ORTHODONTIC-SURGICAL APPROACH TO A CLASS III MALOCCLUSION ASSOCIATED TO NEW TECHNOLOGIES: CASE REPORT

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Abstract

Class III maloclusions are challenging for clinical orthodontics due to its multifactorial etiology and the craniofacial growth's unpredictability. Numerous skeletal and dental profiles associated with Class III maloclusions can result from mandibular prognathism, maxillary retrusion or association of both. After growth is ceased, treatment of these conditions is limited to dental compensation or orthodontic-surgical treatment. This article reports the case of a patient with Class III skeletal and dental malocclusion, treated with orthodontics and bimaxillary orthognathic surgery. This treatment plan was chosen due to the impossibility of orthodontic camouflage and to improve aesthetics and function. Data were collected through a review of medical records, study models, radiographs, cone beam computed tomography, and intra and extraoral photos. The treatment achieved the desired functional and aesthetic results, with adequate intercuspidation between the dental arches, increased volume of the face's middle third region, and reduction of chin's projection.

Keywords: *Malocclusion, Angle Class III. Orthodontics, Corrective. Orthognathic surgery.*

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INTRODUCTION

Class III malocclusion is challenging for orthodontists due to its multiple etiologic factors and the difficulty to predict craniofacial growth. The etiology includes genetic predisposition, congenital alterations, and other factors, such as burns, neoplasia, infections, hormonal diseases, surgical resections and iatrogenic radiation. Patients with skeletal Class III malocclusion most commonly display a craniofacial pattern characterized by atretic and retrognathic maxilla. However, isolated mandibular prognathism or an association of both conditions can also be found (1,2). Epidemiologic research done in Latin America showed a 5% prevalence of Class III (3), but the prevalence varies among racial groups and different nationalities.

There are many treatment alternatives for a Class III malocclusion. For young patients with hypoplastic midface and in the first stages of mixed dentition, the indication is maxillary protraction, with or without palatal expansion (4, 5). For adult patients, as growth has ceased, treatment option depends on the skeletal discrepancy, facial profile and chief complaint. Orthodontic camouflage, with or without extractions, can achieve good results in patients with small discrepancies and esthetically acceptable facial profiles. For more severe cases, with compromised facial esthetics, recommended treatment is a combination of orthodontics and orthognathic surgery. Due to the social and esthetic impacts of this facial deformity, patients seek treatment and more readily accept the surgical option (6-8).

Historically, two-dimensional cephalometric tracings were used for planning, predicting, and choosing the best surgical approach to each case. With the development of new technologies, such as cone-beam computerized tomography (CBCT), digital dental casts, and computer-aided design/computer-aided manufacturing (CAD/CAM) systems, three-dimensional virtual planning was made possible. These new technologies, together with simplification of surgical techniques, allow for a more precise orthodontic-surgical treatment, with less post operatory complications and comorbidities, and more predictable results, contributing to a higher acceptance of the surgery approach by patients (9).

This case report presents a patient with skeletal Class III malocclusion, whose surgical treatment was planned virtually, by using these technologies. The aim is to highlight the improvements in function and esthetics achieved by this approach.

CASE REPORT

This case report was approved by the Research Ethics Committee of the Marcílio Dias Naval Hospital (*Hospital Naval Marcílio Dias – HNMD*), conforming to the resolution 196/96 and the Declaration of Helsinki, approval number 2.951.779/2018. The patient signed the Informed Consent form.

Diagnosis and Treatment Planning

A 15 year-old female, with good overall health, reported to the Naval Dental Center (Odontoclínica Central da Marinha – OCM) with a chief complaint of uncomfortable bite. The facial analysis showed symmetric mandible and facial thirds, with slight increase of the lower third. She had a concave profile, acute nasolabial angle, good mentolabial angle, low smile line with limited display of the upper incisors, deep nasolabial folds, and wide buccal corridors.

