



Surgical Orthodontic Treatment of Severe Class Iii and Anterior Open Bite

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Abstract

The dentofacial deformity associated to the Class III malocclusion occurs in 2.5% of the population, and 40% of these cases are severe enough to require adjunctive surgical intervention. This deformity can be caused by excessive mandibular growth (mandibular prognathism), lack of maxillary growth (maxillary hypoplasia) or the association of these two conditions. The present work aims to report a case in which it was performed surgical orthodontic treatment of a patient with Class III malocclusion, with well-positioned maxilla and protruded mandible, and the presence of severe anterior open bite. The orthodontic treatment was performed with alignment and leveling, coordination of dental arches, followed by orthognathic surgery including only mandibular setback. The results were satisfactory, with an improvement of facial profile and an excellent occlusion.

Keywords: Malocclusion; Angle Class III; Open Bite; Orthognathic Surgery

Introduction

Surgical intervention, concomitant with orthodontic treatment, is necessary in 40% of the severe cases of Class III malocclusion deformity, which affects 2.5% of the population. Class III malocclusion may result from mandibular prognathism, maxillary retrusion or association of both, but its most frequent cause is maxillary deficiency in conjunction with the midface deficiency [1-3]. Thus, 3 treatment options are most commonly indicated: growth redirection through the use of orthopedic appliances, dentoalveolar compensation (orthodontic camouflage) and orthodontic-surgical treatment [4]. When the skeletal involvement is small, the case can be treated with compensatory orthodontics. In cases of great skeletal involvement with impairment of the patient's facial profile, the best treatment indicated is orthodontic and orthognathic surgery, which may involve mandibular retrusion, maxillary advancement, or both.

Due to the great aesthetic dissatisfaction, patients with large dentofacial deformities presented more acceptance of orthodontic-surgical treatment, which is the most indicated in cases where facial growth potential has already been ceased [1,5].

In this way, orthognathic surgery becomes an adjunct to the orthodontic therapy of these patients, whose simplification of techniques has led to the least postoperative discomfort and more standardized and precise orthodontic-surgical planning [6].

Generally, when in addition to Class III malocclusion, there is another malocclusion involved, such as the anterior open bite, the case becomes even more complex, and requiring orthodontic-surgical treatment, since the compensation in these cases is contraindicated due to the severity and complexity of the orthodontic treatment alone of these malocclusions.

The development and magnitude of the open bite are related to the pattern of facial growth. Facial types of multidimensional nature derive from a combination of peculiar features in the vertical and anteroposterior senses. A skeletal open bite is difficult to treat and in most cases, treatment without orthognathic surgery becomes impossible. Thus, the differential diagnosis between dentoalveolar and skeletal open bite is of fundamental importance and radiographic cephalometry is an excellent diagnostic tool for these abnormalities, which helps in the determination of the treatment plan [7].

The present study aims to describe a clinical case in which surgical-orthodontic treatment was performed in a patient with severe Class III malocclusion and anterior open bite, with well positioned maxilla and protruded mandible. The orthodontic treatment was done with alignment

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Received Date: 20 Mar 2018

Accepted Date: 30 Apr 2018

Published Date: 03 May 2018

Citation:

Camargo EC, De Freitas DS, De
Freitas KMS, Moretti AHM, Francisconi
MF, Henriques RP. Surgical Orthodontic
Treatment of Severe Class Iii and
Anterior Open Bite: A Case Report.
World J Oral Maxillofac Surg. 2018;
1(1): 1004.

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Table 1: Cephalometric measurements used in initial, pre-surgical and Initial stages.

