 | 0.5 |
| 1.1 (°) | 131.0 | 139.0 | 146.0 |
| IMPA (°) | 90.0 | 78.0 | 68.0 |
| Occl plane.SN (°) | 14.0 | 19.0 | 15.0 |
| Overjet (mm) | | -1.0 | 1.0 |
| Overbite (mm) | | 0.0 | 3.0 |
| Soft tissues | | | |
| Z-angle | 80.0 | 95.0 | 90.0 |
| Pog-NB (mm) (°) | - | 5.0 | 7.0 |
| S line-lower lip (mm) | 0.0 | -3.0 | -3.0 |
| S line-upper lip (mm) | 0.0 | -2.0 | -3.0 |
| Nasolabial angle (°) | 100.0 | 121.0 | 112.0 |

The treatment plan considered the extraction of teeth in the lower arch to facilitate the retraction of the incisors and to correct the dental asymmetries and midline deviation. Edgewise brackets incorporating a 0.022-inch slot were planned to treat the malocclusion.

Treatment alternatives

Because no future growth was expected to influence the treatment goals,⁵ two alternative options (with or without orthognathic surgery) were considered.

The patient, however, did not want orthognathic surgery due to social and psychologic reasons, and current satisfaction with his facial profile and appearance. Therefore, orthodontic camouflage with the extraction of the lower first premolars and third molars, and dentoalveolar compensation using miniscrew anchorage was planned to correct the mandibular dental asymmetries and the occlusal relationship.

A non-surgical orthodontic treatment option would reduce the risk of morbidity; however, there would be greater demands related to time and patient compliance.⁶

Treatment progress

The mandibular first premolars and third molars were removed before appliance treatment. A Hyrax expander (0.9 mm, Morelli, São Paulo, Brazil) was placed to correct the posterior crossbite. It was activated by turning the screw twice a week (0.2 mm per turn) for 3 months. Once sufficient transverse expansion had been obtained, the appliance was stabilised in place for approximately 3 months for retention. A standard orthodontic edgewise appliance (0.022 × 0.028-inch slot; Generus, GAC, Dentsply) was subsequently placed.

Initial levelling and alignment followed a sequence of co-ordinated archwires of 0.016- to 0.020-inch stainless steel. To enhance anchorage, two miniscrews (diameter, 1.5 mm; length, 8 mm; ref. 37.10.202; Morelli, São Paulo, Brazil) were placed between the mandibular second premolar and first molar. The lower left first molar was distalised using a sliding archwire jig with a long arm placed mesial to the first molar and associated elastic chains to provide a distalising force. The extraction space was used to relieve the crowding and correct the midlines.⁷

The mandibular incisors were retracted using a 0.018 × 0.025-inch rectangular closing loop archwire and Class III elastic wear. Patient compliance was very good and at the end of treatment after 38 months, occlusal interdigitation had been achieved and the miniscrews were removed.

A maxillary wrap-around retainer was worn full time for 12 months and then at night for a further 12 months. In addition, a 0.028-inch stainless steel lower lingual retainer was anteriorly bonded from canine-to-canine.

Treatment results

The nonsurgical orthodontic results achieved the treatment goals. The post-treatment extraoral photographs showed that the patient's facial profile was mostly unchanged. The patient still exhibited Class III facial characteristics mildly affected by a slight clockwise rotation of the mandible. The dental relationships improved along with retraction of the lower lip and an increase of the inferior labial sulcus (Figure 3).

The post-treatment intraoral photographs showed a functional occlusal relationship. Despite the missing left maxillary canine, the patient appeared to exhibit

a natural intact dentition. The anterior and posterior crossbites were corrected, the dental midlines were coincident with the facial midline and the maxillary and mandibular arches were well aligned and levelled. Good intercuspal, interproximal contacts, and an ideal incisor relationship were established. The maxillary right canine was in a Class I relationship, and the occlusion was well interdigitated. As planned, the maxillary left second premolar occluded with the mandibular first molar, and the maxillary left first molar occluded with the mandibular left second molar. The maxillary left third molar had no antagonist and was planned for extraction (Figure 4).

