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Research Article

Contributions of Orthognathic Surgery in the Treatment of Obstructive Sleep Apnea Syndrome (OSAS), Literature Review

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Abstract

Apnea is a medical condition characterized by temporary pauses in breathing during sleep. Apneas are mainly classified into 2 types: Central sleep apnea (ACS): it is caused by a temporary failure of the ponto-spinal center that is responsible for generating rhythmic breathing. Obstructive sleep apnea syndrome (OSAS): It is characterized by involuntary collapse of the upper airways while the patient sleeps. The Gold standard for diagnosis is polysomnography. Untreated OSAS can have several negative health consequences, including excessive daytime sleepiness, concentration problems, irritability and mood swings, increased risk of cardiovascular diseases, among others. Skeletal malocclusions can contribute to obstructive sleep apnea by altering the position of the maxillomandibular complex and upper airway, which can cause partial or complete obstruction during sleep. Conservative treatment corresponds to CPAP (Continuous Positive Airway Pressure), which is very effective; however, it is frequently rejected due to the discomfort associated with using a mask while sleeping. As an alternative, there is the MAD (Mandibular Advancement Device). The different surgical options are based on the Stanford protocol, which divides the surgery into two phases. Phase I includes uvulo-palatopharyngoplasty and/or genioplasty. Phase II consists of the advancement of the mandible or the maxilla and mandible together. The purpose of this study is to report the contributions of orthognathic surgery in the treatment of Obstructive Sleep Apnea Syndrome (OSAS), focusing on the aesthetic, functional and stabilization benefits of the upper airway.

Keywords: Obstructive Apnea; Central Apnea; Orthognathic Surgery; Apnea Treatments

Abbreviation

OSAS: Obstructive Sleep Apnea Síndrome; ACS: Central Sleep Apnea; CPAP: Continuous Positive Airway Pressure; MAD: Mandibular Advancement Device

Introduction

Apnea is a pathology characterized by pauses in breathing during sleep. These pauses can be short or long, and they can also occur several times during sleep [8]. Apneas are mainly classified into 2 types:

- **Central sleep apnea (CSA):** It is caused by a failure of the ponto-spinal center, which is responsible for generating rhythmic breathing. When this results in a lower respiratory effort of at least 90% compared to the eupnea value and lasts 10 seconds or more, it is considered central apnea [12].
- **Obstructive sleep apnea syndrome (OSAS):** This condition is characterized by collapse/obstruction of the upper airways when the patient sleeps [9].

The diagnosis is made by polysomnography or respiratory polygraphy, an abbreviated method valid for 75% of cases [8].

OSAS is a disorder in which the upper airways become obstructed during sleep, resulting in pauses in breathing and a decrease in blood oxygen levels.

Untreated OSAS can have several negative health consequences, including excessive daytime sleepiness, concentration problems, irritability and mood swings, increased risk of cardiovascular diseases (stroke, coronary heart disease), metabolic pathologies, among others [14].

Skeletal malocclusions can contribute to OSAS by altering the position of the maxillomandibular complex, which affects the upper airway, causing partial or total obstruction during sleep [1].

In patients with severe or moderate OSAS the standard non-invasive treatment is the continuous positive airway pressure (CPAP) device. It is very effective, however, this treatment is often rejected because of the discomfort associated with wearing a mask while sleeping, the equipment is very large and requires a continuous source of energy, and the noise of the compressor is often annoying [9].

The alternative treatment to CPAP is the use of mandibular advancement devices (MAD), which generates a volumetric increase of the upper airway, induced by a mandibular protrusion maintained during sleep. Its use is especially indicated in patients with mild or moderate OSAS, and in those patients who do not tolerate CPAP [9,13].

Surgical treatment is based on the Stanford protocol, which divides the surgery into two phases. Phase I includes uvulo-palato-pharyngoplasty and/or genioplasty. Phase II consists of advancement of the mandible or the maxilla and mandible together (bimaxillary advancement surgery). According to this protocol, phase II operations are performed in those cases in which phase I does not achieve positive results. However, the effectiveness of phase II is considerably higher and the skeletal changes achieved are stable in the long term [9].

In patients with dentomaxillofacial disharmony, the ideal treatment is phase II, since orthognathic surgery provides aesthetic and functional benefits of the stomatognathic system and stability of the upper airway [7]. The purpose of this study is to report the contributions of orthognathic surgery in the treatment of OSAS focusing on the esthetic, functional and upper airway stabilization benefits.

Materials and Methods

An electronic search was performed in the databases: PubMed, Science Direct and SCOPUS, using as keywords: obstructive apnea - central apnea - orthognathic surgery - apnea treatments using the boolean operators AND/OR. Inclusion criteria: study less than 10 years old, Spanish or English language, open access. Exclusion criteria: studies older than 10 years, language other than Spanish or English, without open access, systematic reviews. Critical reading of titles and abstracts was performed, and those that presented significant evidence were included.

