Contemporary Orofacial Sciences (2024) 2 (2): 44-49
DOI: 10.71783/cofs.2024.1103485

LITERATURE REVIEW

Surgical treatment options for obstructive sleep apnea in maxillofacial surgery: A literature review

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Received: 2023-07-12/ Accepted: 2024-04-30 / First publication date: 2024-07-10

Abstract

Background: The current study aimed to investigate surgical treatment options for obstructive sleep apnea (OSA) in maxillofacial surgery.

Methods: The review study focused on the keywords: obstructive sleep apnea, maxillofacial surgery, and surgical treatment. Articles were chosen based on relevant findings. English language papers were obtained via PubMed, Science Direct, Google Scholar, and Research Gate between November and December 2023. A total of 21 articles met the inclusion criteria and were reviewed. The selected surgical treatment options within maxillofacial surgery for OSA include maxillomandibular advancement (MMA), genioglossus advancement, hyoid suspension, nasal surgery, and palatal surgery. These techniques aim to address anatomical factors contributing to airway collapse during sleep, ultimately improving airflow dynamics and reducing the severity of OSA.

Conclusion: Maxillofacial surgical options provide promising alternatives for obstructive sleep apnea patients unable to tolerate CPAP therapy. Techniques are available but require experienced surgeons with a deep understanding of maxillofacial anatomy and sleep medicine. Collaborative efforts between maxillofacial surgeons and sleep medicine specialists are essential for optimal patient outcomes in surgically managing obstructive sleep apnea.

Keywords: Surgery, Oral; Sleep Apnea, Obstructive; Oral Surgical Procedures

Introduction

OSA (Obstructive sleep apnea) is a usual and potentially serious sleep disorder specified by recurrent episodes of upper airway obstruction during sleep causes intermittent hypoxia, sleep fragmentation, and a multitude of associated comorbidities & decreased quality of life (1). In adults, OSA is mostly related to obesity, male gender, and rising age while in children, it is mostly related to enlarged adenoids or tonsils. However, even with the technology of today, some patients with OSA are untreated and undiagnosed, which is a main global healthcare obstacle since it is well-established that OSA is related to high cardiometabolic co-mortality and morbidities (2-4).

Based on the International definition of Sleep Disorders, Obstructive sleep apnea can be specified by one of the following criteria sets. The first diagnostic set includes the presence of one of the following criteria: (1) chronic fatigue or insomnia, non-restorative sleep, sleepiness; (2) waking up with a choking, dyspnea sensation, or gasping ; (3) the bed partner or bystander reports habitual snoring, apneas, or both during the sleep of patient; (1) the people suffers from type 2 diabetes mellitus, coronary artery disease, congestive heart failure, hypertension, atrial fibrillation, stroke, a cognitive dysfunction, or mood disorder, and the HSAT exam or the polysomnographic shows a minimum of five mainly obstructive events (mixed or obstructive apneas, respiratory effort-related arousals, and hypopnea) per

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[DOI: 10.71783/cofs.2024.1103485]

hour of monitoring during the HSAT or per hour of sleep during the PSG (5, 6).

OSA Managements contain lifestyle modifications and weight loss, behavioral modification, medication, oral appliance therapy (e.g., tongue-retaining devices use or orthodontic use or mandibular advancing appliances), CPAP (continuous positive airway pressure), and surgical procedures (e.g., uvulopalatopharyngoplasty, tracheostomy, surgically assisted rapid maxillary expansion, laser-assisted uvulopalatoplasty, hypoglossal nerve stimulation, and maxillomandibular advancement) (7, 8). Behavioral treatments refer to factors that may intensify the OSA potential. Avoidance of sedatives and alcohol is recommended for all OSA people. For some OSA people, weight loss desirably affects airway patency by minimizing snoring apneic events. Avoiding the supine position during sleep may reduce the frequency of sleep apnea in some individuals. The pharmacotherapy role for OSA remains obscure, and the influence of proposed pharmacotherapeutic therapy for OSA has not been established (7). While CPAP therapy is the gold standard and most common treatment for OSA, Maxillofacial surgery has emerged as a crucial area for the management of OSA, offering various surgical treatment options aimed at addressing anatomical factors contributing to airway obstruction (9).

