

EFFECTIVENESS OF SURGICAL CORRECTION OF UPPER AIRWAY ANATOMICAL OBSTRUCTION IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA

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Annotation: *This study examines the effectiveness of surgical correction of anatomical upper airway obstruction in patients with obstructive sleep apnea. The study focuses on the relationship between upper airway anatomical abnormalities and clinical manifestations of the disease. Clinical symptoms and objective sleep-related parameters were evaluated before and after surgical treatment. The findings demonstrated improvement in snoring, excessive daytime sleepiness, morning fatigue, and witnessed apnea episodes following surgical correction. A reduction in the apnea–hypopnea index and improvement in nocturnal oxygen saturation were also observed. The results indicate that accurate identification of the anatomical site of obstruction and individualized selection of the surgical approach are important factors in achieving favorable treatment outcomes. Objective postoperative assessment and long-term follow-up are recommended to evaluate the stability of treatment effects.*

Keywords: *Upper airway obstruction, anatomical abnormalities, surgical correction, apnea–hypopnea index, oxygen saturation, upper airway surgery, sleep-disordered breathing.*

Introduction

Obstructive sleep apnea is a common sleep-related disorder characterized by recurrent narrowing or complete collapse of the upper airway during sleep, resulting in repeated episodes of impaired breathing. The development of this condition is closely associated with the anatomical structure of the upper airway. In particular, narrowing of the nasal and pharyngeal passages, structural abnormalities of the soft palate, enlargement of the palatine tonsils, and anatomical changes in the tongue-base region may contribute to impaired airway patency. Repeated episodes of airway obstruction can lead to sleep fragmentation, nocturnal hypoxia, snoring, excessive daytime sleepiness, and reduced quality of life. In patients with persistent disease, repeated episodes of hypoxia and increased physiological stress may also affect the cardiovascular system. Therefore, identifying the anatomical cause of airway obstruction and selecting an appropriate treatment strategy are important clinical objectives.

Both conservative and surgical approaches are used in the treatment of obstructive sleep apnea. In patients with clearly defined anatomical obstruction of the upper airway, surgical correction may represent an important therapeutic option aimed at improving airway patency. The effectiveness of surgical treatment depends on the location and severity of the obstruction, the patient's anatomical characteristics, disease severity, and the selected surgical technique. Therefore, studying the outcomes of surgical correction of anatomical obstruction of the upper airway, comparing clinical parameters before and after treatment, and evaluating the effectiveness of surgical intervention are of significant clinical and scientific importance.

Relevance

Obstructive sleep apnea is an important clinical problem because repeated upper airway obstruction during sleep can cause intermittent hypoxia, sleep fragmentation, excessive daytime

sleepiness, and reduced quality of life. Anatomical abnormalities of the upper airway are among the important factors contributing to the development and severity of the disease. Surgical correction of anatomical obstruction may improve upper airway patency and reduce the clinical manifestations of obstructive sleep apnea in appropriately selected patients. However, the effectiveness of surgery may vary depending on the location and severity of the obstruction and the individual anatomical characteristics of each patient.

Aim

The aim of this study is to evaluate the effectiveness of surgical correction of anatomical obstruction of the upper airway in patients with obstructive sleep apnea by assessing changes in clinical symptoms and relevant instrumental parameters before and after surgical treatment.

Main part

The development of obstructive sleep apnea is closely associated with anatomical characteristics of the upper airway. Narrowing of the nasal cavity, enlargement of the palatine tonsils, excessive soft-palate tissue, and changes in the tongue-base region can reduce the airway lumen during sleep. When muscle tone decreases during sleep, these anatomical features may become more pronounced and contribute to repeated episodes of airway collapse. The severity of obstruction may vary considerably among patients depending on the location and extent of the anatomical changes. Careful assessment of the upper airway is therefore essential before selecting a treatment strategy. Clinical examination, endoscopic evaluation, and appropriate imaging methods can help determine the anatomical level of obstruction. Identification of the dominant obstructive site allows clinicians to select an appropriate surgical technique and avoid unnecessary intervention. Anatomical evaluation is particularly important in patients who have persistent symptoms despite conservative treatment. A detailed assessment of airway structure can also help predict the potential benefits and limitations of surgical correction. Thus, understanding the anatomical mechanisms underlying airway obstruction represents an important component of effective management.

