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ENT • ORIGINAL ARTICLE

Adult sleep apnea and tonsil hypertrophy: should pharyngoplasty be associated with tonsillectomy?

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Abstract

Purpose Velopharyngoplasty and palatine tonsillectomy are at the very heart of the surgical treatment of obstructive sleep apnea syndrome (OSAS) care. In cases of major tonsil hypertrophy, we evaluated the relevance of associating soft palate surgery with palatine tonsillectomy, independent of the soft palate length.

Methods We conducted a retrospective single-center study in OSAS patients with grade III or IV tonsils treated with tonsillectomy. Preoperative assessment included an upper airway examination performed while the patient was awake, a polysomnography and a drug-induced sedation endoscopy (DISE). Surgical efficacy was assessed on postoperative polysomnography. Success was considered when the postoperative apnea-hypopnea index (AHI) was less than 20 events/h with a 50% reduction. We compared palatine tonsillectomy efficacy alone (group A) and associated with soft palate surgery (group B).

Results We analyzed 33 patients who had undergone surgery between December 2006 and May 2018. Their preoperative mean BMI and mean AHI were 27.3 ± 7.5 kg/m^2 and 38.6 ± 21.4 events/h, respectively. The two groups (A, $n = 18$ and B, $n = 15$) were clinically comparable. The success rate was 72.2% in group A and 60% in group B. There was no statistically significant difference between the two groups ($p > 0.1$).

Conclusions According to this study, in our institution, in cases of major tonsillar hypertrophy, simultaneous soft palate surgery had no significant impact on the success rate, regardless of soft palate length. Associating soft palate surgery with palatine tonsillectomy does not seem mandatory to increase the success rate.

Level of evidence III. Retrospective comparative study

Keywords Obstructive sleep apnea · Tonsillectomy · Upper airway surgery · Soft palate · Pharyngoplasty

Introduction

The standard treatment for obstructive sleep apnea syndrome (OSAS) is continuous positive airway pressure (CPAP). It requires rigorous compliance for complete effectiveness on the symptoms and to prevent complications [1]. Over the long term, the probability of adherence to treatment after 5, 10, and 15 years is respectively 82%, 77%, and 61% [2]. Mandibular advancement splints are usually indicated in second-line treatment in cases of CPAP failure or refusal. Soft tissue surgery is considered a viable option in cases of mild to moderate OSAS. This difficult CPAP compliance questions the superiority of this treatment and encourages reconsidering surgery as the first-line treatment [3].

Surgery of the palatine tonsils is the reference treatment in children for OSA, whereas soft palate surgery uvulopalatopharyngoplasty (UPPP) is the reference surgery in adults. Ikematsu first described UPPP in 1952 [4] and Fujita expanded the technique in the early 1980s [5].

International guidelines for adults are discordant on the best adapted surgery to treat pharyngeal obstructions. US and French guidelines do not discriminate soft palate surgery from tonsillectomy, whereas Canadian guidelines recommend first-line tonsillectomy in case of major tonsillar hypertrophy and restrict UPPP to CPAP/mandibular advancement splint (MAS) failure or refusal [6–8].

An analysis of the literature did not clearly indicate the respective roles played by the soft palate and the tonsils in

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pharyngeal obstructions. To our knowledge, the relevance of associating soft palate surgery with palatine tonsillectomy has never been proven, although it could induce a number of significant complications such as velar stenosis or insufficiency [9]. In cases of clinically major tonsil hypertrophy, and independent of the soft palate length, we evaluated the relevance of associating velopharyngoplasty with palatine tonsillectomy.

Material and methods

This retrospective study took place in a university ENT department specialized in sleep disorders. Patients included in the study had Friedman grade III or IV tonsil hypertrophy on clinical examination. Friedman et al. described four clinical grades of tonsil sizes: grades III and IV correspond to hypertrophic tonsils that extend beyond the pillars but not to the midline (grade III) and to the midline (grade IV) [10]. Other inclusion criteria were age ≥ 18 years old, OSAS with an Apnea-Hypopnea Index (AHI) ≥ 5 events/h, and tonsillectomy completion.

