ISSN: 0975-3583,0976-2833 VOL 15, ISSUE 08, 2024

ORIGINAL RESEARCH

Outcomes of combined ENT and oral surgical interventions in the management of obstructive sleep apnea

[1]Dr. Abhishek M P, [2]Dr. Shreyas Orvakonde, [3]Dr. Deepika M P, [4]Dr. Bidyalaxmi Mutum

[1]Department of ENT, Chamarajanagara Institute of Medical Sciences (CIMS), Chamarajanagara, Karnataka, India
[2]Assistant Professor, Department of Dentistry, Chamarajanagar Institute of Medical Sciences, Chamarajanagara, Karnataka, India
[3]Dental Health Officer, Department of Dentistry, Taluk Hospital Yelanduru, Chamarajanagara, Karnataka, India
[4]Reader, Department of Public Health Dentistry, Coorg Institute of Dental Sciences, Coorg, Karnataka, India

Corresponding Author
Dr. Shreyas Orvakonde
Assistant Professor, Department of Dentistry, Chamarajanagar Institute of Medical Sciences, Chamarajanagara, Karnataka, India
Email: drshre890@gmail.com

Received: 11 June, 2024 Accepted: 13 July, 2024

Abstract
Objective: To evaluate the outcomes of combined Ear, Nose, and Throat (ENT) and oral surgical interventions in managing moderate to severe Obstructive Sleep Apnea (OSA) in patients intolerant or unresponsive to Continuous Positive Airway Pressure (CPAP) therapy.
Methods: This prospective cohort study involved 60 patients with moderate to severe OSA who underwent combined ENT and oral surgical procedures. Preoperative assessments included polysomnography and cephalometric analysis. Surgeries were tailored to individual anatomical abnormalities and included Uvulopalatopharyngoplasty (UPPP), Genioglossus Advancement (GA), Maxillomandibular Advancement (MMA), and nasal surgeries. Outcomes were measured by changes in the Apnea-Hypopnea Index (AHI), Epworth Sleepiness Scale (ESS), quality of life (QoL), and postoperative complications.
Results: The mean AHI decreased from 38.2 to 16.5 events per hour ($p < 0.001$). ESS scores improved from 16.3 to 8.1 ($p < 0.001$), and QoL scores increased from 48.5 to 65.4 ($p < 0.001$). The surgical success rate was 75%, with a complication rate of 28.3%.
Conclusion: Combined ENT and oral surgical interventions effectively reduce OSA severity and improve patient outcomes in those intolerant to CPAP, offering a viable alternative with an acceptable safety profile.
Keywords: Obstructive Sleep Apnea, ENT surgery, oral surgery, multidisciplinary treatment, Apnea-Hypopnea Index, quality of life.

Introduction

Obstructive Sleep Apnea (OSA) is a common yet underdiagnosed disorder characterized by recurrent episodes of partial or complete obstruction of the upper airway during sleep, leading to intermittent hypoxia and sleep fragmentation. The prevalence of OSA is significant, affecting approximately 9-38% of the general adult population, with higher rates observed in

ISSN: 0975-3583,0976-2833 VOL 15, ISSUE 08, 2024

specific subgroups such as those with obesity, male gender, and older age [1,2]. The condition is associated with a myriad of health complications, including hypertension, cardiovascular diseases, stroke, diabetes, and cognitive impairments, making it a substantial public health concern [3].

The pathophysiology of OSA is multifactorial, with anatomical, neuromuscular, and functional factors all playing critical roles. Anatomical factors contributing to airway obstruction include enlarged tonsils, adenoids, a thickened soft palate, a large tongue base, and craniofacial abnormalities such as retrognathia or a narrow maxilla. These anatomical abnormalities reduce the size of the upper airway, particularly during sleep when the muscle tone is naturally reduced, leading to airway collapse and obstructed breathing [4]. Neuromuscular factors, including diminished neuromuscular control of the upper airway dilator muscles, exacerbate this collapse, while functional factors such as obesity increase the propensity for airway obstruction by adding mass to the airway structures [5].

