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CASE REPORT:

Obstructive Sleep Apnea: A Case Report and Literature Review

Apnea obstructiva del sueño: reporte de caso y revisión de literatura

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ABSTRACT: Obstructive sleep apnea (OSA) is a sleep disorder caused by upper airway obstruction during sleep, leading to airflow interruption. Despite its increasing prevalence, OSA remains largely underdiagnosed. This literature review and case report aims to update the dental community on the diagnosis and management of OSA while presenting the case of a patient treated with a multidisciplinary approach including surgical intervention. We report the case of a 27-year-old patient with a chief complaint of respiratory impairment, snoring, and unaesthetic chin projection, associated with daytime sleepiness, headaches, severe snoring, fatigue, and extreme exhaustion. The patient presented with a BMI of 32 kg/m², a class II dentofacial deformity, mandibular retrognathism, and moderate OSA (apnea-hypopnea index: 22), and was treated with maxillomandibular advancement (MMA) with counterclockwise rotation of the occlusal plane, genioplasty and lifestyle modifications. The intervention resulted in a reduction of the Apnea-Hypopnea Index to 0.5 events/hour and a favorable esthetic and functional outcome. Long-term weight management remains crucial to prevent recurrence, while annual follow-up ensures appropriate monitoring. This case supports existing evidence on the benefits of surgical correction in appropriately selected patients and highlights the importance of multidisciplinary management in OSA treatment.

KEYWORDS: Obstructive sleep apnea; Orthognatic surgery; Maxillomandibular advancement; Le Fort type I osteotomy; Counterclockwise rotation; Bilateral sagittal split osteotomy; Case report.

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RESUMEN: La apnea obstructiva del sueño (AOS) es un trastorno del sueño causado por la obstrucción de la vía aérea superior durante el sueño, lo que provoca interrupciones en el flujo de aire. A pesar de su creciente prevalencia, la AOS continúa siendo ampliamente subdiagnosticada. Esta revisión de literatura y reporte de caso tiene como objetivo actualizar a la comunidad odontológica sobre el diagnóstico y manejo de la AOS, así como presentar el caso de una paciente tratada mediante un enfoque multidisciplinario que incluyó intervención quirúrgica. Se presenta el caso de una paciente de 27 años con una queja principal de ronquidos y proyección antiestética del mentón, asociados con somnolencia diurna, cefaleas, ronquido severo, y fatiga. La paciente presentaba un IMC de 32 kg/m², deformidad dentofacial clase II, retrognatia mandibular y AOS moderada (índice de apnea-hipopnea: 22), y fue tratada mediante avance maxilomandibular (MMA) con rotación antihoraria del plano oclusal, genioplastia y modificaciones del estilo de vida. La intervención resultó en una reducción del índice de apnea-hipopnea a 0.5 eventos/hora y en un resultado estético y funcional favorable. El control del peso a largo plazo continúa siendo fundamental para prevenir recurrencias, mientras que el seguimiento anual permite un monitoreo adecuado. Este caso respalda la evidencia existente sobre los beneficios de la corrección quirúrgica en pacientes apropiadamente seleccionados y destaca la importancia del manejo multidisciplinario en el tratamiento de la AOS.

PALABRAS CLAVE: Apnea obstructiva del sueño; Cirugía ortognática; Avance maxilomandibular; Osteotomía Le Fort I; Rotación antihoraria; Osteotomía sagital bilateral mandibular; Reporte de caso.

INTRODUCTION

Sleep apnea is defined as recurrent episodes of interrupted airflow during sleep and is broadly classified into obstructive sleep apnea (OSA) and central sleep apnea. In central sleep apnea, there is an absence of respiratory effort during the apneic event, whereas OSA is characterized by a persistent respiratory effort despite airflow limitation caused by a physical obstruction of the upper airway, leading to a partial (hypopnea) or complete (apnea) cessation of airflow. Mixed sleep apnea may also occur, in which the apneic event begins as central sleep apnea and progresses to an obstructive pattern (1-3).

