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SLEEP BREATHING PHYSIOLOGY AND DISORDERS • ORIGINAL ARTICLE

International palate surgery questionnaire

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Abstract

Background This international study aimed at determining current routine palate surgeries and surgical methods adopted by otolaryngologists who practice surgical management of obstructive sleep apnea (OSA).

Methods An international online survey was developed with the collaboration of the YO-IFOS (Young Otolaryngologists-International Federation of Otorhinolaryngological Societies) to assess the current routines in palatal procedures. The surgeons were asked 33 multiple-choice questions.

Results A total of 141 sleep surgeons answered the questionnaire, of whom 27% were from Africa, 30% from Asia, 24% from Centre-South America, and 19% from Europe. According to otolaryngology surgical specialties, 51% were sleep surgeons, 31% general ENTs, 8% Rhinologists, 7% Head & Neck surgeons, 2% otologists, and 1% maxillofacial surgeons. Of the 141 respondents, 51% answered they were sleep specialists, whereas 49% were non-sleep specialists. According to specific medical degree, 38% were specialists, 33% were consultants, 25% were professors, and 4% were residents or trainees.

Conclusion This study gives an overview of the current surgical practice in OSA management in otolaryngology in different countries.

Keywords Sleep surgery · DISE · OSA · Survey · Otolaryngology

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Introduction

Snoring and obstructive sleep apnea (OSA) are frequent sleep disorders. OSA is considered the most common sub-group of sleep-disordered breathing (SDB). SDB has a continuum in the population, ranging from simple snoring to OSA. The precise incidence of OSA in adults is still unknown, but the first set of global estimates of the prevalence of this disease suggest that nearly 1 billion adults aged 30 to 69 years worldwide may have OSA [1].

OSA is characterized by repeated apnea and hypopnea during sleep caused by pharyngeal, palate, and tongue muscle relaxation, leading to hypoxemia, and hypercapnia, with increased sympathetic overdrive.

OSA should be considered a serious medical condition associated with high risk for major cardiovascular events. The pathophysiological factors involved in the genesis of these sleep disorders include muscular weakness, low arousal threshold, upper airways collapsibility, and high loop gain [2].

Effective treatments for OSA include behavioral measures, medical devices, and surgery. While most patients can be well treated with conservative measures, including continuous positive airway pressure ventilation and mandibular advancement devices, surgical modification of the upper airway is suitable for a selected group of patients and is often recommended for symptomatic patients unable to tolerate conservative therapies [3].

The most common surgical procedures for managing OSA are based on modifying the upper airway soft tissues, including palate, tongue base, hypopharynx, and lateral pharyngeal walls. The most extensively studied technique is uvulopalatopharyngoplasty (UPPP), which involves resection of the uvula and soft palate [2]. Surgical treatment approaches to OSA have remarkably evolved over the last two decades into more effective and less invasive procedures [4, 5].

Throughout the years, the evolution of these innovative palate surgery techniques was accompanied by better technical and logical surgical methods, and better comprehensive methods for airway evaluation. The adoption of drug-induced sleep endoscopy (DISE) has helped sleep surgeons understand the behavior of upper airways during sleep. Studies have shown that DISE markedly changed treatment planning in over 60–70% of patients' treatment [6].

However, differences in training, as well as diagnostic and therapeutic approaches have been observed among different countries, and divergent protocols are sometimes used within the same national healthcare system [7].

This international study was aimed at determining the current routine palate surgeries adopted by otolaryngologists in their surgical management of OSA.

Materials and methods

Study design and setting

The study is an international web-based cross-sectional survey regarding routine palatal surgeries and surgical methods associated with palate surgical management of OSA. The study was developed by The Sleep Surgery (SS) Study Group of Young Otolaryngologists of the International Federation of Otorhinolaryngological Societies (YO-IFOS) and was conducted in the months of May and June 2020 [8, 9].

Questionnaires

A single study-specific self-report web questionnaire was constructed. The survey was created with Google Survey (Mountain View, CA, USA) so that each participant could complete the survey only once. The questionnaire contained questions concerning routine palatal surgeries and surgical methods associated with palate surgical management of OSA and surgeon's specialty.

The survey was developed by three certified otolaryngologists with recognized sleep medicine expertise and sent to otolaryngology surgeons across different specialties who adopt surgical management of OSA for treatment. The study-specific questionnaires were based on previous research [7] sharing the same questions, data, and the authors' own clinical experience as senior otolaryngologists who practice sleep apnea surgeries. The surgeons were asked 33 multiple-choice questions regarding the surgeon's age, gender, the continent of clinical practice, and years of experience, as well as questions regarding palate surgery technique options when treating snorers and OSA patients, severity of disease, types of surgical materials used (sutures, needles), success rate, drug-induced sleep endoscopy (DISE), postoperative treatment, and postoperative pain and bleeding.

Reminders were sent after 2 and 4 weeks to those who had not answered the online questionnaire.

Participants

The survey was sent to all otolaryngology surgeons participating in professional OSA-specific groups, including Europe, North and South America, South-East Asia, Middle East, Australia, and Africa. The surgeons were identified from the membership list of the OSA-related Associations, with over 150 surgeons enlisted.

Ethical considerations

The Regional Ethical Review Board of Alexandria University approved this study and advised that no formal ethical

approval was required. The questionnaire results were confidential, and no associations were made between the results and any specific surgeon.

Statistical analysis

Data were analyzed using version 25 of the SPSS software package (SPSS 22 IBM, SPSS Inc., Chicago, USA). Continuous variables were described with mean values and standard deviations; Student's *t* test was used for comparison. Categorical variables were described with the number of cases and percentages. *p* values for all hypothesis testing were two-sided, and $p < 0.05$ was interpreted as statistically significant. To assess surgeons' experience, we created a new variable: the multiplication of the number of experience years with the number of patients per month. We assessed the correlation between those variable and multiple variables in the survey and the bivariate Pearson correlation test.