The exclusion criteria were missing pre- or postoperative sleep evaluation; evident tongue base obstruction on awake examination, noted when the vallecula was not seen and when the tongue base partially or totally hid the vocal cords during the nasoendoscopy; craniofacial deformity and marked retrognathia on clinical examination; missing drug-induced sedation endoscopy (DISE); and any severe cardiac, respiratory, or neurological disease. Any patient who had undergone tonsillectomy with pharyngoplasty without posterior pillar section was excluded.

The patient's past medical history was taken and a physical examination was performed. Daytime sleepiness was assessed using the Epworth Sleepiness Scale (ESS). An ENT sleep specialist evaluated the patient while awake and seated, including with a flexible nasoendoscope.

Each patient benefited from a preoperative type 1 or 2 polysomnography or a polygraphy (type 3 simplified polysomnography) [11]. Apnea was defined by the airflow cessation for more than 10 s. Hypopnea was defined as a ≥ 30% airflow reduction longer than 10 s associated with a ≥ 3% desaturation in the O_2 saturation levels, or a ≥ 10-bpm pulse rate increase and a clear body movement (on polysomnography level 3) or a microarousal (polysomnography types 1 and 2). An AHI ≥ 5 events/h in a symptomatic patient defined OSAS. Each patient benefited from the same pre- and postoperative type of sleep recording.

Two ENT sleep specialists performed the interventions. One practiced tonsillectomy alone (group A) and the other one performed tonsillectomy and pharyngoplasty (group B). The operative strategy did not depend on the clinical awake examination, the length of the soft palate, or the DISE examination, but on the surgeon who was treating the patient. DISE examinations were performed just before surgery using continuous Propofol perfusion and were interpreted using the VOTE classification [12]. DISE was interpreted by one of the two surgeons who performed surgery. If there was a discordant result between the DISE conclusion and the surgical result, the DISE video was postoperatively analyzed again by the two surgeons together. Concentric, lateral, and anteroposterior velar obstructions were distinguished. Concentric velar obstructions included an anteroposterior and a transverse narrowing of the soft palate upper to the tonsil level.

Tonsillectomy was performed under general anesthesia. It was completed with cold instruments or electric scalpel and bipolar forceps. The entire tonsil, including the inferior pole was removed. No ligatures of the pillars were made. When a velar intervention was performed, we practiced, after tonsillectomy, section of the palatopharyngeus muscle at its upper third in its entire thickness. The lower part of the muscle was detached from the mucosa of the posterior pillar downwards for 1 cm. The posterior pillar in its lower part was sutured laterally and the upper part of the muscle was sutured up and out, allowing lateral widening and anterior and superior traction. Nasal surgery, if undertaken, was not considered conclusive because its impact on AHI proved to be limited [13].

Each patient underwent a physical examination and a postoperative sleep study at least 3 months after surgery. The body mass index (BMI) and ESS were recorded.

Three severity subgroups were constituted: mild (AHI ≥ 5 events/h and < 15 events/h), moderate (AHI ≥ 15 events/h and < 30 events/h), and severe (AHI ≥ 30 events/h) OSAS.

Postoperative AHI was the primary endpoint. Surgical efficacy was assessed on postoperative polysomnography using Sher's criteria: success was considered when postoperative AHI was less than 20 events/h with a 50% reduction in the preoperative AHI [14]. Patients were considered "cured" in case of a postoperative AHI < 10 events/h [15]; therefore, if patients had a preoperative AHI between 5 and 10 events/h, they were excluded from the "cure rate" calculation and the postoperative outcome was only evaluated with the success criteria. Secondary endpoints were the patient's answers to the ESS and minimum sleep oxygen saturation after surgery. Bleeding, velopharyngeal insufficiency and nasopharyngeal stenosis were reported.

Means and standard deviations were calculated. Mann-Whitney-Wilcoxon, chi-squared, and Fisher nonparametric tests were used. A p value < 0.05 was considered significant.

Informed consent was obtained from all individual participants included in the study.

Results

Eighty-one OSA patients had surgery from December 2006 to May 2018 and 33 were included. Eighteen patients were lost to follow-up (their clinical and sleep characteristics were equivalent to those of the population analyzed). Thirty patients were excluded: 15 presented a tongue base obstruction in awake examination, six had no DISE, seven underwent soft palate surgery without resection of the posterior tonsillar pillar and enlargement pharyngoplasty, one patient presented Guillain-Barre syndrome in the weeks after surgery, and one patient suffered from severe restrictive pulmonary disease.