Untreated OSA has been associated with an increased risk of multiple comorbidities, including hypertension, cardiovascular disease, stroke, and type 2 diabetes mellitus. Common symptoms include unrefreshing sleep, snoring, excessive daytime sleepiness, and fatigue, which contribute to a reduced quality of life (2).

Several anatomical and physiological factors contribute to OSA. Craniofacial abnormalities, such as Class II deformities and mandibular retrognathism, are strongly associated with OSA, as these structural characteristics may reduce upper airway dimensions and predispose patients to airway collapse during sleep (3). Additionally, OSA has a higher prevalence in patients with obesity, male sex and older age (4-10).

The management of OSA can be broadly divided into surgical and non-surgical interventions. Surgical options, including uvulopalatopharyngoplasty (UPPP), maxillomandibular advancement (MMA), genioplasty, and hypoglossal nerve stimulation, aim to increase airway space by altering the anatomy of the upper airway (1,10-21). Non-surgical treatments, such as continuous positive airway pressure (CPAP), oral appliance therapy (OA), myofunctional therapy, pharmacological treatments, and behavioral interventions (weight loss, lifestyle modifications and positional therapy), can also be effective. Nonetheless,

their success often depends on patient adherence, which can be inconsistent, particularly with OAs and CPAP (7,22-27). For patients with dentofacial deformities, moderate to severe OSA or a limited compliance to OAs or CPAP, maxillomandibular advancement (MMA) has emerged as an effective and long-term surgical treatment (9). This literature review and case report aims to update the dental community on the diagnosis and management of OSA while presenting the case of a patient treated with a multidisciplinary approach including surgical intervention.

CASE REPORT

This case report was conducted following the Case Report (CARE) guidelines (28). A 27-year-old female patient with no hereditary or systemic medical conditions presented with a chief complaint of respiratory impairment, snoring, and unaesthetic chin projection, along with the following associated symptoms: daytime sleepiness, headaches, severe snoring, fatigue, and extreme exhaustion. She had previously been evaluated by other practitioners, who recommended the use of CPAP or a mandibular advancement device. However, the patient sought a long-term treatment option that was not dependent on compliance and that would address both her respiratory impairment and facial esthetic concerns.

On physical examination, the patient measured 1.67 meters in height and weighed 90 kg., with a body mass index (BMI) of 32 kg/m², categorizing her as class I obese. To address this, she underwent treatment with a nutritionist and was guided to implement lifestyle modifications, including dietary management and regular exercise. Additionally, she was diagnosed with stage I, grade B periodontitis and underwent periodontal treatment. Once periodontal stability was achieved, she began orthodontic decompensation treatment in preparation for orthognathic surgery.

A comprehensive diagnostic evaluation was conducted, including maxillofacial cone-beam computed tomography (CBCT) using a Planmeca Oy Promax 3D Plus®, intraoral photographs, extraoral photographs taken in a natural head position (Figure 1), orthopantomography (OPG), lateral cephalometric radiograph (Figure 2) and clinical facial analysis. STL files of maxillary and mandibular dental scans were obtained with a 3Shape® TRIOS 3 scanner. Following this evaluation, the patient was diagnosed with a Class II dentofacial deformity and mandibular retrognathism, with no clinical or radiographic pathological findings in the temporomandibular joints (TMJ).

The patient underwent evaluation with a sleep specialist, who evaluated her sleep-related symptoms. The assessment revealed an Epworth Sleepiness Scale (ESS) score of 8 and a STOP-BANG questionnaire score of 5, indicating a high risk of obstructive sleep apnea. A home-based nocturnal polysomnography was performed in March 2024 using a Philips Respironics Alice NightOne device, equipped with a respiratory inductance plethysmography (RIP) effort belt and a pressure-based flow sensor. The collected data included measurements of snoring, respiratory activity, oxygen saturation, heart rate, hypopneas, obstructive sleep apneas, mixed sleep apneas, central sleep apneas, and body position. The polysomnography recorded an AHI of 22 events/hour, consistent with moderate OSA. Detailed respiratory event data are presented in Table 1.

