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Article

## Expansion pharyngoplasty for treatment of snoring and obstructive sleep apnea

Otorhinolaryngology

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### ABSTRACT

**Background:** Obstructive sleep apnea is defined as “five or more respiratory events (apneas, hypopneas) in combination with severe daytime somnolence, waking with gasping, choking, or breath-holding.”

**Objective:** to investigate the importance of anterolateral pharyngoplasty in the management of obstructive sleep apnea by increasing pharyngeal airspace and decreasing palatal and lateral pharyngeal wall collapse.

**Methodology:** A prospective interventional study included 30 patients over the age of 18 who were suffering from symptoms suggestive of obstructive sleep apnea; each patient was assessed by history, polysomnography, and a cahal VI lateral pharyngoplasty, with the patients being followed-up for six months after the procedure.

**Results:** There was statistically significant reduction of sleeping index postoperatively compared to preoperatively ( $51.27 \pm 5.71$  vs.  $37.53 \pm 2.64$ ). There was statistically significant reduction of apnea hypopnea index postoperatively compared to preoperatively ( $27.77 \pm 9.55$  vs.  $21.33 \pm 8.07$ ). There was statistically significant reduction of Epworth sleepiness scale postoperatively compared to preoperatively ( $2.40 \pm 0.72$  vs.  $0.83 \pm 0.70$ ).

**Conclusion:** Cahali VI lateral pharyngoplasty can be used as a stand-alone treatment for all OSA patients.

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**Keywords:** Obstructive sleep apnea, polysomnography, lateral pharyngoplasty.

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### INTRODUCTION

Obstructive sleep apnea (OSA) is a sleep disorder in which a person repeatedly stops breathing while sleeping. Low motor tone of the tongue and/or airway dilator muscles cause an obstruction of the upper airway while sleeping. Worldwide, the prevalence of OSA in men is estimated to be 3% to 7%, and in women it is estimated to be 2% to 5%. OSA is present in 41% of individuals with a BMI greater than 28, which is determined as a person's weight in kilograms divided by the square of their height in meters<sup>[1][2]</sup>. patient may not be aware of snoring or apneic episodes. Thus, Collateral sleep history and recognition of linked medical comorbid illnesses that may imply OSA as an underlying diagnosis are critical<sup>[3]</sup>. OSA has a complicated etiology, involving a complex interplay of anatomic, neuromuscular, and genetic variables, as well as an underlying hereditary predisposition to the condition<sup>[4]</sup>.

Snoring, male gender, middle age, women's menopause, obesity, large neck circumference, nasal obstruction, enlarged tonsils, adenoids, macro-glossia, and low-lying soft palate are all risk factors<sup>[7][8]</sup>. Increased snoring index prior to surgery is a strong predictor of operation failure. However, a high basal SpO<sub>2</sub> level before surgery is a strong predictor of success. When the brain fails to communicate with the muscles that control breathing, central sleep apnea (CSA) occurs. In contrast to obstructive sleep apnea, which is a mechanical problem<sup>[6]</sup>.

To diagnose OSA, various levels of nocturnal monitoring of respiratory, sleep, and cardiac parameters (Polysomnography) is used, with the goal of detecting obstructive events and changes in oxygen saturation<sup>[9]</sup>. The aim of study is to detect the of

importance anterolateral advancement pharyngoplasty in treating obstructive sleep apnea by increasing pharyngeal airspace and decreasing palatal and lateral pharyngeal wall collapse.

## PATIENTS AND METHODS

It's an interventional prospective study. The research procedure was authorized by the research ethics committee of Al-Azhar University's faculty of medicine for girls and the hospital's ethics board, and the patients signed a written informed permission form. This research was carried out at otorhinolaryngology department of Al-Zahraa University hospital. The patients were operated upon between December 2017 and May 2019. This study involved 30 patients over the age of 18 complaining of obstructive sleep apnea. The patients were followed up for six months after operation. We asked for postoperative symptoms and satisfactions one month after operation. Polysomnography was done at Kobry el Koppa military hospital.

### Inclusion criteria:

The following patients were included into the study; adults more than 18 years, BMI less than 30 kg/m<sup>2</sup>, suitable for general anesthesia, have sleep study and diagnosed as OSA syndrome, Patients who are unable to use continuous positive airway pressure (CPAP) or who are non-compliant, with no previous history of sleep surgery.

