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Evaluating the effectiveness of barbed reposition palatopharyngoplasty compared to uvulopalatopharyngoplasty for treatment of obstructive sleep apnea

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Abstract

Background The majority of obstructive sleep apnea cases involve the oropharynx. The hypercollapsibility of the upper airway walls (UAWs) was the cause of obstructive sleep apnea syndrome (OSAS), which most often manifested itself at the retropalatal and/or retrolingual level. Modular and adaptable barbed snore surgery (BSS) is a novel treatment for retropalatal OSA (based on the anatomy and findings of drug-induced sleep endoscopy (DISE).

Objectives To compare between the outcomes of uvulopalatopharyngoplasty and the barbed reposition palatopharyngoplasty technique, and to establish if there is indeed a significant variance in post-operative results among both types of surgeries.

Patients and methods This was a prospective randomized clinical trial conducted on Department of Otorhinolaryngology, Faculty of Medicine, Cairo University, and it was carried out on 50 patients (28 males and 22 females) suffering from OSAS. They were randomly distributed into two groups: group A and group B.

Results There was a substantial distinction among the two groups regarding to post-operative data, comparison between values of all domains of Sleep Apnea Quality of Life Index (SAQLI) and bleeding and nasal regurgitation after surgery. There was no substantial distinction among the two groups in terms of age, sex, body mass index (BMI), smoking, hypertension, and diabetes mellitus.

Conclusion Barbed reposition pharyngoplasty is superior to traditional uvulopalatopharyngoplasty in terms of results of Apnea Hypopnea Index (AHI), Epworth Sleepiness Scale (ESS), and in Sleep Apnea Quality of Life Index (SAQLI) in addition to producing less post-operative complications as well as being easy to learn.

Keywords Barbed reposition palatopharyngoplasty, Uvulopalatopharyngoplasty, Obstructive sleep apnea

Background

Obstructive sleep apnea (OSA) is a common type of the breathing disorders during sleep, disturbs up to 10% of men and 3% of women [1]. OSA is caused by either complete or partial obstructions affecting the upper airway and it may be present at multiple levels such as nasal, retropalatal, or retrolingual area. It is defined by the presence of at least five obstructive apneas and/or hypopneas per hour of sleep and results in decrease in blood oxygen saturation [2].

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The anatomical collapsibility of the upper airway, neuromuscular tone and function, ventilator control instability, and the arousal threshold all contribute to the pathophysiologic features that characterize the types of OSA. If left untreated, it has been associated with many complications affecting neurological, cardiac, low quality of life, and may be death [3].

The treatment of OSA includes many conservative and surgical treatment options. The conservative treatments include weight loss, position therapy, many oral appliances, medications, and continuous positive airway pressure (CPAP) treatment [4]. CPAP represents the first-line treatment for OSA; however, many patients cannot withstand CPAP and require alternative treatment [4].

If the conservative treatment fails, surgical treatment is the other option. These aim at reducing the airway obstruction due to the excessive bulk of soft tissues lining the pharynx, and they can be performed as a single stage or multiple stages according to the patient condition [5].

The most common site of obstruction is oropharyngeal region and there is an important factor in obstruction which is the lateral pharyngeal wall collapse. Consequently, palatal surgical procedures have changed throughout recent years from the classic uvulopalatopharyngoplasty (UPPP) to lateral pharyngoplasty techniques [6]. These include two recent procedures, expansion sphincter pharyngoplasty (ESP) and barbed reposition pharyngoplasty (BRP), targeting the lateral pharyngeal wall of the oropharynx [7].

The main objective of this study is to compare between the results of UPPP versus the barbed reposition pharyngoplasty (BRP).

Methods

This is an upcoming randomized controlled trial. Fifty cases were included (28 males and 22 females). They were randomly separated into two equal groups; the first group comprised patients who received uvulopalatopharyngoplasty (group A), and the second group included cases who underwent barbed reposition palatopharyngoplasty (group B). Patients were recruited among June 2019 and August 2022 from the otolaryngology outpatient clinic at the Kasr Al Ainy Medical School. The patients gave their informed consent to participate in the trial and to complete the follow-up sheets with their clinical data. The research ethics committee (REC) has given its blessing to this project, and the following is the REC's approval number: MS-148–2022.