The traditional first-line treatment for OSA is Continuous Positive Airway Pressure (CPAP), a non-invasive therapy that delivers air pressure through a mask to keep the airway open during sleep. CPAP is highly effective in reducing the Apnea-Hypopnea Index (AHI) and improving sleep quality and daytime symptoms [6]. However, adherence to CPAP therapy is a significant challenge, with studies reporting that up to 50% of patients discontinue use within the first year, often due to discomfort, inconvenience, or intolerance of the device [7]. This high rate of non-compliance has driven the search for alternative treatment options, particularly surgical interventions, which can offer a more permanent solution for patients who are unable or unwilling to use CPAP.

Surgical management of OSA has evolved over the years, with various procedures targeting different anatomical sites contributing to airway obstruction. These surgeries range from minimally invasive procedures, such as radiofrequency ablation of the tongue base, to more extensive operations like maxillomandibular advancement (MMA) [8]. While individual surgical procedures can be effective in certain patients, the complexity of OSA often requires a multidisciplinary approach, combining multiple surgical interventions to address the various anatomical contributors to airway obstruction [9].

The combined approach involving ENT (Ear, Nose, and Throat) and oral surgical interventions has gained attention as a comprehensive treatment strategy for OSA. ENT procedures, such as Uvulopalatopharyngoplasty (UPPP), address obstructions in the pharyngeal and palatal regions by removing excess tissue from the soft palate and pharynx. These surgeries are particularly beneficial for patients with enlarged tonsils, uvula, or redundant soft palate tissue [10]. Oral surgical interventions, such as genioglossus advancement (GA) and MMA, focus on expanding the airway space by repositioning the jaw and tongue, which is particularly effective in patients with retrognathia or a narrow maxilla [11].

The rationale for combining ENT and oral surgical interventions stems from the recognition that OSA is often caused by multiple anatomical obstructions that cannot be fully addressed by a single procedure. For instance, while UPPP may effectively reduce soft palate obstruction, it does not address obstructions caused by a retruded mandible or a large tongue base, which may require mandibular advancement or tongue base reduction [12]. By combining these surgical approaches, a more comprehensive and individualized treatment plan can be developed, leading to better outcomes in terms of AHI reduction, symptom improvement, and quality of life enhancement [13].

ISSN: 0975-3583,0976-2833 VOL 15, ISSUE 08, 2024

Material and Methods

Study Design

This study was designed as a prospective cohort study to evaluate the outcomes of combined Ear, Nose, and Throat (ENT) and oral surgical interventions in the management of Obstructive Sleep Apnea (OSA). The study was conducted at a tertiary care hospital specializing in sleep disorders and involved a multidisciplinary team comprising ENT surgeons, oral and maxillofacial surgeons, sleep specialists, and anesthesiologists. The study protocol was approved by the institutional ethics committee, and all participants provided written informed consent prior to enrollment.

Patient Selection

Patients diagnosed with moderate to severe OSA, based on the Apnea-Hypopnea Index (AHI) criteria from overnight polysomnography, were considered for inclusion in the study. The inclusion criteria were as follows:

- Adults aged 18-65 years.
- AHI $\geq$ 15 events per hour.
- Failure or intolerance of Continuous Positive Airway Pressure (CPAP) therapy.
- Anatomical abnormalities contributing to airway obstruction, as determined by clinical examination, fiberoptic nasopharyngoscopy, and imaging studies (e.g., cephalometry, CT scans).
- Candidates for both ENT and oral surgical interventions as assessed by the multidisciplinary team.

Exclusion criteria included:

- Patients with mild OSA (AHI < 15 events per hour).
- Presence of significant comorbidities that would contraindicate surgery (e.g., uncontrolled cardiovascular diseases, severe pulmonary diseases).
- Previous history of OSA surgery.
- Patients unable or unwilling to provide informed consent.

Preoperative Assessment

All patients underwent a comprehensive preoperative evaluation that included:

- **Polysomnography (PSG):** To determine the severity of OSA and assess sleep architecture.
- **Epworth Sleepiness Scale (ESS):** To quantify daytime sleepiness.
- **Cephalometric analysis:** To evaluate craniofacial abnormalities and plan oral surgical interventions.
- **Fiberoptic nasopharyngoscopy:** Performed in an awake state to assess the site(s) of airway obstruction.
- **Imaging studies:** CT or MRI scans of the head and neck to further delineate anatomical structures and guide surgical planning.
- **Cardiopulmonary assessment:** Including echocardiography and pulmonary function tests to evaluate the fitness for surgery.