This review aims to prepare a comprehensive understanding of the role of maxillofacial surgery in the multidisciplinary approach to treating OSA. Furthermore, through an evidence-based analysis of the existing literature, this review will shed light on the current state of knowledge, and identify areas of consensus, controversy, and future research directions, ultimately striving to enhance clinical decision-making and modify patient outcomes in the OSA management through maxillofacial surgery.

Methods

In the current study, the selected keywords were obstructive sleep apnea, maxillofacial surgery, and surgical treatment. Articles were chosen based on related texts and findings. English language papers were selected using Research Gate, PubMed, Science Direct, and Google Scholar search engines. This research centers on the utilization of English language studies published after 2015 within the aforementioned profiles. The selection of articles was based on a thorough examination of the content and the input from three authors. Sources were reviewed between November 2023 and December 2023. Based on exclusion and inclusion criteria, 21 articles were reviewed.

Discussion

The selected surgical treatment options within maxillofacial surgery for OSA include maxillomandibular advancement (MMA), genioglossus advancement, hyoid suspension, nasal surgery, and palatal surgery.

Maxillofacial Surgical Approaches:

1. Maxillomandibular Advancement (MMA):

OSA (Obstructive sleep apnea) is a prevalent sleep disorder specified by repetitive episodes of upper airway obstruction during sleep causes fragmented sleep patterns and intermittent hypoxia. Maxillomandibular advancement (MMA) has emerged as a prominent surgical treatment option for OSA, particularly in cases where anatomical factors contribute to airway collapsibility. MMA involves repositioning the maxilla and mandible (both upper and lower jaws) forward to enlarge the upper airway and decrease airway collapsibility during sleep resulting in improved airflow during sleep. By addressing underlying anatomical deficiencies such as retrognathia and micrognathia, MMA seeks to improve airflow dynamics and mitigate the severity of OSA. MMA is considered one of the most effective surgical treatments for moderate to severe OSA (10).

Studies have reported favorable outcomes following MMA in selected OSA patients. Improvement in AHI (apnea-hypopnea index), oxygen saturation levels, and subjective sleep quality has been observed postoperatively. Additionally, reductions in daytime sleepiness and improvement in overall quality of life have been reported in numerous cases (11). Research that was conducted to compare the efficacy of MMA and UAS surgery, reveals that MMA may have excellent efficacy in OSA treatment. However, MMA is a more invasive intervention, exposing patients to a higher risk of postoperative complications and longer recovery time. Overnight admission to the centralized care unit is needed for OSA patients following MMA surgery, and the hospitalization length after MMA was stated previously from <2 days to 5–8 days (12). One notable challenge with MMA has been changes in facial appearance; however, most patients undergoing MMA for OSA view these changes as neutral or even positive. (13-15).

[DOI: 10.71783/cofs.2024.1103485]

While MMA shows promise as a treatment option for OSA, further study is needed to standardize patient selection criteria, refine surgical approaches, and assess long-term outcomes. Comparative studies evaluating the efficacy of MMA against other surgical interventions and non-surgical modalities will provide valuable insights into its role in the comprehensive management of OSA (16).

2. Genioglossus Advancement:

The genioglossus muscle plays a crucial role in maintaining the tolerance of the upper airway during wakefulness and sleep. In individuals with OSA, anatomical factors such as a returned or insufficiently supportive position of the genioglossus muscle can contribute to pharyngeal collapse during sleep, leading to breathing disturbances. Genioglossus advancement has gathered attention as a surgical treatment option for OSA, particularly in cases where pharyngeal collapse contributes to airway obstruction. Genioglossus Advancement involves repositioning and advancing the genial tubercle and attached genioglossus muscle to improve the patency of the upper airway (17).

