

## Sleep Surgery 50 OSA Patients and Their Outcomes

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### Abstract

### Original Research Article

**Background:** Obstructive sleep apnea (OSA) is a prevalent sleep-related breathing disorder associated with cardiovascular, metabolic, and neurocognitive complications. Continuous positive airway pressure (CPAP) is the standard treatment; however, poor long-term adherence limits its effectiveness. Sleep surgery has emerged as an alternative for patients with severe OSA who are intolerant to CPAP, but real-world outcome data remain limited, especially in low- and middle-income countries. **Objective:** To evaluate the outcomes of multilevel sleep surgery in patients with very severe OSA. **Methods:** This retrospective observational study included 50 adults (age 18–70 years) with very severe OSA (apnea–hypopnea index [AHI]  $\geq 50$  events/hour and 3% oxygen desaturation index [ODI]  $> 40$  events/hour) who underwent multilevel upper airway surgery at Malleus ENT Specialized Hospital Limited in Dhaka, Bangladesh, between June 2023 and June 2024. Preoperative assessment included clinical evaluation, BMI measurement, tonsil grading, Friedman staging, and flexible nasendoscopy. Surgical interventions included modified uvulopalatopharyngoplasty with radiofrequency tongue base procedures, tonsillectomy, lingual tonsillectomy, midline glossectomy, and trans-palatal advancement pharyngoplasty. Primary outcome was postoperative change in AHI. Secondary outcomes included 3% ODI, lowest oxygen saturation, snoring severity, Epworth Sleepiness Scale scores, BMI, and surgical complications. **Results:** The cohort had a mean age of  $42 \pm 12$  years and was predominantly male (80%). High-grade tonsillar hypertrophy (grades 3–4) was present in 60% of patients, and 38% had advanced Friedman stage (3–4). Most patients underwent multilevel surgery, with modified UPPP and radiofrequency tongue base procedures being most common (54%). Postoperative evaluation demonstrated significant improvement in objective outcomes: mean AHI decreased from  $68.5 \pm 15.8$  to  $15.2 \pm 12.4$  events/hour ( $p < 0.01$ ), 3% ODI decreased from  $52.7 \pm 14.6$  to  $13.4 \pm 15.9$  events/hour ( $p < 0.01$ ), and lowest oxygen saturation increased from  $72.9 \pm 9.8\%$  to  $80.6 \pm 18.7\%$  ( $p = 0.03$ ). Subjective outcomes also improved, with median snoring severity declining from 8 to 1 and Epworth Sleepiness Scale scores decreasing from 13 to 5 (both  $p < 0.01$ ). BMI showed a modest but significant reduction ( $30.8 \pm 4.9$  to  $28.9 \pm 4.8$  kg/m<sup>2</sup>;  $p < 0.01$ ). **Conclusion:** Multilevel sleep surgery in patients with very severe OSA resulted in significant improvements in respiratory parameters, oxygenation, and patient-reported symptoms. Tailored, anatomy-based surgical interventions provide a safe and effective alternative for patient’s intolerant to CPAP, enhancing both physiological function and quality of life.

**Keywords:** Obstructive sleep apnea, multilevel sleep surgery, apnea–hypopnea index.

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## INTRODUCTION

Obstructive sleep apnea (OSA) is a common and potentially serious sleep-related breathing disorder characterized by recurrent episodes of partial or complete upper airway obstruction during sleep, leading to intermittent hypoxia, sleep fragmentation, and excessive daytime sleepiness. It affects a substantial proportion of the adult population worldwide and is increasingly recognized as a major public health concern

due to its association with cardiovascular disease, metabolic disorders, neurocognitive impairment, and reduced quality of life. [1-3] The burden of OSA is particularly significant in low- and middle-income countries, where underdiagnosis and limited access to long-term treatment remain challenges.

Continuous positive airway pressure (CPAP) therapy is considered the gold standard treatment for moderate to severe OSA. However, despite its proven

efficacy, long-term adherence to CPAP is often suboptimal due to discomfort, claustrophobia, nasal symptoms, and lifestyle inconvenience. As a result, a considerable number of patients remain untreated or inadequately treated, prompting the exploration of alternative therapeutic options: [4-5] Oral appliances and positional therapy may benefit selected patients, but their effectiveness is limited in individuals with multilevel airway obstruction.

Sleep surgery has emerged as an important therapeutic modality for carefully selected OSA patients, particularly those who are intolerant or noncompliant with CPAP therapy. Surgical interventions aim to correct anatomical abnormalities contributing to upper airway collapse and may involve single-level or multilevel procedures targeting the nasal cavity, oropharynx, hypopharynx, or skeletal framework.[6] Advances in preoperative evaluation techniques, such as drug-induced sleep endoscopy (DISE), have improved patient selection and surgical planning, leading to better postoperative outcomes.