The inclusion criteria were adults (above 18 years old), cases with moderate to severe OSA (AHI > 15) Failed or inadequate CPAP and patients with localized obstruction at the level of palate and oropharynx.

The exclusion criteria were bleeding diathesis, anemic patients, patients with uncontrolled systemic diseases, excessive overweight (BMI > 35), Apnea Hypopnea Index (AHI) < 15 and age ≤ 18.

Patients

In the clinic, the patients were offered two upside-down cards; each contained a letter (A or B). Each letter contained the name of the technique they would undergo (A = UPPP, B = barbed). Approving patients chose a card randomly. All patients included are fulfilling criteria OSA (snoring, day time sleepiness, nocturnal choking, and morning headaches), sleep endoscopy indicating retropalatal collapse and polysomnography with AHI more than 15.

Surgical techniques and equipment

All patients underwent one of two operations, group (A) treated by uvulopalatopharyngoplasty, while group (B) underwent barbed reposition palatopharyngoplasty. During both procedures, DISE was accomplished under general anesthesia with the help of a flexible nasopharyngoscope and target-controlled infusion (TCI) of propofol to assess the degree of upper airway (UA) collapse, in particular the lateral pharyngeal walls (Figs. 1, 2, 3, 4, 5, 6, 7 and 8).

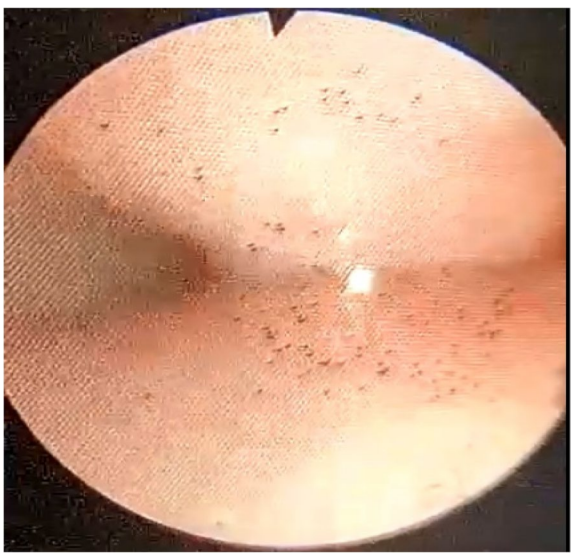

Fig. 1 Picture of DISE for one of BRP group with antroposterior velopharyngeal collapse

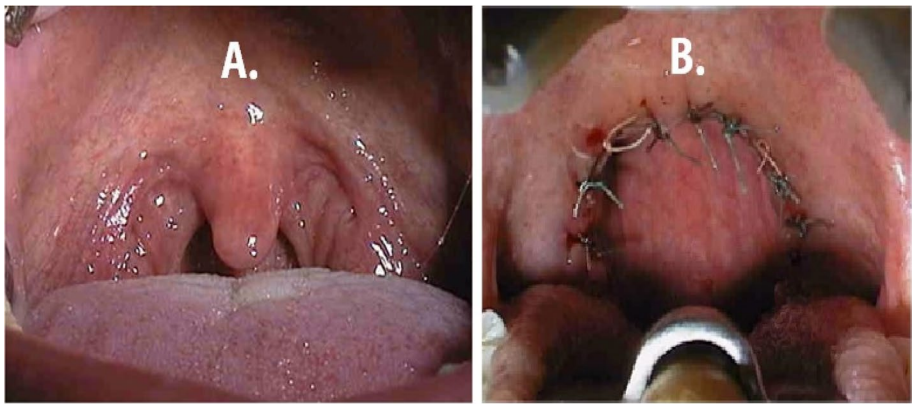

Fig. 2 Picture of one of UPPP group. **A** Pre-surgery. **B** Immediate post-surgery

