MedNEXT
Journal of Medical an Health Sciences

REVIEW ARTICLE

DOI: 10.54448/mdnt22201

Orthognathic surgery and obstructive sleep apnea syndrome: a systematic review

Carmen Verónica Ordóñez Mullo[1]*, Wilson Gabriel Azuero Palta[2]

[1] Universidad Nacional de Loja, Av. Manuel Agustín Aguirre y Manuel Montero "Azuero Dental", Ecuador.
[2] Universidad autónoma de los andes, Av. Manuel Agustín Aguirre y Manuel Montero, "Azuero Dental", Ecuador.

*Corresponding author: Carmen Verónica Ordóñez Mullo Universidad Nacional de Loja, Av. Manuel Agustín Aguirre y Manuel Montero "Azuero Dental", Ecuador.
E-mail: carmita210970@gmail.com
DOI: https://doi.org/10.54448/mdnt22201
Received: 11-14-2021; Revised: 02-12-2022; Accepted: 02-14-2022; Published: 03-29-2022; MedNEXT-id: e22201

Abstract

Introduction: In the scenario of Obstructive Sleep Apnea Syndrome (OSAS), Orthognathic Surgery (OS) corrected the deformities of the maxillary and mandibular bones OS has evolved a lot in the last two decades. OS treats patients with moderate and severe facial deformities, allowing the achievement of functional balance and harmony in facial aesthetics. **Objective:** To present the current findings of the importance of orthognathic surgery in the treatment of obstructive sleep apnea syndrome. **Methods:** A total of 78 articles were found involving mesh terms about Orthognathic Surgery and OSAS. Initially, was held the exclusion of existing title and duplications following the interest described in this work. After this process, the summaries were evaluated, and a new exclusion was held. Thus, 20 articles were included and discussed in this study. **Major considerations and conclusion:** In recent years, with the involvement and deepening of oral medicine in the diagnosis and treatment of OSAS, the role of OS in OSAS has become increasingly recognized. Early appropriate diagnosis and treatment can significantly improve patients' quality of life, reduce sudden death, and prevent various complications. OS corrects maxillofacial deformities through an incision of the upper and lower jaws, which has a significant relief effect on the symptoms of OSAS in patients with upper airway stenosis, especially in small mandibular patients.

Keywords: Orthognathic Surgery. Obstructive Sleep Apnea Syndrome. Malocclusion. Quality of life.

Introduction

In the scenario of Obstructive Sleep Apnea Syndrome (OSAS), Orthognathic Surgery (OS) corrected the deformities of maxillary and mandibular bones [1,2]. OS has evolved a lot in the last two decades. The importance of airway dimensions is that they are related to respiratory disorders since the narrow dimensions of the upper airways in the oropharynx area cause respiratory problems and may lead to reduced levels of growth hormone in children [3].

In this context, facial deformity with destructive psychological and social potential has a negative impact, which may influence not only the patient's self-confidence but also external relations, resulting in social and psychological disadvantages [4-6]. The objectives of the patient with dentofacial deformity, related to the repair, are also psychosocial and this can express the expectation of solving their personal and social difficulties with the physical change [6].

Thus, OS treats patients with moderate and severe facial deformities, allowing the achievement of functional balance and harmony in facial aesthetics [7]. In this sense, as a consequence of functional imbalance, OSAS can occur, which is the airway arrest by the upper airway, in the presence of respiratory effort, lasting more than 10 seconds. Hypopnea, constitutes a reduction in the passage of air, in said area, in this same period. These respiratory events occur innumerable times and exclusively during sleep, determining symptoms and signs that characterize OSAS [8].

Furthermore, OSAS is related to comorbidities such as systemic arterial hypertension or diabetes mellitus. The prevalence reaches 32% in the general population, ranging from 1% to 20% when it is associated with Chronic Obstructive Pulmonary Disease (COPD) (overlap syndrome) and is described as over 60% in populations with COPD and obesity (COPD triad, OSAS, and obesity) [8]. The methods of treatment are

numerous and presented. Multidisciplinary participation and multidisciplinary development trends. In recent years, with the participation and deepening of oral medicine in the diagnosis and treatment of OSAS, the role of OS in OSAS has become increasingly recognized [8].

