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Orthognathic surgery in class II patients and the treatment of obstructive sleep apnea syndrome: a concise systematic review of the clinical studies

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Abstract

Introduction: Obstructive sleep apnea (OSA) is characterized by intermittent partial or complete obstruction of the airways during sleep, being called OSA syndrome (OSA) when associated with daytime/nighttime symptoms and/or comorbidities, such as systemic arterial hypertension or diabetes mellitus. The prevalence reaches 32% in the general population, varies between 1% and 20% when associated with COPD (overlap syndrome), and is described as above 60% in populations with COPD and obesity, Orthognathic Surgery (OS) corrects the deformities of the bones of the maxilla and mandible. **Objective:** It was to highlight the main considerations and outcomes of clinical studies on the importance of orthognathic surgery in class II patients and the treatment of obstructive sleep apnea syndrome. **Methods:** The systematic review rules of the PRISMA Platform were followed. The search was carried out from October to December 2022 in the Scopus, PubMed, Science Direct, Scielo, and Google Scholar databases, using articles from 2005 to 2022. The quality of the studies was based on the GRADE instrument and the risk of bias was analyzed accordingly, according to the Cochrane instrument. **Results and Conclusion:** A total of 420 articles were found, 157 articles were evaluated and 25 were included and developed in this systematic review study. Considering the Cochrane tool for risk of bias, the overall assessment resulted in 103 studies with a high risk of bias and 42 studies that did not meet GRADE. It was concluded that obstructive sleep apnea syndrome is related to comorbidities such as systemic arterial hypertension or diabetes mellitus. Orthognathic surgery treats patients with moderate and severe facial deformities, enabling the achievement of functional balance and harmony in facial aesthetics. Maxillomandibular advancement is an orthognathic surgery procedure that has been used to treat obstructive sleep apnea syndrome. However, maxillomandibular advancement often leads to unsatisfactory esthetic results. Proper early diagnosis and treatment can significantly improve a patient's quality of life, reduce sudden death, and prevent various complications. significantly increased compared to those before surgery, which can significantly improve the symptoms of obstructive sleep apnea syndrome and even achieve complete disappearance of symptoms.

Keywords: Orthognathic Surgery. Obstructive Sleep Apnea Syndrome. Comorbidities. Maxillomandibular advancement. Quality of life.

Introduction

Sleep disorders comprise a wide range of clinical conditions capable of negatively interfering with all organs and systems, and, in particular, the cardiovascular system. The consequences are countless and not limited to the phase in which we are sleeping; on the contrary, sleep disorders also have important repercussions during wakefulness, compromising the quality of life and contributing to the emergence of many diseases [1]. The importance of this issue has increasingly gained the attention of society, mainly due to drastic changes in the lifestyle of the world's population in recent decades, as people are sleeping less and less, and excess weight contributes to the increase in the prevalence of sleep-disordered breathing [2].

In this sense, obstructive sleep apnea (OSA) is

characterized by intermittent partial or complete obstruction of the airways during sleep and is called OSA syndrome (OSAS) when associated with daytime/nighttime symptoms and/or comorbidities, such as systemic arterial hypertension or diabetes mellitus. The prevalence reaches 32% in the general population, varies between 1% and 20% when associated with COPD (overlap syndrome), and is described as above 60% in populations with COPD and obesity (COPD triad, OSAS, and obesity). In this regard, the acute hemodynamic changes of OSA include hyperactivity of the sympathetic nervous system, endothelial dysfunction, inflammation, cardiovascular damage, bradyarrhythmia, worsening heart failure, and right and left ventricular longitudinal deformities [1-3].

In the scenario of OSAS, Orthognathic Surgery (OS) corrects the deformities of the bones of the maxilla and mandible [4]. The OS has evolved a lot in the last two decades. The importance of airway dimensions is that they are related to breathing disorders, as the narrow dimensions of the upper airways in the oropharyngeal area cause breathing problems and can lead to reduced growth hormone levels in children [5,6].

In this context, facial deformity, with its psychological and socially destructive potential, has a negative impact, which can influence not only the patient's self-confidence but also external relationships, resulting in social and psychological disadvantages [7-10]. The goals 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 [11].