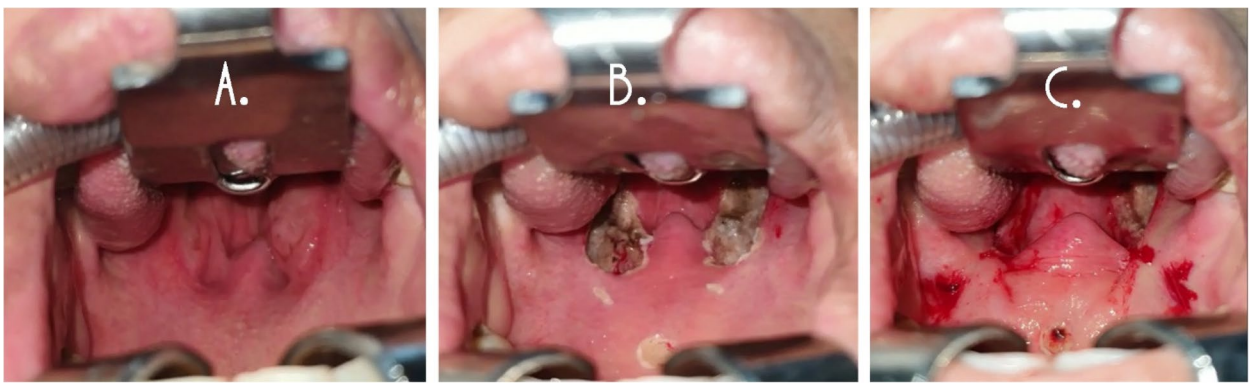

Fig. 3 **A** Patient after application of mouth gag. **B** After tonsillectomy by coblation and marking of suture sites. **C** After taking sutures

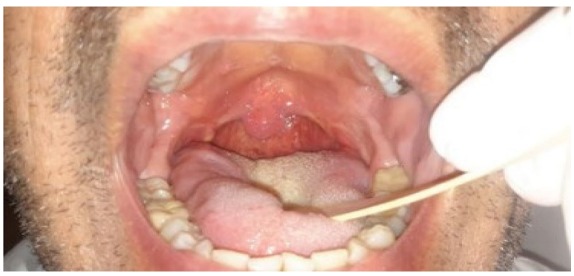

Fig. 4 Picture of oropharynx of one of BRP group 3 months post-operative

Uvulopalatopharyngoplasty

Initially, cold dissection was used to conduct bilateral tonsillectomy. The bleeders required bipolar diathermy electrocoagulation. A horizontal incision was created from the base of the uvula to the upper poles of the bilateral anterior tonsillar pillars following tonsillectomy. The uvular mucosa was divided along the uvular edge, and a 1-cm full-thickness uvular muscle excision was performed. Several 3-0 vicryl absorbable sutures were used to close the anterior and posterior tonsillar pillars. To avoid haematoma formation and posterior pillar lateralization, the sutures travel through mucosal margins and superficial mucosal layers. The nasal surface of the soft palate is advanced to be sutured to the oral surface of the soft palate and the uvula, therefore increasing the nasopharynx's anteroposterior dimension.

Barbed reposition palatopharyngeoplasty

After tonsillectomy (Using V-Loc ™ sutures), we began bidirectional suturing from the posterior nasal spine (midline of the junction of the soft palate and hard palate) through to a point midway between the free border of the soft palate and the junction of the hard and soft palate vertically and midway between the pterygomandibular raphe and the midline of the palate horizontally, reintroducing the needle close to the point of exit towards the pterygomandibular raphe near maxillary tuberosity, and then the palatopharyngeous muscle from lateral to medial sparing the mucosa, and repeatedly anchoring to the pterygomandibular raphe. Finally, the suture was taken back on to the soft palate until the midline,

