JOURNAL Acta Oto-Laryngologica

CITATION Knubb, J., Sjöblom, H. M., Ikonen, E., Suomela, M., & Piitulainen, J. M. (2024). Long-term outcomes of extracapsular tonsillectomy in the treatment of obstructive sleep apnoea in adults. *Acta Oto-Laryngologica*, *144*(11–12), 646–651.

DOI https://doi.org/10.1080/00016489.2024.2420700

Long-term outcomes of extracapsular tonsillectomy in the treatment of obstructive sleep apnoea in adults

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Statements and Declarations

Authorship statement: All authors listed made substantial contributions to the design of the work and revised the work critically for content. All authors approve of the published version.

Conflict of interest: The Authors declare that they have no conflict of interest.

Ethics approval: The study protocol was accepted by The Ethics Committee of Southwest Finland (diary number 73/2021) and the institutional review board (permit number T06/050/21).

Funding

The work was supported by The Finnish ORL-HNS Foundation; and Sakari Alhopuro Foundation.

Code availability: Statistical analyses were performed using SPSS software (version 28.0, IBM Corp., Armonk, NY, USA).

Data availability: Data of each patient is presented in Table 1.

ABSTRACT

Background: Tonsillectomy is an effective treatment option for obstructive sleep apnoea in selected adult patients, but there has been a lack of long-term follow-up data.

Objectives: To analyse the long-term outcomes of extracapsular tonsillectomy in the treatment of obstructive sleep apnoea in adults, with the longest follow-up periods to date.

Material and Methods: We recruited adults who had undergone extracapsular tonsillectomy because of obstructive sleep apnoea between 2004 and 2018 in the Hospital District of Southwest Finland. A new home sleep study, questionnaires, and a structured phone interview were conducted on these patients 4–17-years after surgical treatment. The primary outcome was the change in the apnoea-hypopnoea index.

Results: The mean apnoea-hypopnoea index was reduced from 27.1 preoperatively to 14.1 after the long-term follow-up (mean 12 years), and the mean Epworth Sleepiness Scale score decreased from 9.2 to 4.6. The long-term surgical success rate was 38.5%. Four out of five patients would choose the surgery again according to the phone interview.

Conclusions and Significance: This study supports the notion that extracapsular tonsillectomy alone can be considered as a surgical treatment option for selected adults with obstructive sleep apnoea and tonsillar hypertrophy. For most of the patients, the obstructive sleep apnoea is alleviated.

Keywords: Adult tonsillectomy, obstructive sleep apnoea, adult tonsillar hypertrophy, sleep apnoea syndromes

INTRODUCTION

Daytime sleepiness and persistent loud snoring caused by obstructive sleep apnoea (OSA) causes many to seek treatment. OSA affects up to 3.7–4.2% of the population [1,2]. Continuous positive airway pressure (CPAP) is an effective treatment for many, but 46–83% of patients are non-adherent to therapy [3]. Even though there is still debate about the overall effectiveness of surgical treatment for OSA, a wide variety of surgical interventions have been described to treat it [4].

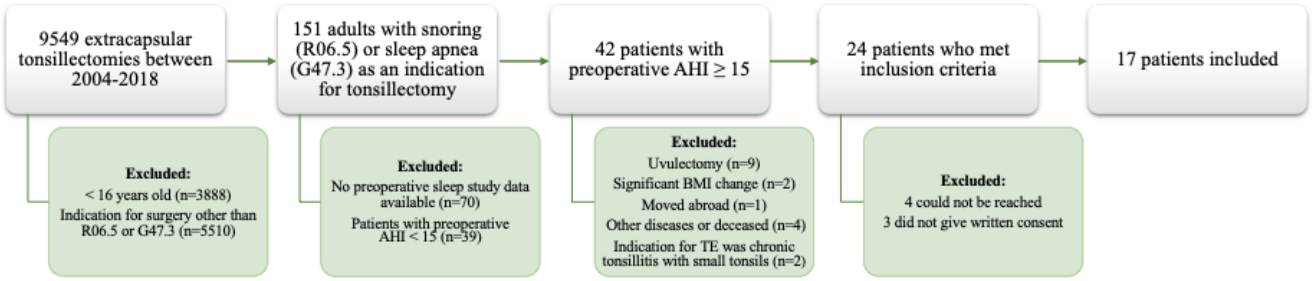
Isolated traditional extracapsular tonsillectomy (TE), without surgery of the soft palate, remains a good treatment option for adult OSA in selected patients. However, the literature remains scarce regarding long-term outcomes. In previous reports, patient numbers range from 1 to 56 and follow-up times only range from 1 to 15 months [5–7]. In patients with tonsillar hypertrophy, simultaneous soft palate surgery has been suggested to have no significant added impact [8].