Intraorally, she had all permanent teeth, with exception of the third molars, good oral hygiene and periodontal health, Class III molar and canine relationship, bilateral posterior crossbite, and anterior teeth in edge to edge occlusion. The panoramic radiograph showed good root parallelism, normal trabecular bone and the presence of impacted third molars in close contact with the second molars. The lateral cephalometric analysis indicated a skeletal Class III pattern (ANB = -2°, AO-BO = -10 mm), with proportional growth pattern tending to vertical (SN-GoGn = 35°, FMA = 29°), and the mandibular incisors were retroinclined (IMPA = 80 °, 1-NB = 21°) (Figure 1).

Treatment progress
Preoperative phase

Diagnosis and treatment plan alternatives were discussed with the patient and her parents. First, the transverse discrepancy was addressed using a Hyrax appliance, activated a quarter turn in the morning and at night, every day, for 2 weeks. The maxillary expansion was successful, but it didn't change the anteroposterior relationship, compromising the possibility of camouflage treatment with exodontias. Besides, the possible outcome of the non-surgical approach did not meet the patient's esthetic

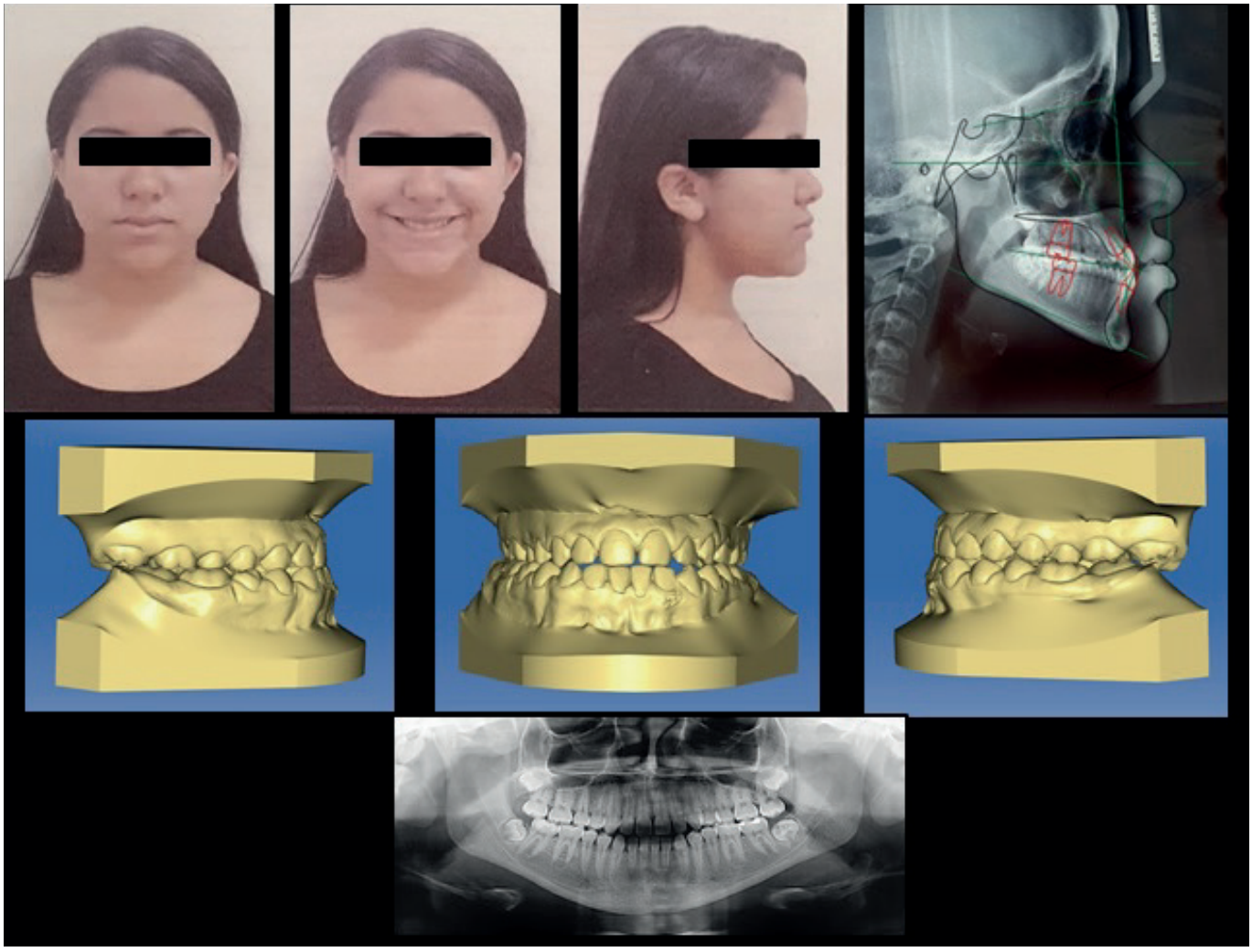

Figure 1 - Diagnostic records: facial photographs, lateral cephalometric radiograph with tracing, digital study casts, and panoramic radiograph.

expectations. Therefore, the patient decided to have orthognathic surgery without exodontia (4-6).