Following a multidisciplinary evaluation, a treatment plan was developed based on the patient's OSA diagnosis, her dentofacial deformity, and her chief complaint. As the patient preferred a long-term treatment option that was not dependent on compliance, and considering that she was an appropriate candidate for surgical intervention due to her craniofacial characteristics and OSA severity, orthognathic surgery was determined

to be the most appropriate treatment choice, in combination with lifestyle modifications.

Virtual surgical planning was performed using NemoFAB® software, and occlusal splints were printed and prepared for use in the operating room. The surgical treatment plan included orthognathic surgery, consisting of MMA with subspinal LeFort type 1 osteotomy, counterclockwise rotation of the occlusal plane, and genioplasty. No intraoperative complications were encountered.

The patient was hospitalized and received: intravenous (IV) cephalexin (2g), IV dexketoprofen (50 mg every 8 hours), IV morphine (3mg, administered as needed every 6 hours), dimenhydrinate (50 mg PO every 8 hours), IV dexamethasone (4 mg every 8 hours), facial icepacks, and a liquid diet. The patient was discharged after 12 hours and prescribed: amoxicillin/clavulanic acid (875mg/125mg, every 12 hours for 7 days), dexketoprofen (25 mg, every 8 hours for 5 days), acetaminophen/codeine (500 mg/30 mg, every 6 hours for 5 days), deflazacort (30 mg, daily for 3 days), oral rinses with chlorhexidine (0.12%, every 12 hours for 7 days), oxymetazoline nasal spray (0.05%, every 8 hours for 3 days) and a liquid diet. To facilitate a rapid recovery, early physiotherapy was encouraged with a structured regimen of masticatory muscle thermotherapy and exercises to monitor maxillomandibular opening.

OPG, extraoral photographs in natural head position (Figure 3) and a lateral cephalometric radiograph (Figure 4) were taken one week postoperatively. Follow-ups were conducted weekly during the first month, transitioning to monthly evaluations thereafter. Postoperative orthodontic treatment was performed.

To assess the surgical outcome on her OSA, the patient underwent a second home-based nocturnal polysomnography in December 2024, approximately 9.5 months postoperatively. Ideally, another CBCT would have been performed; however, as the patient was pregnant at the time, it was not obtained. The post-operative polysomnography recorded an AHI of 0.5 events/hour, with no recorded obstructive, central, or mixed apneas. Only three hypopneas were identified. Detailed respiratory event data are presented in Table 2. At the time of evaluation, the patient's weight had decreased to 88 kg, corresponding to a BMI of 31.3 kg/m^2. The patient expressed satisfaction with both the esthetic and functional outcomes of the surgery, with improvement in the initially reported symptoms of daytime sleepiness, headaches, severe snoring, fatigue, and extreme exhaustion.



Figure 1. Preoperative right profile.



Figure 2. Preoperative lateral cephalometric radiograph.

Table 1. Preoperative polysomnographic respiratory events and positional analysis.

Respiratory Events									
					Number of events per position				
Event type	Index (events/hour)	Total events	Mean duration (s)	Maximum duration (s)	Supine	Prone	Left	Right	Upright
Central apneas	0.1	1	76.0	76.0	1		0	0	0
Obstructive apneas	4.8	38	15.1	32.5	37		1	0	0
Mixed apneas	0.0	0	0.0	0.0	0		0	0	0
Hypopneas	17.1	136	29.3	98.0	120		14	1	1
Apneas + hypopneas	22.0	175	26.5	98.0	158		15	1	1
RERA	0.0	0	0.0	0.0	0		0	0	0
Total	22.0	175	26.5	98.0	158		15	1	1
Time in position (min)					272.3		156.4	47.5	3.7
REI in position					34.8		5.8	1.3	85.7

RERA: Respiratory effort related arousal. REI: Respiratory event index.