In this study, we aimed to gather more knowledge on the long-term outcomes of extracapsular tonsillectomy in the treatment of OSA in adults.

MATERIALS AND METHODS

This was a follow-up study that recruited adult patients who had undergone TE because of OSA between 2004 and 2018. Auria Clinical Informatics collected data from medical records of the Hospital District of Southwest Finland by searching for the Nordic classification code for extracapsular tonsillectomy (EMB10). The inclusion criteria were preoperatively diagnosed OSA with an apnoea-hypopnoea index (AHI) of 15 or more, patients aged 16 or older at the time of TE, and the indication for TE was OSA or snoring (International Classification of Diseases 10th Revision diagnosis codes G47.3 or R06.5). TE patients with or without partial uvulectomy or radiofrequency thermal ablation (RFTA) of the soft palate were included. Patients with uvulopalatopharyngoplasty, uvulopalatoplasty, uvulectomy, or orthognathic surgeries were excluded. The process of study selection is shown in Figure 1.

Figure 1: Study selection flow chart



The study was conducted in the Department of Otorhinolaryngology of Turku University Hospital, Turku, Finland. The study protocol was accepted by The Ethics Committee of Southwest Finland (diary number 73/2021) and the institutional review board (permit number T06/050/21) and registered in a public database (ClinicalTrials.gov, Identifier: NCT05049369).

Twenty-four patients who met the inclusion criteria, were sent invitation letters in January and February 2022. Seventeen of them gave their informed written consent to participate and were included in the study. Patients' age, sex, body mass index (BMI), diagnostic codes for surgery, tonsil sizes, surgery date, possible earlier or subsequent nasal surgeries, and other possible treatments for sleep apnoea were collected. Retrospective data from preoperative and short-term postoperative home sleep studies were used when available. Tonsil sizes were translated to English from Finnish descriptions and sorted into four categories: small, medium, large, and very large. Numeric tonsil grades (e.g., Friedman–Brodsky) were not available for any patient in our retrospective records. Medium, large and very large tonsils were considered hypertrophic.

Patients were interviewed by telephone using a short, structured, non-validated questionnaire about their satisfaction with the surgery, sleep apnoea, and symptoms.

Preoperative and follow-up daytime sleepiness was measured with the Epworth Sleepiness Scale (ESS) [9]. The total score can range from 0 indicating a low level of sleepiness to 24 indicating a very high level of daytime sleepiness. Retrospective data from preoperative ESS was used when available.

Patients underwent a home sleep study (NoxT3 or Embletta devices). These recordings were interpreted by the same specialist who also reinterpreted the preoperative home sleep study recordings when available (n=6) and the short-term follow-up home sleep study recordings (< 1 year after surgery, available for four patients); this was to reduce variation due to different

interpreters and criteria. Apnoea-hypopnoea index was calculated with the latest valid American Academy of Sleep Medicine criteria [10]. Three of the reinterpreted preoperative apnoea-hypopnoea indexes (ID 4, 8, 23) were decreased to < 15. The remainder of the preoperative home sleep study data (n=7) was collected retrospectively from patients' medical records.