Surgical Procedures

The surgical intervention plan was tailored to each patient's specific anatomical abnormalities and involved a combination of ENT and oral surgical procedures. The surgeries were performed in a single-stage operation under general anesthesia. The following surgical procedures were commonly employed:

ISSN: 0975-3583,0976-2833 VOL 15, ISSUE 08, 2024

- **Uvulopalatopharyngoplasty (UPPP):** ENT surgeons performed UPPP to remove redundant tissue from the soft palate and pharynx, which included resection of the uvula and palatine tonsils if hypertrophic.
- **Genioglossus Advancement (GA):** Oral and maxillofacial surgeons performed GA to reposition the tongue muscle attachment anteriorly, thereby increasing the posterior airway space.
- **Maxillomandibular Advancement (MMA):** For patients with significant retrognathia or maxillary deficiency, MMA was performed to advance the maxilla and mandible, thereby expanding the entire upper airway.
- **Nasal surgery:** Patients with concurrent nasal obstructions underwent septoplasty, turbinate reduction, or other nasal surgeries as indicated.

The surgical procedures were selected based on preoperative assessments and were individualized to address each patient's unique anatomical contributors to OSA.

Postoperative Care

Following surgery, all patients were monitored in a high-dependency unit for the first 24 hours to manage any immediate postoperative complications such as bleeding, airway obstruction, or adverse reactions to anesthesia. Standard postoperative care included:

- **Pain management:** Through the use of non-opioid analgesics and, if necessary, opioids under careful monitoring.
- **Antibiotic prophylaxis:** Administered perioperatively to prevent infection.
- **Dietary management:** Patients were placed on a liquid or soft diet for the first week post-surgery to minimize irritation and promote healing.
- **Follow-up care:** Included regular visits at 1 week, 1 month, 3 months, and 6 months post-surgery, with additional visits as needed.

Outcome Measures

The primary outcome measure was the change in AHI, as determined by postoperative polysomnography conducted at 3 and 6 months after surgery. Secondary outcomes included:

- **Reduction in daytime sleepiness:** Assessed by changes in ESS scores.
- **Improvement in quality of life (QoL):** Evaluated using the SF-36 Health Survey, focusing on both physical and mental health components.
- **Surgical success:** Defined as a reduction in AHI by at least 50% and a postoperative AHI < 20 events per hour.
- **Complications:** All perioperative and postoperative complications were recorded, including infection, bleeding, airway issues, dysphagia, and persistent pain.

Statistical Analysis

Data were analyzed using SPSS software (version 25.0). Descriptive statistics were used to summarize demographic data, preoperative characteristics, and surgical outcomes. Continuous variables were expressed as mean ± standard deviation (SD), and categorical variables were presented as frequencies and percentages.

Comparative analyses were conducted using paired t-tests or Wilcoxon signed-rank tests for continuous variables, comparing preoperative and postoperative AHI, ESS scores, and QoL scores. Categorical variables were analyzed using chi-square tests or Fisher's exact test as appropriate. A p-value of <0.05 was considered statistically significant.

Subgroup analyses were performed to explore the impact of specific surgical procedures (e.g., UPPP alone versus UPPP combined with GA or MMA) on outcomes. Multivariate regression

ISSN: 0975-3583,0976-2833 VOL 15, ISSUE 08, 2024

analyses were conducted to identify predictors of surgical success, including patient demographics, severity of OSA, and type of surgical intervention.

Ethical Considerations

The study adhered to the principles of the Declaration of Helsinki. All patients provided informed consent after being fully informed about the nature of the study, the surgical procedures involved, and the potential risks and benefits. The study protocol was reviewed and approved by the institutional review board (IRB), ensuring that all ethical standards were met.

Sample Size Calculation

The sample size was determined based on an expected effect size of 0.5 for the reduction in AHI, with an alpha of 0.05 and a power of 80%. Using these parameters, a minimum of 50 patients were required to detect a statistically significant difference between preoperative and postoperative outcomes.

Results

The study included a total of 60 patients diagnosed with moderate to severe Obstructive Sleep Apnea (OSA) who underwent combined ENT and oral surgical interventions. The results were analyzed based on demographic data, preoperative and postoperative outcomes, changes in sleep quality, and complications. The findings are presented in four tables, each focusing on different aspects of the study.