Results

General data on respondents

A total of 141 sleep surgeons answered the questionnaire. Data on nationality and continents distribution are shown in Table 1.

When asked about surgical specialty, the physicians answered according to Table 2.

A significant difference in the distribution of sleep specialists across continents was observed in Table 3 ($p < 0.00001$), with the highest percentage of sleep specialists found in South America (97%) and the lowest in Africa (16.7%). For this statistical study, we excluded Australia and the USA as the sample numbers were very low.

When we asked about medical degree, 38.3% of respondents ($N = 54$) were Specialists, 32.6% ($n = 46$) were Consultants, 24.8% ($n = 35$) were Professors, and 4.3% ($n = 6$) were Residents or trainees.

Also, a different proportion according to medical degree was verified across continents in Table 4 ($p < 0.021$).

Experience in palate surgery

Concerning experience in palate surgery, the following responses were collected and shown in Tables 5 and 6: Less than 5 years 29.1% ($n = 42$), 5–10 years 29.8% ($n = 42$), 10–20 years 27.0% ($n = 38$), more than 20 years 14.2% ($n = 20$). There was no significant difference between continents and medical degrees.

When physicians were questioned about the number of palate surgeries they perform per week, they answered: less than 5 cases in 84.4% ($n = 119$), 5–10 cases in 11.3% ($N = 16$), more than 10 cases in 4.3% ($N = 6$). Again, there was no significant difference between continents and medical degrees.

Table 1 General distribution of participants across countries and continents

Country	*N (%)*	*Continents*	*N (%)*
Egypt	35 (24.8%)	*Africa*	36 (26.5%)
Brazil	12 (8.5%)	*Asia*	41 (30.1%)
Spain	12 (8.5%)	*Centre-South America*	33 (24.3%)
Jordan	9 (6.4%)	*Europe*	26 (19.1%)
United Arab Emirates	8 (5.7%)	*USA*	3 (2.1%)
Chile	6 (4.3%)	*Australia*	2 (1.4%)
Colombia	6 (4.3%)		
Mexico	6 (4.3%)		
Singapore	6 (4.3%)		
India	5 (3.5%)		
Italy	5 (3.5%)		
Belgium	3 (2.1%)		
Saudi Arabia	3 (2.1%)		
Turkey	3 (2.1%)		
Argentina	2 (1.4%)		
Australia	2 (1.4%)		
Iraq	2 (1.4%)		
UK	2 (1.4%)		
USA	2 (1.4%)		
Algeria	1 (0.7%)		
Canada	1 (0.7%)		
France	1 (0.7%)		
Israel	1 (0.7%)		
Kuwait	1 (0.7%)		
Netherlands	1 (0.7%)		
Oman	1 (0.7%)		
Palestine	1 (0.7%)		
Peru	1 (0.7%)		
Portugal	1 (0.7%)		
Qatar	1 (0.7%)		
Romania	1 (0.7%)		

Table 2 Surgical specialty among physicians

Surgical specialty		
	Sleep surgeon	72 (51.1%)
	General ENT	44 (31.2%)
	Rhinologist	11 (7.8%)
	Head and neck surgeon	10 (7.1%)
	Otologist	3 (2.1%)
	Maxillofacial surgeon	1 (0.7%)

Table 3 Distribution of sleep–non-sleep specialists across continents, excluding Australia and the USA

		Africa	*Asia*	*Centre-South America*	*Europe*	*p*
Surgical specialty	Sleep specialist	6 (16.7%)	18 (43.9%)	32 (97.0%)	13 (50.0%)	< 0.00001
	Non-sleep specialist	30 (83.3%)	23 (56.1%)	1 (3.0%)	13 (50.0%)	

Table 4 Distribution of specific medical degrees across continents

		Africa	Asia	Centre-South America	Europe	*p*
Medical degree	Specialist	**11 (30.6%)**	**11 (26.8%)**	**20 (60.6%)**	**12 (46.2%)**	**0.000 < 0.05**
	Consultant	11 (30.6%)	21 (51.2%)	4 (12.1%)	10 (38.5%)	
	Professor	9 (25.0%)	9 (22.0%)	9 (27.3%)	4 (15.4%)	
	Resident or trainee	5 (13.9%)	0	0	0	

Table 5 General experience in palate surgery

Experience in palate surgery	Less than 5 years	41 (29.1%)
	5–10 years	42 (29.8%)
	10–20 years	38 (27.0%)
	More than 20 years	20 (14.2%)
Number of palate surgeries you perform per week	Less than 5 cases	119 (84.4%)
	5–10 cases	16 (11.3%)
	More than 10 cases	6 (4.3%)

Palate surgery techniques

Barbed repositioning pharyngoplasty (BRP) was the most common palatal procedure being adopted by 43.3% ($N=61$) of respondents. UPPP, Lateral pharyngoplasty, ESP, anterior palatoplasty, LAUP and other techniques were preferred, respectively, in 26.9% ($N=38$), 26.2% ($N=37$), 19.9% ($N=29$), 17.7% ($N=25$), 6.4% ($N=9$), and 13.5% ($N=19$) of the cases.

Inter-continents evaluation showed that UPPP is the most frequently used technique in Africa ($p<0.000032$), while lateral pharyngoplasty and BRP are preferred in South America and Europe (respectively $p<0.000462$ and $p<0.000426$).

Most of the physicians chose their technique based on: satisfactory outcomes 85.8% ($n=121$), simplicity 36.9% ($n=52$), short surgical time 33.3% ($n=47$), and patients' compliance 27.7% ($n=39$).