Thus, OS treats patients with moderate and severe facial deformities, enabling the achievement of functional balance and harmony in facial aesthetics [3,11]. In this sense, as a consequence of the functional imbalance, OSAS can occur, which is the arrest of the airway through 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 countless times and exclusively during sleep, determining symptoms and signs that characterize OSAS [12].

Given the above, this systematic review aimed to highlight the main considerations and outcomes of clinical studies on the importance of orthognathic surgery in class II patients and the treatment of obstructive sleep apnea syndrome.

Methods

Study Design

This was followed by a systematic literature review model on the main clinical findings of mandible fractures, according to the PRISMA rules.

Data sources and research strategy

The literary search process was carried out from December 2022 to February 2023 and was developed based on Scopus, PubMed, Science Direct, Scielo, and Google Scholar, using scientific articles from 2013 to 2022, using the descriptors (MeSH Terms): *Orthognathic Surgery. Obstructive Sleep Apnea Syndrome. Comorbidities. Maxillomandibular advancement. Quality of life*, and using the Booleans "and" between the descriptors (MeSH Terms) and "or" between the historical findings.

Study Quality and Risk of Bias

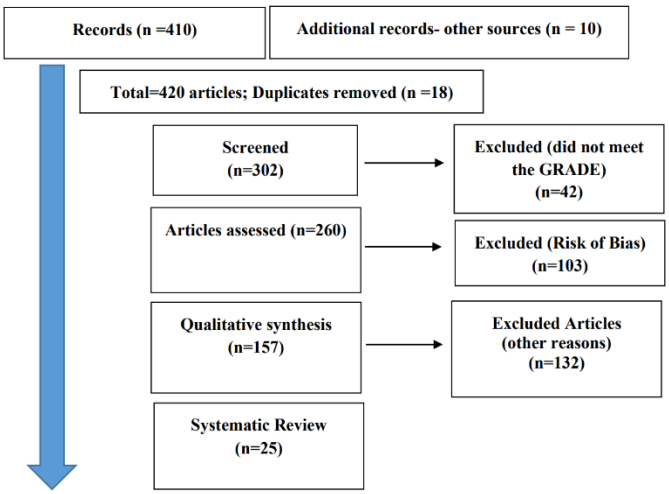
The quality of the studies was based on the GRADE instrument, with randomized controlled clinical studies, prospective controlled clinical studies, and studies of systematic review and meta-analysis listed as the studies with the greatest scientific evidence. The risk of bias was analyzed according to the Cochrane instrument.

Results and Discussion

Summary of Findings

A total of 420 articles were found. Initially, duplication of articles was excluded. After this process, the abstracts were evaluated and a new exclusion was performed, removing the articles that did not include the theme of this article, resulting in 260 articles. A total of 157 articles were evaluated and 25 were included and developed in this systematic review study (Figure 1). Considering the Cochrane tool for risk of bias, the overall assessment resulted in 103 studies with a high risk of bias and 42 studies that did not meet GRADE.

Figure 1. Selection of studies.



Clinical Findings – Orthognathic Surgery and Treatment of Sleep Apnea

Maxillomandibular advancement (MMA) is an OS procedure that has been used to treat OSAS. However, maxillomandibular advancement often leads to unsatisfactory esthetic results. Based on this, a prospective study carried out by the authors Choi et al. 2021 investigated the functional and aesthetic results using polysomnography and three-dimensional computed tomography after counterclockwise rotational orthognathic surgery. A total of 17 patients with OSAS underwent OS between March 2013 and December 2018. After 12 months, the patients' mean self-assessment score for facial appearance using a 10-step visual analog scale was 7.36. The preoperative apnea-hypopnea index and respiratory disturbance index were 34.70 and 37.45, respectively; postoperative indices were 11.60 and 12.69, respectively (p=0.003). The mean posterior pharyngeal airway space increased from 5357.88 mm3 preoperatively to 8481.94 mm3 6 months postoperatively. facial aesthetics [13].