The primary outcome was the change in the AHI. Surgical success was defined according to Sher's criteria: a reduction in AHI of > 50% and a total AHI of < 20 after TE, as in previous studies [5,7,11]. Secondary outcomes were the surgical success rate, change in daytime sleepiness, and the phone interview answers.

Statistical analyses were performed using SPSS software (version 28.0, IBM Corp., Armonk, NY, USA). Kolmogorov-Smirnov and Shapiro-Wilk tests were used to test the normality assumption for the distribution (AHI, BMI, ESS and lowest oxygen saturation). A Wilcoxon matched-pairs signed-rank test was used to test the change in the variables which were not normally distributed (AHI, ESS, lowest oxygen saturation). A paired sample t-test was used for normally distributed variables (BMI). A p-value of < 0.05 was considered significant.

RESULTS

A total of 17 patients (4 females, 13 males) were included in this study. The preoperative and follow-up sleep studies of 13 patients (3 females, 10 males) were analysed; this was due to three only wished to partake in the phone interview, and one recording was insufficient for analysis. The mean long-term reduction in the AHI was 13.0 (95% CI -22.2 to -3.7). Individual results of each patient are presented in Table 1. The change in preoperative and follow-up means of each variable and p-values are shown in Table 2. The mean AHI before TE was 27.1 (95% CI 15.0–39.1) and after a 4–17-year follow-up the postoperative mean was 14.1 (95% CI 7.6–20.6) with a reduction of 48.0% (Figure 2a, p=0.019). The mean age was 51.9 years (range 34–76) at the time of the long-term follow-up. The time from surgery to the long-term follow-up sleep study and questionnaires ranged from 4 to 17 years (mean 12 years, median 13 years). All patients, except one, had tonsillar hypertrophy preoperatively.

Table 1 Individual results of each patient, who underwent a long-term follow-up home sleep study.

Patient ID	Tonsil size	Time from surgery to sleep study (years)	Pre-op AHI	Short-term post-op AHI	Long-term follow-up AHI	AHI change (%)	Pre-op BMI	Follow-up BMI	Weight change (%)	Surgical success
2[a]	Large	4	16.2		8.9	- 45.1	32.4	33.2	+ 2.5	no
3[a]	Medium	9	15.5	8.7	7.9	- 49.0	35.1	30.3	- 13.7	no
4	Large	17	11.4		12.5	+ 9.6	26.3	27.7	+ 5.3	no
8	Large	15	5.5		12.3	+ 123.6	31.0	30.3	- 2.3	no
9	Large	14	22.0		7.7	- 65.0	24.5	27.5	+ 12.2	yes
12	Large	14	31.7	0.2	5.8	- 81.7	25.5	23.6	- 7.5	yes
13[b]	Medium	17	25.4		17.6	- 30.7	33.2	35.4	+ 6.6	no
14	Large	15	34.5		9.4	- 72.8	26.3	28.0	+ 6.5	yes
17	Large	12	81.5		35.9	- 56.0	28.4	29.7	+ 4.6	no
19[c]	Medium	8	49.3		6.0	- 87.8	26.1	27.4	+ 5.0	yes
20[c]	Small	8	21.0		17.1	- 18.6	27.1	27.7	+ 2.2	no
23[d]	Very large	12	13.4	0.8	4.9	- 63.4	23.2	25.7	+ 10.8	yes
24[a,d,e]	Large	13	24.6	32.0	37.4	+ 52.0	27.7	32.9	+ 18.8	no
Mean ± SD		12 ± 4	27.1 ± 19.9		14.1 ± 10.8	- 29.6 ± 57.8	28.2 ± 3.6	29.2 ± 3.2	+ 3.9 ± 8.0	

a. Continuous Positive Airway Pressure as other treatment of sleep apnoea

b. Positional therapy as other treatment of sleep apnoea

c. Partial uvulectomy in conjunction with extracapsular tonsillectomy

d. Radiofrequency thermal ablation of the soft palate in conjunction with extracapsular tonsillectomy

e. Septoplasty before extracapsular tonsillectomy but after preoperative sleep study

AHI = Apnoea-Hypopnoea Index; BMI = body mass index in kg/m^2; SD = standard deviation

Table 2 The change in outcome measures before and after extracapsular tonsillectomy.