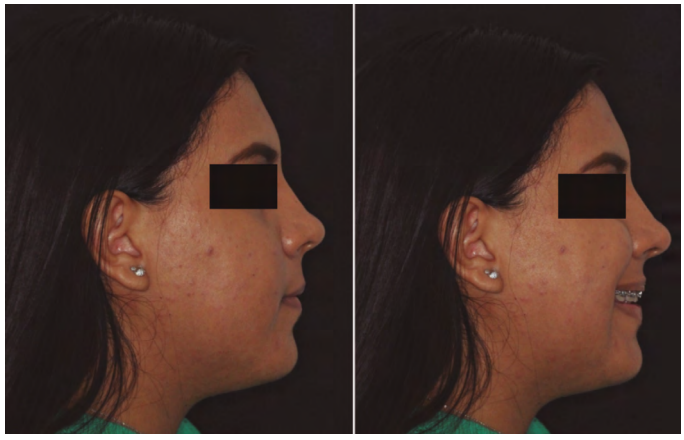


Figure 3. Postoperative right profile.

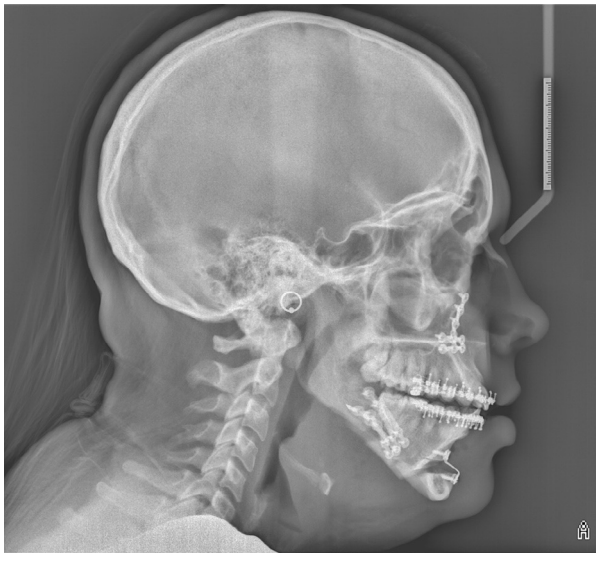


Figure 4. Postoperative lateral cephalometric radiograph.

Table 2. Postoperative polysomnographic respiratory events and positional analysis.

Respiratory Events									
					Number of events per position				
Event type	Index (events/hour)	Total events	Mean duration (s)	Maximum duration (s)	Supine	Prone	Left	Right	Upright
Central apneas	0.0	0	0.0	0.0	0		0	0	0
Obstructive apneas	0.0	0	0.0	0.0	0		0	0	0
Mixed apneas	0.0	0	0.0	0.0	0		0	0	0
Hypopneas	0.5	3	21.5	24.5	3		0	0	0
Apneas + hypopneas	0.5	3	21.5	24.5	3		0	0	0
RERA	0.0	0	0.0	0.0	0		0	0	0
Total	0.5	3	21.5	24.5	3		0	0	0
Time in position (min)					224.7		122.6	107.2	0.4
REI in position					1.2		0.0	0.0	0.0

RERA: Respiratory effort related arousal. REI: Respiratory event index.

DISCUSSION

ASSESSMENT AND DIAGNOSIS OF OSA

OSA is a respiratory sleep disorder with increasing prevalence, yet patients rarely report sleeping problems. Therefore, practitioners should include questions about common symptoms such as snoring, excessive daytime sleepiness, and nighttime breathing pauses (29).

Tools such as the STOP-BANG questionnaire are highly sensitive for identifying moderate and severe OSA. (6) It can be completed in a short amount of time and consists of yes/no questions based on its acronym: (S) Snoring, (T) Tiredness, (O) Observed pauses in breathing, (P) High blood pressure, (B) BMI >35 kg/m², (A) Age >50 years, (N) Neck circumference ≥17 inches in men and ≥16 inches in women, and (G) Gender: male (29).

The Epworth Sleepiness Scale (ESS) could be useful for measuring daytime sleepiness and quality of life, but it should not be used as a screening tool, as it has low sensitivity for OSA and identifies daytime sleepiness independent of its cause. Other questionnaires, such as the Berlin Sleep Apnea Questionnaire, may also provide valuable information, as it was developed for the risk of OSA in the primary care setting (29).