In this sense, OSAS refers to when an adult has at least 30 apneas during 7 hours of night sleep, at least 10 s or more for each episode; or more than 4% apnea during apnea, or an apneahypopnea index (apnea-hypopnea index, AHI, the average number of apnea hypopneas per hour) is greater than 5 times per hour, so the apnea is mostly obstructive [8,14].

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 body organs [9,15]. Long-term presence can cause or exacerbate respiratory failure, or cerebrovascular risk factors for accidents, myocardial infarction, and hypertension [11,16-18]. Proper early diagnosis and treatment can significantly improve a patient's quality of life, reduce sudden death, and prevent various complications [1-3].

Therefore, the basic principle of surgical treatment is to alleviate the structural factors of stenosis in the upper airway [11]. It is suitable for patients who can relieve upper airway obstruction through surgery. Commonly used surgical methods include uvulopalate pharyngoplasty and its enhancement, mandibular advancement, anterior and mandibular migration, maxillofacial anterior migration and lingual muscle suspension, laser-assisted pharyngoplasty, pharyngeal angioplasty, tracheostomy, bariatric surgery, an implant such as soft abutment implant, hypoglossal nerve stimulation, upper airway surgery reconstruction, smooth airway reconstruction, tonsillectomy, adenoidectomy, nasal septoplasty, inferior turbinate radiofrequency ablation or nasal surgery, etc [19,20].

In this sense, OS is an effective treatment for OSAS due to mandibular factors. OS is a type of surgery that corrects maxillofacial deformities by making an incision in the upper and lower jaws. It has a significant relieving effect on OSAS symptoms 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 minor severe mandibular deformity. Due to the advancement of the maxilla and mandible, the parameters of upper airway volume and minimum upper airway cross-sectional area were significantly increased compared to those before surgery, which can significantly improve OSAS symptoms and even achieve complete disappearance of symptoms [21,22].

In this surgical context, a case report study in a 12-year-old boy with unilateral temporomandibular joint ankylosis and OSAS underwent surgical release of the ankylosis with success in opening the mouth [1,2]. However, he continued to suffer from OSAS, as confirmed by postoperative polysomnography. Thus, the OS for mandibular advancement was not favorable due to his young 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 surgical treatment of definitive retrognathism after skeletal maturity. Surgical release of temporomandibular joint ankylosis corrects the oral problem but does not adequately address the narrow pharyngeal air space [2].

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 underwent midface advancement 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 may provide consistent reductions in the apnea-hypopnea index [23-25].

Furthermore, although MMA is an orthognathic surgical procedure used to manage OSAS, it encounters problems in terms of esthetic results with pre-existing dentoalveolar protrusion. Thus, a prospective study investigated changes in the posterior pharyngeal space and aesthetic outcomes of patients suffering from OSAS after counterclockwise rotational OS. The 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. Counterclockwise rotational OS without maxillary advancement for correction of OSAS can effectively increase the posterior pharyngeal space, with favorable esthetic results [10].

Also, in some patients with severe skeletal Class III, mandibular setback surgery using sagittal ramus osteotomy (SSRO) is performed to correct mandibular protrusion. However, in patients diagnosed with OSAS, the risk of worsening as a result of SSRO is very high [3,4]. Maxillary advancement can reduce the degree of mandibular retroposition and expand the skeletal structure in the pharyngeal region, leading to airway enlargement. However, the nasal deformity is an undesirable result 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 (ACVY) closure. After treatment, better occlusal relationships and improvement in OSAS were observed [11].

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 on 20 patients before and six months after the mandibular advancement. Cephalometric analysis at both times included two-dimensional and threedimensional 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 [17].

Also, 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, Sant'ana E. et al. [19] showed that the Brazilian profile presented a substantial difference when compared to the North American profile.

Moreover, the authors 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 the retrolingual region. However, there was a decrease in the upper airway space in patients submitted to maxillary advancement associated with mandibular retreat. In orthognathic mandibular surgery, retreatment leads to a decrease in parapharyngeal space, and maxillary advances, combined with indentations can lead to a moderate decrease in the upper airways [3,24,25].