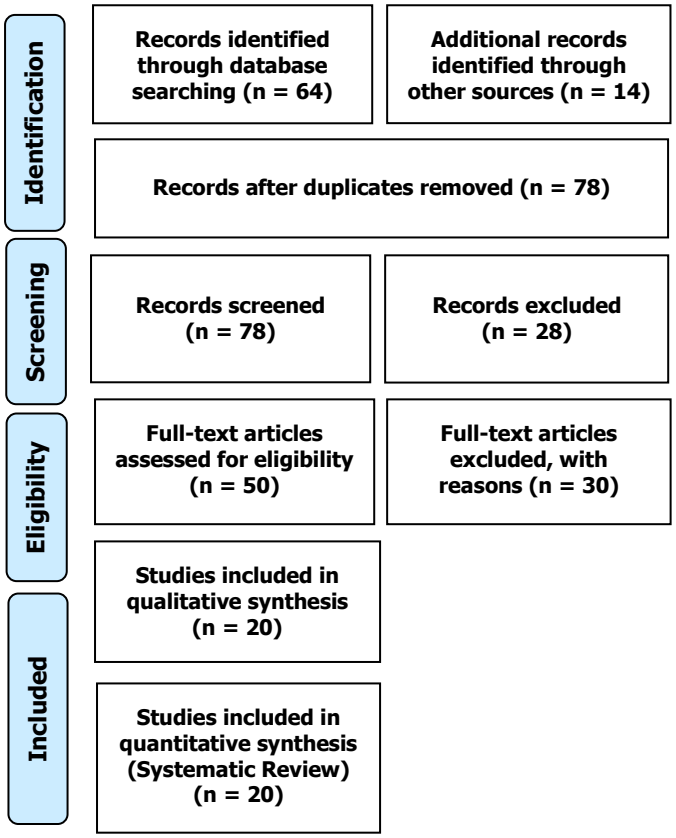
Therefore, the present systematic review aimed to present the current findings of the importance of orthognathic surgery in the treatment of obstructive sleep apnea syndrome.

Methods

Eligibility and Study Design

A total of 78 articles were found involving *Orthognathic Surgery, Obstructive Sleep Apnea Syndrome, Malocclusion*, and *Quality of life*. Initially, was held the exclusion of existing title and duplications following the interest described in this work. After this process, the summaries were evaluated, and a new exclusion was held. Thus, 20 articles were included and discussed in this study (**Figure 1**).

Figure 1. Flow Chart.



Clinical studies were included (case reports, retrospective, prospective, randomized trials, and systematic review and meta-analysis) with qualitative and/or quantitative analysis. Initially, the keywords were determined by searching the DeCS tool (Descriptors in Health Sciences, BIREME base) and later verified and validated by the MeSH system (Medical Subject Headings, the US National Library of Medicine) in order to achieve consistent search, following the rules of systematic review- PRISMA (Transparent reporting of systematic reviews and meta-analyses- http://www.prisma-statement.org/).

Results and Discussion

This review has demonstrated through the main literary findings the main benefits of orthognathic surgery on the treatment of OSAS. In this sense, OSAS refers to when an adult presents at least 30 apneas during 7 hours of nocturnal sleep, at least 10 s or more for each episode; or more than 4% of apnea during apnea or an apnea-hypopnea index (apnea and hypopnea index, AHI, the average number of apnea hypopneas per hour) is greater than 5 times per hour, so apnea is mainly obstructive [3,9].

Thus, it can be highlighted that the main pathophysiological characteristic of OSAS is high stenosis caused by apnea or restricted ventilation during sleep, causing nocturnal hypoxemia, resulting in chronic damage to multiple organs of the body [5,10]. Long-term presence may cause or aggravate respiratory failure, or cerebrovascular risk factors for accidents, myocardial infarction, and hypertension [11-13]. Early appropriate diagnosis and treatment can significantly improve patients' quality of life, reduce sudden death, and prevent various complications [18,19].

Thus, the basic principle of surgical treatment is to alleviate the structural factors of upper airway stenosis [7]. It is suitable for patients who can alleviate upper airway obstruction through surgery. The surgical methods commonly used include uvulas palate pharyngoplasty and its enhancement, mandibular advancement, anterior and mandibular migration, anterior maxillofacial migration and suspension of lingual muscle suspension, laser-assisted pharyngoplasty, pharyngeal angioplasty, tracheostomy, bariatric surgery, implant surgery such as soft abutment implantation, hypoglossal nerve stimulation, reconstruction of upper airway surgery, soft airway reconstruction, tonsillectomy, adenoidectomy, nasal septoplasty, nasal concha radiofrequency ablation or nasal surgery, etc [20].