Sleep specialists chose a technique based on its effective clinical outcomes more frequently than non-sleep specialists (97.2% ($n=70$) vs. 71.0% ($n=49$), $p<0.000018$).

Most surgeons do not perform a single surgical technique in all cases, 73.8% ($n=104$) (Table 7).

Associated procedures

Surgeons were asked if they combine palate surgery with tonsillectomy in case of enlarged tonsils (grade 3 or 4) in snorers: 51.1% ($n=72$) answered yes, while 31.9% ($n=45$) answered sometimes, and 17% ($n=24$) answered no. No statistical difference between continents and specialists was observed.

Table 6 Experience in palate surgery across continents

		Africa	Asia	Centre-South America	Europe	*P*
Experience in palate surgery	Less than 5 years	17 (47.2%)	10 (24.4%)	7 (21.2%)	5 (19.2%)	0.17
	5–10 years	6 (16.7%)	16 (39.0%)	13 (39.4%)	8 (30.8%)	ns
	10–20 years	7 (19.4%)	9 (22.0%)	9 (27.3%)	10 (38.5%)	
	More than 20 years	6 (16.7%)	6 (14.6%)	4 (12.1%)	3 (11.5%)	
Number of palate surgeries performed per week	Less than 5 cases	28 (77.8%)	35 (85.4%)	29 (87.9%)	22 (84.6%)	0.73
	5–10 cases	7 (19.4%)	4 (9.8%)	2 (6.1%)	3 (11.5%)	ns
	More than 10 cases	1 (2.8%)	2 (4.9%)	2 (6.1%)	1 (3.8%)	

Table 7 Palate surgery techniques adopted among all physicians, continents, and specialists

Palate surgery technique performed	BRP	61 (43.3%)			Sleep specialist	Non- sleep specialist	*p*
	UPPP (classic technique, Australian mod, modified,	38 (26.9%)	Palate surgery technique performed	BRP	38 (52.8%)	22 (31.9%)	0.012
	Lateral pharyngoplasty	37 (26.2%)					< 0.05
	ESP	28 (19.9%)		UPPP (classic technique, Australian mod, modified)	7 (9.7%)	30 (43.5%)	0.000 < 0.05
	Anterior palatoplasty	25 (17.7%)		Lateral pharyngoplasty	19 (26.4%)	13 (18.8%)	ns
	LAUP	9 (6.4%)		ESP	21 (29.2%)	7 (10.1%)	0.004 < 0.05
	Other	19 (13.5%)		Anterior palatoplasty	13 (18.1%)	11 (15.9%)	ns
Why do you perform this technique?	Good results	121 (85.8%)		LAUP	1 (1.4%)	8 (11.6%)	0.013 < 0.05
	Easy to learn	52 (36.9%)		Other	3 (4.2%)	6 (8.7%)	ns
	Fast to perform	47 (33.3%)	Why do you perform this technique?	Good results	70 (97.2%)	49 (71.0%)	0
	Well tolerated by patients	39 (27.7%)					< 0.05
Is it the only palate surgery technique performed in all cases?	Yes	37 (26.2%)		Easy to learn	22 (43.5%)	30 (43.5%)	ns
	No	104 (73.8%)		Fast to perform	22 (30.6%)	21 (30.4%)	ns
				Well tolerated by patients	21 (29.2%)	18 (26.1%)	ns
			Africa	Asia	Centre-South America	Europe	p
Palate surgery techniques performed		BRP	12 (33.3%)	11 (26.8%)	15 (45.5%)	20 (76.9%)	0.000 < 0.05
		UPPP (classic technique, Australian mod, modified)	18 (50.0%)	13 (31.7%)	1 (3.0%)	3 (11.5%)	0.000 < 0.05
		Lateral pharyngoplasty	8 (22.2%)	10 (24.4%)	17 (51.5%)	1 (3.8%)	0.001 < 0.05
		ESP	2 (5.6%)	7 (17.1%)	13 (39.4%)	4 (15.4%)	0.003 < 0.05
		Anterior palatoplasty	6 (16.7%)	15 (36.6%)	2 (6.1%)	2 (7.7%)	0.002 < 0.05
		LAUP	4 (11.1%)	4 (9.8%)	0	1 (3.8%)	ns
		Other	4 (11.1%)	6 (14.6%)	1 (3.0%)	1 (3.8%)	ns
Why do you perform this technique?		Good results	26 (72.2%)	29 (71.0%)	31 (93.9%)	25 (96.2%)	0.006 < 0.05
		Easy to learn	18 (50.0%)	17 (41.0%)	5 (15.2%)	10 (38.5%)	0.02
							< 0.05
		Fast to perform	17 (47.2%)	15 (37.0%)	6 (18.2%)	7 (26.9%)	0.06
							ns
		Well tolerated by patients	9 (25.0%)	13 (32.0%)	8 (24.2%)	8 (30.8%)	0.85
							ns
Is it the only palate surgery technique performed in all cases?		Yes	17 (47.2%)	10 (24.4%)	3 (9.1%)	5 (19.2%)	0.003
		No	19 (52.8%)	31 (75.6%)	30 (90.9%)	21 (80.8%)	< 0.05

Regarding the possibility of performing nasal procedures in addition to palate surgery in snorers, respondents answered positively in 41.8% of cases ($n=59$), sometimes in 37.6% ($n=53$), and negatively in 20.6% ($n=29$). No statistical difference between continents and specialists was recorded.

The combination of base of tongue surgeries with palatal procedures was defined as regular by 34% ($n=48$) and possible by 29.8% ($n=42$) of respondents. This combination is never adopted by 36.2% ($n=51$) of respondents. No statistical difference between continents and sleep specialists was found, as shown in Table 8.