### Exclusion criteria:

Patients with the following criteria were excluded from the study; patients less than 18 years, BMI more than 30 kg/m<sup>2</sup>, those who aren't candidates for general anesthesia, patients who have had previous palatal surgery, such as uvulopalatopharyngoplasty (UPPP), and severe craniofacial abnormalities.

The Stop Bang score and the Epworth score questionnaire were used to examine each patient based on their medical history, with special attention devoted to their sleep history. BMI, Neck circumference, and blood pressure are all part of a general systemic checkup. ENT evaluation, polysomnography, and lateral pharyngoplasty were performed.

### Surgical procedure

A bilateral tonsillectomy preceded the lateral pharyngoplasty procedure if it hasn't been done previously. The palatoglossus and palatopharyngeus muscles are identified by removing the tonsillar fossa mucosa. Next, we remove a triangle of mucosa and muscle (palatoglossus) from the lateral oral free margin of the soft palate and anterior pillar using an upside-down 'V-shape' incision. Then, using both monopolar cautery and blunt dissection, elevate the cranial half of the palatopharyngeus muscle from the superior pharyngeal constrictor muscle (SPC).

After that, we used three to four interrupted 3-0 monofilament absorbable, vertical mattress sutures to suture the palatopharyngeus flap to the anterior pillar (the portion that was detached from the SPC), taking generous bites with each stitch. The sutures were then tied just tightly enough to oppose the edges.

### Statistical analysis

The data were analysed using the social package for statistical science (SPSS) version 17. Categorical variables are presented as relative frequency (n.) and percentages, while quantitative data is presented as arithmetic mean and standard deviation (SD). The statistical difference between two points in time was investigated using the paired (t) test. To interpret the results, a P value of less than 0.05 was used as the margin of significance.

## RESULTS

**Table (1)** shows that the studied patients were 18 males (60%) and 12 females (40%) with mean age of (45.10 ± 9.06).

**Table (2)** There was statistically significant decrease of sleeping index postoperatively compared to preoperatively (37.53 ± 2.64 vs 51.27 ± 5.71) (p < 0.001). The percentage of reduction of SI was (26.27 ± 6.37). There was statistically significant decrease of apnea hypopnea index (AHI) postoperatively compared to preoperatively (21.33 ± 8.07 vs 27.77 ± 9.55) (p < 0.001). The percentage of reduction of AHI was (24.21 ± 8.01). There was statistically significant decrease of Epworth sleepiness scale (ESS) postoperatively compared to preoperatively (0.83 ± 0.7 vs 2.40 ± 0.72) (p < 0.001). The percentage of reduction of ESS was (68.89 ± 25.04). There was statistically significant increase of base line Spo<sub>2</sub> postoperatively compared to preoperatively (94.40 ± 2.42 vs 84.97 ± 3.21) (p < 0.001). The percentage of increase of Spo<sub>2</sub> was (9.43 ± 2.79).

**Table (3)** demonstrated that the postoperative pain collected from patient on 7<sup>th</sup> day by visual analogue scale (VAS) it was mild in 12 patient (40%) patient and it was moderate in 10 patient (33.3%), and severe in 8 patient (26.7%). As regard to intraoperative bleeding according to aspirated blood intraoperatively in suction containers there was no bleeding in 2 patient (6.7%) and small amount 15 patient (50%), moderate amount in 5 patient (16.7%), and large amount in 8 patient (26.7%). As regard to postoperative dysphagia (two weeks postoperative) it was mild 15 patient (50%) and moderate 10 patient (33.3%), and severe 5 patient (16.7%).

**Table (4)** revealed that as regard to satisfaction of patients after operation the patients who was completely satisfied was 10 patient (33.3%), very satisfied was 10 patient (33.3%), somewhat satisfied 5 patient (16.7%), and not at all 5 patient (13.3%).