These questionnaires are useful for identifying the risk of OSA, but they are not definitive diagnostic tools. The standard diagnostic method is the polysomnography, which monitors various sleep and respiratory parameters. The evaluation can be performed either in a laboratory or at the patient's home; however, the home-based method is preferred, as the laboratory-based method is labor-intensive and inconvenient for the patient, and generally more costly than the home-based version. Polysomnography records respiratory effort, snoring, brain activity (electroencephalography) to monitor sleep stages and arousal activity, eye movements (electrooculography), muscle activity (electromyography) to track body position and body movements, heart rhythm (electrocardiography), and oxygen saturation during sleep. This test provides the AHI, which quantifies OSA severity as: an AHI of less than 5 is considered normal, 5-14.9 mild OSA, 15-29.9 moderate OSA, and 30 or higher as severe OSA (30).

RISK FACTORS

OSA risk factors comprise overweight and obesity, male sex, older age, enlarged upper airway soft tissues (tonsils, adenoids, and tongue), and certain craniofacial abnormalities (Class II malocclusion, maxillary protrusion, vertical maxillary excess, mandibular retrusion, and narrow palate) (6). Patients with OSA typically have longer, narrower, and oval-shaped airways, caused by factors such as an abnormal inferior position of the hyoid bone, mandibular or maxillary retrognathia, and enlargement of the tongue and pharyngeal walls due to fat deposition (4,6,29,31,32). Excess adipose tissue around the upper airway, common in obese and overweight individuals, further increases airway susceptibility to collapse (33). Men are more likely than women to have increased adipose tissue deposition around the airway and a longer airway, both of which predispose to collapse. Additionally, AHI has been demonstrated to increase with age, but the underlying physiological mechanism remains unclear (34).

PATHOPHYSIOLOGY

OSA results from an imbalance between collapsing and dilating forces on the upper airway. Collapsing forces include anatomical and extraluminal factors such as adipose tissue deposition, pharyngeal edema or inflammation, adenotonsillar hypertrophy, macroglossia, and skeletal factors including mandibular or maxillary retrognathia. Intraluminal collapsing forces refer to pressure changes during inspiration and expiration (31,34).

Dilating forces oppose these collapsing forces of the upper airway, which are primarily mediated by the activity of pharyngeal dilator muscles. The genioglossus muscle acts as the main dilator. Its basal tone helps maintain upper airway patency and provides a reflexive response to negative intraluminal pressure (16, 32).

Beyond these anatomical factors, the organism's response to the metabolic disturbance (hypoxia or hypercapnia) caused by airway obstruction, is also crucial in the pathogenesis of OSA. Episodes of hypoxia and hypercapnia trigger arousal responses to restore ventilation, therefore, this response must be efficient and well-controlled to avoid sleep interruptions (31,35).

In the present case, the combination of class I obesity and mandibular retrognathia likely contributed to this imbalance between collapsing and dilating forces. Adipose tissue deposition around the airway and the patient's class II skeletal deformity reduced airway dimensions and increased susceptibility to pharyngeal collapse during sleep.

NON-SURGICAL MANAGEMENT OF OSA

CONTINUOUS POSITIVE AIRWAY PRESSURE (CPAP)

CPAP is considered as the gold standard treatment for OSA. Pressure is delivered to the airway through a nasal or oro-nasal mask to maintain airway patency during sleep and prevent the airway's collapse (36). When used consistently, CPAP has demonstrated to be highly effective in reducing symptoms, significantly lowering AHI, and improving daytime sleepiness, quality of life, mental and physical functionality, and cognitive performance (26,37).

Nonetheless, CPAP requires long-term adherence and patient cooperation for apnea control, but due to its side effects this treatment lacks proper compliance (24). Reported side effects include dry mouth, discomfort and air leaks caused by the mask, nasal congestion, sleep disruption, noise, eye irritation and difficulty adjusting sleep positions (2,27).

ORAL APPLIANCE THERAPY

Other authors have found oral appliances (OAs) to be an effective alternative treatment (26,27,37,38). There are three main types: mandibular advancement devices (MADs) which are the most used, tongue retaining devices (TRDs), and soft palate-lifting devices (26). MADs work by holding the mandible and surrounding soft tissues forward during sleep, increasing the upper airway diameter at the oropharyngeal level (29).