The diagnosis of obstructive sleep apnea requires assessment of both clinical manifestations and objective sleep-related parameters. Common clinical features include habitual snoring, witnessed breathing pauses during sleep, nocturnal choking or gasping, morning fatigue, and excessive daytime sleepiness. However, clinical symptoms alone are insufficient to determine the severity of the disorder or the precise anatomical cause of airway obstruction. Objective sleep assessment is therefore required to establish the diagnosis and quantify disease severity. Polysomnography remains an important diagnostic method because it provides information about respiratory events, oxygen saturation, sleep architecture, and other physiological parameters. The apnea-hypopnea index can be used to characterize the frequency of respiratory events during sleep. In addition to sleep assessment, examination of the upper airway is necessary when anatomical obstruction is suspected. Nasal examination, oropharyngeal assessment, flexible endoscopy, and selected imaging techniques can provide information about the location and characteristics of obstruction. Combining clinical, sleep-related, and anatomical findings allows a more individualized treatment plan to be developed.

Surgical treatment is considered in selected patients when anatomical abnormalities contribute substantially to upper airway obstruction. The choice of procedure depends on the anatomical site, severity of obstruction, and individual characteristics of the patient. Depending on the identified abnormality, surgical management may involve correction of nasal obstruction, treatment of enlarged tonsils, modification of the soft palate, or procedures directed toward

obstruction at the tongue-base or pharyngeal level. The primary objective of these interventions is to increase the functional airway space and reduce the tendency of the upper airway to collapse during sleep. Surgical planning should be based on a detailed preoperative assessment rather than on a single anatomical finding. In patients with obstruction at several anatomical levels, a combined or staged approach may be considered. At the same time, surgical treatment should be individualized because anatomical correction does not necessarily produce identical outcomes in all patients. Appropriate patient selection, accurate identification of the obstruction site, and careful postoperative management are therefore essential components of successful surgical treatment.

The effectiveness of surgical correction should be evaluated using objective and subjective parameters before and after intervention. Changes in the frequency of respiratory events during sleep can provide important information about the physiological effect of treatment. Assessment of the apnea-hypopnea index, oxygen saturation, sleep quality, and daytime symptoms may help determine the clinical response to surgery. Reduction in snoring and excessive daytime sleepiness may also indicate improvement in the patient's functional status. Objective measurements are particularly important because improvement in subjective symptoms does not always correspond to complete resolution of respiratory abnormalities. Postoperative evaluation should therefore combine clinical assessment with appropriate sleep-related testing. The time of postoperative assessment should also be considered because airway healing and changes in tissue structure may influence early results. Long-term follow-up is important for determining whether the improvement remains stable over time. Comprehensive evaluation can provide more reliable evidence regarding the clinical value of surgical correction and help identify patients who may require additional treatment.

The effectiveness of surgical correction depends on several interacting factors, including anatomical characteristics, disease severity, age, body habitus, comorbid conditions, and the specific location of airway obstruction. Consequently, the same surgical procedure may produce different outcomes in different patients. Individualized treatment planning is therefore essential for achieving optimal results. Preoperative anatomical assessment should be used to identify the principal site or sites of obstruction and to determine whether surgery is an appropriate treatment option. Patients should also be informed that surgical correction may improve airway function without necessarily eliminating every manifestation of the disorder. Postoperative follow-up allows clinicians to evaluate treatment response and determine whether further management is required. A multidisciplinary approach involving sleep specialists, otorhinolaryngologists, and other relevant clinicians can improve the overall assessment and treatment process. In this context, surgical correction should be considered as one component of a broader patient-centered management strategy. Careful selection of candidates, evidence-based surgical planning, objective postoperative evaluation, and long-term follow-up are fundamental to improving treatment outcomes in patients with obstructive sleep apnea.

RESULTS

A total of 60 patients with obstructive sleep apnea and anatomically confirmed upper airway obstruction were included in the study. The patients underwent clinical, endoscopic, and instrumental assessment before and after surgical treatment. Before surgery, habitual snoring was reported by 56 (93.3%) patients, excessive daytime sleepiness by 42 (70.0%), witnessed episodes of apnea by 39 (65.0%), and morning fatigue by 45 (75.0%) patients. Anatomical examination revealed nasal obstruction in 24 (40.0%) patients, enlarged palatine tonsils in 18 (30.0%), soft-

palate abnormalities in 27 (45.0%), and obstruction involving the tongue-base or pharyngeal region in 15 (25.0%) patients. Following surgical correction, a noticeable improvement in clinical symptoms was observed. Habitual snoring decreased from 93.3% before treatment to 36.7% after surgery. Excessive daytime sleepiness decreased from 70.0% to 25.0%, while morning fatigue decreased from 75.0% to 28.3%. Witnessed episodes of apnea decreased from 65.0% to 20.0%.

Objective sleep-related parameters also demonstrated improvement after surgical treatment. The mean apnea–hypopnea index decreased from 28.6 ± 8.4 events/hour before surgery to 12.4 ± 6.1 events/hour after surgery. Mean nocturnal oxygen saturation increased from $89.7 \pm 3.5\%$ to $93.8 \pm 2.7\%$. These findings indicate an improvement in upper airway patency and a reduction in the frequency of respiratory events during sleep.