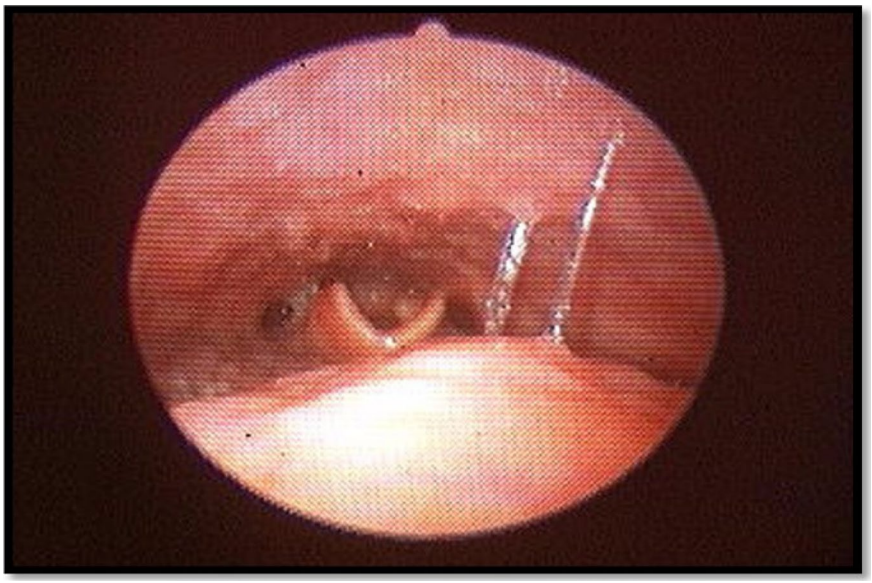

Fig. 5 Picture of flexible nasopharyngoscopy showing wide posterior airway space of one of BRP group 3 months post-operative

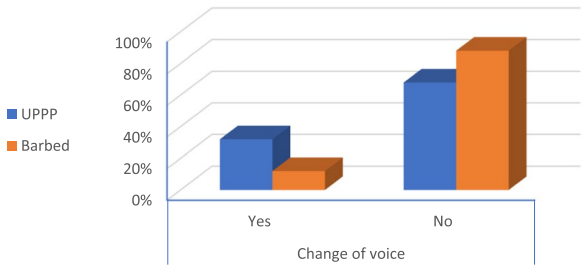

Fig. 6 Comparison between percentages of change of voice between 2 groups

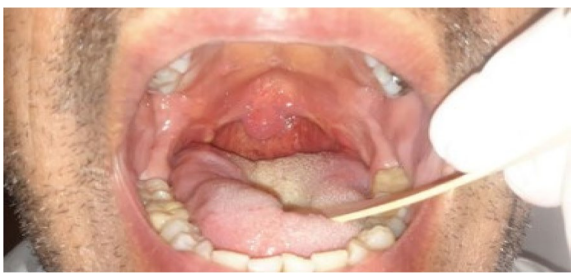

Fig. 7 Picture of oropharynx of one of BRP group 3 months post-operative

without exposing the suture material. The procedure was repeated on the other side.

Assessment parameters

Pain was assessed using visual analogue scale (VAS), incidence of postoperative hemorrhage if present, other complications (dysphagia, nasal regurgitation of food, etc.), polysomnography 3 months post-operative and Sleep Apnea Quality of Life Index (SAQLI) 3 months post-operative (Table 1).

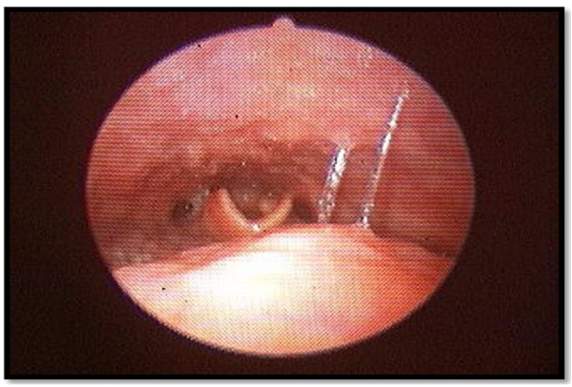

Fig. 8 Picture of flexible nasopharyngoscopy showing wide posterior airway space of one of BRP group 3 months post-operative