According to Ngiam *et al*. (37), OAs are indicated for patients with snoring and mild to moderate OSA who prefer OAs over CPAP, are not CPAP candidates, or have failed CPAP treatment. They are contraindicated in cases of multiple comorbidities, severe periodontal disease, temporomandibular disorder, inadequate retention for the OA, severe gag reflex, and poor coordination for handling of the OA (1).

A study analyzing three-dimensional changes of the upper airway during OA therapy found that MADs significantly increased the cross-sectional area at a posterior soft palate level. There was a 102% increase in the mean volume of the entire upper airway, an increase of 128% at a retropalatal level and 98% at a retroglossal level (39). OAs have proved to reduce AHI and daytime sleepiness (26).

Long-term use of OAs has been reported to cause arthralgia, myofascial pain, tooth pain, and occlusal changes, which can interfere with patient compliance. Thus side effects should be carefully managed by the dental practitioner (37). Although compliance with both CPAP and OAs tends to decline over time, studies indicate that patients are generally more likely to adhere to

OA therapy, as demonstrated by a randomized, placebo-controlled trial, which showed a higher compliance rate for MADs than for CPAP (27,40). While CPAP is more effective at reducing AHI, both treatments show similar improvements in quality of life, daytime sleepiness, and cognitive function. This is attributed to the fact that, although CPAP has higher efficacy for apnea control than OAs, it is offset by CPAP's lower compliance rate, leading to similar long-term outcomes in terms of AHI reduction (40,41).

OTHER ADJUNCTIVE THERAPIES

Several adjunctive strategies may contribute to the management of OSA as part of a comprehensive treatment approach. Lifestyle modifications, such as weight loss, should be recommended as an adjunct to other treatments for all overweight and obese OSA patients (7). As our patient had class I obesity, regular exercise and diet control were recommended to reduce her BMI. Regular exercise, independent of weight loss, may improve OSA, however, the mechanism remains unclear (6).

Withdrawing or reducing alcohol consumption is advised, as its consumption has been linked to an increase in the number of apneic events (7). For some patients, simply altering sleep posture from supine to prone or lateral positions may significantly reduce symptoms (6). Barbiturates, narcotics, benzodiazepines and sleep-inducing medications should be avoided, as they cause respiratory depression and may worsen OSA (22).

Pharmacological treatments targeting various aspects of OSA, such as upper airway muscle tone, mucosal surface, airway diameter, lower airway tract, ventilatory drive, and arousal threshold, have been explored. However, the results remain inconclusive, and based on current evidence, pharmacotherapy cannot be recommended as a treatment for OSA (22,42).

Myofunctional therapy has been proposed as a potential adjunctive treatment. This therapy involves a range of isometric and isotonic exercises targeting the lips, tongue, lateral pharyngeal walls, soft palate, as well as swallowing and chewing exercises that aim to improve stomatognathic function and enhance oropharyngeal muscle tone while reducing adipose tissue in the tongue (24). However, when compared to other treatments, myofunctional therapy showed minimal or no improvement in daytime sleepiness and had little to no impact on AHI (23). Further research is needed to better assess its effectiveness in treating OSA.

SURGICAL MANAGEMENT OF OSA

HYPOGLOSSAL NERVE STIMULATION

Hypoglossal nerve stimulation has recently emerged as a surgical treatment option for OSA. Since the hypoglossal nerve controls the genioglossus muscle, stimulating it causes the tongue to move forward, helping maintain airway patency (13). This treatment involves implanting a device with a nerve stimulator, a sensor to detect breathing patterns, and a pulse generator placed in the chest. A controller is provided to the patient for therapy control (25). Candidates for this procedure include patients who are 22 years or older, have failed CPAP therapy, have an AHI between 15 and 65 (moderate or severe OSA), a BMI $\leq$ 32 kg/m^2 and an adequate anatomy for implantation (13,25). While studies have shown a significant reduction in AHI, the treatment is only effective for a select group of patients: CPAP non-responders with a BMI below 32, an AHI under 50, and a favorable upper airway collapse pattern on drug-induced sleep endoscopy (43).