Conclusion

It was concluded that obstructive sleep apnea syndrome is related to comorbidities such as systemic arterial hypertension or diabetes mellitus. Orthognathic surgery treats patients with moderate and severe facial deformities, enabling the achievement of functional balance and harmony in facial aesthetics. Maxillomandibular advancement is an orthognathic surgery procedure that has been used to treat obstructive sleep apnea syndrome. However, maxillomandibular advancement often leads to unsatisfactory esthetic results. Proper early diagnosis and treatment can significantly improve patient's quality of life, reduce sudden death, and prevent various complications. significantly increased compared to those before surgery, which can significantly improve the symptoms of obstructive sleep apnea syndrome and even achieve complete disappearance of symptoms.

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Ethical Approval

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Informed consent

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Data sharing statement

No additional data are available.

Conflict of interest

The authors declare no conflict of interest.

Similarity check

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References

1. Bouzerda A. Risque cardiovasculaire et syndrome d'apnées obstructives du sommeil [Cardiovascular risk and obstructive sleep apnea]. Pan Afr Med J. 2018 Jan 18;29:47. French. doi: 10.11604/pamj.2018.29.47.11267.
2. Antonaglia C, Passuti G. Obstructive sleep apnea syndrome in non-obese patients. Sleep Breath. 2022 Jun;26(2):513-518. doi: 10.1007/s11325-021-02412-1.
3. Brown J, Yazdi F, Jodari-Karimi M, Owen JG, Reisin E. Obstructive Sleep Apnea and Hypertension: Updates to a Critical Relationship. Curr Hypertens Rep. 2022 Jun;24(6):173-184. doi: 10.1007/s11906-022-01181-w.
4. Surani S, Taweesedt P. Obstructive Sleep Apnea: New Perspective. Medicina (Kaunas). 2022 Dec 29;59(1):75. doi: 10.3390/medicina59010075.
5. Rossi DS, Goker F, Cullati F, Baj A, Pignatelli D, Beltramini G, Russillo A, Giannì AB, Lucchina AG, Mortellaro C, Del Fabbro M. Analysis and comparison of quality of life and patients' satisfaction between dental-skeletal dysmorphisms and Obstructive Sleep Apnea (OSA) patients following orthognathic surgery. Eur Rev Med Pharmacol Sci. 2022 Dec;26(3 Suppl):62-77. doi: 10.26355/eurrev_202212_30796.
6. Wiedemeyer V, Berger M, Martini M, Kramer FJ, Heim N. Predictability of pharyngeal airway space dimension changes after orthognathic surgery in class II patients: A mathematical approach. J Craniomaxillofac Surg. 2019 Oct;47(10):1504-1509. doi: 10.1016/j.jcms.2019.07.024.
7. Chen K, Sun X, Wang L, Ni S, Wu Z, Gao Y, Wang X, Xie K, Liu S, Wu G. A Modified Cosmetic Genioplasty Can Affect Airway Space Positively in Skeletal Class II Patients: Studying Alterations of Hyoid Bone Position and Posterior Airway Space. Aesthetic Plast Surg. 2020 Oct;44(5):1639-1655. doi: 10.1007/s00266-020-01790-3.
8. 1Shaeran TAT, Samsudin AR.Temporomandibular Joint Ankylosis Leading to Obstructive Sleep Apnea. J Craniofac Surg. 2019 Jun 28. doi: 10.1097/SCS.0000000000005689.
9. 2Susarla 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.
10. 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.
11. Ishida T, Manabe A, Yang SS, Watakabe K, Abe Y, Ono T. An orthodonticorthognathic 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.

12. 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.
13. 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.
14. 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.
15. 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.
16. 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.
17. 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.
18. 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.
19. 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.
20. 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.
21. Mattos CT, Vilani GNL, Sant´Anna EF, Ruellas ACO, Maia LC. Effects of orthognathic surgery on oropharyngeal airway: a meta-analysis. Int. J. Oral Maxillofac.Surg.2011; 40: 1347-1356.
22. 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.
23. Proffit WR, Jackson TH, Turvey TA. Changes in the pattern of patients receiving surgicalorthodontic treatment. American Journal of Orthodontics and Dentofacial Orthopedics, 2013, v. 143, n. 6, p. 793-798.
24. 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.
25. 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.