Edgewise appliances with 0.022 x 0.028-in slots (Morelli®, Sorocaba, São Paulo, Brazil) were bonded on both arches. The teeth were leveled and aligned with a progression of conventional nickel-titanium (0.014 and 0.016-in) and stainless steel (0.018-in) round wires. Rectangular stainless-steel wires (0.018 x 0.025-in and 0.019 x 0.025-in) were used for decompensation and torque control. On the upper arch, buccal root torque bends were used on the incisors, and omega loops were bent mesially to the tubes of the second molars to allow for tie-back mechanics. On the lower arch, lingual root torque bends were used on the lower incisors.

Class II intermaxillary elastics were used bilaterally to assist in the decompensation of the anterior teeth inclination to place them over basal bone. The unfavorable outcome of decompensation is the increase of negative overjet, worsening facial esthetics. For the finishing steps of the preoperative phase, impressions were taken regularly to evaluate arch coordination and intercuspation. The surgical movements were simulated on the dental casts and, when cast stability was achieved, the patient was referred to the HNMD Clinic of Trauma and Oral Maxillo-Facial Surgery. (*Clínica de Traumatologia e Cirurgia Buco-Maxilo-Facial do HNMD*) The maxillofacial surgeon confirmed the cast stability, deemed the patient orthodontically ready for orthognathic surgery, and requested preoperative records (Figure 2).

The cephalometric tracing shows verticalization of the upper (1:NA=26.5°) and lower incisors (1:NB = 30 °; IMPA = 89°) to a better position over the basal bone. There was also an opening of the mandibular plane (GoGn:SN=37° e FMA=34°).