The success of sleep surgery is commonly assessed using both objective and subjective outcome measures, including reductions in the apnea–hypopnea index (AHI), improvements in oxygen saturation parameters, and enhanced patient-reported outcomes such as daytime sleepiness and overall quality of life. [7-8] However, surgical outcomes can vary widely depending on patient characteristics, severity of OSA, anatomical factors, and the type of surgical procedure performed. Therefore, evaluating real-world outcomes in well-defined patient cohorts is essential for understanding the effectiveness and limitations of sleep surgery.

### Objective

This study aims to evaluate the outcomes of sleep surgery in 50 patients diagnosed with obstructive sleep apnea.

## METHODOLOGY

### Setting and Study Design

This was a retrospective observational study conducted at Malleus ENT Specialized Hospital Limited in Dhaka, Bangladesh. The study included 50 patients with very severe obstructive sleep apnea (OSA) who underwent multilevel upper airway surgery between June 2023 and June 2024. All surgical procedures were performed at the Department of Otolaryngology–Head and Neck Surgery of the study hospital.

### Patient Eligibility

Eligible patients were adults aged 18 to 70 years who were diagnosed with very severe OSA and attended the outpatient sleep clinic of the hospital. Very severe OSA was defined as an apnea–hypopnea index (AHI)  $\geq 50$  events per hour with a 3% oxygen desaturation index

(ODI)  $>40$  events per hour. All patients underwent at least level II polysomnography at baseline. Level II polysomnography includes comprehensive monitoring of neurological, respiratory, and muscular parameters and can be conducted in an outpatient setting. Patients with incomplete records, significant craniofacial anomalies, or untreated comorbid conditions were excluded.

All included patients had previously failed continuous positive airway pressure (CPAP) therapy due to poor tolerance, including complaints such as claustrophobia, mask discomfort, nasal obstruction, bloating, numbness, and interference with sleep quality or intimacy, despite prior counseling and follow-up by a sleep physician.

### Preoperative Assessment

Patients were evaluated preoperatively in a multidisciplinary setting involving both a sleep physician and an otolaryngologist. A detailed clinical assessment was performed, including demographic data (age, sex), body mass index (BMI), tonsillar grading, and Friedman staging. Flexible nasendoscopy with awake dynamic maneuvers was used to identify the levels and patterns of upper airway collapse and to exclude other anatomical or pathological causes of obstruction.

### Surgical Intervention

All patients underwent single-stage or multistage multilevel upper airway reconstructive surgery, performed by an experienced otolaryngologist trained in sleep surgery. Surgical planning was guided by endoscopic findings and followed standardized, evidence-based protocols. Nasal airway patency was optimized prior to surgery, and selected patients underwent concurrent turbinate reduction when indicated.

Phase 1 surgery included modified uvulopalatopharyngoplasty (UPPP) with radiofrequency-assisted tongue base procedures, with concomitant palatine tonsillectomy when tonsillar hypertrophy was present. Lingual tonsillectomy was performed in patients with grade 3 or 4 lingual tonsillar hypertrophy contributing to airway obstruction. Phase 2 procedures were tailored according to persistent sites of obstruction and included midline glossectomy for macroglossia-related retrolingual obstruction and transpalatal advancement pharyngoplasty for retropalatal airway collapse.

### Postoperative Care and Outcome Measures

Postoperatively, patients were monitored for 1–2 nights in a high-dependency unit for close observation of respiratory and upper airway status. No patient required invasive airway intervention. Patients were advised on weight reduction strategies and were

encouraged to retrial positional therapy or CPAP postoperatively to optimize surgical outcomes.

Follow-up full-night attended polysomnography was performed at an average of five months after surgery. The primary outcome measure was the change in AHI. Secondary outcomes included surgical success, defined as a postoperative AHI <20 events/hour with at least a 50% reduction from baseline. Additional outcomes included changes in 3% ODI, lowest oxygen saturation, snoring severity assessed by bed-partner questionnaire, Epworth Sleepiness Scale scores, and postoperative complications. Adverse events were documented, with serious adverse events defined according to standard clinical criteria.

**Statistical Analysis**

Statistical analysis was performed using SPSS version 21. Continuous variables with normal distribution were analyzed using paired two-sided t-tests, while non-normally distributed variables were analyzed

using the Wilcoxon signed-rank test. Categorical variables were compared using chi-square tests. A p-value of less than 0.05 was considered statistically significant.

