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Unexpected Obstructive Sleep Apnea Following Surgery-First Mandibular Setback in a Class III Patient

By Fernanda Henkin, MD; Eduardo Martinelli Santayana de Lima, MD, PhD; Susana Deon Rizzato, MD; Luciane Macedo de Menezes, MD, PhD; Guilherme Fritscher, MD, PhD; Renata Petersen, MD, PhD Candidate

Abstract: *Combined surgical-orthodontic treatment is usually the first option for adult patients with Class III skeletal malocclusion and mandibular prognathism. Surgery-first is a treatment alternative for mandibular prognathism, which avoids presurgical decompensation of the teeth and anticipates dentofacial esthetics improvement. Surgical correction of mandibular prognathism produces esthetic and functional benefits but may also have undesirable effects. Mandibular setback can cause narrowing of the airway space, which in association with other factors might lead to obstructive sleep apnea (OSA) symptoms. This case report presents the surgical orthodontic treatment of a female with mandibular prognathism, who experienced symptoms of OSA after surgical mandibular setback.*

Key words: *Surgery-first, Orthognatic surgery, Skeletal Class III malocclusion, Obstructive sleep apnea*

Introduction

Combined surgical-orthodontic treatment is usually the first option for adult patients with Class III skeletal malocclusion and mandibular prognathism.[1] Typically, pre-surgical orthodontic treatment performs decompensation, alignment, and leveling of the teeth and establishes compatible arch forms in the maxilla and in the mandible.[2,3] Then, orthognathic surgery for mandibular reduction is carried out through bilateral sagittal split ramus osteotomy (BSSO), having occlusion as the key to stabilization. Post-surgical orthodontics allows the detailing and finishing of the occlusion.

Surgery-first is a treatment alternative for mandibular prognathism, which avoids pre-surgical decompensation of the teeth and anticipates dentofacial esthetics improvement.[4-6] This procedure is challenging in obtaining stable occlusion after surgery due to multiple dental interferences [7] and in predicting the final occlusion.[4,7] Careful case selection is mandatory.[7] Decision-making with regard to timing of surgery must take into account the patients' needs and the surgical-orthodontic team skills.

Surgical correction of mandibular prognathism produces esthetic and functional benefits but may also have undesirable effects.[8-10] Mandibular setback can cause narrowing of the airway space,[1,8-13] which in association with other factors might lead to obstructive sleep apnea (OSA) symptoms.[8,9,11,13,14] OSA is a sleep disorder characterized by repeated collapse of the pharyngeal airway during sleep.[8] Hypoxia and repeated sleep awakenings experienced by patients with OSA have a significantly negative impact in the cardiovascular and respiratory systems and in quality of life.[8] The airway narrowing after mandibular setback surgery has received increasing attention in recent years, and new evidence shows that mandibular setback cannot be directly associated to the development of obstructive sleep apnea.[8-10] The real impact of the anatomical alterations following mandibular setback and their impact on the respiratory system still requires investigations and high quality data.[9,13]

This study reports the surgical-orthodontic treatment carried out in a woman with mandibular prognathism, who experienced symptoms of OSA after surgical mandibular setback.