Prior to surgery, hooks were attached to both

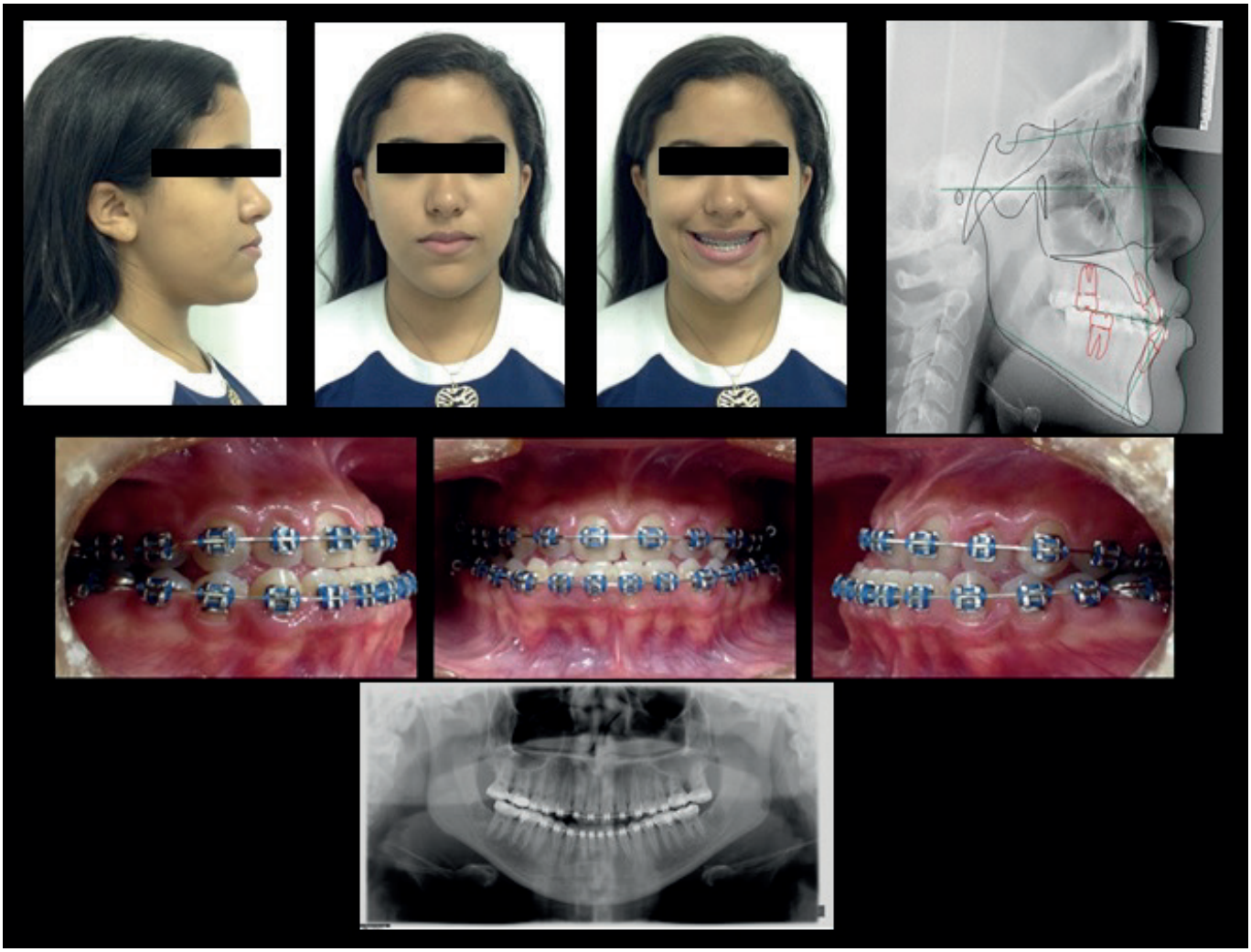

Figure 2 - Preoperative records: facial and intraoral photographs, lateral cephalometric radiograph with tracing, and panoramic radiograph. Note the worsening of the facial esthetics due to the anterior teeth decompensation.

archwires in all interproximal spaces and the wires were tied with steel ligatures. The patient was referred back to the HNMD for final surgical planning and to proceed with the orthognathic surgery.

Surgical Phase

Using CBCT and the Dolphin Imaging® software (Chatsworth, CA, U.S.A), virtual surgical planning was done. A LeFort I osteotomy was planned to allow maxillary impaction of 2.1 mm on the right canine, 1.0 mm on the left canine, and 2.6 mm on the first molars. The advancement of the maxilla was planned to be 4.5 mm at the anterior nasal spine and 3.0 mm on the central incisors. A bilateral sagittal split osteotomy was planned on the mandible to set it back 2.0 mm. Due to the clockwise rotation of the occlusal plane, the chin was planned to set back 1.5 mm (Figure 3). All necessary surgical splints were generated by a 3D printer. The surgery was carried out according to the virtual surgical plan and the patient recovered without complications.

Postoperative phase

Three months after surgery, the patient was cleared by the maxillofacial surgeon to resume orthodontic treatment and start postoperative finishing procedures. She had a Class I relationship on molars and canines, good intercuspation, proper overjet and overbite, and coincidence of dental and facial midlines. Small dental movements were done during the finishing phase to achieve better protrusive and canine guidance and root parallelism. Postsurgical treatment was completed in three months. After debonding, a maxillary wraparound Hawley retainer was delivered, and a mandibular