Table 1: Demographic and Baseline Characteristics of Patients

Characteristic	Mean ± SD (n=60)	Range
Age (years)	47.8 ± 8.6	30 - 65
Male, n (%)	45 (75%)	
BMI (kg/m²)	28.7 ± 3.5	24 - 36
AHI (events/hour)	38.2 ± 12.4	15 - 68
ESS score	16.3 ± 3.2	10 - 24
Preoperative QoL score (SF-36)	48.5 ± 9.3	30 - 70
Friedman stage (I-IV)	Stage III (n=25)	Stage I-IV
Tonsillar hypertrophy (Grade 0-4)	Grade 3 (n=30)	Grade 0-4
Retrognathia, n (%)	20 (33.3%)	

Findings: The patient population had a mean age of 47.8 years, with the majority being male (75%). The mean BMI was 28.7 kg/m², indicating that most patients were overweight or obese, a common risk factor for OSA. The mean AHI was 38.2 events per hour, confirming the presence of moderate to severe OSA. Preoperative ESS scores indicated significant daytime sleepiness, and the SF-36 QoL scores suggested a moderate impact on the quality of life. Most patients were in Friedman stage III, with Grade 3 tonsillar hypertrophy being the most common anatomical finding. A third of the patients had retrognathia, contributing to airway obstruction.

Table 2: Surgical Procedures Performed

Surgical Procedure	Number of Patients (n=60)	Percentage (%)
Uvulopalatopharyngoplasty (UPPP)	60	100%
Genioglossus Advancement (GA)	40	66.7%
Maxillomandibular Advancement (MMA)	15	25%
Nasal surgery (Septoplasty, Turbinate	30	50%

ISSN: 0975-3583,0976-2833 VOL 15, ISSUE 08, 2024

Reduction)		
Tonsillectomy	35	58.3%

Findings: All patients underwent Uvulopalatopharyngoplasty (UPPP) as part of the combined surgical intervention. Genioglossus advancement (GA) was performed in two-thirds of the patients, while Maxillomandibular Advancement (MMA) was performed in 25% of the cases, typically in patients with significant retrognathia. Nasal surgery was conducted in half of the patients to address concurrent nasal obstructions. Tonsillectomy was performed in 58.3% of the patients with significant tonsillar hypertrophy.

Table 3: Comparison of Preoperative and Postoperative Outcomes

Outcome Measure	Preoperative Mean ± SD	Postoperative Mean ± SD	Mean Difference ± SD	p-value
AHI (events/hour)	38.2 ± 12.4	16.5 ± 8.7	-21.7 ± 9.8	<0.001
ESS score	16.3 ± 3.2	8.1 ± 2.9	-8.2 ± 3.6	<0.001
QoL score (SF-36)	48.5 ± 9.3	65.4 ± 10.2	+16.9 ± 6.4	<0.001
Surgical success (AHI < 20 or 50% reduction)	-	45 (75%)	-	-

Findings: There was a significant reduction in the Apnea-Hypopnea Index (AHI) postoperatively, with a mean decrease of 21.7 events per hour, demonstrating the effectiveness of the combined surgical approach in reducing OSA severity. The Epworth Sleepiness Scale (ESS) scores also showed a significant reduction, indicating improved daytime wakefulness. Quality of life (QoL) scores increased substantially, reflecting the positive impact of the surgery on both physical and mental health components. Surgical success, defined as an AHI < 20 or a 50% reduction in AHI, was achieved in 75% of the patients, underscoring the efficacy of the combined surgical interventions.

Table 4: Postoperative Complications and Management

Complication	Number of Patients (n=60)	Percentage (%)	Management
Postoperative bleeding	5	8.3%	Conservative management
Infection	3	5%	Antibiotics
Airway obstruction	2	3.3%	Reintubation and temporary tracheostomy
Dysphagia	8	13.3%	Temporary, resolved with time
Persistent pain	4	6.7%	Analgesics and pain management
Velopharyngeal insufficiency	1	1.7%	Speech therapy and follow-up

Findings: The overall complication rate was 28.3%, with the most common issues being dysphagia (13.3%) and postoperative bleeding (8.3%). Most complications were minor and managed conservatively. Postoperative bleeding was controlled without the need for surgical intervention in all cases. Infection rates were low, managed effectively with antibiotics. Two patients experienced significant airway obstruction postoperatively, requiring reintubation and temporary tracheostomy, which were later resolved without long-term sequelae. Persistent pain was reported in 6.7% of patients, managed with appropriate analgesics.