**Table (1): Distribution of the studied cases according to demographic data**

Characteristics	Studied group	Patients with OSA (n = 30)
<b>Age \ years</b>		
Range		28– 61
Mean ± SD		45.10 ± 9.06
<b>Age groups \ years</b>		<b>n (%)</b>
<50		20 (66.7)
≥50		10 (33.3)
<b>Sex</b>		<b>n (%)</b>
Male		20 (66.7)
Female		12 (40.0)

**Table (2): Comparison between pre and post according to Apnea-hypopnea index - sleeping index Epworth sleeping scale**

Item	Preoperative (n=30)	Postoperative (n=30)	Decrease	% decrease	t	p value
<b>AHI</b>	Min. – Max. Mean ± SD	6.0 – 40.0 27.77 ± 9.55	5.0 – 30.0 21.33 ± 8.07	6.43 ± 2.22	24.21 ± 8.01	1.99 0.001
<b>ESS</b>	Min. – Max. Mean ± S	1.0 – 3.0 2.40 ± 0.72	0.0 – 2.0 0.83 ± 0.70	1.57 ± 0.63	68.89 ± 25.04	6.05 0.001
<b>SI</b>	Min. – Max. Mean ± SD	40.0 – 65.0 51.27 ± 5.71	33.0 – 42.0 37.53 ± 2.64	13.73 ± 4.52	26.27 ± 6.37	8.45 0.001
		<b>Preoperative (n=30)</b>	<b>Postoperative (n=30)</b>	<b>Increase</b>	<b>% Increase</b>	<b>t</b> <b>p value</b>
<b>SpO<sub>2</sub></b>	Min. – Max. Mean ± SD	80.0 – 94.0 84.97 ± 3.21	91.0 – 98.0 94.40 ± 2.42	9.43 ± 2.79	11.20 ± 3.56	18.53 0.001

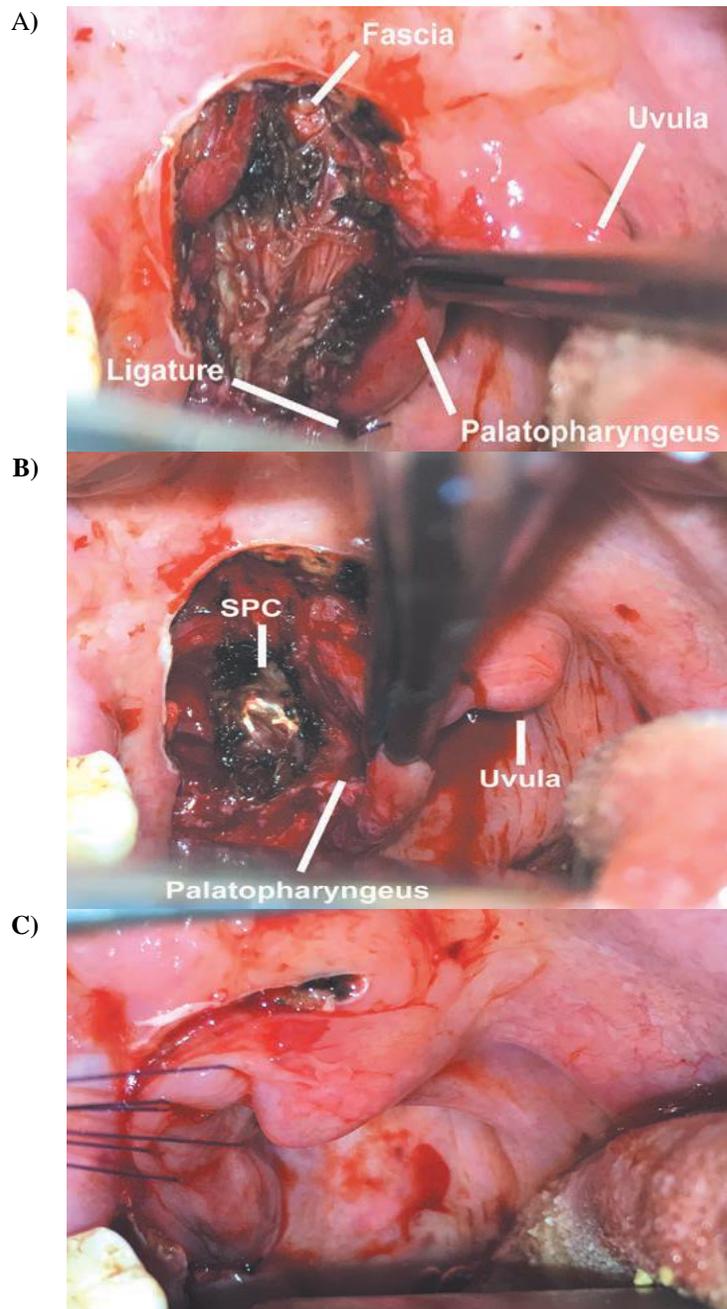
Apnea-hypopnea index (AHI), Sleeping index (SI), Epworth sleeping scale (ESS), SpO<sub>2</sub>: oxygen saturation, paired t-test (t)