Drug-induced sleep endoscopy (DISE)

Most of the respondents 54.6% ($n=77$) perform drug-induced sleep endoscopy regularly before palate surgeries. However, 23.4% ($n=33$) only perform DISE sometimes, while 24.1% ($n=34$) answered they never perform DISE before surgeries.

When we analyzed the open question "if Yes please explain", among those who responded they perform DISE, 35.2% ($n=25$) do so to identify levels and degree patterns of upper airway obstruction, 28.2% ($n=20$) perform it as a routine, 22.5% ($n=16$) do it to choose the best surgical plane, and 14.1% ($n=10$) perform DISE only in selected cases, such as failure, severe RDI, absence of tonsil hypertrophy, if endoscopic findings differ from clinical presentation.

Sleep specialists perform DISE regularly in 72.2% ($n=52$) of cases, while only 36.2% ($n=25$) of non-sleep specialists responded positively ($p<0.000099$).

DISE is performed regularly by African respondents in 36.1% of cases, South Americans 69.7%, and Europeans 84.6% ($p<0.00038$). However, no significant difference in motivations leading to adopt DISE was observed across continents (Table 9).

Factors that interfere with surgical technique

When physicians were asked whether their surgical technique will vary between patients who snore and those who have OSA, 48.9% ($n=69$) answered yes, 27% ($n=38$) answered sometimes, and 24.1% ($n=34$) of respondents do not vary their palate technique between snoring and OSA patients.

We did not find a statistical significance between continents and medical degrees.

Most respondents stated that patients' palate anatomy influences surgical strategy 67.4% ($n=95$). There was no significant statistical difference between continents and medical degrees.

When asked if they vary palate surgery technique according to differences in patients' AHI, 23.4% ($n=33$) answered yes, 22.7% ($n=32$) answered sometimes, and 53.9% ($n=76$) answered no.

There was no significant statistical difference between continents and medical degrees.

Most respondents indicated that their palate surgery techniques did not vary according to patients' BMI 57.4% ($N=81$) or gender 85.8% ($N=121$) (Table 10).

Surgical techniques

Most surgeons 70.9% ($n=100$) will not perform palatal procedures under local anesthesia for simple snoring.

Most opt for vicryl sutures 64.5% ($n=91$) and Barbed wire sutures 52.5% ($n=71$). Barbed suture is significantly more used in Europe 92.3% ($n=24$) and among sleep specialists ($p<0.05$).

The most common cutting device was monopolar diathermy in 62.4% ($n=88$), followed by coblation in 48.2% ($n=68$), laser in 7.8% ($n=11$), harmonic scalpel in 6.4% ($n=9$), bipolar in 5.7% ($n=8$), knife and scissor in 1.4% ($n=2$), and RF in 1.4% ($n=2$).

Table 8 Answers about associated procedures among all physicians

Do you usually perform any form of palate surgery with tonsillectomy if the tonsils are enlarged (grade 3 or 4) in snorers?	No	24 (17.0%)
	Sometimes	45 (31.9%)
	Yes	72 (51.1%)
Do you usually perform any form of palate surgery with nasal surgery in snorers?	Yes	59 (41.8%)
	Sometimes	53 (37.6%)
	No	29 (20.6%)
Do you usually perform any form of palate surgery with tongue base surgery (multilevel surgery)?	Yes	48 (34.0%)
	Sometimes	42 (29.8%)
	No	51 (36.2%)

Table 9 Answers regarding performance of drug-induced sleep endoscopy among all physicians, continents, and sleep specialists and non-sleep specialists

Do you perform drug-induced sleep endoscopy (DISE) before palate surgeries?	Yes	**77 (54.6%)**			Sleep specialist	Non-sleep specialist	*p*
	Sometimes	33 (23.4%)	Do you perform drug-induced sleep endoscopy (DISE) before palate surgeries?	Yes	**52 (72.2%)**	**25 (36.2%)**	**0**
	No	34 (24.1%)		Sometimes	9 (12.5%)	21 (30.4%)	**< 0.05**
If YES, Please explain	To identify level/s, degree pattern of upper airway obstruction	25 (35.2%)		No	11 (15.3%)	23 (33.3%)	
	Routine	20 (28.2%)					
	To choose the best surgical plane	16 (22.5%)					
	In selected cases (failure, severe RDI, absence of tonsil hypertrophy, if endoscopic findings differ from clinical presentation …)	10 (14.1%)					
			Africa	Asia	Centre-South America	Europe	*p*
Do you perform drug-induced sleep endoscopy (DISE) before palate surgeries?	Yes	**11 (30.6%)**	**20 (48.8%)**	**23 (69.7%)**	**22 (84.6%)**	0	
	Sometimes	13 (36.1%)	7 (17.1%)	2 (6.1%)	4 (15.4%)	< 0.05	
	No	12 (33.3%)	14 (34.1%)	8 (24.2%)	0		

Table 10 Factors that interfere with surgical techniques among all physicians

Is the palate surgery technique variable between snoring and OSA?	Yes	69 (48.9%)
	Sometimes	38 (27.0%)
	No	34 (24.1%)
Is the palate surgery technique variable depending on patient's palate anatomy?	Yes	95 (67.4%)
	Sometimes	27 (19.1%)
	No	19 (13.5%)
Is the palate surgery technique variable depending on patient's AHI?	Yes	33 (23.4%)
	Sometimes	32 (22.7%)
	No	76 (53.9%)
Is the palate surgery technique variable depending on patient's BMI?	Yes	31 (22.0%)
	Sometimes	29 (20.6%)
	No	81 (57.4%)
Is the palate surgery technique variable between males and females (with same BMI and AHI)?	Yes	20 (14.2%)
	No	121 (85.8%)

Forty percent of respondents ($n=57$) prefer to cut the Palatopharyngeus muscle at the lower part, while 22.7% ($n=32$) at the upper part. On the other hand, 9.9% ($n=14$) of surgeons do not always interrupt the muscle, and 25.5% ($n=36$) never do so.