UVULOPALATOPHARYNGOPLASTY

Uvulopalatopharyngoplasty (UPPP) is a surgical procedure that involves the excision of

the uvula, tonsils, and the soft palate mucosa with preservation of the muscle layer (1). First introduced by Fujita *et al*. (1) in 1981, UPPP was initially considered a promising surgical treatment for OSA, with reports of significant improvements in daytime sleepiness, snoring, nocturnal oxygenation, and apnea frequency, without major postoperative side effects. However, recent studies (14,15) have reported a low success rate of 40.8% and adverse effects including nasal regurgitation, difficulty swallowing, dry throat, taste disturbances, and voice changes. Certain side effects may be reduced by preservation of the uvula. Nevertheless, OSA typically involves multilevel airway obstruction (16), therefore, sole treatment with UPPP is unlikely to fully resolve OSA symptoms, as it primarily targets obstruction at a retropalatal level (13).

MAXILLOMANDIBULAR ADVANCEMENT

Maxillomandibular advancement (MMA) is a surgical procedure that enlarges the airway at a nasopharyngeal, retropalatal and hypopharyngeal level by simultaneously advancing the maxilla and mandible forward using a LeFort type I osteotomy and bilateral sagittal split osteotomy (BSSO), respectively. (17). The advancement of the skeletal structure pulls the tongue, velopharyngeal, and suprahyoid muscles forward, increasing airway diameter and reducing the risk of collapse (18). Patients with moderate to severe OSA, maxillomandibular hypoplasia, mandibular retrognathism, and high residual AHI after failure of other surgical and therapeutic interventions are highly likely to benefit from MMA (10,44).

The most common reported adverse event is inferior alveolar nerve paresthesia, which resolves in 90% of patients, within 6 to 12 months (17). Surgical relapse occurs in 15% of OSA patients, but with no associated symptoms or worsening of AHI (10). Major complications are rare, and no deaths have been reported directly associated with MMA (17). Our patient did not experience any complications.

The anterior movement of the airway musculature insertion site with MMA increases soft tissue tension, expanding the airway both laterally and anteroposteriorly (17). Faria *et al*. (20) conducted a study based on the cephalometric analysis of OSA patients before and after MMA, reporting a mean advancement of 6.16 mm for the maxilla and 6 mm for the mandible. This resulted in an increase in pharyngeal airway space (PAS) from a mean 8.74 mm to 15.95 mm (20). These findings support MMA as an effective method for airway enlargement. However, since cephalometry provides a two-dimensional view of a three-dimensional structure, these results are not as accurate as those obtained from a three-dimensional analysis of the airway.

Schendel, Broujerdi, and Jacobson (35), performed three-dimensional analysis of the upper airway and reported a 237% increase in total upper airway volume after MMA, with larger expansion laterally and a more pronounced increase at the retropalatal level (361%) compared to the retroglossal level (165%). Compared to OAs, MMA achieves a significantly greater airway enlargement. Additionally, MMA leads to a slight shortening of the airway due to superior displacement of the hyoid bone and a transformation of the airway shape from a funnel to a more cylindrical form, reflecting a normalization in the shape of the airway (35).

Butterfield *et al*. (21) reported an 80% increase in airway volume and a 212% increase in the minimal cross-sectional area. Similarly, Gottsauner *et al*. (4), stated in a systematic review that most linear, areal, and volumetric measurements showed significant post MMA improvements, correlating with reductions in AHI. These findings indicate that MMA achieves a greater degree of three-dimensional airway expansion compared to OAs, with the

added advantage that its effects are permanent and do not rely on the continuous use of an intraoral device.

While we were unable to conduct a postoperative three-dimensional airway analysis, the polysomnography results showed a significant improvement, with the AHI decreasing from an initial 22 to a postoperative value of 0.5, reflecting a reduction in AHI of 97.73%. MMA's impact on OSA severity is assessed through post operative AHI changes, using the definitions of surgical success and surgical cure. Surgical success is defined as an AHI reduction of >50% or <20 events per hour. Surgical cure is defined as <5 events per hour (12,17,21). Therefore, our patient met the criteria for surgical cure.