The post-treatment panoramic radiograph showed good overall root parallelism and confirmed that no pathosis or root resorption was present. The maxillary right third molar was well developed and still unerupted; this molar was also to be extracted (Figure 4).

The post-treatment cephalometric radiograph and tracing (Figure 4 and Table I) illustrates the dental and skeletal treatment outcomes. The interincisal angle increased from 139° to 146°. The lower incisor was uprighted and retracted over basal bone during space closure as shown by the FMIA angle (from 68° to 77°), IMPA angle (from 78° to 68°), L1 to NB angle (from 17° to 11°), and 1-NB distance (from 3 to 1 mm). The upper incisor position remained stable as shown by U1 to NA angle and 1-NA distance. The maxilla remained relatively stable (SNA 78°), as did the mandible (SNB 81°; SND 80°). The ANB angle and Wits appraisal remained unchanged. The vertical cephalometric values were increased as shown by the SN-GoGn, FMA, SN-Y-axis, facial angle measurements, which increased facial height and helped to improve the Class III appearance. An increase in the nasolabial angle was observed (Table I).

Superimpositions results

The maxillary superimposition revealed maintenance of incisor position. The mandibular molars were uprighted without extrusive side effects and the lower incisors were retracted. No maxillomandibular growth was observed (Figure 5).

Assessment after retention

Five years after the completion of active treatment, the occlusion remained stable with an acceptable incisor



Figure 3. Extra- and intra-oral posttreatment photographs.

relationship, and good posterior intercuspidation. The periodontal health of the teeth was maintained without bone loss (Figures 6 and 7).

Discussion

For adults presenting with a class III malocclusion, two treatment approaches are possible: orthognathic surgical treatment or orthodontic camouflage and factors related to individual patterns of growth, the magnitude of the skeletal discrepancy, the facial profile, patient expectations,^{4,8} root parallelism, the functional occlusion, patient compliance, and the duration of treatment,^{2,9–11} need to be taken into full consideration.

After the treatment options were discussed with the patient, the orthognathic surgical approach was refused because of the surgical risks and likely post-operative discomfort. A viable approach was to perform dentoalveolar compensation without correcting the underlying skeletal deformity.¹⁰

The patient presented with a significant skeletal discrepancy (ANB -3.0°), but the presence of a functional deviation and an end-to-end incisor relationship in centric relation (CR) made nonsurgical orthodontic treatment possible. An acceptable facial profile and functional occlusion could be achieved with mandibular extractions instead of orthognathic surgery. Although the maxillo-mandibular relationship was not corrected, and the facial profile remained concave, a genioplasty procedure to reduce the prominence of the chin and achieve a more uniform and aesthetic facial profile was also declined.⁸

The compensatory orthodontic treatment for a non-growing Class III patient includes extraction decisions. A lower incisor may be removed in moderate cases expressing an edge-to-edge relationship or anterior crossbite.^{8,12} Its success depends on the extent of anterior crowding, the Bolton's ratio, and the overjet and overbite. An alternative treatment possibility includes lower premolar extractions to provide space