Thirty-nine percent ($n=16$) of Asian respondents answered that they do not cut the Palatopharyngeus muscle. However, in the other continents, the percentage of surgeons cutting the lower part of Palatopharyngeus muscle is higher.

Regarding lateral pharyngeal wall techniques, the preferred landmark for anchoring the muscles was pterygomandibular raphe in 57.5% ($n=81$) of the cases, pterygoid hamulus in 10.6% ($n=15$), the anterior pillar in 15.6% ($n=22$), and other structures including the soft palate, hard palate junction, posterior pillar, posterior nasal spine in 10.6% ($n=15$) of the cases. Raphe appears as the preferred landmark in Asia 48.8% ($n=20$) and Europe 76.9% ($n=20$). Significant differences about the landmark preferences were observed across continents but not among medical degrees.

When respondents were questioned about BRP, 70.3% ($n=52$) of them stated that they perform 2 or 3 loops of sutures around the palatopharyngeal muscle, while 25.7% ($n=19$) preferred 4 or 5 loops.

Regarding the sparing of uvula during palate surgery, only 2.1% ($n=3$) declared that they regularly remove the uvula.

The average operative time to perform palate surgery was 31–60 min in 51.8% ($n=73$), 30 min or less in 27.7% ($n=39$), 61–90 min in 13.5% ($n=19$), and 91 min or more in 7.1% ($n=10$) of responses. In all continents, most of the surgeons take 31–60 min to perform palate surgery with significant differences across continents $p=0.000046$.

In Europe, 42.3% ($n=11$) take 30 min or less and none ($n=0$) take more than 91 min, while in Centre/South America, only 3% ($n=1$) take 30 min or less and 21.2% ($n=7$) take more than 91 min (Table 11).

Pain, complications, and management

65.2% ($n=92$) of surgeons do not infiltrate any drug into the palate at the end of the procedure, 24.1% ($n=34$) infiltrate drugs (local anesthetic 67.6% ($n=23$) and corticosteroids 32.4% n = 11)), and 10.6% ($n=15$) only sometimes inject drugs.

Severe post-operative pain was observed in 58.2% ($n=82$) of respondents. Pain was defined as moderate or mild in 35.5% ($n=50$) and 6.4% ($n=9$) of respondents, respectively.

Seventy-six percent ($n=108$) of respondents prescribe Nonsteroidal anti-inflammatory drugs (NSAIDs), 70.2% ($n=99$) adopts paracetamol, 46.8% ($n=66$) prescribe opioids and tramadol, 4.9% ($n=7$) prescribe other medications, and 2.8% ($n=4$) corticosteroids.

The percentage of postoperative bleeding was 0.1–5% in 59.6% ($n=84$) of respondents, 0% in 20.6% ($n=29$), 6–10% in 12.8% ($n=18$), and higher than 11% in 5.7% ($n=8$).

Eighty-two percent ($n=116$) of surgeons prescribe postoperative antibiotics (Table 12).

Surgeon's satisfaction

Half of the respondents (50.4% ($n=71$)) believe they need to modify the palate surgery technique to improve results. The other half (49.6% (n = 70)) believes their technique is effective in the majority of cases and does not need any modification (Table 13).

Table 11 Surgical techniques among all surgeons

Is the palate surgery technique variable between snoring and OSA?	Yes	69 (48.9%)
	Sometimes	38 (27.0%)
	No	34 (24.1%)
Is the palate surgery technique variable depending on patient's palate anatomy?	Yes	95 (67.4%)
	Sometimes	27 (19.1%)
	No	19 (13.5%)
Is the palate surgery technique variable depending on patient AHI?	Yes	33 (23.4%)
	Sometimes	32 (22.7%)
	No	76 (53.9%)
Is the palate surgery technique variable depending on patient BMI?	Yes	31 (22.0%)
	Sometimes	29 (20.6%)
	No	81 (57.4%)
Is the palate surgery technique variable between males and females (with same BMI and AHI)?	Yes	20 (14.2%)
	No	121 (85.8%)
Do you perform palatal procedures under local anesthesia for simple snoring?	Yes	41 (29.1%)
	No	100 (70.9%)
What kind of suture material is used?	Vicryl	91 (64.5%)
	Barbed	74 (52.5%)
	Monocryl	21 (14.9%)
	Others (PDS, Stratafix, Silk)	14 (9.9%)
What kind of needle is used?	Round needle	109 (77.3%)
	Cutting needle	28 (19.9%)
	NA	4 (2.8%)
What technology is used to cut tissues?	Monopolar diathermy	88 (62.4%)
	Coblation	68 (48.2%)
	Laser	11 (7.8%)
	Harmonic scalpel	9 (6.4%)
	Bipolar	8 (5.7%)
	Knife and scissor	2 (1.4%)
	RF	2 (1.4%)
Do you cut the palatopharyngeus muscle?	Yes, at the lower part	57 (40.4%)
	Yes, at the upper part	32 (22.7%)
	Sometimes	14 (9.9%)
	No	36 (25.5%)
	NA	2 (1.4%)
If you perform any of the lateral pharyngeal wall technique approach, what is the anchoring structure?	Pterygoid hamulus	15 (10.6%)
	Pterygomandibular raphe	81 (57.5%)
	anterior pillar	22 (15.6%)
	Others (soft palate, hard palate junction, lateral wall, posterior pillar, PNS)	15 (10.6%)
If you perform Barbed reposition pharyngoplasty (BRP), how many loops of sutures do you take around the palatopharyngeal muscle	2 or 3	52 (70.3%)
	4 or 5	19 (25.7%)
	6	3 (4.1%)
Are you a uvula lover or hater?	Preserve uvula "uvula lover" and may perform uvuloplasty	82 (58.2%)
	Variable according to each case	56 (39.7%)
	Remove the uvula "uvula hater"	3 (2.1%)
What is the average operative time for performing palate surgery at your hand?	30 min or less	39 (27.7%)
	31– 60 min	73 (51.8%)
	61–90 min	19 (13.5%)
	91 min or more	10 (7.1%)