Cephalometric Measurements	Initial	Pre-surgical	Final
1. Dentoskeletal factors (determine profile)			
a. Maxilla			
Maxillary incisor inclination (Mx1-MxOP) (°)	46.5	44.8	45.4
Maxillary incisor projection (Mx1-Sn) (mm)	-11.9	-10.7	-9.2
b. Mandible			
Mandibular incisor inclination (Md1-MdOP) (°)	71.1	80.4	76.2
Mandibular incisor projection (Md1-Sn) (mm)	-1.4	-7.9	-10.9
Overjet (Mx1-Md1) (mm)	-10.6	-2.9	1.8
Skeletal (Md1-Me'/Mx1-Sn) (%)	166	195.3	189.1
c. Vertical			
Overbite (Mx1-Md1) (mm)	-8.4	-8.7	-0.4
Mx anterior height (Sn'-Mx1) (mm)	26.2	23.3	26.5
Mx occlusal plane (MxOP-TVL) (°)	103.3	100.5	95.9
Mentus height (Md1-Me') (mm)	43.5	45.6	50.1
2. Facial heights (all measurements parallel to TVL)			
a. Soft tissue heights			
Upper lip length (Sn'-ULI) (mm)	20.5	20.7	20.4
Interlabial gap (ULI-LLS) (mm)	2.2	1.5	1.8
Lower lip length (LLS-Me') (mm)	55.3	55.4	54.8
Lower x upper lips length (LLS-Me'/Sn'-ULI) (%)	269.2	267.9	268.8
Inferior third of the face (Sn'-Me') (mm)	78	77.6	76.9
Facial height (Na'-Me') (mm)	132.3	130.6	127.2
b. Hard tissue heights			
Maxillary incisor exposure (ULI-Mx1tip) (mm)	5.6	2.6	6.1
Mx anterior height (Sn'-Mx1) (mm)	26.2	23.3	26.5
Mx occlusal plane (MxOP-TVL) (°)	103.3	100.5	95.9
Short-long (Md1-Me') (mm)	43.5	45.6	50.1
Overbite (Mx1-Md1) (mm)	-8.4	-8.7	-0.4
3. Soft tissue thickness			
Upper lip thickness (Mx1 labial-ULA) (mm)	15.2	14.6	14.5
Lower lip thickness (LLinside-LLoutside) (mm)	15.3	13.2	9.2
Soft chin thickness (Pog-Pog') (mm)	11.7	11.6	10.1
Chin thickness (Me-Me') (mm)	10.3	13.7	12.4
4. Projections (all distances horizontal to TVL except *)			
a. Projection of the gigh median face			
Subnasal to soft tissue glabella (Sn to Gb') (mm)	-12.3	-8.5	-17.1
Subnasal to soft tissue orbitale (Sn to soft OR') (mm)	-21.4	-22.4	-26.2
Malar bone soft tissue (CB'-Sn) (mm)	-24.8	-26.8	-27.6
Subpupilar soft tissue (SP'-Sn) (mm)	-21.4	-19.6	-20.1
b. Maxillary projection			
Nasal projection (NT) (mm)	13.7	14.3	13.9
Nasal base soft tissue (NB'-Sn) (mm)	-22.5	-17.3	-21.1
Soft tissue A point (A') (mm)	-1.5	-0.6	-1
Anterior upper lip (ULA-Sn) (mm)	3.1	4.4	4.3
Mx incisor projection (Mx1-Sn) (mm)	-11.9	-10.7	-9.2
Upper lip angle (ULA-Sn'-TVL) (°)	6.2	17.2	6.6
Nasolabial angle (Co'-Sn'-ULA) (°)	103.5	93.9	100

c. Mandibular projection			
Md incisor projection (Md1-Sn) (mm)	-1.4	-7.9	-10.9
Anterior lower lip (LLA) (mm)	8.6	6.7	5.8
Soft tissue B point (B') (mm)	0.4	-3.1	-3
Retrusion-protrusion (Pog'-Sn) (mm)	-1	-4.8	-0.8
Throat length (NTJ-Pog') (mm)	38.8	50.6	41.3
5. Facial harmony (sensitive)			
a. Total facial balance			
Facial angle (G'-Sn'-Pog') (°)	169,3	169,4	165,1
Glabela to Mx (G'-A') (mm)	10,8	7,9	16,0
Glabela to pogonion (G'-Pog') (mm)	11,4	3,6	16,3
b. Orbitale to bone base			
Orbitale to Mx soft tissue (OR'-A') (mm)	19,9	21,8	25,1
Orbitale to soft tissue pogonion (OR-POG') (mm)	20,4	17,6	25,4
c. Intermaxillary			
Pogonion to nasal base (Pog'-Sn') (mm)	1,0	4,8	0,8
Mandibular base to maxillary base (A'-B') (mm)	-1,9	2,5	2,0
Lower lip to upper lip (LLA-ULA) (mm)	-5,5	-2,3	-1,5
d. intramandibular			
Md1 to pogonion (Md1-Pog') (mm)	0,4	3,0	10,2
Lower lip to pogonion (LLA-soft Pog') (mm)	9,6	11,5	6,6
Flat-angular (B'-Pog') (mm)	-1,3	-1,8	2,2