**Table (3): Distribution of the studied cases according to postoperative symptoms**

Postoperative symptoms	Studied group	Patients with OSA (n = 30)
		no. (%)
<b>Pain</b>		
Mild		12 (40.0)
Moderate		10 (33.3)
Severe		8 (26.7)
<b>Bleeding</b>		
No		2 (6.7)
Small amount		15 (50.0)
Moderate amount		5 (16.7)
Large amount		8 (26.7)
<b>Dysphagia</b>		
Mild		15 (50.0)
Moderate		10 (33.3)
Severe		5 (16.7)

**Table (4): Distribution of the studied cases according to satisfaction**

Satisfaction	Studied group	Patients with OSA (n. = 30)
		no. (%)
Not at all		5 (16.7)
Somewhat satisfied		5 (16.7)
Very satisfied		10 (33.3)
Completely satisfied		10 (33.3)



**Figure (1) :Steps of lateral pharyngoplasty**

(A) Beginning of the division of the palatopharyngeus from the superior pharyngeal constrictor muscle (SPC),(B)Cut off the right superior pharyngeal constrictor muscle releasing the arch of the palatopharyngeus flap and exposing the buccopharyngeal fascia. (C) Vertical mattress sutures of the palatopharyngeus flap to the lateral pharyngeal wall and anterior pillar

Patient Data						
Last Name: S				Height: 171 cm		
First Name: A				Weight: 83.0 kg		
Date of Birth: 31/3/1984				BMI: 28.3 kg/m <sup>2</sup>		
Respiratory Analysis						
Recorded Time	from	to		Artefact	Duration	
	12/5/2019 1:09:00 AM	12/5/2019 8:10:00 AM			7:01:00	

Number ( Index )		Sleep	
Obstructive	197 (36.9)	Apnea (Index)	197 (36.9)
Mixed	-	Hypopnea (Index)	99 (18.5)
Central	-	AHI (/h)	55.5
Undef A	-	Flow limitation (index)	-
Total A	197 (36.9)	Max. Apnea Duration [s]	70
Hypopnea	99 (18.5)	Max. Hypopnea Duration [s]	143
A+H	296 (55.5)	Average Apnea Dur. [s]	26.7
Limitation	-	Average Hypopnea Dur. [s]	36.3
RDI	296 (56.5)	Artifact [min]	25.3 (7.3%)

Position	Supine	Not Supine	left	Right	Prone	Upright
Sleep Time Fraction [%]	59.2	40.8	24.9	3	12.9	-
RDI	273 (80.1)	23 (9.8)	8 (5.6)	6 (34.8)	9 (12.1)	-
Obstructive Apnea (Index)	192 (56.4)	5 (2.1)	1 (0.7)	-	4 (5.4)	-
Central Apnea (Index)	-	-	-	-	-	-
Mixed Apnea (Index)	-	-	-	-	-	-
Hypopnea (Index)	81 (23.8)	18 (7.7)	7 (4.9)	6 (34.9)	5 (6.7)	-
Flow Limitation (Index)	-	-	-	-	-	-
RERAs(Index)	-	-	-	-	-	-

	All	Prone	Supine	left	Right	Upright
Snore (Index)	3833 (716.2)	98 (131.7)	1663 (460.3)	1914 (1333.3)	169 (976.5)	-
Absolute snore (min)	64.9	1.1	29.4	31.7	2.7	-
Snore episode (min)	163.0	4.2	68.6	82.3	7.9	-

Figure (2a): PSG of patient with OSA before LPP shows the respiratory analysis and related position changes during sleep cycle

Patient Data			
Last Name: S			Height: 171 cm
First Name: A			Weight: 83.0 kg
Date of Birth: 31/3/1984			BMI: 28.3 kg/m <sup>2</sup>
Respiratory Analysis			
Recorded Time	from	to	Duration
	12/11/2019 12:07:00 AM	12/11/2019 9:10:00 AM	9:03:00