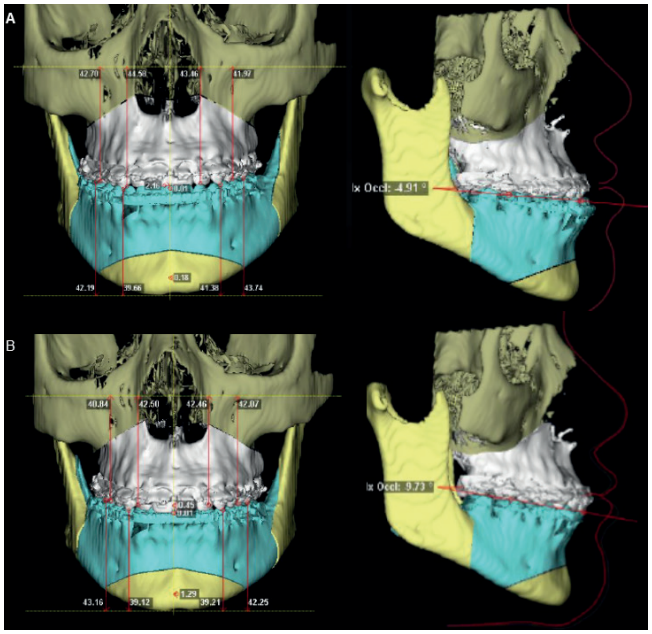

Figure 3 - **A)** 3D frontal and lateral view of the skull, in the preoperative phase, showing the surgical osteotomy sites. **B)** Virtual surgical planning, showing the final expected position of the maxilla, mandible and chin.

placed. Post-treatment records were taken, including facial and intraoral photographs (Figure 4), and lateral cephalometric and panoramic radiographs (Figure 5).

Treatment results

Evaluation of the post-treatment records showed that treatment objectives of satisfactory occlusion, function, and esthetics were achieved. The facial esthetic improvement was due to increase in the midfacial volume, achieved fullness of the upper lip, improving lips' relation, lifting of the nose tip, facial height reduction, and chin prominence reduction on the profile view. Intraorally, the patient had Class I relationship of molars and canines, proper overjet and overbite, coincidence of dental midlines and adequate intercuspation. Due to Bolton discrepancy, there was a small space between lower left canine and first premolar, and closure with composite was recommended.

Post-treatment cephalometric tracing shows the repositioning of the maxilla and mandible, with the establishment of a proper skeletal Class I relationship (SNA = 84°, SNB = 82°, ANB = 2°) (Table 1). The effects of treatment are seen in the superimposition of preoperative and post-treatment cephalometric tracings (Figure 6). Note the maxillary advancement, and mandible setback, as well as the counterclockwise autorotation, that resulted in closing of the mandibular plane (GoGn:SN=34° e FMA=30). The treatment objectives were achieved with a combination of orthodontics and surgery.

DISCUSSION

Correction of a skeletal Class III malocclusion in adult patients can be achieved by dental camouflage or orthognathic surgery, depending on the severity of the case and the patient's chief complaint. The approach chosen for this case was based on patient's complaints and expectations about her esthetic. The severity of basal bone discrepancy was also significant in determining the treatment plan (10,11)

The lack of dental and facial harmony can compromise chewing, swallowing, speech, and smile esthetics, impacting social behaviors. Functional and esthetic impairments drive patients to seek orthodontic treatment and justify the indication of orthognathic surgery as a treatment alternative (12).

The use of 3D technology together with the CBCT to virtually plan the orthognathic surgery maximized the results and efficiency of the treatment. Previous to the development of CAD-CAM technology, surgery planning and surgical splints were hand-made. A variety of procedures were necessary, such as impressions to obtain diagnostic casts, mounting of the casts on articulator, cast surgery and fabrication of surgical splints. Each step added risk of error that could lead to subpar results. Virtual surgical planning and surgery simulation allowed for higher predictability both for the surgeon and the patient (Figure 7) and made it possible to 3D print more precise surgical splints (13,14).

Surgical treatment of the Class III can be addressed in different ways. The most common surgical repositions are advancement of the maxilla, setback of the mandible, or a combination of both (15,16). For this case, two jaw surgery was indicated, with impaction and advancement of the maxilla and setback of the mandible. The impaction of the maxilla allowed for a clockwise rotation of the occlusal plane, due to the 2.6 mm intrusion of the molars while maintaining the vertical position of the incisors. This resulted in a larger advancement of the anterior nasal spine (4.5 mm) in comparison to the incisors (3.0 mm). The two-jaw surgery resulted in

Figure 4 - Post-treatment records: facial and intraoral photographs

a better anteroposterior relationship between the maxilla and the mandible (ANB from -1.5° to 2° and AO:BO from -10 mm to - 3 mm).