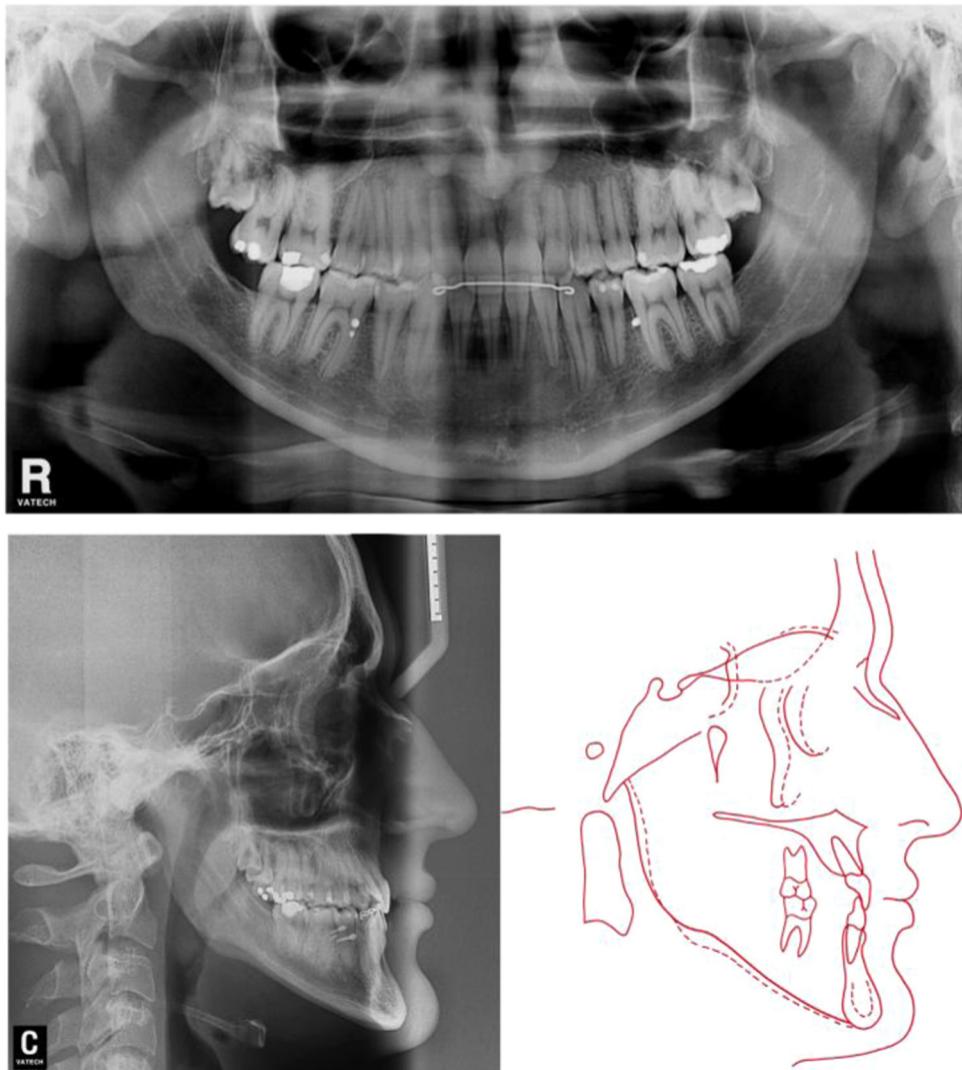


Figure 4. Posttreatment records.

to retract the mandibular incisors, to improve the anterior crossbite and the AP relationship.¹¹

In the presented case, the lower first premolars and third molars were removed to assist delivery of a Class I canine relationship, to allow incisor retraction, to align the teeth, and to correct the midline deviation and the negative overjet. The third molar extraction facilitated distalisation of the mandibular posterior teeth.⁸ The Class III mechanics corrected the anterior crossbite, achieved a positive overjet and overbite and eliminated the functional mandibular deviation. The retroclination of the mandibular anterior teeth (by 5°) produced an overcorrected overjet. The orthodontic camouflage masked the skeletal discrepancies, by virtue of intense linguoversion of the lower incisors⁶ and the labial inclination of the

upper incisors. It might be argued that such tipping of the mandibular incisors, although essential for the crossbite correction, could lead to gingival recession.¹¹ However, no recession was seen five years later (Figure 3).

It has been stated that anteroposterior intermaxillary elastics may produce significant adverse vertical effects.^{2,8,11} The effects can be minimised by using appropriate mechanics involving an 0.018 × 0.025-in stainless archwire as integrated anchorage opposing Class III elastic forces. The results show that the torque maintained maxillary incisor position. However, despite the compensating lingual torque applied to the mandibule incisors, the Class III elastic force still caused uprighting of these teeth (Figures 3 and 4 and Table I).