and leveling, coordination of the arches, followed by orthognathic surgery including only mandibular setback and counterclockwise rotation for correction of the anterior open bite. The results obtained were satisfactory, with improvement of the facial profile and excellent occlusion.

Case Report

Diagnosis: The patient D.R.M.C., male, 17 years, sought for orthodontic treatment in the private practice of Dr. _____, with the main complaint of chewing difficulty and aesthetics.

A normal smile line and a lower anterior face height were observed in the frontal extraoral view (Figure 1). In the lateral extraoral photograph, a good nasolabial angle was observed, absence of passive lip sealing when the patient was taken for centric relation, concave profile and increased Lower Anterior Face Height (LAFH), characterizing a Class III profile with increased vertical dimension. The intraoral examination revealed an extremely severe anterior open bite, slight mandibular anterior crowding, diastema between maxillary central incisors, bilateral complete Class III relationship of molars and canines (Figure 2). Cephalometrically, the patient presented a protruding mandible, severe anterior open bite, increased LAFH (Figure 3). The panoramic radiograph showed the presence of all teeth, mandibular third molars erupted and impacted maxillary third molars (Figure 4).

Objectives and treatment planning: The treatment objectives were to correct the Class III malocclusion and the anterior open bite, resulting in improvement of the profile and mainly of the occlusion of the patient. It was expected to obtain a satisfactory harmonic profile and occlusion with Class I molar and canine relationships. Thus, the planning included orthodontic surgical treatment of the case, without dental extractions, alignment and leveling up to 0.019"



Figure 1: Initial extraoral photographs.



Figure 2: Initial intraoral photographs.



Figure 3: Initial lateral cephalogram.



Figure 4: Initial panoramic radiograph.



Figure 5: Pre-surgical extraoral photographs.



Figure 6: Pre-surgical intraoral photographs.



Figure 7: Pre-surgical lateral cephalogram.

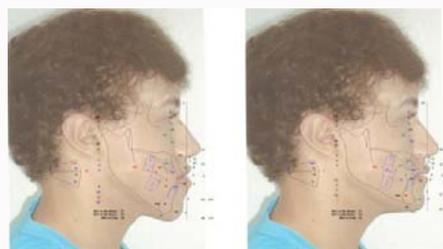


Figure 8: Simulation of surgical treatment by the Dolphin Imaging program. (tpredictive tracing; photograph of the right side).

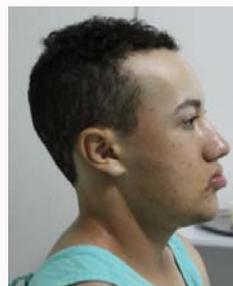


Figure 9: Extraoral photographs of immediate post-operative.



Figure 10: Intraoral photographs of 1 month after surgery.

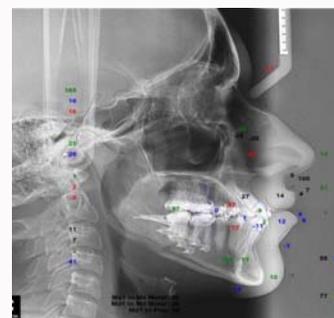


Figure 11: Post-surgical lateral cephalogram (final).