In particular, OS is an effective treatment for OSAS due to mandibular factors. OS is a type of surgery that corrects maxillofacial deformities by incising the upper and lower jaws. It has a significant relief effect on the symptoms of OSAS in patients with upper airway stenosis, especially in small mandibular patients. Surgical methods include maxillary and maxillary

incision, mandibular incision, mandibular incision, and osteogenic distraction of a small, severe mandibular deformity [1]. Due to the advancement of the maxilla and mandible, the parameters of the upper airway volume and the upper transverse area of the upper airways were significantly increased compared to those before surgery, which can significantly improve the symptoms of OSAS and until reaching the complete disappearance of symptoms [2].

In this surgical context, a case report study in a 12-year-old boy with unilateral temporomandibular joint ankylosis and OSAS was submitted to surgical release of ankylosis with the successful opening of the mouth [3]. However, he continued to suffer from OSAS, as confirmed by postoperative polysomnography. Thus, OS for mandibular advancement was not favorable because of its small age and mandibular distraction. Osteogenesis was not a choice. A mandibular advancement device similar to the orthodontic myofunctional appliance was the preferred choice in the postoperative period while awaiting the surgical treatment of definite retrognathism after skeletal maturity. Surgical release of ankylosis of the temporomandibular joint corrects the oral problem but does not adequately address the narrow air space of the pharynx [3].

Furthermore, OSAS is a common problem in patients with achondroplasia. One study aimed to evaluate changes in airway volumes after various degrees of advancement of the facial skeleton. Six patients with achondroplasia were submitted to the advancement of the middle of the face for the treatment of OSAS. Therefore, in patients with OSAS associated with achondroplasia, there are variable improvements in airway volume. This preliminary report suggests that mandibular distraction can provide consistent reductions in the rate of apnea and hypopnea [5].

In addition, although maxillomandibular advancement (MMA) is an orthognathic surgical procedure used to control OSAS, it encounters problems in terms of aesthetic results with pre-existing dentoalveolar protrusion. Thus, a prospective study investigated changes in posterior pharyngeal space and aesthetic outcomes of patients suffering from OSAS after OS rotational counter-clockwise [6]. Patients were skeletal class II patients undergoing OS. A total of 14 patients were included. Satisfactory results were achieved without complications in all patients with OSAS. Airway parameters for anteroposterior length increased significantly. Thirteen patients answered a questionnaire about their facial appearance, and the visual analog scale averaged 7.31 points, indicating a favorable facial appearance. A rotational counterclockwise OS without advancing the maxilla for OSAS correction can effectively increase posterior pharyngeal space with favorable aesthetic results [6].

Also, in some patients with severe skeletal Class III, mandibular recoil surgery using sagittal branch osteotomy (SBO) is performed to correct mandibular protrusion. However, in patients diagnosed with OSAS, the risk of worsening as a result of SBO is very high [7]. The advancement of the maxilla can reduce the degree of mandibular retroposition and expand the skeletal structure in the pharyngeal region, leading to an increase in the airway. However, the nasal deformity is an undesirable outcome of the procedure. Thus, a case report described a 23-year-old man with the maxilla and retrograde OSAS. Maxillary retrusion was treated with Le Fort I osteotomy with alar suture and mucoperiosteal V-Y closure. After treatment, better occlusal relationships and improvement in OSAS were observed [7].

Another study explored how mandibular advancement without maxillary involvement would affect posterior air space in patients with mandibular retrognathism. Cone-beam computed tomography (CT) was performed for 20 patients before and six months after the mandibular advancement. Cephalometric analysis at both moments included two-dimensional and three-dimensional upper airway evaluation. Eight men and 12 women presented preoperative mean W values (7.4) (1.54) mm, with an airway area of 7.11 (1.88) cm2 and volume of 14.92 (4.46) cm3. Six months postoperatively presented a Wits value of 2.7 (0.41) mm, an airway area of 11.33 (3.49) cm2, and a volume of 25.7 (6.10) cm3. There was an average increase (range) of 59 (22-82) % of the area and 73 (29-108)% of the volume. A preoperative figure of 8.0 mm or greater was significantly correlated with a greater increase in posterior air space ($p = 0.002$). At the same time, an improvement in the Reasoning value of 4.5mm or more correlated significantly with an increase in volume ($p = 0.016$). The effect of mandibular advancement on posterior air space was significant, and the volumetric effect appears to be even more relevant than two-dimensional changes [12].