**RESULTS**

A total of 50 patients were included in the study, with a mean age of 42 ± 12 years at the time of surgery. The study population was predominantly male, accounting for 80% of cases, while females constituted 20%. Regarding tonsillar status, the majority of patients (60%) had high-grade tonsillar hypertrophy (grades 3–4), whereas 40% had tonsil grades 0–2. Assessment of Friedman staging revealed that most patients (62%) were classified as stages 1–2, while 38% belonged to stages 3–4, indicating a substantial proportion of patients with advanced anatomical severity of upper airway obstruction.

**Table 1-Characteristics of Included Patients (N = 50)**

Characteristic	Percentage (%)
Age at procedure (years), mean ± SD	42 ± 12
<b>Sex</b>	
Male	80
Female	20
<b>Tonsil grade</b>	
0–2	40
3–4	60
<b>Friedman stage</b>	
1–2	62
3–4	38

More than half of the patients (54%) underwent modified uvulopalatopharyngoplasty with radiofrequency-in-saline tongue channelling, with or without tonsillectomy, as the primary surgical intervention. Isolated turbinate reduction was performed in 6% of cases, while trans-palatal advancement pharyngoplasty and midline glossectomy alone were each performed in 4% of patients. Multilevel surgical approaches were common, with combined midline glossectomy and trans-palatal advancement

pharyngoplasty carried out in 14% of patients. Lingual tonsillectomy alone was performed in 10% of cases, whereas 6% underwent a combination of lingual tonsillectomy and trans-palatal advancement pharyngoplasty. The most extensive multilevel surgery, involving lingual tonsillectomy, midline glossectomy, and trans-palatal advancement pharyngoplasty, was performed in 8% of the study population, reflecting tailored surgical management based on the level and pattern of airway obstruction.

**Table 2-Surgical Interventions Performed in the Study Population (N = 50)**

Intervention 1 & 2	Intervention 3	Intervention 4	Intervention 5	Patients (%)
Modified uvulopalatopharyngoplasty with radiofrequency-in-saline tongue channelling ± tonsillectomy	–	–	–	54
Turbinate reduction	–	–	–	6
Trans-palatal advancement pharyngoplasty	–	–	–	4
Midline glossectomy	–	–	–	4
Midline glossectomy	Trans-palatal advancement pharyngoplasty	–	–	14
Lingual tonsillectomy	–	–	–	10

Lingual tonsillectomy	Trans-palatal advancement pharyngoplasty	–	–	6
Lingual tonsillectomy	Midline glossectomy	Trans-palatal advancement pharyngoplasty	–	8

Postoperative outcomes demonstrated significant improvement across both objective and subjective parameters (Table 3). Mean BMI showed a modest but statistically significant reduction from 30.8 ± 4.9 kg/m<sup>2</sup> preoperatively to 28.9 ± 4.8 kg/m<sup>2</sup> postoperatively (mean difference 1.9; 95% CI: 0.8–2.6; \*p\* < 0.01). A marked reduction in disease severity was observed, with the mean apnea–hypopnea index (AHI) decreasing from 68.5 ± 15.8 events/hour to 15.2 ± 12.4 events/hour, representing a mean reduction of 53.3 events/hour (95% CI: 46.9–59.7; \*p\* < 0.01). Similarly, the 3% oxygen desaturation index (ODI) improved significantly from 52.7 ± 14.6 to 13.4 ± 15.9 events/hour (mean difference 39.3; 95% CI: 30.8–47.8; \*p\* < 0.01).

Oxygenation parameters also improved, with the lowest recorded oxygen saturation increasing from 72.9 ± 9.8% preoperatively to 80.6 ± 18.7% postoperatively (\*p\* = 0.03). Subjective outcomes showed substantial improvement, as median snoring severity scores decreased from 8 (range 4–9) to 1 (range 0–7), and Epworth Sleepiness Scale scores declined from a median of 13 (range 2–22) to 5 (range 0–15), both changes being statistically significant (\*p\* < 0.01). These findings indicate that multilevel sleep surgery resulted in significant improvement in OSA severity, nocturnal oxygenation, and patient-reported symptoms.