Variable	**Preoperative mean ± SD (n)**	**Follow-up mean ± SD (n)**	**p-value (n for test)**
AHI[a]	27.1 ± 19.9 (13)	14.1 ± 10.8 (13)	**0.019** (13)
ESS[a]	9.2 ± 3.8 (13)	4.6 ± 3.4 (16)	**0.008** (13)
BMI[b]	28.2 ± 3.6 (13)	29.2 ± 3.2 (13)	0.177 (13)
LSAT[a]	84.4 ± 5.8 (11)	87.2 ± 3.6 (13)	0.172 (11)
AI[b]	4.4 ± 4.6 (8)	2.5 ± 4.2 (13)	**0.040** (8)
MSAT[a]	94.7 ± 1.9 (12)	94.0 ± 1.3 (13)	0.154 (12)

a. Wilcoxon matched-pairs signed-rank test (2-sided)

b. Paired sample t-test (2-sided)

SD = standard deviation; AHI = Apnoea-Hypopnoea Index; ESS = Epworth Sleepiness Scale; BMI = body mass index in kg/m^2; LSAT = lowest oxygen saturation, AI = Apnoea Index; MSAT = mean oxygen saturation

Figure 2a: The mean apnoea-hypopnoea index before and after extracapsular tonsillectomy

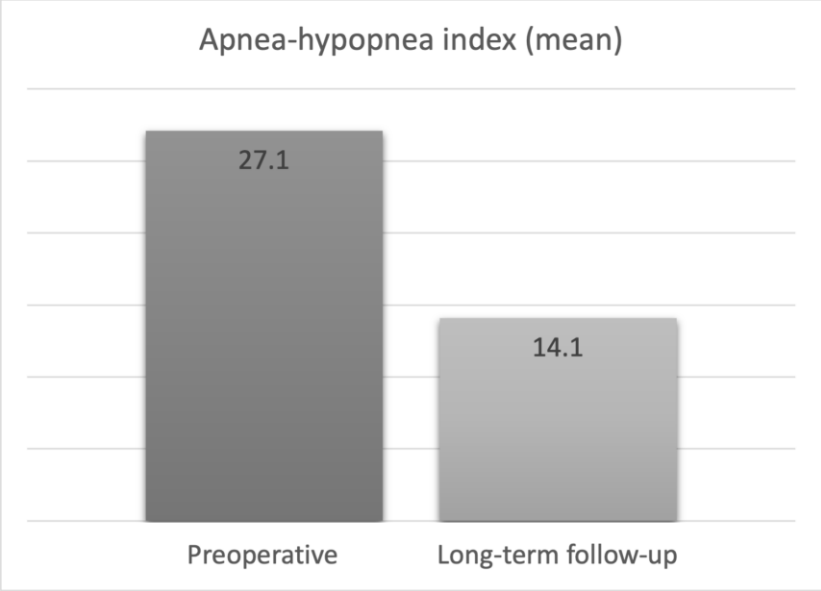
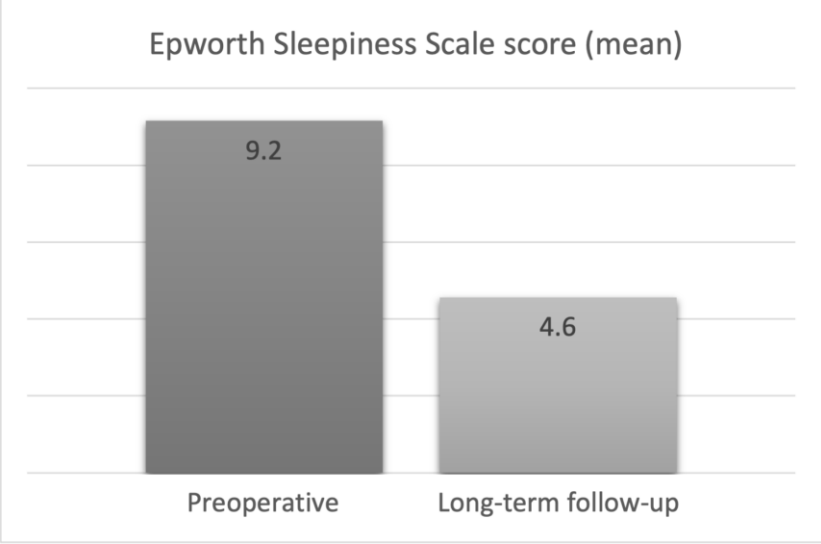