× 0.025" stainless steel arch wire and orthognathic surgery including setback and counterclockwise rotation of the mandible for correction of severe open bite and Class III malocclusion.

Treatment progress: The orthodontist did the conventional orthodontic treatment, not requiring dental extractions, coordinating the archwires, leveling the curve of Spee and preparing the case for surgical treatment. Brackets with 0.022" × 0.025" slot, Roth prescription were used. The sequence of archwires used was conventional, starting with Nitinol round wires, then round stainless steel wires and, finally, 0.019" × 0.025" stainless steel rectangular archwire.

According to medical information, the patient had a good general health status, with no previous history of any disease. At the pre-surgical clinical and radiographic examination, it was observed that the patient had a concave profile, increased LAFH and Class III malocclusion, with a good positioning of the maxilla and mandibular excess, without maxillary midline deviation and with 3 mm of

mandibular midline deviation to the right (Figure 5-7).

Pre-surgical occlusion showed an improvement of the anterior open bite with orthodontic treatment, only by leveling the curve of Spee with wires including a reverse curve in the mandibular arch and a sharp in the maxillary arch. The surgery was performed with 0.019" × 0.025" stainless steel archwire, and kobayashis were placed on all teeth whose brackets had no hooks. The simulation of the surgical treatment to be performed, that is, the predictive tracing was done with the aid of Dolphin Imaging software (Figure 8).

The surgery was performed under general anesthesia, with nasal intubation, and the sagittal surgical technique for the mandibular setback with counterclockwise rotation was used. Intermaxillary elastics for posterior and anterior intercuspation were used, such as post-surgical blockage, for 10 days. After this time, the elastics continued to be used at night, for maintenance and stabilization of



Figure 12: Post-surgical panoramic radiograph (final).



Figure 13: Extraoral photographs of 1.5 years follow-up.



Figure 14: Intraoral photographs of 1.5 years follow-up.

the occlusion obtained after surgery. The immediate postoperative showed a swelling of the patient's face, which is common and expected in orthognathic surgery (Figure 9). The patient was feeling well, without any postoperative complications. The immediate improvement of the profile was noted, which can be observed despite the swelling (Figure 9).

In the 1-month postoperative period, a satisfactory occlusion, Class I relationship of molars and canines, and adequate overjet and overbite were observed, facilitating the stabilization of the occlusion (Figure 10). The patient was released to return to the orthodontist to perform the orthodontic appointment after 2 months of the surgery, to finalization of the occlusion. Intermaxillary elastics were used for finishing for another 4 months, and then the fixed orthodontic appliance was removed.

Results

The final results obtained were excellent. Class I relationship of canines and molars, adequate overjet and overbite, satisfactory functional occlusion and excellent esthetics were obtained, both occlusal, facial and profile. The patient was extremely satisfied with the achieved result.

The patient obtained an impressive improvement in the aesthetics of the face, due to the initial severity of the malocclusion. There was significant retrusion of the mandible, which eliminated the skeletal and soft tissue protrusion of the mentum and resulted in a better definition of the cervico-mandibular angle.

Cephalometrically, there was a retrusion of the mandible, maintenance of the maxillary position, and a significant improvement of the maxillomandibular relationship (Table 1 and Figure 11). There was a decrease in facial height, favoring the aesthetics of the

patient. The immense improvement in the soft profile of the patient is highlighted (Table 1 and Figure 11). The panoramic radiograph shows the root parallelism obtained after the treatment (Figure 12). As retention, a Hawley plaque was used in the maxillary arch for 1 year and a 3 × 3 bonded in the mandibular canines for lifetime. (Figures 13 and 14) show extra and intraoral photographs of post treatment follow-up of 1.5 years, demonstrating the stability of the occlusion obtained at the end of the treatment.

Discussion

Class III malocclusion is of particular interest to orthodontists due to aesthetic and functional compromise, and an unfavorable prognosis for orthopedic and orthodontic mechanics [8]. Often, surgical orthodontic treatment is better indicated in relation to compensatory orthodontics because of the severity of malocclusion and the amount of skeletal involvement [9]. Among the skeletal malocclusions, Class III malocclusion is the most prevalent in the Brazilian population [5]. Class III malocclusion, due to the great aesthetic involvement, most often leads to psychological problems because these patients give great value to their appearance, and the improvement of aesthetics is the major reason for the search for surgical-orthodontic treatment [10].