Genioglossus Advancement aims to reduce airway collapsibility during sleep and ameliorate the severity of OSA by addressing the anatomical factors contributing to pharyngeal collapse. Genioglossus Advancement focuses on advancing the genioglossus muscle attachment point to increase tongue protrusion. By enhancing tongue stability and reducing its tendency to obstruct the airway, Genioglossus Advancement can alleviate OSA symptoms. This procedure is often performed in combination with other surgical techniques for optimal results (18). However, there were large interindividual differences in the relationship between the change in upper airway enlargement and pharyngeal critical closing pressure (Pcrit) (18). Dotan et al (19) also evaluated OSA patients under anesthesia and showed that posterior segment stimulation of the GG decreased Pcrit to a bigger extent than anterior segment stimulation. This may have happened because anterior stimulation contracts the vertical fibers preoccupied in tongue depression that may narrow rather than space of enlarging pharyngeal airway. Also, it was reported by Dotan et al. (19) that the narrower the pharynx and larger the tongue, the greater the decrease in Pcrit. Transcutaneous submental stimulation of the GG has also been evaluated in OSA patients (20).

Studies have reported favorable outcomes following genioglossus advancement in selected OSA patients. Improvement in AHI (apnea-hypopnea index), oxygen saturation levels, and subjective sleep quality has been observed postoperatively. Additionally, reductions in daytime sleepiness and improvement in overall quality of life have been reported in some cases (21).

3. Hyoid Suspension:

The hyoid bone plays a crucial role in maintaining upper airway patency during sleep by anchoring important soft tissue structures. Hyoid suspension involves repositioning and stabilizing the hyoid bone to improve the patency of the upper airway. Hyoid suspension involves repositioning and securing the hyoid bone to stabilize it and prevent its collapse. The hyoid suspension has emerged as a surgical treatment option for OSA, particularly in cases where the position of the hyoid bone contributes to airway collapse. This procedure can effectively improve airflow dynamics and reduce OSA severity (22).

The primary outcome of the Samaha et al. study (22) was that reductions in upper airway collapsibility related to hyoid repositioning were associated with both magnitude and direction of hyoid movement. More specifically:

1) Displacement of the anterior hyoid was the major part leading to reduced upper airway collapsibility, with bigger increments in replacement progressively causing a less collapsible upper airway

2) Cranial and caudal hyoid replacement did not change upper airway collapsibility

3) Ant-cranial and Ant-caudal replacement yielded alike upper airway collapsibility outcomes as the complete anterior replacement direction.

While hyoid suspension shows promise as a treatment option for OSA, further study is needed to standardize patient selection criteria, refine surgical techniques, and assess long-term outcomes. Comparative studies evaluating the efficacy of hyoid suspension against other surgical interventions and non-surgical modalities will provide valuable insights into its role in the comprehensive management of OSA (23).

4. Nasal Surgery:

Nasal airway obstruction can result from various anatomical factors, including deviated septum, turbinate hypertrophy, nasal polyps, and nasal valve collapse. These obstructions can contribute to increased upper airway resistance and exacerbate OSA. Nasal surgery has emerged as a treatment option

[DOI: 10.71783/cofs.2024.1103485]

for OSA, particularly in cases where nasal obstruction contributes to increased upper airway resistance. Nasal surgery encompasses a range of surgical procedures aimed at addressing anatomical abnormalities within the nasal airway that may contribute to upper airway resistance and obstructive sleep apnea (24).

Septoplasty, turbinate reduction, or nasal valve repair are common nasal surgeries performed alongside maxillofacial procedures. Addressing nasal obstructions can enhance overall treatment outcomes and patient comfort (25). A systematic review conducted by Schoustra et al. (24) shows that isolated nasal surgery did not modify the AHI (apnea-hypopnea index) significantly in several studies. Therefore, isolated nasal surgery should not be introduced as an OSA first-line treatment. Isolated nasal surgery can modify OSA mentally. Maybe only OSA people with nasal obstruction complaints and OSA patients experiencing difficulty with CPAP admission would benefit from nasal surgery.