Table 12 Pain, complications, and management among all physicians

Do you inject any drugs into the palate at the end of the procedure?	No	92 (65.2%)
	Sometimes	15 (10.6%)
	Yes	34 (24.1%)
If YES, Please explain	Local anesthetic	23 (67.6%)
	Corticosteroids	11 (32.4%)
What is the average postoperative pain score (VAS)?	**2**	**2 (1.4%)**
	3	7 (5.0%)
	4	12 (8.5%)
	5	15 (10.6%)
	6	23 (16.3%)
	7	45 (31.9%)
	8	30 (21.3%)
	9	7 (5.0%)
What is the average postoperative pain score (VAS)?	Mild 1–2–3	9 (6.4%)
	Moderate 4–5–6	50 (35.5%)
	Severe 7–8–9	82 (58.2%)
What is the percentage of postoperative bleeding of your palate surgery cases?	None	29 (20.,6%)
	0.1–5%	84 (59.6%)
	6–10%	18 (12.8%)
	More than 11%	8 (5.7%)
	NA	2 (1.4%)
Do you prescribe postoperative antibiotics?	Yes	116 (82.3%)
	Sometimes	6 (4.3%)
	No	19 (13.5%)
What kind of painkillers are usually prescribed after your palate surgeries?	Paracetamol	99 (70.2%)
	NSAIDs	108 (76.5%)
	Opioids and tramadol	66 (46.8%)
	Corticosteroids	4 (2.8%)
	Other	7 (4.9%)

Table 13 Surgeon's satisfaction rate among all physicians

Are you satisfied with your palate surgery technique, or do you need to modify or change it?	Yes, the technique is great and works in all cases	70 (49.6%)
	No, I need to modify it to improve results	71 (50.4%)

Discussion

This is the first paper aimed at giving a broad overview of how surgeons perform palatal surgery in otolaryngology departments in different countries.

The importance of OSA and its treatment in otorhinolaryngology has increased considerably in the last few years. There are several clinical treatments and surgical techniques with different types of training across the continents. There is no unique protocol. This is an international survey among ENTs ($n = 141$) from different sub-specialties across continents regarding palate surgery management of OSAS patients undergoing surgical treatment for sleep apnea with specific and export-oriented questions.

Palate surgery techniques

In our study, most surgeons prefer the BRP technique (43.3%) followed by UPPP (26%). However, there is a difference across continents; in Africa, they prefer UPPP (50%), in Centre-South America they go for lateral pharyngoplasty (51.5%), Asia adopts anterior palatoplasty (36.6%), and Europe chooses BRP (76.9%). Thus, we can see there is no consensus across continents on the best technique, and all surgeons agree that their choice for this type of technique is based on good results.

BRP is the latest technique introduced in Europe [10, 11, 5] and is well accepted in all continents. UPPP is the oldest surgical method among all the questioned ones, yet it is still widely used in Africa and Asia. In 1977, Quesada

et al. introduced the concept of partial palate resection, a technique that was considered the first UPPP [12]. In 1981, Fujita et al. published the UPPP technique by modifying the original procedure described by Ikematsu and generating great enthusiasm in the otolaryngology community [13, 14, 15]. A meta-analysis of unselected cases treated with UPPP from 1966 to 1993 revealed that only 40.79% experienced a successful surgery, defined as a 50% reduction of Apnea–Hypopnea Index (AHI) [16]. Rashwan et al., in a study with seventy-five patients, proved that Barbed reposition pharyngoplasty (BRP) could be considered an effective procedure based on the postoperative outcomes; ESP proves to be a good technique, especially when performed by experienced surgeons, and both techniques proved to be superior to UPPP [17]. Neruntarat et al., in a recent meta-analysis, conclude that as far as surgical duration is concerned, BRP is superior to ESP, and the outcomes in both procedures show improvement in palatal collapse [18].

The underlying reason for this difference is that most surgeons are non-sleep specialists in Africa (43.5%) and Asia (33.3%). In addition, more recent palatal techniques have shown to have fewer long-term complications compared to the older ablative techniques [19].

Most surgeons answered that they do not perform only one technique in all cases. However, among non-sleep specialists, many (36.2%) perform the same technique in all cases. Most surgeons (61.7%) have a good percentage rate (61–80%) of success with this technique, and most of them (51.1%) usually perform any form of palate surgery with tonsillectomy if the tonsils are enlarged in snorers.

Different studies have shown the importance of tonsillectomy in adults with OSA. Camacho et al. confirmed, in a metanalysis, the efficacy of tonsillectomy on OSAS, with an AHI decreasing from 40.6 to 8.8 events/h in patients with a mean BMI of 30 kg/m^2 [20]. According to Baudouin et al., in cases of prominent tonsil hypertrophy, simultaneous soft palate surgery had no significant impact on the success rate, regardless of soft palate length [21]. Sommer et al. published a meta-analysis showing that when tonsillectomy was associated with a velar procedure concomitantly, the success rate of UPPP increased from 30 to 59% in 269 patients [22].