Thus, as literary results, Foltán R. et al. [13], in a study on the influence of orthognathic surgery on ventilation during sleep, found an average age of 22 ± 0.8 years, ranging from 16 to 28 years, which contrasts with our study in which the mean of patients was older, 36.50 ± 12.10 years, with ages ranging from 23 to 52 years and with a higher prevalence in the female gender. There is little data available on the predominance of facial features. However, Santana E. et al. [14] showed that the Brazilian profile presented a substantial difference when compared to the North American profile.

Besides, Faria et al. [15], Who demonstrated, through comparisons of cephalometric radiographs, that in each millimeter of maxillo-mandibular advancement, there is an increase of 0.76 mm in the retropalatal region and 1.2 mm in a retrolingual region. However, there was a decrease in the upper airway space in patients submitted to maxillary advancement associated with mandibular retreat, confirming with Mattos et al. [16] that in orthognathic surgery mandibular retreatment leads to a decrease in parapharyngeal space and maxillary advances, combined with indentations can lead to a moderate decrease in the upper airways.

Conclusion

In recent years, with the involvement and deepening of oral medicine in the diagnosis and treatment of OSAS, the role of OS in OSAS has become increasingly recognized. Early appropriate diagnosis and treatment can significantly improve patients' quality of life, reduce sudden death, and prevent various complications. OS corrects maxillofacial deformities through an incision of the upper and lower jaws, which has a significant relief effect on the symptoms of OSAS in patients with upper airway stenosis, especially in small mandibular patients.

Acknowledgement

Not applicable.

Funding

Not applicable.

Data sharing statement

No additional data are available.

Conflict of interest

The authors declare no conflict of interest.

Similarity check

It was applied by Ithenticate@.

References

1. Choi JW, Jeong WS, Kang MK, Lee JY, Chung YS. Counterclockwise Rotational Orthognathic Surgery for the Obstructive Sleep Apnea in Class II Dentofacial Deformity: Polysomnography and 3D Computed Tomographic Analysis. Ann Plast Surg. 2021 Jun 1;86(6):640-646. doi: 10.1097/SAP.0000000000002580. PMID: 33346553.
2. Campos LD, Trindade IEK, Yatabe M, Trindade SHK, Pimenta LA, Kimbell J, Drake AF, Trindade-Suedam IK. Reduced pharyngeal dimensions and obstructive sleep apnea in adults with cleft lip/palate and Class III malocclusion. Cranio. 2021 Nov;39(6):484-490. doi: 10.1080/08869634.2019.1668997. Epub 2019 Sep 17. PMID: 31526316.
3. Shah N, Waite PD, Kau CH. A combined orthodontic / orthognathic approach in the management of obstructive sleep apnoea: Balancing treatment efficacy and facial aesthetics. J Orthod. 2020 Dec;47(4):354-362. doi: 10.1177/1465312520952451. Epub 2020 Sep 4. PMID: 32883153.
4. Shaeran TAT, Samsudin AR.Temporomandibular Joint Ankylosis Leading to Obstructive Sleep Apnea. J Craniofac Surg. 2019 Jun 28. doi: 10.1097/SCS.0000000000005689. [Epub ahead of print]
5. Susarla SM, Mundinger GS, Kapadia H, Fisher M, Smartt J, Derderian C, Dorafshar A, Hopper RA. Subcranial and orthognathic surgery for obstructive sleep apnea in achondroplasia. J Craniomaxillofac Surg. 2017 Dec;45(12):2028-2034. doi: 10.1016/j.jcms.2017.09.028. Epub 2017 Oct 5.
6. Jeong WS, Kim YC, Chung YS, Lee CY, Choi JW. Change in Posterior Pharyngeal Space After Counterclockwise Rotational Orthognathic Surgeryfor Class II Dentofacial Deformity Diagnosed With Obstructive Sleep Apnea Based on Cephalometric Analysis. J Craniofac Surg. 2017 Jul;28(5):e488-e491. doi: 10.1097/SCS.0000000000003761.
7. Ishida T, Manabe A, Yang SS, Watakabe K, Abe Y, Ono T. An orthodontic-orthognathic patient with obstructive sleep apnea treated with Le Fort I osteotomy advancement and alar cinch suture combined with a muco-musculo-periosteal V-Y closure to minimize nose deformity. Angle Orthod. 2019 Jan 30. doi: 10.2319/052818-406.1.
8. Wan HC, Zhou XD, Zou SJ, Zhu SS, Liu YF, Zhou GY, Zheng GN, Yang JN, He YH. Oral treatment for obstructive sleep apnea syndrome. Hua Xi Kou Qiang Yi Xue Za Zhi. 2018 Dec 1;36(6):581-589. doi: 10.7518/hxkq.2018.06.001.
9. Jang SI, Ahn J, Paeng JY, Hong J. Three-