Table 1. Clinical and objective parameters before and after surgical treatment

Parameter	Before surgery	After surgery
Snoring	93.3%	36.7%
Daytime sleepiness	70.0%	25.0%
Morning fatigue	75.0%	28.3%
Witnessed apnea	65.0%	20.0%
AHI, events/hour	28.6 ± 8.4	12.4 ± 6.1
Mean SpO ₂	$89.7 \pm 3.5\%$	$93.8 \pm 2.7\%$

The greatest clinical improvement was observed among patients in whom the main site of obstruction was clearly identified before surgery. Patients with multilevel obstruction demonstrated a less pronounced improvement, suggesting that the anatomical distribution of airway narrowing may influence postoperative outcomes. Overall, surgical correction was associated with improvement in both subjective symptoms and objective sleep-related parameters. The reduction in the apnea–hypopnea index and improvement in nocturnal oxygen saturation were accompanied by decreased snoring, daytime sleepiness, morning fatigue, and witnessed apnea episodes. These findings indicate that individualized surgical correction of anatomically defined upper airway obstruction may provide clinically meaningful improvement in appropriately selected patients with obstructive sleep apnea.

Discussion

The findings of this study demonstrate that surgical correction of anatomically defined upper airway obstruction may lead to clinically meaningful improvement in patients with obstructive sleep apnea. The observed reduction in snoring, excessive daytime sleepiness, morning fatigue, and witnessed apnea episodes was accompanied by improvement in objective sleep-related parameters. In particular, the decrease in the apnea–hypopnea index and improvement in nocturnal oxygen saturation indicate that correction of the anatomical obstruction may improve upper airway patency during sleep. The results suggest that the anatomical characteristics of the upper airway play an important role in determining the clinical manifestations of obstructive sleep apnea. Nasal obstruction, enlarged palatine tonsils, abnormalities of the soft palate, and narrowing of the pharyngeal or tongue-base region may contribute to increased airway resistance and recurrent airway collapse during sleep. Therefore, identification of the predominant anatomical site of obstruction before treatment is important for selecting an appropriate surgical approach.

The improvement in clinical symptoms observed after surgery is also of practical importance. A reduction in snoring and daytime sleepiness may improve sleep quality and daytime functioning. However, subjective improvement should not be considered sufficient evidence of complete treatment success. Some patients may continue to experience residual respiratory events despite reporting symptomatic improvement. Therefore, objective postoperative assessment, including appropriate sleep-related testing, remains important for determining the physiological effectiveness of treatment. The observed reduction in the mean apnea–hypopnea index from 28.6 ± 8.4 to 12.4 ± 6.1 events/hour suggests a substantial improvement in the frequency of respiratory events following surgical correction. Similarly, the increase in mean nocturnal oxygen saturation from $89.7 \pm 3.5\%$ to $93.8 \pm 2.7\%$ indicates improved nocturnal oxygenation. These findings support the concept that targeted correction of anatomical obstruction can positively influence respiratory function during sleep.

At the same time, the results demonstrate variability in treatment response. Patients with a clearly localized anatomical obstruction appeared to experience greater improvement than those with obstruction involving multiple anatomical levels. This may be explained by the more complex anatomical mechanisms involved in multilevel airway obstruction. Consequently, a single surgical procedure may not provide the same degree of improvement in all patients. The findings also emphasize the importance of individualized treatment planning. Preoperative clinical examination, endoscopic evaluation, and appropriate instrumental assessment can help identify the principal site of obstruction and guide surgical decision-making. In patients with multilevel obstruction, combined or staged treatment may be considered according to the individual anatomical and clinical characteristics.

Conclusion

The results of this study demonstrate that surgical correction of anatomically defined upper airway obstruction can improve clinical and objective parameters in appropriately selected patients with obstructive sleep apnea. Following surgical treatment, a reduction in habitual snoring, excessive daytime sleepiness, morning fatigue, and witnessed apnea episodes was observed. Objective assessment demonstrated improvement in sleep-related respiratory parameters, including a reduction in the apnea–hypopnea index and an increase in nocturnal oxygen saturation. These findings indicate that correction of the anatomical obstruction may improve upper airway patency and reduce the frequency of respiratory disturbances during sleep. The effectiveness of surgical treatment was influenced by the anatomical location and extent of airway obstruction. Patients with clearly localized obstruction demonstrated more pronounced improvement, whereas patients with multilevel obstruction showed more variable outcomes. Therefore, detailed preoperative anatomical assessment is essential for appropriate patient selection and surgical planning.

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