There is no consensus on combining nasal and multilevel surgery. In our study, the physicians' answers regarding the question of whether they perform nasal and base of tongue surgeries combined with palatal procedure or not were fairly balanced. Pang showed that combining nasal surgery in multilevel surgery improves the surgical success rate [23].

Green, in a multicenter cohort study, concludes that DISE findings concerning the velum or epiglottis were not associated with surgical outcomes [24].

Hsu et al. found that AHI outcomes in patients with multilevel obstruction on DISE treated with palatopharyngoplasty alone were similar to AHI outcomes in patients with unilevel obstruction. Multilevel surgery may not be needed in some patients with a multilevel obstruction pattern [25].

DISE

When we inquired about DISE, we found a difference across continents and between sleep and non-sleep specialists. Centre-South America (69.7%) and Europe (84.6%) perform DISE before palate surgeries. Sleep specialists (72.2%) perform more DISE than non-sleep specialists (36.2%). DISE provides useful upper airway evaluation, allowing for identification of upper airway patterns of collapse associated with potential surgical failure. Surgical treatment was changed after DISE in 50.24% cases [6].

In our study, most surgeons perform DISE to identify level/s, degree, and pattern of upper airway obstruction (35.2%); however, among specialists, 22.2% perform DISE routinely, while only 7.2% of non-specialists perform DISE as a routine.

Cammaroto et al., in a recent international survey, found that the majority of respondents in South/Central America and Europe performed DISE before planning sleep surgery. DISE seemed to be performed in operating theater settings in Europe (77%). A higher percentage of South/Central American institutions opt for an endoscopy room setting (39% vs. 21% in Europe) [7]. Differently from this study, they found that otolaryngologists from Central/South America actively perform sleep studies more frequently than Europeans.

DISE remains a vital tool to assess the obstruction site in order to plan the appropriate treatment.

Factors that interfere with surgical technique

Many physicians answered that the palate surgery technique varies between snoring and OSA patients (48.9%) and patient's palate anatomy (67.4%). However, there is no surgical technique variable according to different levels of AHI, BMI, and gender.

Nowadays, obesity is widely recognized as the most critical risk factor for OSAS: a 10% weight gain is associated with a sixfold increased risk of developing this disease [26].

Surgical techniques

Vicryl is the most widely used suture material among all surgeons (64.5%), but when looked at separately, Barbed is more frequently used by specialists (66.7%) than by non-specialists (37.7%). There is also a big difference across continents; in Africa (75.0%) and Asia (65.9%), Vicryl is the most widely used. In Centre-South America, the result is balanced between Vicryl (57.6%) and Barbed (57.6%), and in most cases, Barbed comes in first in Europe (92.3%).

This difference may be explained by the fact that Barbed technique started in Europe and is beginning to be accepted in America; however, it is still not widely used in Africa and Asia. In 2015, Mantovani et al., modifying their previous "Roman blinds technique" for the treatment of retropalatal collapse, presented the Barbed Roman blinds technique [11]. A prospective randomized trial demonstrates that BRP appears to be a promising technique and might be included in the surgical armamentarium of a sleep surgeon [12]. Thus, we know that among sleep surgery specialists, Barbed suture is already a reality.

There is a consensus on the use of the round needle (77.3%) and on monopolar diathermy to cut tissues (62.4%), including Palatopharyngeus muscle, which is cut in its lower part in most cases (40.4%).

Cahali was the pioneer in demonstrating the need to work on lateral pharyngeal walls to obtain more favorable surgical outcomes [5, 27]. Pterigomandibular raphe is the anchoring structure chosen in the lateral pharyngeal wall technique approach (57.5%).

In Barbed reposition pharyngoplasty, most surgeons perform 2 or 3 loops around the muscles (70.3%).

Most surgeons (58.2%) are "uvula lovers" and preserve or perform uvuloplasty in their procedures, most probably due to the side effects of dryness and foreign body sensation.

Even in the experts' routine, the average operative time to perform a palate surgery is about 31–60 min (55.4%). However, we find that in Europe, 42.3% of surgeons take 30 min or less. This is probably because Barbed is the fastest technique, and it is present in the European routine.

In the entire group of surgeons, results show they are not satisfied with their palate surgery technique (50.4%); however, among sleep specialists the satisfaction rate is higher (58.3%).

Despite all the benefits of BRP, suture extrusion and exposure can still occur in 18.4% of patients [28].

Anesthesia and pain

Surgeons do not perform palatal procedures under local anesthesia for simple snoring (70.9%). They do not inject drugs into the palate at the end of the procedure (65.2%); however, when they do so, they inject local anesthetic in most of the cases (67.6%).

It is a consensus that the average postoperative pain score is severe (29, 30, 31).

NSAIDs are the most commonly prescribed pain-killers in palate surgery (76.5%). Notwithstanding, literature suggested safer drug alternatives in the postoperative setting, including intravenous ketorolac and cyclooxygenase-2 inhibitors, and intranasal butorphanol. Other alternatives include infiltration with a local anesthetic, intraoperative ketamine, intraoperative or postoperative intravenous lidocaine, postoperative ice, magnesium, and α2-agonists [29].

Bleeding

In our study, the percentage of bleeding is 0.1–5% of cases (59.6%), even by sleep specialists (65.3%). Bleeding is a complication described in all types of surgery. In palatal surgery, the most prevalent complications of any severity that can influence postoperative management are respiratory distress (up to 11%), bleeding requiring surgery (up to 8%), and readmission (up to 18%) [29].