Thirty-three patients were analyzed. Preoperative physical characteristics are summarized in Table 1. Six patients suffered from mild OSAS, 8 from moderate OSAS, and 19 patients from severe OSAS. A postoperative sleep study was performed with a mean follow-up of 6.1 ± 7.2 months after surgery. Group A (tonsillectomy alone) and group B (tonsillectomy + pharyngoplasty) comprised 18 and 15 patients, respectively (Table 2). In group A, 5 patients suffered from mild OSAS (with one patient with preoperative AHI < 10/h) and 2 from moderate OSAS and 11 from severe OSAS. In group B, a patient suffered from mild OSAS, 6 from moderate OSAS, and 8 from severe OSAS.

The general postoperative AHI was 11.8 ± 9.6 events/h vs. preoperative 38.6 ± 21.4 events/h ($p < 0.001$) (Table 2). In group A, the postoperative mean AHI was 11.3 ± 11.1 events/h vs. preoperative 40.9 ± 24.7 events/h ($p < 0.001$) (67.0% ± 28.4 decrease). The success rate was 72.2% and the cure rate was 70.6%. In group B, the postoperative mean AHI was 12.5 ± 7.8 events/h vs. preoperative 35.9 ± 17.2 events/h ($p < 0.001$) (56.5% ± 34.7 decrease). The success rate was 60% and the cure rate was 33.3% (Table 3).

Table 2 Pre- and postoperative results, by group. *AHI* Apnea-Hypopnea Index

	Preoperative	Postoperative	*p*
A (tonsillectomy) ($n = 18$)			
Physical examination			
BMI (kg/m^2)	27.7 ± 9.7	27.7 ± 7.8	NS
Epworth score	12.1 ± 6.0	6.9 ± 4.0	< 0.05
Sleep study			
SaO_2 min (%)	80.6 ± 27.4	86.9 ± 4.8	< 0.05
AHI (events/h)	40.9 ± 24.7	11.3 ± 11.1	< 0.05
B (tonsillectomy + UPPP) ($n = 15$)			
Physical examination			
VBMI (kg/m^2)	26.8 ± 3.3	26.3 ± 3.8	NS
Epworth score	14.5 ± 8.5	9.8 ± 5.3	NS
Sleep study			
SaO_2 min (%)	80.7 ± 22.0	85.1 ± 5.6	NS
VAHI (events/h)	35.9 ± 17.2	12.5 ± 7.8	< 0.05

Differences between the two groups in terms of the success rate ($p > 0.1$) and "cure rate" were not statistically significant. There was no statistically significant difference between the two groups regarding the secondary endpoints (Table 3) or when considering the severity of OSAS (Table 4).

DISE revealed eight tongue base-associated obstruction omitted on the clinical awake examination (group A, $n = 3$; group B, $n = 5$). In this subgroup, two successes and one failure were observed after tonsillectomy (group A); and four successes and one failure were observed after tonsillectomy + pharyngoplasty (group B). DISE found 20 velar-associated obstructions (group A, $n = 10$; group B, $n = 10$). Detailed results are disclosed in Table 5.

In group A, a case of postoperative bleeding required a reintervention, whereas in group B, no complication was reported. Neither velar insufficiency nor velar stenosis were observed.

Table 1 Preoperative characteristics

	A (tonsillectomy) ($n = 18$)	B (tonsillectomy + UPPP) ($n = 15$)	*p*
General examination			
Age (years)	35.9 ± 17.2	37.9 ± 10.1	NS
BMI (kg/m^2)	27.7 ± 9.7	26.8 ± 3.3	
Epworth score	12.1 ± 6.0	14.5 ± 8.5	
Tonsil size			
Class III	61.1% (11)	26.7% (4)	NS
Class IV	38.9% (7)	73.3% (11)	
Sleep study			
SaO_2 min (%)	86.9 ± 4.8	85.1 ± 5.6	NS
AHI (events/h)	40.9 ± 24.7	35.9 ± 17.2	