In the presented case, the treatment plan did not allow the compensatory treatment, being the surgical option the only possible one, due to the extreme severity of the case, including a severe Class III malocclusion with anterior cross bite and exaggerated negative overjet. The surgery was performed only on the mandible, due to the observed fact that the Class III malocclusion was due to a mandibular protrusion and not to a maxillary deficiency.

The surgical-orthodontic treatment of skeletal Class III malocclusion has been much studied in the literature [2,8,11,12].

The surgical-orthodontic treatment of Class III malocclusion presents a good long-term stability, leading to a great satisfaction of the patients with the result and the final aesthetics of the treatment [10,12,13]. The clinical case presented corroborates these results, since in the 1.5 years follow-up after the end of the orthodontic treatment, the results were stable, with excellent facial esthetics and the patient satisfied with the results obtained.

According to Proffit et al. [14], the stability and prognosis of orthognathic surgical procedures vary according to the direction of surgical movement, the type of fixation, and the surgical technique used, exactly in this order of importance. The literature demonstrates the occurrence of a relapse of approximately 21% and a multi factorial etiology, including masticatory function, correct intercuspation, bone healing, condylar position within the glenoid cavity, neuromuscular adaptation, patient's age, surgeon's experience or use of bone grafts in the maxilla [15]. In the case presented, this relapse fortunately was not observed. However, lifelong follow-up remains indicated.

The orthodontic preparation phase for surgery is important for the success of the case and the patient is ready for surgery when the maxillary and mandibular dental arches are aligned and leveled and at this point the wires present should be rectangular stainless steel thickness 0.019" × 0.025" [9]. Proffit et al. [16] mentions that brackets with slot.022" are generally used in surgical treatments. The presence of hooks in them facilitates the phase of elastics use. In the present case, hooks were only used in the brackets of the canines, in the other teeth; Kobayashis were placed in their brackets. It is necessary to level

the curve of Spee to obtain good postoperative occlusion, as was done during leveling and alignment of the case demonstrated [16].

According to Sant'Ana; Janson in order to perform the surgical planning, Dr. Arnett's protocol, which consists of facial analysis, predictive tracing and precise model surgery, should be applied, as was done in the case presented [9]. Facial analysis, predictive tracing and model surgery should be performed by the surgeon, but the orthodontist can and should participate in this phase of treatment. As the case approaches the preparation for surgery, it is helpful to make dental models and examine them through a manual joint to see if there is occlusal compatibility. Minor interferences that can be easily corrected with adjustments in the orthodontic arches can significantly limit surgical movement. The second molars should be placed to increase the stability of the fixation [9].

It has already been shown that orthognathic surgery has a positive psychosocial influence on quality of life [17]. Although these questions have not been measured in the patient through questionnaires, his reports support this finding. The main treatment objectives of dentofacial deformities are to obtain the proportionality of soft tissues of the face and this can be obtained with the planning and execution of orthognathic surgery technique [18]. Also, as a result of orthognathic surgery, a functional improvement of mastication, phonation, respiration and occlusion was obtained [19]. When well indicated and planned, surgical-orthodontic treatment of Class III malocclusion associated with anterior open bite results in a treatment with high predictability and good long-term stability with excellent aesthetic results.

Conclusion

To perform a surgical-orthodontic, a correct diagnosis, efficient orthodontic preparation and well-executed surgery is essential. When skeletal involvement is severe, as in the case of Class III malocclusion and extremely severe open bite, orthodontic-surgical treatment is often the best and only viable option. In the case presented, orthognathic surgery involved only setback and counter clockwise rotation of the mandible, obtaining excellent results, a satisfactory occlusion and a harmonic profile, showing to be stable after 1.5 years of post treatment follow-up.

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