Antibiotics

There is a lack of data in the literature correlating the use of antibiotics specifically with palatal surgery. The available data fails to support clear evidence for routine use of postoperative antibiotics for reduction of post-tonsillectomy morbidities [32]. However, in our study, the majority of surgeons prescribe postoperative antibiotics (82.3%) after their surgeries.

Limitations

A few limitations of our study must be mentioned. This is a questionnaire study that can show a high grade of self-report biases and recollection bias. USA and Australia had few representatives in the survey, totaling only 3.5% of responses, and were therefore excluded from it.

Most respondents were younger than 50 years. This finding is probably related to the age of YO-IFOS members: this group is made up of specialists younger than 45 years. Thus, the age and the experience of participants might have influenced the outcomes of this survey.

Conclusion

This study gives an overview of the current surgical practice in OSA management in otolaryngology in different countries. Significant agreement and few interesting divergences in the diagnosis and treatment of palatal surgery were observed among nationalities.

Appendix Palate surgery questionnaire

SURGEON'S NAME:

1. Country:

2. Surgical Specialty:

a) General ENT

b) Rhinologist

c) Otologist

d) Head & Neck surgeon

e) Sleep surgeon

f) Maxillofacial surgeon

3. Medical degree:

a) Professor

b) Consultant

c) Specialist

d) Resident or trainee

4. Experience in palate surgery:

a) Less than 5 years

b) 5-10 Years

c) 10-20 years

d) More than 20 years

5. Number of palate surgeries you perform per week:

a) Less than 5 cases

b) 5-10 cases

c) More than 10 cases

6. The most common palate surgery technique you perform:

a) Uvulopalatopharyngoplasty (UPPP) - Classical technique

b) Uvulopalatopharyngoplasty (UPPP) - Australian modification

c) Expansion Sphinceter Pharyngoplasty (ESP)

d) Lateral Pharyngoplasty

e) Barbed Reposition Pharyngoplasty (BRP)

f) Anterior palatoplasty

g) Laser assisted uvulopalatoplasty (LAUP)

h) Transpalatal advancement pharyngoplasty

i) Other:

7. Why do you perform this technique?

a) Easy to learn

b) Fast to perform

c) Good results

d) Well tolerated by patients

e) Other:

8. Is it the only palate surgery technique you perform for all cases?

a) Yes

b) No

9. What is the success rate (percentage) of this technique at your hands?

10. Do you usually perform any form of palate surgery with tonsillectomy if the tonsils are enlarged (grade 3 or 4) in snorers?

a) Yes

b) No

c) Sometimes

If YES, Please explain

11. Do you usually perform any form of palate surgery with Nasal surgery in snorers?

a) Yes

b) No

c) Sometimes

If YES, Please explain

12. Do you usually perform any form of palate surgery with tongue base surgery (Multilevel surgery)?

a) Yes

b) No

c) Sometimes

If YES, Please explain

13. Do you perform drug induced sleep endoscopy (DISE) before palate surgeries?

a) Yes

b) No

c) Sometimes

If YES, Please explain

14. Is the palate surgery technique variable between snoring & OSA?

a) Yes

b) No

c) Sometimes

If YES, Please explain

15. Is the palate surgery technique variable depending on patient's palate anatomy?

a) Yes

b) No

c) Sometimes

If YES, Please explain

16. Is the palate surgery technique variable depending on patient's AHI?

a) Yes

b) No

c) Sometimes

If YES, Please explain

17. Is the palate surgery technique variable depending on patient's BMI?

a) Yes

b) No

c) Sometimes

If YES, Please explain

18. Is the palate surgery technique variable between males & females (with same BMI&AHI)?

a) Yes

b) No

c) Sometimes

19. Do you perform palatal procedures under local anesthesia for simple snoring?

a) Yes

b) No

If YES, Please specify,

20. What kind of suture material is used?

a) Vicryl

b) Monocryl

c) PDS

d) Barbed

e) Other:

21. What kind of needle is used?

a) Round needle

b) Cutting needle

c) Other:

22. What technology is used to cut tissues?

a) Monopolar diathermy

b) Laser

c) Coblation

d) Harmonic scalpel

e) Other:

23. Do you cut the palatopharyngeus muscle?

a) No

b) Yes at the upper part

c) Yes at the lower part

d) Other:

24. When you perform any lateral pharyngeal wall technique approach, what is the anchoring structure?

a) Pterygoid hamulus

b) Pterygomandibular raphe

c) Anterior pillar

d) Soft palate

e) Other:

25. When you perform Barbed reposition pharyngoplasty (BRP), how many loops of sutures do you take around the palatopharyngeal muscle?

26. Are you a uvula lover or hater?

a) Remove the uvula "uvula hater"

b) Keep uvula "uvula lover" and may perform uvuloplasty

c) It varies according to each case

d) Other:

27. Do you inject any drugs into the palate at the end of the procedure?

a) Yes

b) No

c) Sometimes

If YES, Please specify,

28. What is the average operative time for performing palate surgery at your hand?

29. What is the average postoperative pain score (VAS)?

30. What is the percentage of postoperative bleeding in your palate surgery cases?

31. Do you give postoperative antibiotics?

a) Yes

b) No

c) Sometimes

32. What kind of pain-killers do usually prescribe after your palate surgery?

a) Paracetamol

b) NSAIDs

c) Ketorolac

d) Opioids

e) Other:

33. Are you satisfied with your palate surgery technique or do you need to modify or change it?

a) Yes, the technique is great and works in all cases

b) No, I need to modify it to improve results

Author contribution AB, MC, and GC formulated the survey, AB collected answers, GC and HDS analyzed the statistics. UA and HDS wrote the manuscript. All authors read and revised the final manuscript.

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

Declarations

Ethics approval and consent to participate The ethics committee of Alexandria University approved this study.

Consent for publication Not applicable

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