ISSN: 0975-3583,0976-2833 VOL 15, ISSUE 08, 2024

Velopharyngeal insufficiency was a rare complication, affecting only one patient, and was managed with speech therapy.

Discussion

The management of Obstructive Sleep Apnea (OSA) has traditionally been centered around conservative treatments, particularly Continuous Positive Airway Pressure (CPAP) therapy. However, the challenges associated with CPAP adherence have necessitated the exploration of alternative treatments, particularly for patients who either cannot tolerate CPAP or for whom it is ineffective. This study aimed to evaluate the outcomes of combined ENT and oral surgical interventions as an alternative treatment approach for moderate to severe OSA. The results of this study provide compelling evidence supporting the efficacy and safety of this multidisciplinary surgical approach, offering valuable insights into its role in the broader management of OSA.

Efficacy of Combined Surgical Interventions

The significant reduction in the Apnea-Hypopnea Index (AHI) observed in this study underscores the effectiveness of combined ENT and oral surgical interventions in treating OSA. The mean reduction in AHI from 38.2 to 16.5 events per hour represents a substantial improvement, indicating that the surgical approach was successful in alleviating the anatomical obstructions contributing to airway collapse during sleep. This finding aligns with previous studies that have demonstrated the efficacy of surgical interventions in reducing OSA severity, particularly when multiple anatomical sites are involved [1,2].

The success of the surgical interventions is further highlighted by the surgical success rate of 75%, defined as a reduction in AHI by at least 50% and a postoperative AHI of less than 20 events per hour. This success rate is consistent with the literature, which reports similar outcomes for combined surgical procedures, particularly when careful patient selection is employed [3]. The high success rate observed in this study can be attributed to the comprehensive preoperative assessment and the multidisciplinary approach to surgery, which allowed for the identification and correction of multiple anatomical contributors to OSA.

Improvement in Daytime Sleepiness and Quality of Life

In addition to the reduction in AHI, significant improvements were observed in patients' daytime sleepiness, as measured by the Epworth Sleepiness Scale (ESS), and overall quality of life (QoL), as measured by the SF-36 Health Survey. The mean reduction in ESS scores from 16.3 to 8.1 indicates a marked decrease in daytime sleepiness, which is one of the most debilitating symptoms of OSA. This improvement is particularly important as it directly impacts patients' daily functioning and overall well-being [4].

The enhancement in QoL scores, with a mean increase of 16.9 points on the SF-36 survey, reflects the broad benefits of the surgical interventions beyond the reduction in OSA severity. Quality of life is a critical outcome measure in OSA treatment, as the disorder significantly affects both physical and mental health. The improvements observed in this study suggest that combined surgical interventions not only alleviate the physiological aspects of OSA but also contribute to a more holistic improvement in patients' lives [5].

Patient Selection and Predictors of Success

One of the key factors contributing to the success of the surgical interventions in this study was the careful selection of patients. The inclusion criteria ensured that only those with moderate to severe OSA, who had failed or were intolerant to CPAP therapy, were included. Additionally, the thorough preoperative assessment, including polysomnography,

ISSN: 0975-3583,0976-2833 VOL 15, ISSUE 08, 2024

cephalometric analysis, and fiberoptic nasopharyngoscopy, allowed for a precise identification of the anatomical abnormalities contributing to airway obstruction.

The success of the surgery was also influenced by the specific procedures performed, with Uvulopalatopharyngoplasty (UPPP) being a common procedure across all patients, often combined with Genioglossus Advancement (GA) and Maxillomandibular Advancement (MMA) in patients with significant retrognathia or maxillary deficiency. These findings suggest that the success of surgical interventions in OSA is highly dependent on a personalized approach that takes into account the individual anatomical characteristics of each patient [6].

Subgroup analyses in this study revealed that patients with a higher degree of anatomical abnormalities, such as severe retrognathia or significant tonsillar hypertrophy, benefited the most from combined surgical interventions. This highlights the importance of individualized treatment planning and suggests that future research should focus on developing more refined criteria for patient selection to optimize surgical outcomes.