Number ( Index )		Sleep	
Obstructive	-	Apnea (Index)	44(6.6)
Mixed	-	Hypopnea (Index)	16(2.4)
Central	-	AHI (/h)	8.9
Undef A	44(6.6)	Flow limitation (index)	-
Total A	44(6.6)	Max. Apnea Duration [s]	114
Hypopnea	16(2.4)	Max. Hypopnea Duration [s]	51
A+H	60(8.9)	Average Apnea Dur. [s]	18.3
Limitation	-	Average Hypopnea Dur. [s]	13.6
RDI	60(8.9)	Artifact [min]	17.6 (4.2%)

Position	Supine	Not Supine	left	Right	Prone	Upright
Sleep Time Fraction [%]	70.7	29.3	20.0	8.8	-	0.5
RDI	46 (9.3)	14 (6.8)	6(4.3)	8(13.0)	-	-
Obstructive Apnea (Index)	-	-	-	-	-	-
Central Apnea (Index)	-	-	-	-	-	-
Mixed Apnea (Index)	-	-	-	-	-	-
Hypopnea (Index)	8 (1.6)	8 (3.9)	3(2.1)	5(8.1)	-	-
Flow Limitation (Index)	-	-	-	-	-	-
RERAs(Index)	-	-	-	-	-	-

Figure (2b): PSG of the same patient 6 month after LPP shows the marked improvement of respiratory events and related position changes during sleep cycle.

## DISCUSSION

Obstructive sleep apnea is a serious medical condition that affects up to 4% of adults in their forties. The most common complaints include loud snoring, sleep disruption, and excessive daytime tiredness. Patients with apnea have fragmented sleep and may develop cardiovascular problems as a result of the repeated cycles of snoring, airway collapse, and arousal. The majority of individuals are obese and have a short, thickneck<sup>[1][16]</sup>. Obstructive sleep apnea is classified into 3 degrees according to the apnea-hypopnea index (AHI) which is the number of apnea and hypopneas per hour of sleep<sup>[5]</sup>.

The current study revealed that there was male predominance (60%). Our result agreed with Khan et al<sup>[10]</sup> where men made up 81% of the population with OSA. This suggests that OSA is more common in men.

In present study there was significant reduction of AHI postoperatively ( $21.33 \pm 8.07$ ) compared to preoperative value ( $27.77 \pm 9.55$ ). Our result agrees with Cahali<sup>[11]</sup> who found that the median AHI decreased from 41.2 (34.0) to 9.5 (17.7). Sixty percent of patients had a postoperative AHI of less than 20. Also our results agree with Dizdar et al.<sup>(12)</sup> The mean AHI of lateral pharyngoplasty patients before surgery was 23.4, and the mean AHI after surgery was 11.3 ( $P < 0.05$ ).

In the present study there was statistically significant decrease of sleeping index postoperatively compared to preoperatively ( $37.53 \pm 2.64$  vs.  $51.27 \pm 5.71$ ) ( $p < 0.001$ ). Our result agreed with Cahali<sup>[11]</sup> who discovered that ten persons with OSAHS who were first selected for treatment with the Lateral pharyngoplasty operation had a statistically significant difference ( $p = 0.005$ ) in their snoring index from 10 IQR preoperatively to 3.5 IQR postoperatively.

In present there was statistically significant decrease of Epworth sleepiness scale postoperatively compared to preoperatively ( $0.83 \pm 0.7$  vs  $2.40 \pm 0.72$ ) ( $p < 0.001$ ). Our result agree with O'Bryan<sup>[13]</sup> who found that the median ESS in the Lateral pharyngoplasty group improved from 11 IQR to 7 IQR with a statistically significant difference ( $P < 0.01$ ). Also, our result agrees with Cahali<sup>[11]</sup> where the median ESS improved from 13 quartile range to 5 quartile range with statistically high significance difference in the group of 10 patients who underwent Lateral pharyngoplasty.

As regard to postoperative dysphagia (after two weeks postoperative) it was mild (50%) and moderate (33.3%), and severe (16.7%) Our result agrees with Junior and Cahali<sup>[14]</sup>, who conducted a prospective study on 20 patients with obstructive sleep apnea (OSA) between March 2008 and August 2009, discovered that patients who had a lateral pharyngoplasty completely returned to

normal swallowing after 33 days, with a return to normal diet after 10.9 days, with a range of 5 to 17 days.