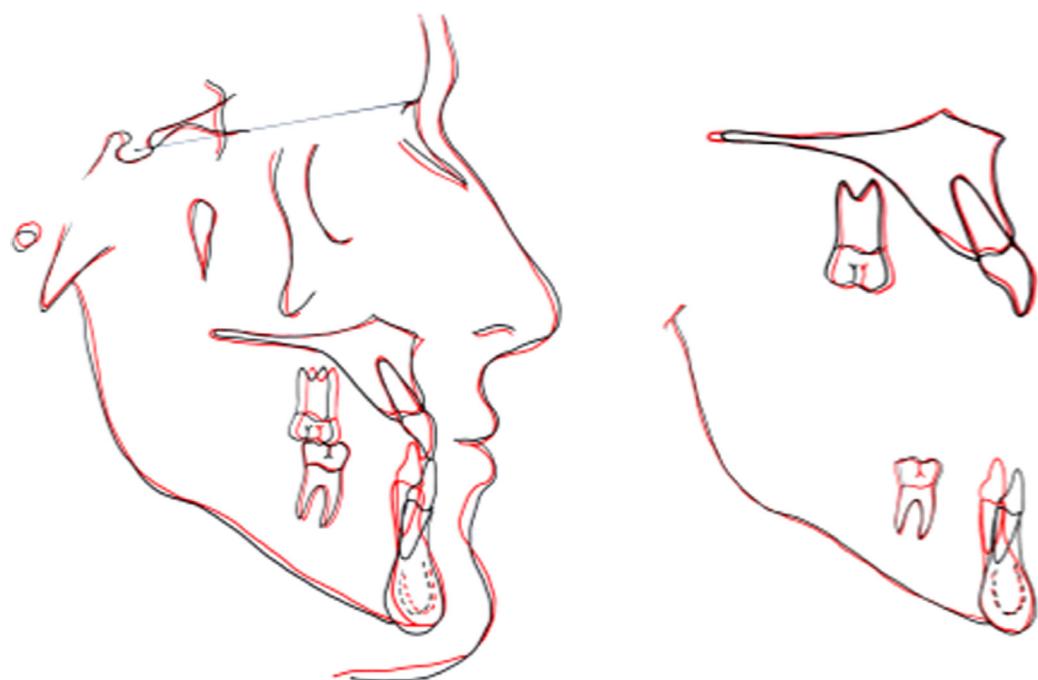


Figure 5. Superimposition of initial and final tracings at SN, maxilla and mandible, respectively.



Figure 6. Extra- and intra-oral photographs after 5 year retention.