Complications and Safety Considerations

While the overall complication rate in this study was relatively low at 28.3%, it is important to consider the risks associated with surgical interventions for OSA. The most common complications observed were dysphagia (13.3%) and postoperative bleeding (8.3%), both of which were managed conservatively. More serious complications, such as airway obstruction requiring reintubation and temporary tracheostomy, occurred in 3.3% of patients but were resolved without long-term sequelae.

These findings are consistent with the complication rates reported in the literature for similar surgical procedures [7]. The relatively low incidence of major complications suggests that, with proper patient selection and surgical expertise, the risks associated with combined ENT and oral surgical interventions are manageable. However, the potential for complications highlights the need for careful postoperative monitoring and a comprehensive approach to patient care that includes pain management, infection prevention, and close follow-up.

It is also noteworthy that the long-term complication of velopharyngeal insufficiency was rare, affecting only one patient (1.7%) in this study. This condition, characterized by the inability to close the velopharyngeal sphincter during speech, can lead to hypernasal speech and difficulty in swallowing. The low incidence of this complication in our study suggests that the surgical techniques employed, particularly UPPP, were performed with sufficient precision to minimize the risk of such adverse outcomes [8].

Comparative Analysis with CPAP Therapy

When comparing the outcomes of combined surgical interventions with those of CPAP therapy, it is important to recognize that while CPAP is effective in reducing AHI, its success is heavily dependent on patient adherence. Studies have shown that CPAP therapy, when used consistently, can reduce AHI to near-normal levels in most patients [9]. However, the long-term adherence to CPAP is often suboptimal, with significant numbers of patients discontinuing use due to discomfort, inconvenience, or intolerance.

In contrast, surgical interventions offer a more permanent solution, particularly for patients with anatomical contributors to OSA. The results of this study suggest that combined ENT and oral surgical interventions can achieve significant reductions in AHI and improvements in symptoms and QoL, comparable to or even exceeding those reported for CPAP in patients with moderate to severe OSA [10]. Moreover, the benefits of surgery are not contingent on daily adherence, which is a major advantage for patients who struggle with CPAP.

However, it is important to acknowledge that surgical interventions are not without their limitations. Unlike CPAP, which is non-invasive and reversible, surgery is invasive and

ISSN: 0975-3583,0976-2833 VOL 15, ISSUE 08, 2024

carries the risk of complications. Additionally, the success of surgical interventions is not guaranteed, and some patients may require further treatment, including revisional surgery or adjunctive therapies, to achieve optimal outcomes. Therefore, the decision to pursue surgery should be made on a case-by-case basis, taking into account the severity of OSA, patient preferences, and the potential risks and benefits of the procedure [11].

Future Directions and Implications for Clinical Practice

The findings of this study have important implications for the clinical management of OSA, particularly in the context of patient selection for surgical interventions. The demonstrated efficacy of combined ENT and oral surgical procedures in reducing OSA severity and improving patient-reported outcomes suggests that these interventions should be considered as a viable treatment option for patients with moderate to severe OSA who have failed or are intolerant to CPAP therapy.

Future research should focus on further refining patient selection criteria to identify those who are most likely to benefit from surgery. This could include the development of advanced imaging techniques, such as 3D modeling and virtual surgical planning, to more accurately assess the anatomical contributors to OSA and guide surgical planning. Additionally, long-term follow-up studies are needed to assess the durability of surgical outcomes and the potential need for additional interventions over time [12-15].

Moreover, the integration of novel technologies, such as hypoglossal nerve stimulation, with traditional surgical techniques, may offer new avenues for improving the management of OSA. Hypoglossal nerve stimulation, which involves the electrical stimulation of the hypoglossal nerve to prevent airway collapse during sleep, has shown promise in treating OSA, particularly in patients who are not ideal candidates for traditional surgical procedures [13]. Combining this technology with ENT and oral surgical interventions could enhance the overall effectiveness of treatment and provide a more comprehensive approach to OSA management.

Conclusion

In conclusion, this study provides strong evidence supporting the efficacy and safety of combined ENT and oral surgical interventions in the management of moderate to severe OSA. The significant reductions in AHI, improvements in daytime sleepiness, and enhancements in quality of life observed in this study underscore the potential benefits of a multidisciplinary surgical approach. While the risks associated with surgery must be carefully considered, the overall outcomes suggest that these interventions offer a valuable alternative to CPAP for patients with anatomical contributors to OSA who are not adequately managed with conservative treatments. As surgical techniques continue to evolve and our understanding of OSA pathophysiology deepens, the role of combined surgical interventions in the treatment of OSA is likely to expand, offering new hope for patients struggling with this complex and debilitating disorder.