Maxillary advancement results in prominent esthetic modifications, such as increased projection of the zygomatic bones and paranasal region, increased fullness of upper lip, lifting of the nose tip,

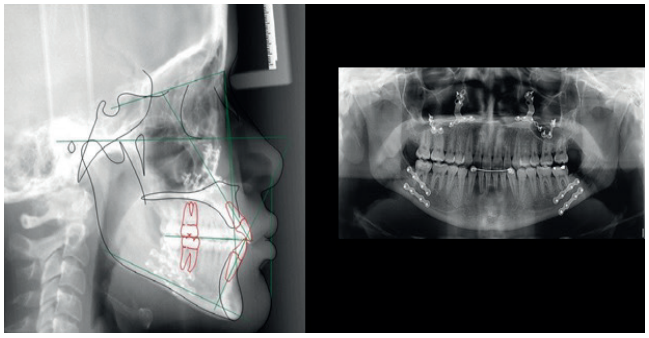

Figure 5 - Post-treatment records: lateral cephalometric radiograph with tracing and panoramic radiograph.

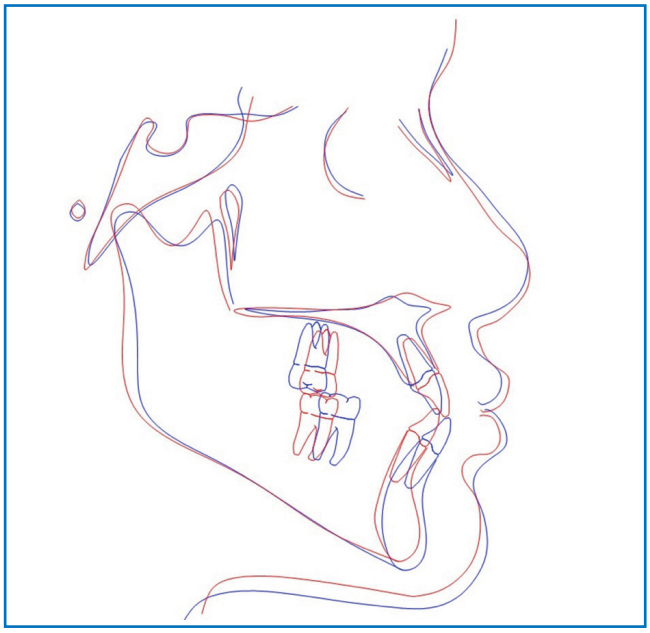

Figure 6 - Superimposition over the SN line of the cephalometric tracings: preoperative (blue) and post--treatment (red)

Table I - CEPHALOMETRIC VALUES THROUGH TREATMENT PHASES

	STANDARD VALUES	INITIAL 10/2013	PREOPERATIVE 05/2016	POST-TREATMENT 10/2017
SNA (°)	82	83	83	84
SNB (°)	80	85	84,5	82
ANB (°)	2	-2	-1,5	2
1:NA (mm)	4	7	6	6
1:NA (°)	22	28	26	26
1:NB (mm)	4	5	7	6
1:NB (°)	25	21	30	30
1:1 (°)	131	131	123	120
Ocl:SN (°)	14	19	17	14
GoGn:SN (°)	32	35	37	34
S-UL (mm)	0	1,6	1,4	3,3
S-LL (mm)	0	3,5	3	2,5
AO-BO (mm)	-1/1	-10	-10	-3
Y AXIS (°)	59,4	57	61,5	60
Facial angle (°)	87,8	94	90	90
Convexity angle(°)	0	-4	-3,5	-0,9
FMA (°)	25	29	34	30
FMIA (°)	68	71	57	59
IMPA (°)	87	80	89	91

and softening of the nasolabial folds. These changes give the patient a younger look (17), as observed in this case. The increase on the convexity angle from -3.5° to - 0.9° resulted in a straight total facial profile. The lifting and projection of the nose tip, the proper relationship between upper and lower lip, which was inverted before surgery, and the narrowing of the buccal corridor, are some of the important esthetic changes that contributed to a more youthful appearance