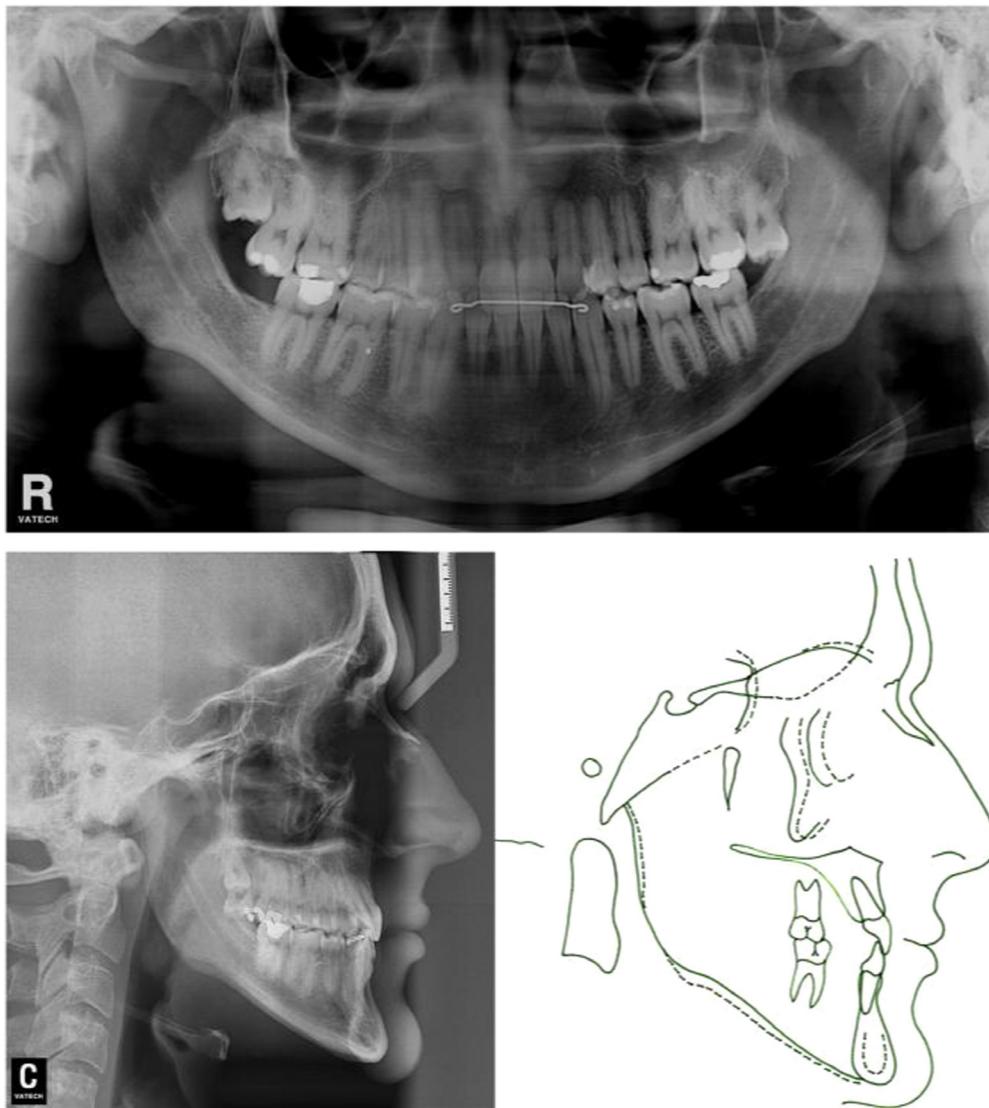


Figure 7. Records after 5 years of retention.

The achieved occlusal and aesthetic results were due to significant dentoalveolar compensation and excellent patient elastic compliance. The lingual cusp of the maxillary left first premolar required equilibration to avoid premature contact in excursive movements. The right molars were in a Class III relationship and the canines were in a Class I relationship, but on the left side, the first premolar was substituted for the canine. The lingual cusp of the maxillary left first premolar required equilibration to avoid interfering contact in excursive movements. Incisal and canine guidance and group function in lateral excursions can also be achieved.

The sliding jig mechanics attached to the archwire together with elastic chains to the miniscrew provided

specific tooth movements and allowed control of the occlusal plane.^{2,6,10} The miniscrew anchorage provided stability of the occlusal plane and uprightness of the entire mandibular posterior dentition without side effects affecting the maxillary teeth. The third molars were removed and contributed to the control of the vertical dimension in a patient who had a clinically long face.⁹

A backward rotation of the mandible is sometimes useful to improve a concave profile in Class III patients.^{7,13} However, in the presented case, a clockwise rotation of the mandible could not be performed because of the lateral open bite (Figure 1). Therefore, it was important to consider the direction of the retraction force delivered from the miniscrews. A retraction force

was applied in a distal and downward direction⁷ and, as a result, the lower molars were distally inclined without extrusion, and the mandibular plane angle did not change throughout the treatment period.⁷

The orthodontic treatment of non-growing patients requires realistic objectives to be established and followed.⁵ The present case achieved an excellent final result that met the patient's needs. The functional occlusion was stable 5 years after appliance removal, orthognathic surgery was avoided and the patient's quality of life was greatly improved.