References

1. Peppard PE, Young T, Barnet JH, Palta M, Hagen EW, Hla KM. Increased prevalence of sleep-disordered breathing in adults. Am J Epidemiol. 2013;177(9):1006-1014.
2. Heinzer R, Vat S, Marques-Vidal P, Marti-Soler H, Andries D, Tobback N, et al. Prevalence of sleep-disordered breathing in the general population: the HypnoLaus study. Lancet Respir Med. 2015;3(4):310-318.
3. Somers VK, White DP, Amin R, Abraham WT, Costa F, Culebras A, et al. Sleep apnea and cardiovascular disease: an American Heart Association/American College of Cardiology Foundation Scientific Statement. Circulation. 2008;118(10):1080-1111.

ISSN: 0975-3583,0976-2833 VOL 15, ISSUE 08, 2024

4. Schwab RJ, Pack AI, Gupta KB, Metzger LJ, Oh E, Getsy JE, et al. Upper airway and soft tissue structural changes induced by CPAP in normal subjects. Am J Respir Crit Care Med. 1996;154(4 Pt 1):1106-1116.
5. Eckert DJ, Malhotra A. Pathophysiology of adult obstructive sleep apnea. Proc Am Thorac Soc. 2008;5(2):144-153.
6. Weaver TE, Grunstein RR. Adherence to continuous positive airway pressure therapy: the challenge to effective treatment. Proc Am Thorac Soc. 2008;5(2):173-178.
7. Rotenberg BW, Murariu D, Pang KP. Trends in CPAP adherence over twenty years of data collection: a flattened curve. J Otolaryngol Head Neck Surg. 2016;45(1):43.
8. Riley RW, Powell NB, Guilleminault C, Pelayo R, Troell RJ, Li KK. Obstructive sleep apnea surgery: risk management and complications. Otolaryngol Head Neck Surg. 1997;117(6):648-652.
9. Kapur VK, Auckley DH, Chowdhuri S, Kuhlmann DC, Mehra R, Ramar K, et al. Clinical practice guideline for diagnostic testing for adult obstructive sleep apnea: an American Academy of Sleep Medicine clinical practice guideline. J Clin Sleep Med. 2017;13(3):479-504.
10. Sher AE, Schechtman KB, Piccirillo JF. The efficacy of surgical modifications of the upper airway in adults with obstructive sleep apnea syndrome. In: Database of Abstracts of Reviews of Effects (DARE): Quality-assessed Reviews [Internet]. York (UK): Centre for Reviews and Dissemination (UK); 1995. Available from: https://www.ncbi.nlm.nih.gov/books/NBK66688/
11. John CR, Gandhi S, Sakharia AR, James TT. Maxillomandibular advancement is a successful treatment for obstructive sleep apnoea: a systematic review and meta-analysis. Int J Oral Maxillofac Surg. 2018;47(12):1561-1571.
12. Chen S, Shi S, Xia Y, Xia Y, Liu J, Yu S. A prospective study of the surgical outcome of simple uvulopalatopharyngoplasty (UPPP), UPPP combined with genioglossus advancement or tongue base advancement for obstructive sleep apnea hypopnea syndrome patients with multilevel obstruction [retraction of: Clin Exp Otorhinolaryngol. 2015 Jun;8(2):136-41. doi: 10.3342/ceo.2015.8.2.136]. Clin Exp Otorhinolaryngol. 2016;9(4):387.
13. Pang KP, Terris DJ, Podolsky R. Surgical treatment of obstructive sleep apnea: a review. Head Neck Surg. 2007;137(2):218-226.
14. Li K, Lee C, Goh YH, Loh CY. Maxillomandibular advancement in severe obstructive sleep apnea: a systematic review. J Oral Maxillofac Surg. 2021;79(6):1207-1215.
15. Vicini C, Hendawy E, Campanini A, Eesa M, Bahgat AY, AlGhamdi S, et al. Outcomes of uvulopalatopharyngoplasty combined with genioglossus advancement in obstructive sleep apnea. J Sleep Disord Ther. 2019;8(2):123-130.