Table 3 Results of primary and secondary endpoints

Postoperative	A (tonsillectomy) ($n = 18$)	B (tonsillectomy + UPPP) ($n = 15$)	*p*
Primary endpoints			
AHI (events/h)	11.3 ± 11.1	12.5 ± 7.8	NS
AHI reduction (%)	67.0 ± 28.4	56.5 ± 34.7	NS
Cured	70.6% (12/17†)	33.3% (5/15)	NS
Success	72.2% (13/18)	60.0% (9/15)	NS
Secondary endpoints			
Epworth score	6.9 ± 4.0	9.8 ± 5.3	NS
SaO_2 min (%)	86.9 ± 4.8	85.1 ± 5.6	NS

† Rate calculated on total − 1 patient because one patient had preoperative AHI < 10 events/h

Table 4 Results of primary endpoints by severity subgroups

Severity subgroups	A (tonsillectomy) ($n = 18$)	B (tonsillectomy + UPPP) ($n = 15$)	p
Mild to moderate	$n = 7$	$n = 7$	
Cured	83.3% (5/6†)	42.9% (3/7)	NS
Success	71.4% (5/7)	42.9% (3/7)	NS
Severe	$n = 11$	$n = 8$	
Cured	63.6% (8/11)	25.0% (2/8)	NS
Success	81.8% (9/11)	75.0% (6/8)	NS

† Rate calculated on total − 1 patients because a patient had preoperative AHI < 10 events/h

Discussion

Results recall

The results obtained in this study suggest that adding soft palate surgery to tonsillectomy is not more effective than tonsillectomy alone in OSAS adults with grade III or IV tonsils.

Tonsillectomy in OSAS literature

Different studies have shown the importance of tonsillectomy in adults with OSA. Smith et al. showed a significant AHI reduction and quality-of-life improvement, regardless of weight in a series of 18 patients who underwent tonsillectomy. The success rate was 78% and the cure rate 50% [16]. 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 [17].

When tonsillectomy is combined with another surgery, including soft palate surgery, the authors raise the question of the value of tonsillectomy. Maurer et al. published a meta-analysis showing that if tonsillectomy was associated with a velar procedure concomitantly, the success rate of UPPP increased from 30 to 59% in 269 patients [18]. The velar procedure seems to be advantageous but far from essential to achieving good surgical results, and tonsillectomy seems to play a great role. However, the matter remains unresolved even in children: a study from Ulualp S. in a child population with severe OSA and lateral wall collapse a modified expansion sphincter pharyngoplasty gave a significant better improvement than tonsillectomy + adenoidectomy [19].

In all cases, no study so far has questioned in adults the usefulness of associating velar surgery with tonsillectomy in the case of significant hypertrophy of the palatal tonsils whereas oropharyngeal (tonsillar and velar) obstruction is highly frequent and multisite surgery is more and more developed.

Multisite surgery

The DISE literature describes the presence of multiple sites of obstruction in patients with OSAS. More specifically, Vroegop et al. found the oropharyngeal walls (including palatine tonsils) were the obstructive sites in 21.9% of patients, but isolated in only 0.9% [20]. In 108 patients, Kezirian et al. found 68% tonsillar obstruction but associated with the soft palate in 84%, the tongue in 71% and the epiglottis in 29% of the cases [15]. Bearing this in mind, treating several obstructing levels (multisite treatment) seems logical in order to increase the chances of success in a single step. Multisite treatment can be performed on all nasal, high oropharynx (i.e., soft palate and oropharyngeal lateral walls including tonsils), low oropharynx (i.e., tongue base comprising the lingual tonsils and hypopharyngeal walls), and the larynx. For safety reasons (respiratory and hemorrhagic), some teams only perform multisite surgery on a single segment, such as a high

Table 5 Multilevel obstruction on DISE with success rates in each subgroup

DISE		A (tonsillectomy) ($n = 18$)	B (tonsillectomy + UPPP) ($n = 15$)	p
Tongue base obstruction	n	3/18	5/15	NS
	Success	2/3	4/5	NS
Velar obstruction	n	10/18	10/15	NS
	Success	7/10	5/10	NS
Anteroposterior velar obstruction	n	8/18	6/15	NS
	Success	6/8	3/6	NS
Concentric velar obstruction	n	2/18	4/15	NS
	Success	1/2	2/4	NS

oropharyngeal level, and associate tonsillar surgery with velar surgery. This is warranted in view of the DISE data. In fact, Kezirian et al. showed that high oropharyngeal obstruction is present in 92% in OSAS. When it exists, the velar site is more often implicated (55%) than the tonsils (30%) [21]. If one decides to perform a tonsillectomy because of significant tonsil hypertrophy (grades III and IV), it seems legitimate, based on the literature, to act simultaneously on the soft palate or the oropharyngeal walls.