Results and Discussion

In the planning of surgical treatment for OSAS, phase II should be subject to the patient's dentomaxillary characteristics, that is, it should be determined whether the patient presents any maxillofacial disharmony that requires correction or on the contrary, whether the patient presents a harmonious orthognathic profile that should be altered as little as possible. Mareque., *et al*. propose a protocol for proper treatment selection [11].

Class I patients with bimaxillary hypoplasia

- Bimaxillary advancement.

Class II patients with mandibular hypoplasia:

- Accepts orthodontic treatment: Mandibular advancement.
- Does not accept orthodontic treatment.
- No aesthetic compromise: Geniohyoid advancement by anterior mandibular osteotomy.
- Esthetic compromise: Advancement genioplasty.

In Class I patients with a diagnosis of bimaxillary hypoplasia, the treatment of choice should be bimaxillary advancement surgery. In Class I patients, with an adequate development of the jaws (without maxillary hypoplasia) it is essential a correct diagnosis and an accurate planning in the maxillary mandibular advancement, since besides improving the condition of the airway, it can produce aesthetic changes to the patient. Therefore, it is essential that the patient is aware of the esthetic changes that will occur and that he/she approves them [9].

The genioglossus muscle is a pharyngeal dilator, which is why it is supposed to play an important role in OSAS. Valls-Ortañon and collaborators suggest that in patients who present a harmonic dentomaxillofacial profile and who must be surgically managed for OSAS, isolated genioplasty could be an alternative, since depending on the type of movement performed, it could narrow or enlarge the upper airway. The movements that help to enlarge the upper airway are upward and forward, however, studies that evaluate the apnea-hypopnea index are required to obtain evidence of greater validity [15].

On the other hand, Mareque., *et al*. postulate that genioglossus advancement, which corresponds to anterior mandibular osteotomy, is a technique that should be included in the protocol for patients with OSAS and harmonious maxillomandibular development. However, in cases where the patient needs chin projection, advancement genioplasty should be chosen.

Maxillomandibular advancement surgery is a predictable treatment for the treatment of OSAS, since it allows an increase of the air space at the pharyngeal level. The advancement of the insertion sites of the pharyngeal musculature increases the total volume of the airway, changes its shape from circular to oblong and tightens the lateral pharyngeal walls, making the airway less susceptible to collapse and generating a more stable upper airway [2].

Hernandez., *et al*. evaluated the effects of mono- and bimaxillary advancement surgery on pharyngeal airway volume by CBCT imaging. The least significant change was observed in patients who underwent single maxillary advancement surgery (Le Fort I), where the average increase in volume was 37.7%. In patients who underwent bimaxillary advancement surgery (Le Fort I maxillary and bilateral sagittal mandibular osteotomy), the increase was 69.8%. The most significant increase was observed in patients undergoing mandibular advancement surgery (bilateral sagittal sagittal osteotomy) the average increase in volume was 78.3% [10]. It is deduced that the correct location of the mandible is a determining factor in the volume of the upper airway, however it is important to consider that dentomaxillofacial disharmonies usually involve both mandible and maxilla.

Chang., *et al*. conclude in their work that orthognathic maxillary advancement surgery has a plateau effect in which advancement causes relative volume increase up to 7 mm. Advances greater than 7 mm have an inverse effect. However, in mandibular advancement this plateau effect was not observed, in which the oropharynx had the greatest expansion with movement. The above indicates that there is a physiological limit to the amount that the pharyngeal airway can be expanded without compensatory narrowing of the local or adjacent segment. During advancement the anteroposterior dimension of the pharynx increases, but there is also a decrease in its transverse dimension. This could explain the physiological limit of advancement raised by Chang, as when the transverse narrowing exceeds the anteroposterior increase the symptomatology of OSAS could increase [3].

It is important to carry out detailed planning in patients who require maxillary, mandibular or bimaxillary retrograde movements to achieve a harmonious profile, since retrograde movements are expected to have an inverse effect, that is, to cause an increase in airway resistance and, therefore, breathing disorders during sleep. Therefore when planning orthognathic surgery, it is essential to consider upper airway modifications. However it is postulated that a compensatory transverse increase occurs. It is thought that this situation is responsible for the fact that no cases of postoperative OSAS in mandibular retropositions are reported in the literature [9].

Conclusion

The treatment of OSAS requires a comprehensive evaluation and management. It is essential to determine the primary etiology of OSAS in order to perform the most appropriate surgical therapy. When airway obstruction is produced by retroposition of the maxilla, mandible or both, the corresponding procedure should be performed to advance these bony components, with the aim of increasing the lumen of the upper airway and thereby decreasing the risk of obstruction during sleep. It is necessary to study the airway volumetry by CT or airway cone beam in order to compare the pre and post surgical volumes.

Multiple aspects should be considered before deciding to advance the maxilla, mandible or both, since this also has repercussions on the soft tissue modifying the patient profile with the corresponding esthetic changes. The counterclockwise movement is privileged with the purpose of expanding the airway and generating the least change in profile in patients who do not have alteration of the latter. In skeletal class III patients in whom the aim is to improve the profile and occlusion, it is important to perform a detailed study of the upper airway so as not to narrow it and induce OSAS symptoms.

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