Figure 1: Pre-treatment facial and intraoral photographs

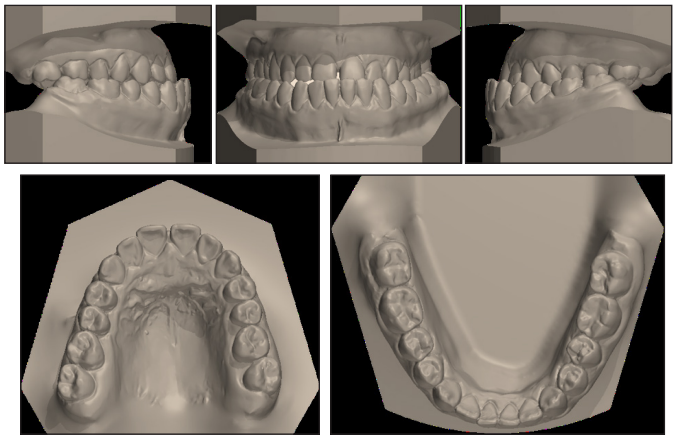

Figure 2: Pretreatment dental casts

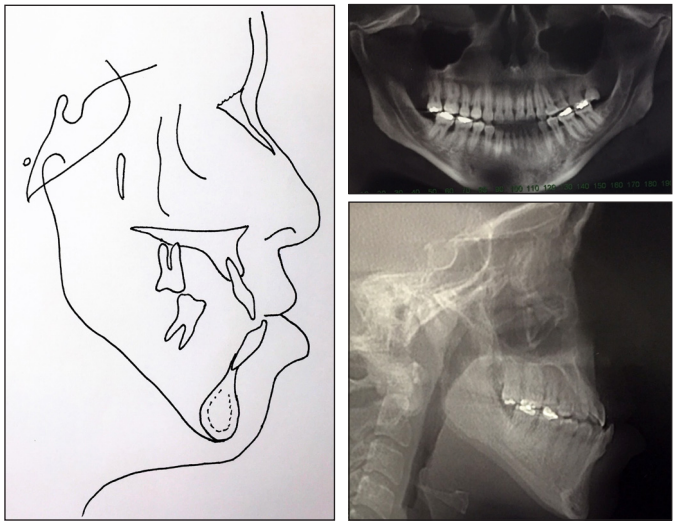

Figure 3: Pre-treatment lateral cephalometric and panoramic radiographs

Diagnosis and Etiology

A 20-year-old woman sought surgical-orthodontic treatment with a chief complaint of unpleasant facial appearance due to mandibular prognathism. The patient also reported chewing difficulties, chronic rhinitis, and adenoidectomy at the age of 17. She had evident speech and swallowing disorders. Pre-treatment photographs revealed a hyperdivergent facial type, with mandibular prognathism, slight mandibular asymmetry, and low smile. The profile was convex, with protruded lower lip, and no passive lip sealing. The intraoral photographs and dental casts presented all permanent teeth, except maxillary first molars and mandibular third molars, compatible maxillary and mandibular arch forms, mild crowding of mandibular incisors (3 mm), and no space discrepancy in the maxilla. Occlusion showed Class III molar and canine relationships, complete maxillary crossbite, normal overbite, and negative overjet (- 4 mm). Maxillary dental midline was coincident with facial midline, and mandibular dental midline was deviated 1 mm to the left side (Figures 1 and 2).

Lateral cephalometric analysis indicated a hyperdivergent Class III skeletal pattern (ANB, -1°; Wits, -5 mm; GoGn. SN, 44°), with mandibular prognathism (NPog.FH, 94°), proclination of maxillary incisors (1.NA, 25°; 1-NA, 9 mm), and upright mandibular incisors (IMPA, 83°). The profile was convex with a marked protrusion of the lower lip (S-Li, 10 mm). Pre-treatment panoramic radiograph demonstrated extrusion of maxillary third molars, root resorption in the upper left second premolar and in the lower right second molar, and failure of metallic restorations in the mandibular molars (Figure 3).

Treatment Objectives

The patient received the diagnosis of hyperdivergent skeletal Class III malocclusion with mandibular prognathism. Treatment objectives were: (1) to correct the maxillomandibular relationship, (2) to achieve Class I molar and canine relationship, normal overjet, and normal overbite, (3) to establish a functional occlusion, and (4) to improve dentofacial esthetics.

Treatment Alternatives

Comprehensive analysis of the data indicated that orthognathic surgery was essential to correct the skeletal discrepancy and improve dentofacial esthetics. Surgical maxillary advancement was discarded due to the adequate sagittal position of the maxilla and acute nasolabial angle.

Surgical mandibular setback alone was a viable treatment alternative for correction of sagittal discrepancy, mandibular prognathism, and mandibular asymmetry. The risk of this procedure was a reduction in the pharyngeal airway space with possible symptoms of OSA. Surgical procedures of reduction glossoplasty and chin advancement genioplasty, associated to surgical mandibular setback, would be alternative procedures to prevent these undesirable effects.

Instead of conventional surgical-orthodontic treatment, a surgery-first approach was chosen by the patient and the surgical-orthodontic team in attempt to anticipate dentofacial esthetics improvement. Full fixed appliances allowed decompensation, alignment and leveling of the teeth, and occlusion finishing.

Treatment Progress

Metallic 0.022-in standard edgewise brackets (American Orthodontics, Sheboygan, WI) were mounted in the maxillary and mandibular teeth, with bands in the four first molars. Afterwards, stainless steel passive 0.019 x 0.025-in arch wires with surgical hooks were placed (Figure 4). Before orthognathic surgery, alginate impressions were taken to obtain dental casts that demonstrated proper occlusion when manipulated in Class I molar and canine relationships.

Models surgery considering a 6 mm mandibular setback was performed, and a surgical splint was manufactured with self-curing acrylic. Cephalometric prediction of surgery outcomes was carried out with the Dolphin® software (Dolphin Imaging software, St. Paul, MN).