In adults, the soft palate is very commonly included in the multisite surgical strategy, sometimes independently of the tonsils' size or other pathophysiological factors. There seems to be a principle that the more space there is, or the tighter the structures are, the more likely surgery will be effective.

When surgery is performed on more than one site, evaluating the impact of action on one site compared to the others is difficult. It seems logical, however, that if several sites of obstruction exist, treating all the sites at the same time would provide better results. This is the trend observed in recent years. In the present study, contrary to what could be expected, patients who received the soft palate procedure in addition to the tonsillectomy did not perform better than those who had a tonsillectomy. These results were obtained whatever the length of the soft palate in patients without evident tongue base hypertrophy on the awake clinical examination. However, all patients had grade III or IV tonsillar hypertrophy that could dynamically and statically modify the aerial flow of the upper respiratory tract.

Major tonsillar hypertrophy impact

Based on our findings, it appears that the presence of significant palatine tonsil hypertrophy in adults can be an explanation for OSAS occurrence. In part of the patients, this would then be an anatomical ("volumetric" or "tumoral") cause of obstruction, without functional or neuropathic participation or without pharyngeal walls, soft palate and/or tongue base excessive collapsibility. Concentric velar obstructions may be considered as a consequence of the oropharyngeal transverse obstruction due to the major tonsillar hypertrophy. On the opposite, strictly anteroposterior velar obstructions may be considered as soft palate collapse, independent of tonsil transverse obstruction. These evaluations of obstructive sites before surgery were based on DISE.

DISE examination and limits

DISE is the gold standard technique to understand obstruction levels and mechanisms occurring during sleep. Epiglottic or tongue base obstructions are more often observed during DISE [15] than at the time of the awake examination [22].

However, several controversies surround DISE. First, is Propofol sedation endoscopy similar to natural sleep? [23]. Second, did the multilevel obstruction seen on DISE systematically lead to failure in cases with limited surgery, such as isolated palatine tonsillectomy? Some of the results raised questions about DISE conclusions and surgical efficacy. Eight patients were diagnosed with an associated tongue base obstruction. In group A, tonsillectomy alone resulted in failure in one patient, as logically expected, and two successes, which seems illogical; for these two patients, the observer noted that the tongue base collapse was incomplete. In group B, four patients were successfully treated with tonsillectomy and velopharyngoplasty despite the untreated multilevel obstruction. This appears illogical. In group A, six patients with an anteroposterior velar obstruction on DISE were successfully treated with tonsillectomy alone. This also appears illogical. In group B, anteroposterior velar obstruction was confirmed in six patients on DISE: three patients were in failure after surgery despite the tonsillectomy and velopharyngoplasty. Here again, this appears illogical.

The obstructive sites seen on DISE, particularly those omitted on clinical awake examination, should be questioned in terms of their pathogenesis in cases of major hypertrophic tonsils. This is even more significant in that palatine tonsillectomy could change upper airway pressure and obstruction patterns. Victores et al. showed that removing the oropharyngeal obstruction by stenting it with a nasopharyngeal tube could alleviate other obstructive sites (collapse reduction in lateral walls (86%), epiglottis (55%), and tongue base (50%), with a more important effect in case of complete obstruction of the velum meaning that obstruction downward should be interpreted as possibly secondary to velotonsillar complete obstructions [24].

The role of pathogenesis is particularly questionable for tongue base obstruction seen on DISE because this would imply nonanatomical therapy (CPAP) or every-night anatomical therapy (mandibular advancement device) or heavier surgery (maxillomandibular advancement surgery), in case of failure of tonsillectomy ± velopharyngoplasty. This is highlighted by a study reported by Hsu et al., who showed a similar success rate and similar AHI outcome after palatopharyngoplasty between a group with no obstruction on DISE ($n = 11$) and another one with multilevel, complete tongue base obstruction on DISE ($n = 19$) [25].

Methodological weaknesses

The main limitation to our study is the small sample size and the absence of difference with found could be due to our impossibility to put in evidence such a difference without enough patients. A larger surgery, a fortiori prospective, might find different results and should be lead.