Results

The mean ± SD of the age of the cases ($n=50$) was 39.4 ± 10.75 years with mean ± SD of the UPPP group ($n=25$) 40.36 ± 10.66 years and mean ± SD of the BRP group ($n=25$) 38.44 ± 10.98 years. Twenty-eight of 50 patients (56%) were male, in UPPP group ($n=25$) 13 (52%) males and 12 (48%) females while in BRP group ($n=25$) 15 (60%) males and 10 (40%) females. Mean ± SD BMI in UPPP group 33.5 ± 4.90 while in BRP group

Table 1 Summary of patient's characteristic's results

	Type of surgery				*P* value
	UPPP ($n=25$)		BRP ($n=25$)		
	Count	%	Count	%	
Age					
Mean (SD)	40.36 (10.66)		38.44 (10.98)		0.533
Range	24.00–56.00		22.00–58.00		
Sex					
M	13	52.0%	15	60.0%	0.569
F	12	48.0%	10	40.0%	
BMI					
Mean (SD)	33.8 (4.90)		33 (5.03)		0.843
Range	27.00–40.00		26.00–40.00		
Smoking					
Yes	10	40.0%	13	52.0%	0.395
No	15	60.0%	12	48.0%	
HTN					
Yes	11	44.0%	11	44.0%	1
No	14	56.0%	14	56.0%	
DM					
Yes	12	48.0%	7	28.0%	0.145
No	13	52.0%	18	72.0%	

33 ± 5.03. Twenty-seven patients (54%) of the total were non-smokers with 10 patients (20%) smokers in UPPP group while 13 patients (26%) smokers in BRP group. There was no substantial variation among the UPPP and BRP groups in terms of age, sex, smoking, BMI, DM, or blood pressure.

Variables for all patients who had been followed up with 3 months after surgery are provided in Table 2, and a comprehensive comparison of SAQLI factors is provided in Table 3. Postoperative AHI values improved considerably from baseline in both groups; however, the BRP group's postoperative AHI was lower than the UPPP group's (from 40.79 ± 11.35 to 19.18 ± 6.45 in the UPPP group and from 39.67 ± 11.63 to 13.71 to 6.63 in the BRP group; $P=0.006$). After undergoing UPPP and BRP, patients saw considerable improvement in both their ESS and SAQLI ratings postoperative. There was no substantial distinction in postoperative ESS ratings between the two groups ($P=0.231$). There was no substantially distinction among the groups in the postoperative SAQLI scores for social functioning, emotional functioning, or symptoms; however, the BRP group received substantially higher ratings for daily functioning and treatment-related symptoms. To be noted that snoring decreased significantly to 10 patients out of total 50 patients, with better improvement in BRP group by 91.3% (from 23 to 2 patients out of 25) while it improved by 60% in UPPP group (from 20 to 8 patients out of 25) with a statistical difference between both groups ($P=0.027$).

The post-op SAQLI total score was 4.85 ± 0.15 in the UPPP group, against 5.05 ± 0.27 in the BRP group (mean $\pm$ SD) (Tables 4 and 5).

There was a statistically significant difference in the post-operative total SAQLI score variance among the 2 groups ($P=0.002$).

There was no fatality, respiratory compromise, or other substantial complication during the before surgery or after surgery period, or a need for tracheotomy, was noted. Nine patients (36.0%) of the UPPP group presented with bleeding from wound site within 24 h after surgery compared to 2 patients in BRP group ($P=0.017$). Bleeding was managed during surgery with careful usage of bipolar cautery or with conservative measures (cold beverages and gargling) at the ward except for one patient from UPPP group was taken back to operation room for hemostasis. Fifteen patients out of 25 patients in UPPP group reported partial nasal regurgitation of food which was noted the day following surgery and resolved spontaneously within 1 month post-operative compared to 4 patients in BRP group ($P=0.001$).

Eight patients out of 25 in UPPP group reported change of voice in form of nasal tone compared to 3 patients in BRP group which resolved spontaneously within 1 month after surgery ($P=0.088$), while 14 patients (56.0%) in UPPP suffered from dysphagia compared to 9 patients (36.0%) in BRP group ($P=0.156$).