Surgical mandibular setback was performed trough BSSO, using rigid fixation and stabilization with acrylic splint and short Class III intermaxillary elastics. There were no transoperative complications and no immediate post-operative intercurrences. On sagittal view, the post-surgical scan showed the correction of mandibular prognathism and proper mandibular fixation (Figure 5). In the two-week follow-up consultation, the patient complained of snoring and breathing difficulties at nighttime.

Figure 4: Fixed appliances with passive rectangular arch wires: pre-surgical

Figure 5: Post-surgical photographs; scan in sagittal view

A polysomnography test confirmed the diagnosis of light OSA with an Hypopnea and Apnea Index (AHI) of 7.2. Epworth Sleepiness Scale Questionnaire was applied and indicated excessive sleepiness (14 points). A new decision-making process indicated surgical re-intervention. A glossoplasty reduced the hyperplasic tongue that was resting backwards and occluding the pharyngeal airway space. A chin advancement genioplasty stretched the excessive soft-tissue in the submandibular region and improved the profile contour and decreased anterior inferior facial height.

Orthodontic treatment proceeded using nickel-titanium (.014, .016, .018-in) and stainless steel (.018, .020-in) arch wires for alignment and leveling, and stainless steel .019 x .025-in wires for finishing and detailing of the occlusion. Following removal of fixed appliances, retention was carried out with an upper wraparound removable appliance and a metallic bar bonded to the mandibular canines.

Treatment Results

Treatment outcomes showed a dramatic improvement in the dentofacial esthetics. The patient achieved a symmetric face with pleasant appearance, harmonious profile, and attractive smile. Maxillary and mandibular arch forms were semi-elliptical, presenting well-aligned and leveled teeth. There was bilateral molar and canine Class I relationships, normal overjet and overbite (Figure 5). Functional occlusion was established with proper anterior guides and coincidence between centric relation and centric occlusion.

Post-treatment panoramic radiograph shows parallel tooth roots and root resorption control. Lateral cephalometric radiograph analysis revealed a Class I hyperdivergent skeletal pattern (ANB, 1°; Witts, 1 mm; GoGn.SN, 47°); slight protrusion of maxillary incisors (1.NA, 24°; 1-NA, 8 mm); upright mandibular incisors (IMPA, 84°); and harmonious profile (S-Ls, 1 mm; S-Li, 1 mm) (Figure 6; Table 1). Pre-treatment and post-treatment cephalograms superimposition shows similar amount of mandibular reduction and of chin advancement (Figure 6).

OSA symptoms were overcome after glossoplasty and genioplasty. The patient made clear her satisfaction with treatment esthetic and functional outcomes, as well as with improvement in quality of life. The surgical-orthodontic team considered treatment benefits were taken to the highest level.

Discussion

In the present case, surgery-first treatment was performed to treat a patient with a chief complaint of unaesthetic mandibular prognathism. Due to the adequate incisors position, compatible arch forms, and stable occlusion presented at the beginning of treatment, verified by dental casts analysis and model surgery, this patient was eligible for a surgery-first approach. The advantages of such procedure includes immediate improvement of facial esthetics,[4] shorter treatment time, [4,15,16] and the possibility of physiologic decompensation,[4] as tooth movements are favored by muscle force, instead of going against it. In the present case, treatment was performed in 30 months. This longer treatment time was attributed to the development of obstructive sleep apnea secondary to the mandibular surgical intervention and the need for chin advancement and tongue reduction.

Mandible surgery was indicated for this patient due to prognathism, slight deviation, and high mandibular plane angle. A bilateral sagittal split osteotomy with a mandibular setback of 6 mm was performed. This procedure reduced the posterior airway space. Minimum axial area reduced from 168 mm^2 to 132 mm^2, verified by means of the Dolphin Imaging® Software. This reduction may have contributed to the developed OSA symptoms.