Nevertheless, annual follow-ups are recommended to monitor her condition, and continued adherence to the recommended lifestyle modifications remains essential. Although the patient experienced some weight reduction, her BMI remained within the range of class I obesity, however, the postoperative measurements were obtained during pregnancy. She continues to follow healthy practices, including diet control and regular physical activity, to further reduce OSA risk factors and support long-term respiratory health.

Aside from MMA's functional benefits, it can also have a significant impact on facial appearance as the patient's skeletal structure is significantly altered. Cohen-Levy *et al*. (50) state that MMA produces a "reverse facelift" effect, as it brings forward the mid and lower facial skeletal structures, tightening soft tissues and rejuvenating the patient's appearance. Since OSA has a higher prevalence in older patients with visible signs of aging, this forward repositioning may help conceal visible signs of aging while also contributing to a satisfactory functional outcome. Post MMA analysis shows 93% of patients were satisfied with their appearance as well as a significant improvement in quality of life and OSA symptom relief (50).

Several modifications can optimize both airway function and esthetic results, including counterclockwise rotation of the occlusal plane, genioplasty and genioglossus advancement, pre or postoperative orthodontics, and Le Fort I modifications involving the maxilla, zygoma, or subspinal osteotomies. These adjustments are tailored to each patient's characteristics and desired outcomes (17,45,46). For our patient, the surgical modifications included counterclockwise occlusal plane rotation, genioplasty, and a subspinal Le Fort type I osteotomy.

MMA with counterclockwise occlusal plane rotation provides greater airway volume increases than straight MMA advancement (47). When combined with a subspinal Le Fort type I osteotomy, the nasolabial esthetics are enhanced (48). This approach has been reported to improve posterior pharyngeal airway dimensions, superior facial esthetic results and a significant reduction in AHI (10, 33).

Genioplasty and genioglossus advancement are commonly performed in combination with MMA for facial esthetics and to provide further advancement of the genial tubercles to target obstruction at a hypopharyngeal level by pulling the genioglossus muscle forward. Patients with mandibular retrognathism and retrogenia particularly benefit, as it also targets their skeletal anomaly, and a better esthetic result is achieved, as was the case with our patient (11). When combined with MMA, genioplasty has been linked to increased PAS, particularly at the hypopharyngeal level. Genioplasty and genioglossus advancement are widely used as part of multilevel surgery for OSA patients to provide better esthetic results (49,50).

CONCLUSION

OSA is not a solely anatomic disorder, but rather a multifactorial condition, where anatomical and physiological factors converge to cause airway collapse during sleep. The increasing prevalence of OSA, which is often underreported by patients, highlights the need for greater awareness in the dental community. Increased recognition of OSA symptoms is essential to ensure appropriate testing and diagnosis in patients with symptoms or those with predisposing anatomical characteristics.

Risk factors such as obesity, craniofacial abnormalities, and lifestyle habits play a crucial role in OSA pathophysiology, as observed in our patient, who presented with class I obesity and a Class II dentofacial deformity with mandibular retrognathia. This case highlights the importance of a personalized, multidisciplinary approach. Treatment in this instance began with addressing the patient's periodontal needs, evaluation by a sleep specialist, followed by orthodontic intervention, orthognathic surgery and a concurrent management of her BMI with a nutritionist. Furthermore, the case emphasizes the potential benefit of correcting underlying anatomical deficiencies through definitive surgical interventions such as MMA, which directly mitigates airway obstruction.

Despite the successful surgical outcome, the patient still requires annual check-ups, diet control, regular exercise, and ongoing management to further decrease BMI, as obesity remains a predisposing factor for OSA. This multidisciplinary approach will help ensure continued health and minimize the risk of recurrence. While non-surgical therapies like CPAP and oral appliances remain effective for many patients, those with dentofacial anomalies and compliance difficulties may achieve more sustainable outcomes through surgical intervention.

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