Conclusion

A nonsurgical orthodontic treatment approach involving dental extractions and dentoalveolar compensation can be a successful orthodontic treatment strategy to manage a Class III malocclusion by creating an acceptable aesthetic functional occlusion without orthognathic surgery. However, it is important that anchorage considerations in the mandibular arch are efficient to enable maximum retraction of the lower incisors.

Corresponding author

Wendes Dias Mendes
 Faculdade de Odontologia de Ribeirão
 Preto da Universidade de São Paulo-FORP/USP
 Ribeirão Preto, São Paulo, Brazil
 Emails: wendes_veras@hotmail.com;
 wendesveras@gmail.com; wendesorto@usp.br

Conflict of Interest

The authors declare no conflict of interest.

References

1. Staudt CB, Kiliaridis S. Different skeletal types underlying Class III malocclusion in a random population. *Am J Orthod Dentofacial Orthop* 2009;136:715–21.
2. Troy BA, Shanker S, Fields HW, Vig K, Johnston W. Comparison of incisor inclination in patients with Class III malocclusion treated with orthognathic surgery or orthodontic camouflage. *Am J Orthod Dentofacial Orthop* 2009;146:e1–9.
3. Chang HP, Liu PH, Yang YH, Lin HC, Chang CH. Craniofacial morphometric analysis of mandibular prognathism. *J Oral Rehab* 2006;33:183–93.
4. Kuroda S, Sugawara Y, Yamashita K, Mano T, Takano-Yamamoto T. Skeletal Class III oligodontia patient treated with titanium screw anchorage and orthognathic surgery. *Am J Orthod Dentofacial Orthop* 2005;127:730–8.
5. Maruo H, Maruo IT, Saga AY, Camargo ES, Guariza Filho O, Tanaka OM. Orthodontic-prosthetic treatment of an adult with a severe Class III malocclusion molars. *Am J Orthod Dentofacial Orthop* 2010;138:820–8.
6. Yang Z, Ding Y, Xian X. Developing skeletal Class III malocclusion treated nonsurgically with a combination of a protraction facemask and a multiloop edgewise archwire. *Am J Orthod Dentofacial Orthop* 2011;140:245–53.
7. Yanagita T, Kuroda S, Takano-Yamamoto T, Yamashiro T. Class III malocclusion with complex problems of lateral open bite and severe crowding successfully treated with miniscrew anchorage and lingual orthodontic brackets. *Am J Orthod Dentofacial Orthop* 2011;139:679–89.
8. Hu H, Chen J, Guo J, Li F, Liu Z, He S. Distalization of the mandibular dentition of an adult with a skeletal Class III malocclusion. *Am J Orthod Dentofacial Orthop* 2012;142:854–62.
9. Janson G, Prado de Souza JE, de Andrade Alves FV, Andrade JP, Nakamura A, Roberto de Freitas M. Extreme dentoalveolar compensation in the treatment of Class III malocclusion. *Am J Orthod Dentofacial Orthop* 2005;128:787–94.
10. Burns NR, Musich DR, Martin C, Razmus T, Gunel E, Ngan P. Class III camouflage treatment: what are the limits? *Am J Orthod Dentofacial Orthop* 2010;137:9.e1–13.
11. Moulas AT, Palomo JM, Gass JR, Amberman BD, White J, Gustovich D. Nonsurgical treatment of a patient with a Class III malocclusion. *Am J Orthod Dentofacial Orthop* 2006;129 (Suppl): S111–8.
12. Zhylich D, Suri S. Mandibular incisor extraction: a systematic review of an uncommon extraction choice in orthodontic treatment. *J Orthod* 2011;38:185–95.
13. Sabri R. Nonextraction treatment of a skeletal class III adolescent girl with expansion and facemask: long-term stability. *Am J Orthod Dentofacial Orthop* 2015;147:252–63.