As regard to postoperative bleeding there was no bleeding in (6.7%) and small amount (50%), moderate amount in (16.7%), and large amount in (26.7). Our result agrees with Park et al<sup>[15]</sup> Postoperative bleeding was noted in four patients (9.8%), and it stopped spontaneously in all four cases without the need for emergency surgery, with just one incidence of VPI (2.4 %).

As regard to postoperative pain collected from patient on 7<sup>th</sup> day by VAS, it was mild in (40%) patient and it was moderate in (33.3%), and severe in (26.7%). Our result agrees with Cahali<sup>[11]</sup> who conducted a study on 10 patients whom Lateral pharyngoplasty giving a median value of 4.5 (4.0). After 10 days of the procedure, analgesics were usually no longer required. The median time it took for patients to return to normal nourishing was 14.5 (10) days.

## CONCLUSION

In selected patients, splinting the lateral pharyngeal wall (by extended lateral pharyngoplasty) obtains significant improvement in subjective snoring and daytime sleepiness, as well as objective adverse sleep respiratory events and sleep architecture, while retaining normal pharyngeal function. There is great improvement in snoring index and baseline SpO<sub>2</sub> level postoperative so it ensure the success of operation. As a stand-alone treatment, Cahali VI lateral pharyngoplasty can help all OSA patients.

**Conflict of interest:** there is no conflict of interest.

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## الملخص العربي

**الجراحة الوظيفية لتوسيع البلعوم لعلاج الشخير وانقطاع النفس الانسدادي أثناء النوم**  
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### ملخص البحث

**الخلفية:** يُعرّف انقطاع النفس الانسدادي النومي بأنه "خمسة أحداث تنفسية أو أكثر انقطاع النفس، وقلة التنفس بالاقتران مع النعاس المفرط أثناء النهار، أو الاستيقاظ مع اللهاث، أو الاختناق، أو حبس النفس.

**الهدف:** تهدف الدراسة إلى التحقق من فاعلية عملية تجميل البلعوم التقدمي الأمامي لتوسيع المجال البلعومي وتقليل انهيار جدار الحلق والبلعوم اللاحق في علاج انقطاع النفس الانسدادي النومي.

**الطرق:** تضمنت الدراسة المستقبلية 30 مريضاً تزيد أعمارهم عن 18 عاماً يشكون من انقطاع النفس الانسدادي النومي، وقد تم تقييم كل مريض من خلال التاريخ، وتقييم النوم، ونقوم بإجراء عملية رأب البلعوم الجانبي (كاهالي السادس)، وتم متابعة المرضى لمدة ست أشهر بعد العملية.

**النتائج:** فيما يتعلق بمؤشر النوم كان متوسط قبل الجراحة ( $51.27 \pm 5.71$ ) وكان متوسط بعد الجراحة ( $37.53 \pm 2.64$ )، كانت ذات دلالة إحصائية عالية.

فيما يتعلق بمؤشر توقف التنفس أثناء التنفس كان متوسط قبل الجراحة ( $27.77 \pm 9.55$ ) ومتوسط بعد الجراحة ( $21.33 \pm 8.07$ ) وكان ذو دلالة إحصائية عالية. فيما يتعلق بمقياس إبورث للنعاس، كان متوسط قبل الجراحة ( $2.40 \pm 0.72$ ) ومتوسط بعد الجراحة ( $0.83 \pm 0.70$ ) وكان ذو دلالة إحصائية عالية.

**الاستنتاجات:** تم إثبات أهمية قابلية انهيار الجدار البلعومي الجانبي في التسبب في متلازمة توقف التنفس أثناء النوم. يمكن استخدام عملية رأب البلعوم الجانبي (كاهالي السادس) كإجراء مستقل في جميع المرضى. دراسة النوم كأداة تشخيصية أساسية للتشخيص الدقيق قبل الجراحة لحدوث متلازمة توقف التنفس أثناء النوم.

**الكلمات المفتاحية:** انقطاع النفس الانسدادي النومي، تخطيط النوم، رأب البلعوم الجانبي.

### الباحث الرئيسي

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