dimensional analysis of changes in airway space after bimaxillary orthognathic surgerywith maxillomandibular setback and their association with obstructive sleep apnea. Maxillofac Plast Reconstr Surg. 2018 Nov 9;40(1):33. doi: 10.1186/s40902-018-0171-3.

10. Gong X, Li W, Gao X. Effects of Craniofacial Morphology on Nasal Respiratory Function and Upper Airway Morphology. J Craniofac Surg. 2018 Oct;29(7):1717-1722. doi: 10.1097/SCS.0000000000004638.
11. Louro RS, Calasans-Maia JA, Mattos CT, Masterson D, Calasans-Maia MD, Maia LC. Three-dimensional changes to the upper airway after maxillomandibular advancement with counterclockwise rotation: a systematic review and meta-analysis. Int J Oral Maxillofac Surg. 2018 May;47(5):622-629. doi: 10.1016/j.ijom.2017.11.003. Epub 2017 Nov 26.
12. Dalla Torre D, Burtscher D, Widmann G, Rasse M, Puelacher T, Puelacher W. Long-term influence of mandibular advancement on the volume of the posterior airway in skeletal Class II-patients: a retrospective analysis. Br J Oral Maxillofac Surg. 2017 Oct;55(8):780-786. doi: 10.1016/j.bjoms.2017.06.005. Epub 2017 Jun 29.
13. Foltán R., Hoffmannová J., Pavlíková G., Hanzelka T., Klíma K., Horká E., Adámek S., Sedý, J. The influence of orthognathic surgery on ventilation during sleep. Int. J. Oral Maxillofac. Surg. 2011;40: 146-149.
14. Sant´Ana E., Furquim LZ, Rodrigues MTV, Kuriki EU, Pavan AJ, Camarini ET, Iwaki Filho L. Planejamento digital em cirurgia ortognática: precisão, previsibilidade e praticidade. Rev ClinOrtodon Dental Press. Maringá.2006:5:2:92-102.
15. Faria AC, Xavier SP, Silva Jr. SN, VoiTrawitzki LV, de Melo-Filho FV. Cephalometric analysis of modifications of pharynx due to maxilla-mandibular advancement surgery in patients with obstructive sleep apnea. Int J Oral MaxillofacSurg.2013;42:579-584.
16. Mattos C.T., Vilani G.N.L., Sant´Anna E.F., Ruellas A.C.O., Maia L.C.: Effects of orthognathic surgery on oropharyngeal airway: a meta-analysis. Int. J. Oral Maxillofac.Surg.2011; 40: 1347-1356.
17. O'brien K, Wright J, Conboy F. et al. Prospective, multi-center study of the effectiveness of orthodontic/orthognathic surgery care in the United Kingdom. American Journal of Orthodontics and Dentofacial Orthopedics, 2009, v. 135, n. 6, p. 709-714.
18. Proffit WR, Jackson TH, Turvey TA. Changes in the pattern of patients receiving surgical-orthodontic treatment. American Journal of Orthodontics and Dentofacial Orthopedics, 2013, v. 143, n. 6, p. 793-798.
19. Farhad B. Naini, Daljit S. Gill. Orthognathic Surgery: Principles, Planning and Practice is a definitive clinical guide to orthognathic surgery, from initial diagnosis and treatment planning to surgical management and postoperative care. WileyOnline Library. 23 DEC 2016. DOI: 10.1002/9781119004370.
20. Jaspers GW, Booij A, De Graaf J, De Lange, J. Long-Term Results of Maxillomandibular Advancement Surgery In Patients With Obstructive Sleep Apnoea Syndrome. J Oral Maxillofac Surg, 2013, v. 51, n. 3, p. 37-39.