Discussion

OSA is a widespread and possibly severe sleep disease that should be regarded as a major health concern because to its negative impact on not only physical but also social and cognitive capabilities [8].

Surgical and non-surgical methods can be used to treat OSA, with the oldest surgical procedure being the UPPP. The purpose of subsequent improvements to the original approach and the adoption of novel techniques has been to achieve continually increased success rates and fewer problems [9].

Our research comprised 50 subjects divided randomly into 2 groups, group A composed of 25 cases had UPPP and group B included 25 cases had BRP. Twenty-eight patients (56%) were male, in UPPP group ($n=25$) 13 (52%) males and 12 (48%) females while in BRP group 15 (60%) males and 10 (40%) females. This is an interesting finding as other studies done show that males patients were usually more common than females. One study done by Cammaroto et al. [10] showed that the prevalence of male to female ratio was closer to 9:1, whereas in our study it was closer to 1.3:1. This shows an abnormally large number of female patients, and might possibly be

Table 2 Comparison of post-operative data between the two groups

	Type of surgery								***P* value**
	UPPP				**BRP**				
	Mean	**SD**	**Minimum**	**Maximum**	**Mean**	**SD**	**Minimum**	**Maximum**	
Post-Op ESS	7.80	2.80	4.00	13.00	6.92	2.31	3.00	10.00	0.231
Post-Op AHI	19.18	6.45	10.40	33.10	13.71	6.63	5.80	32.10	0.006
Post-Op SAQLI	4.85	0.15	4.57	5.04	5.05	0.27	4.54	5.44	0.002

Table 3 Detailed comparison between values of all domains of SAQLI between two groups

	Type of surgery								*P* value
	UPPP				BRP				
	Mean	SD	Minimum	Maximum	Mean	SD	Minimum	Maximum	
A Pre-op	4.51	0.11	4.64	5.00	4.50	0.30	4.00	5.00	0.764
B Pre-op	4.30	0.32	3.92	5.00	4.21	0.23	3.54	4.54	0.797
C Pre-op	4.54	0.10	4.64	5.00	4.21	0.09	4.09	4.36	0.001
D Pre-op	3.85	0.34	3.20	4.40	3.66	0.40	3.20	4.40	0.087
Total Pre-op	4.30	0.37	3.54	4.78	4.15	0.25	3.71	4.58	0.094
A Post-op	4.95	0.47	4.09	5.27	5.24	0.17	5.00	5.55	0.005
B Post-op	5.54	0.05	5.46	5.62	5.57	0.75	4.23	6.08	0.824
C Post-op	5.86	0.08	5.73	6.00	6.00	0.39	5.27	6.55	0.084
D Post-op	4.81	0.04	4.80	5.00	4.84	0.15	4.60	5.00	0.316
E Post-op	1.74	0.40	1.20	2.60	1.44	0.39	1.00	2.40	0.011
Total Post-op	4.85	0.15	4.57	5.04	5.05	0.27	4.54	5.44	0.002

Table 4 Comparing bleeding and nasal regurgitation after surgery in 2 groups

	Type of surgery				*P* value
	UPPP		BRP		
	Count	%	Count	%	
Bleeding					
Yes	9	36.00%	2	8.00%	0.017
No	16	64.00%	23	92.00%	
Partial nasal regurgitation of food					
Yes	15	60.00%	4	16.00%	0.001
No	10	40.00%	21	84.00%	

Table 5 Comparing change of voice and dysphagia after surgery in 2 groups

	Type of surgery				*P* value
	UPPP		BRP		
	Count	%	Count	%	
Change of voice					
Yes	8	32.00%	3	12.00%	0.088
No	17	68.00%	22	88.00%	
Dysphagia					
Yes	14	56.00%	9	36.00%	0.156
No	11	44.00%	16	64.00%	

explained by other factors such as obesity and sedentary lifestyles, as our results also showed that most of our subjects had a BMI of around 34 (class 1 obesity).