One of the disadvantages of this approach is the worsening of the facial esthetics that occurs as a consequence of the anterior teeth decompensation during the preoperative phase. To avoid this step, a surgery-first approach has been suggested in the past years (18). However, this technique requires

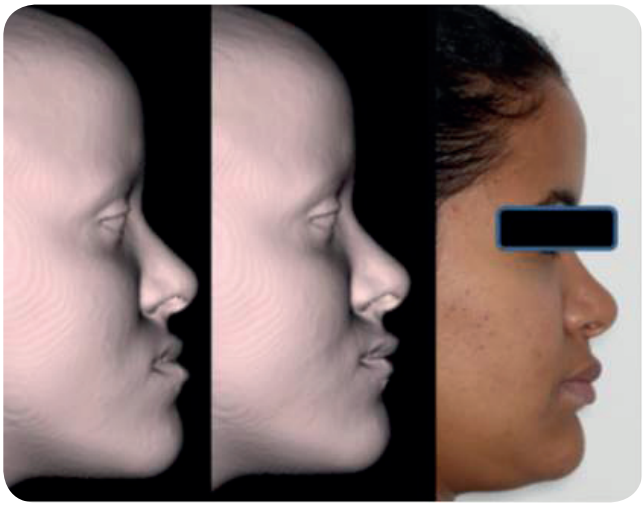

Figure 7 - Virtual surgery simulation and final profile photograph

advanced skills from the maxillofacial surgeon and the orthodontist. There is no preoperative orthodontic treatment to adjust the occlusion and, therefore, there is no occlusion to guide the positioning of the bones during surgery, especially when there is a transverse discrepancy (19). The orthodontist has to be able to correct the occlusion relationship after surgery, increasing the risk of not achieving an ideal result.

When there is a preoperative phase, the proper positioning of the teeth over the basal bones is extremely important for a successful surgery and overall treatment. The objective is to reverse dental compensation, establishing a negative overjet that is compatible with the skeletal discrepancy. During orthognathic surgery, the surgeon will reposition the basal bones guided by the planned final occlusion with proper overjet, overbite and intercuspation (20). In this case, there was a slight alteration on incisor inclination on the upper arch, with the initial 1:NA changing from 28° to 26° in the preoperative phase. On the lower arch, a major movement of the incisors is evident, with 1:NB changing from 21° to 30° and IMPA changing from 80° to 89°. These changes were due to the correction of the lower incisors retroinclination over the basal bone, characteristic of Class III malocclusions

The preoperative orthodontic goals are aligning, leveling, correction of dental compensations, and arch coordination. Achieving these goals is necessary to obtain occlusal stability and correct intercuspation of the preoperative casts; the final stage before a patient is considered cleared for surgery. It is recommended that the patient goes to surgery with thick rectangular archwires that fill in the slots of the brackets. These archwires provide stabilization of the dental movements done during the preoperative phase, suffer less deformation, and allow the attachment of hooks. The hooks are used during surgery to engage ligature ties that are used to connect the arches. In this case, they were also used for placement of intermaxillary elastics (21).

By comparing preoperative and post-treatment cephalometric tracings, one can observe that the anterior teeth position achieved prior to surgery did not change after surgery, as expected (1:NA: 26° / 6mm and 1:NB: 30° / 7mm). These changes provided increased tooth support for the lower lip, achieving a better relationship of the lips (Figure 4) (11,18).

After surgery, the changes in patients' facial characteristics positively impact their quality of life. There is an increase in self-esteem, confidence and, emotional stability, leading to changes in the patients' behavior and well-being (22)

CONCLUSION

Treatment objectives were achieved with the combination of orthodontic treatment and orthognathic surgery for the correction of a skeletal Class III malocclusion. Satisfactory occlusion, with proper overjet and overbite, was established, with improvements in function and facial esthetics. Virtual surgical planning done using CBCT and the Dolphin Imaging software allow for better predictability of the desired repositioning of the basal bones. The use of 3-D printed surgical splints contributed to the success of the case.

The authors declare that there is no conflict of interest or disclosures of any economic or natural interest that could be compromising if known after this article is published.

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