Figure 6: Post-treatment facial and intraoral photographs

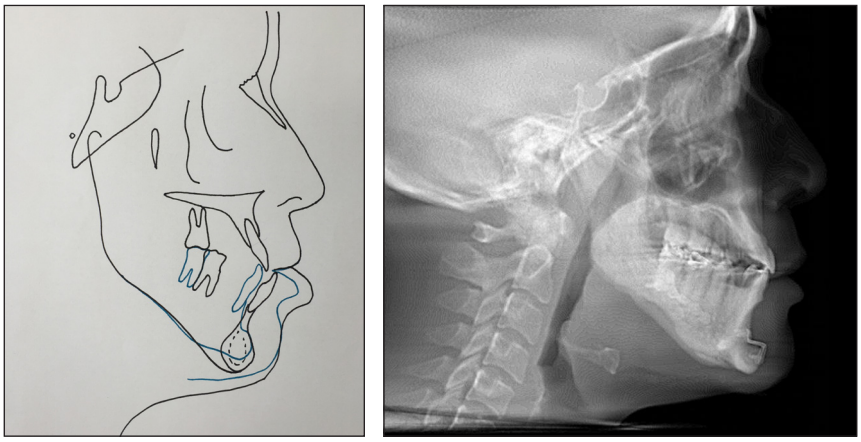

Figure 7: Post-treatment lateral cephalometric radiograph and superimposition

The pathophysiology of OSA includes factors related to upper airway anatomy, upper airway resistance, and upper airway muscle function during sleep. Obese patients that require large mandibular setback are considered at high risk of developing OSA symptoms.[1] Upper airway anatomy varies considerably among patients, so that no single finding is pathognomonic of obstructive apnea. However, the narrowing of the upper airway is commonly observed, especially at the level of the soft palate and the base of the tongue.[1] Mandibular setback osteotomies tend to decrease the pharyngeal airway dimensions[1,8-11,14] possibly by inferior displacement of the hyoid bone[1,8,11] and posterior displacement of the base of the tongue.[1,8] The reduction in airway dimensions was associated to the developed OSA symptoms in our patient. This complication was not anticipated as there were no symptoms at the beginning of treatment, and the patient did not require a large mandibular setback.

To solve OSA different procedures have emerged: mainly maxillo-mandibular advancement (MMA),[17] tongue base reduction, and genioplasty advancement.[18] Advancement genioplasty has been cited as an effective method of anterior repositioning of the hyoid and of tongue base with statistically significant increase in the oropharyngeal size.[18] The results of these various procedures depend on their correct indication, with definition of the obstructive site prior to the election of any technique.

There is evidence that the narrowed pharyngeal airway mostly recovers with time, meaning that OSA symptoms may be transitory.[9,19] Despite this evidence, our patient requested an advancement genioplasty for better aesthetic results, indicating the need of new surgical intervention. New decision-making process considered the large tongue size a possible risk factor for OSA as well as for relapse. Thus, genioplasty and glossectomy would possibly diminish the respiratory disturbance, while generating optimal aesthetic results and contributing for case stability, respectively.

Currently, an effective craniofacial surgical technique to reduce AHI values is MMA.[10,17] This technique alters the posterior airway by anterior positioning of the tongue, elevation of the hyoid, shortening of the soft palate, and expansion of the airway in the lateral and AP dimensions. Despite these indications, maxillary advancement was not considered for our patient due to aesthetic considerations. The OSA developed secondary to the mandibular retrusion was undermined by advancement genioplasty and glossectomy. Advancement genioplasty has been cited as an effective method of anterior repositioning of the hyoid and of tongue base, with statistically significant increase in the oropharyngeal size.[18] Surgical chin advancement was also indicated for additional improvement in facial profile and lower anterior face height.

After the second surgical intervention, a gain in the oropharynx area and volume was observed. Total airway area changed from 438 to 448 mm^2 and airway volume from 9573 to 9741 $mm,^3$ which probably correlates to clinical findings of improved breathing. At this point, there were no respiratory symptoms or snoring issues.

After completion of treatment, a Class I normal occlusion with adequate overjet and overbite was obtained. A three-year follow-up revealed maintenance of the occlusal and facial results, indicating stability of the intervention.

The patient remained satisfied with her appearance and did not present sleeping or breathing difficulties.

Although mandibular setback reduces the airway space, there is evidence that it does not affect AHI values or induces obstructive sleep apnea alone.[8-10,12] OSA is a multifactorial condition,[1] and other factors may play a role. This case report highlights the importance of careful planning when considering mandibular setback, as there is a risk of secondary respiratory complications in high risk patients.[1,8,11,13,14] In order to identify sleep disorders and respiratory disturbances, a polysomnography is the gold standard for diagnosis. Conducting an Epworth Sleepiness Questionnaire may help to identify patients at risk of developing obstructive sleep apnea.

Conclusions

In the present case, surgery-first was used to effectively treat a patient with severe skeletal Class III malocclusion due to mandibular prognathism. Patient developed obstructive sleep apnea secondary to the surgical intervention. A new surgical procedure for chin advancement and tongue reduction overcame the OSA symptoms and provided additional aesthetic improvement. Optimal respiratory and occlusal functions with pleasant esthetical results were achieved.

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