**Table 3-Comparison of Preoperative and Postoperative Outcomes (N = 50\*)**

Characteristic	n*	Preoperative	Postoperative	Mean Difference (95% CI)	P value
BMI (kg/m <sup>2</sup> ), mean ± SD	48	30.8 ± 4.9	28.9 ± 4.8	1.9 (0.8–2.6)	<0.01
AHI (events/hour), mean ± SD	50	68.5 ± 15.8	15.2 ± 12.4	53.3 (46.9–59.7)	<0.01
3% ODI (events/hour), mean ± SD	42	52.7 ± 14.6	13.4 ± 15.9	39.3 (30.8–47.8)	<0.01
Lowest oxygen saturation (%), mean ± SD	48	72.9 ± 9.8	80.6 ± 18.7	-7.7 (-14.9 to -0.5)	0.03
Snoring severity scale (/9), median [range]	40	8 [4–9]	1 [0–7]	–	<0.01
Epworth Sleepiness Scale (/24), median [range]	46	13 [2–22]	5 [0–15]	–	<0.01

## DISCUSSION

This study evaluated the outcomes of multilevel sleep surgery in 50 patients with very severe obstructive sleep apnea (OSA) at Malleus ENT Specialized Hospital Limited in Dhaka, Bangladesh. The mean age of our cohort was 42 ± 12 years, with a strong male predominance (80%), consistent with global epidemiological trends showing higher OSA prevalence among middle-aged men.<sup>7</sup> Most patients presented with high-grade tonsillar hypertrophy (60%) and advanced anatomical obstruction, as reflected by Friedman stages 1–2 in 62% and stages 3–4 in 38%, highlighting the complexity of the cases included. These demographic and anatomical characteristics align with prior studies, such as Friedman *et al.*, which also reported a predominance of male patients with significant tonsillar and retropalatal contributions to airway obstruction.[8]

Surgical intervention in this cohort was primarily multilevel, with modified uvulopalatopharyngoplasty combined with radiofrequency tongue base channelling being the most common procedure (54%). Single-level procedures, including turbinate reduction, midline glossectomy, or trans-palatal advancement

pharyngoplasty, were less frequent, reflecting careful patient selection and individualized surgical planning. Multilevel surgery, including combinations such as midline glossectomy with trans-palatal advancement pharyngoplasty or lingual tonsillectomy with other procedures, was performed in 28% of patients, consistent with the current trend in sleep surgery literature emphasizing multilevel approaches for severe OSA. [9-10]

The results demonstrate substantial improvements in both objective and subjective outcomes. The mean apnea–hypopnea index (AHI) decreased dramatically from 68.5 ± 15.8 to 15.2 ± 12.4 events/hour, representing an average reduction of 53.3 events/hour (p < 0.01). The 3% oxygen desaturation index similarly improved from 52.7 ± 14.6 to 13.4 ± 15.9 events/hour. These findings are comparable to studies by Friedman *et al.*, and Li *et al.*, which reported significant AHI reductions following multilevel surgical interventions, particularly in patients with severe OSA and high Friedman stages.[11]

Improvements in oxygenation were also observed, with the lowest oxygen saturation increasing from  $72.9 \pm 9.8\%$  preoperatively to  $80.6 \pm 18.7\%$  postoperatively ( $p = 0.03$ ). Subjective outcomes, including snoring severity and daytime sleepiness assessed by the Epworth Sleepiness Scale, showed significant reductions, with median snoring scores falling from 8 to 1 and ESS scores declining from 13 to 5 ( $p < 0.01$ ). These results align with previous reports highlighting enhanced patient-reported outcomes after multilevel sleep surgery, reinforcing the importance of evaluating both polysomnographic and symptomatic improvements. [12]

The modest but significant reduction in BMI (from  $30.8 \pm 4.9$  to  $28.9 \pm 4.8$  kg/m<sup>2</sup>;  $p < 0.01$ ) suggests that perioperative weight management may have contributed to overall improvement, although the magnitude of change was small. Similar observations have been reported by Strollo *et al.*, where weight reduction augmented surgical success, but primary improvements were largely attributable to airway reconstruction. [11,9]

Overall, our findings indicate that multilevel sleep surgery is an effective intervention for patients with very severe OSA who are intolerant to CPAP therapy. The combination of tailored surgical approaches based on anatomical assessment and careful preoperative planning resulted in marked improvements in respiratory parameters, oxygenation, and quality of life. These results support the growing evidence that individualized, multilevel surgical management should be considered a viable alternative for severe OSA in populations similar to ours, particularly in settings where CPAP adherence is limited.

## CONCLUSION

In conclusion, multilevel sleep surgery in this cohort of 50 patients with very severe OSA resulted in significant improvement in both objective and subjective outcomes. Postoperative measures demonstrated marked reductions in AHI and 3% ODI, improved lowest oxygen saturation, and substantial relief in snoring severity and daytime sleepiness, alongside a modest decrease in BMI. These findings indicate that individualized, anatomy-based multilevel surgical interventions are an effective and safe alternative for patient's intolerant to CPAP therapy, leading to meaningful enhancement in respiratory function and overall quality of life.

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