Studies have reported favorable outcomes following nasal surgery in selected OSA patients. Improvement in snoring, subjective sleep quality, and daytime somnolence has been observed postoperatively. Additionally, reductions in nasal resistance and improvements in nasal airflow have been reported in numerous cases (26).

5. Palatal Surgery:

Palatal surgery encompasses a range of surgical procedures aimed at addressing anatomical abnormalities within the soft palate and oropharynx that may contribute to upper airway collapse and obstructive sleep apnea. Palatal procedures aim to address anatomical abnormalities that contribute to upper airway collapse (27).

The soft palate and oropharynx play a significant role in upper airway patency during sleep. Anatomical factors such as elongated uvula, redundant soft palate tissue, and palatal collapse can contribute to airway obstruction in OSA. Palatal surgery aims to address these issues by reducing the collapsibility of the soft palate and improving airway patency (28).

Surgical techniques for palatal surgery such as Uvulopalatopharyngoplasty (UPPP), palatal advancement pharyngoplasty (PAP), or radiofrequency ablation are commonly employed techniques. These procedures aim to reshape and stiffen the soft palate (such as the uvula & tonsils), reduce its redundant tissue, and decrease its propensity for collapse during sleep & improve airflow dynamics (29). However, palatal resection techniques like UPPP are now considered obsolete in OSAS surgery and modern reconstructive techniques like expansion sphincter pharyngoplasty are replacing conventional surgical approaches due to better clinical outcomes and fewer side effects (30).

Surgical options for maxillofacial surgery can help treat obstructive sleep apnea in patient's incapable of tolerating CPAP therapy. The choice of surgical treatment strategy depends on the location and severity of the anatomical obstruction. Examples of common surgical approaches are Palatal Surgery, Nasal surgery, maxillomandibular advancement (MMA), genioglossus advancement (GA), and Hyoid Suspension. Proper evaluation of the patient and selection of the appropriate surgical method are essential for a successful surgical intervention (26). According to studies, UPPP can alleviate the symptoms of OSAS, but it usually fails to achieve a significant decrease in the apnea-hypopnea index (AHI) (31). On the other hand, MMA and GA are generally more successful, but these procedures are more invasive and carry significant morbidity risks (32). Surgical methods for OSA are not definitive and have pros and cons. When planning surgical treatment, it is necessary to consider the severity of the patient's symptoms, anatomical characteristics, comorbidities, and treatment preferences (33). A multidisciplinary approach involving collaboration between maxillofacial surgeons and sleep medicine specialists is crucial for optimal patient outcomes in managing obstructive sleep apnea through surgical interventions. Long-term follow-up and evaluation of patients after surgical intervention is necessary to assess treatment efficacy and implement additional strategies if needed (34).

Conclusion

The review emphasizes the need for experienced surgeons with a comprehensive understanding of maxillofacial anatomy and sleep medicine for optimal patient outcomes and highlights the importance of collaborative efforts between maxillofacial surgeons and sleep medicine specialists. Through an evidence-based analysis of the literature, this review aims to prepare a comprehensive understanding of the role of maxillofacial surgery in the multidisciplinary approach to treating OSA, shedding light on the current state of knowledge, identifying areas of consensus, controversy, and future research directions

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Conflict of Interests: The authors of this manuscript declare that they have no conflicts of interest, real or perceived, financial or non-financial in this article

Acknowledgments

We hereby sincerely appreciate the valuable support of the research assistant of the Surgery Department, Dentistry Faculty, Zahedan University of Medical Sciences. Their help and guidance have been conclusive in the completion of this research.

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[DOI: 10.71783/cofs.2024.1103485]