Our study used the SAQLI questionnaire to evaluate patients pre- and post-operative. Both groups showed an improvement in quality of life. Moreover, those in the UPPP group reported a total overall quality of life of 4.5 out of 7 pre-operatively (with 7 being the best value), which improved to 4.85 postoperatively ($P<0.001$). The BRP group showed an overall 4.15 before the operation and 5.05 after ($P<0.001$). There are five main domains in the questionnaire (everyday function, socializing, emotional feature, symptoms, and post-treatment symptoms). There was no substantial distinction among the groups in terms of postoperative SAQLI scores for social functioning, emotional functioning, or symptoms; however, the BRP group displayed substantially higher postoperative SAQLI total scores and scores for everyday functioning and treatment-related symptoms. This difference in results between both techniques may be due to that the BRP technique is a less invasive technique as it avoids tissue excision and it leads to increase in the tension of the soft palate not just shortening it.

A randomized clinical research performed by Amali et al. [11], which used methods similar to our study and was comparing uvulopalatopharyngoplasty and a new surgical modality (modified radiofrequency tissue ablation) using the same SAQLI questionnaire, found that the overall quality of life in the UPPP group was 4.19 before the operation and increased to 4.95 ($P<0.001$), which is comparable to the results of our study.

Regarding postoperative results and complications, our study revealed that the most important complications were bleeding, which was 36% in UPPP ($n=9$) and only 8% in the BRP group ($n=2$) and partial nasal regurgitation of food which was 60% ($n=15$) in UPPP and 16% ($n=4$) in BRP, they were substantial ($P=0.017$) and ($P=0.001$) respectively.

Other complications were Change of voice with 32% in UPPP group compared to 12% in BRP group, also dysphagia in 56% of UPPP group in contrast with 36% in BRP group, They were not substantial ($P=0.088$) and ($P=0.156$) respectively.

Amali et al. [11] investigated the post-operative consequences of UPPP and found that patients in the UPPP group reported trouble swallowing, voice change, and taste disturbance at rates of 31%, 13%, and 5%, respectively, in UPPP procedures, which is much lower than our findings. Montevecchi et al. performed a prospective multicentric study with 111 cases and found that no intra-operative problems were recorded in 103 cases (93% of the time). However, in 3 patients (3%), there was partial thread extrusion, 3 patients (3%) had intra-operative bleeding, and in 1 case (1%), a surgeon experienced intra-operative suture rupture. Temporary dysphagia was the most prevalent symptom among patients (21%) and post-operative hemorrhage was rare (6%), similar to our findings.

Conclusion

Barbed reposition pharyngoplasty is superior to traditional uvulopalatopharyngoplasty in terms of results of AHI, ESS, and in SAQLI in addition to producing less post-operative complications.

Abbreviations

AHI	Apnea hypopnea Index
BMI	Body mass index
BRBT	Barbed roman blinds technique
BRP	Barbed reposition palatopharyngoplasty
BSS	Barbed snore surgery
CPAP	Continuous positive airway pressure
DISE	Drug-induced sleep endoscopy
EEG	Electroencephalography
ESP	Expansion sphincter pharyngoplasty
ESS	Epworth sleepiness scale
LP	Lateral pharyngoplasty
MRI	Magnetic resonance imaging
OSA	Obstructive sleep apnea
OSAS	Obstructive sleep apnea syndrome
PSG	Polysomnography
SAQLI	Sleep apnea quality of life index
UPPP	Uvulopalatopharyngoplasty
VAS	Visual analogue scale
UAW	Upper airway walls

Acknowledgements

Not applicable

Authors' contributions

AK had done most of surgeries included in this study, supervised the statistical analysis, and wrote most of the paper (corresponding author). HD had put the research plan and had done some surgeries. ME supervised the research and analysis of the data of the patients and the terminal interpretation. HA prepared the patients for surgery and supervised the follow-up, statistical analysis, and collection of data. All authors read and approved the final manuscript.

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Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

This study was approved by the ethical committee (REC) of Kasr Elainy College of Medicine, Cairo University and the following is the REC's approval number: MS-148–2022. All patients gave their written informed consent to undergo surgery and participate in this study.

Consent for publication

All the participants in this study gave their written informed consent for the publication of this study.

Competing interests

The authors declare that they have no competing interests.

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