In order to have a population with homogeneous characteristics, we chose to limit our population to patients with similar velar or tonsillar oropharyngeal obstructions who had similar limited surgery of the tonsils or soft palate. This greatly restricted the number of patients included. The 33.3% cure rate in group B is lower than the rates observed by Camacho et al. [17] and Maurer [18]. We observed a threshold effect which is not corrected by the sample size: indeed, five patients with severe OSAS had a postoperative AHI > 10/h and < 20/h may not have been counted among the cured despite a major AHI reduction > 50%. Nevertheless, velar surgery did not seem to have improved surgical efficacy.

The mild OSAS proportion in the two groups was not equivalent ($n = 5$ in group A; $n = 1$ in group B). In group A, a patient was excluded from the cured rate outcome due to a preoperative AHI inferior to 10/h. Five patients in group A and 2 patients in group B had a preoperative AHI < 20/h which fills one of the two criteria to determine the success rate outcome (postoperative AHI < 20/h and > 50% decrease after surgery). Such a difference could be a bias in our appreciation of the procedure outcomes.

Sleep examination was led using preoperative and postoperative polygraphy or polysomnography. Most of our patients had a polygraphy. Arousals entered in the scoring rules for the hypopnea and could not be scored using polygraphy [26]. AHI scoring could not be strictly equal using either a polygraphy or a polysomnography. Such a bias was alleviated by using the same sleep examination for each patient.

Our UPPP technique should be put into perspective with more recent procedures described to treat soft palate obstruction. Soft palate surgery technique evolved in the last decade during our patients were operated [27]. Our technique theoretically enlarged the retrovelar space in the anteroposterior dimension and the oropharynx in the transverse dimension. Compared with an older UPPP technique, we did not resect the lower part of the soft palate, which could have been effective in the longest soft palate with obstruction at the ower part of the soft palate. Compared to our technique, the more recent pharyngoplasty expansion [28] transposes the palatopharyngeus muscle upwards and could possibly advance the soft palate slightly more forward than our technique; and the lateral pharyngoplasty [29] transects the upper constrictor muscle of the pharynx, which in theory should allow it to fight against retrovelar circumferential obstruction.

However, this type of obstruction can only be visualized during DISE and is a challenge for surgery with worse results in patients with concentric velar collapse [25]. Recently Montovani et al. described successful results in tonsillectomized patients with residual concentric velar collapse with a combination of a Roman blind technique and a barbed anterior pharyngoplasty called the Alianza technique [30]. A future larger and prospective study must include advanced in pharyngoplasties techniques appeared in the last decades. Results might not be the same as ours.

A point weighted these methodological weaknesses: although retrospective, the group of surgery depended solely on the surgeon who took care of the patients, regardless of clinical or DISE examinations data. The choice of the surgeon was made independently of any sleep examination or anatomic criteria: patients were addressed to one of them by medical correspondents (truly unaware of such a highly specialized difference in the surgical taking care) or by taking themselves a first appointment and no patient was specially affected to a surgeon or the other.

Conclusion

According to this study in our institution, the addition of soft palate surgery to tonsillectomy in an OSAS patient with grade III or IV tonsil hypertrophy should be discussed in weighing the benefits and risks, independent of soft palate obstruction and the peripharyngeal space. This is a preliminary monocentric retrospective report before the larger and prospective studies needed to answer the question raised herein.

Compliance with ethical standards

Ethical standards Informed consent was obtained from all individual participants included in the study.

Conflict of interest The authors declare that they have no conflicts of interest.

Statement All authors have seen and approved the manuscript.

Abbreviations OSAS, obstructive sleep apnea syndrome; DISE, drug-induced sleep endoscopy; AHI, Apnea-Hypopnea Index; /h, per hour; CPAP, continuous positive airway pressure; UPPP, uvulopalatopharyngoplasty; MAS, mandibular advancement splint; ESS, Epworth Sleepiness Scale; BMI, body mass index

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Comment

In this article, the addition of UPPP to tonsillectomy does not seem to add anything to tonsillectomy alone. These results must be put in the correct perspective, as the sample size is small, and nowadays there are other types of pharyngoplasties that may add something to tonsillectomy.

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