Figure 2b: The mean Epworth Sleepiness Scale score before and after extracapsular tonsillectomy



Preoperative and long-term follow-up AHI of each patient is presented in Figure 3. Before surgery, three patients (after reinterpretation) had mild OSA, and ten patients had moderate or severe OSA. After TE and long-term follow up, nine patients had mild or no OSA, while four patients still had moderate or severe OSA (Figure 4).

Figure 3: The pre- and postoperative apnoea-hypopnoea index of each patient individually

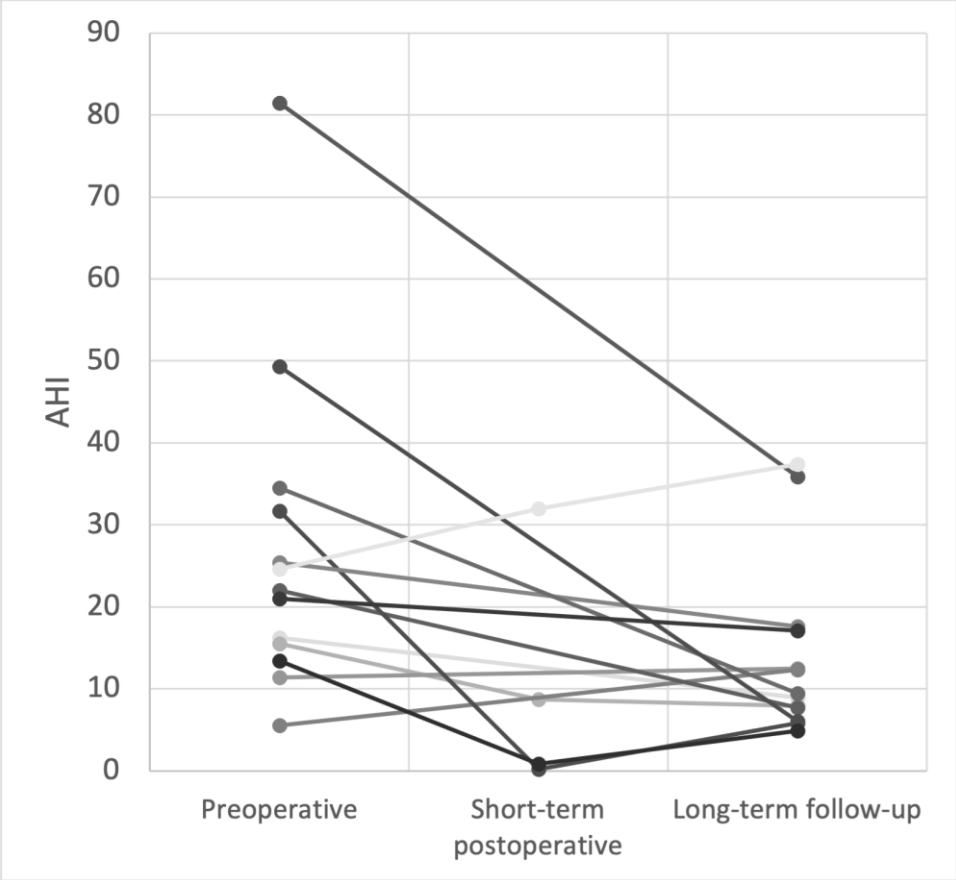
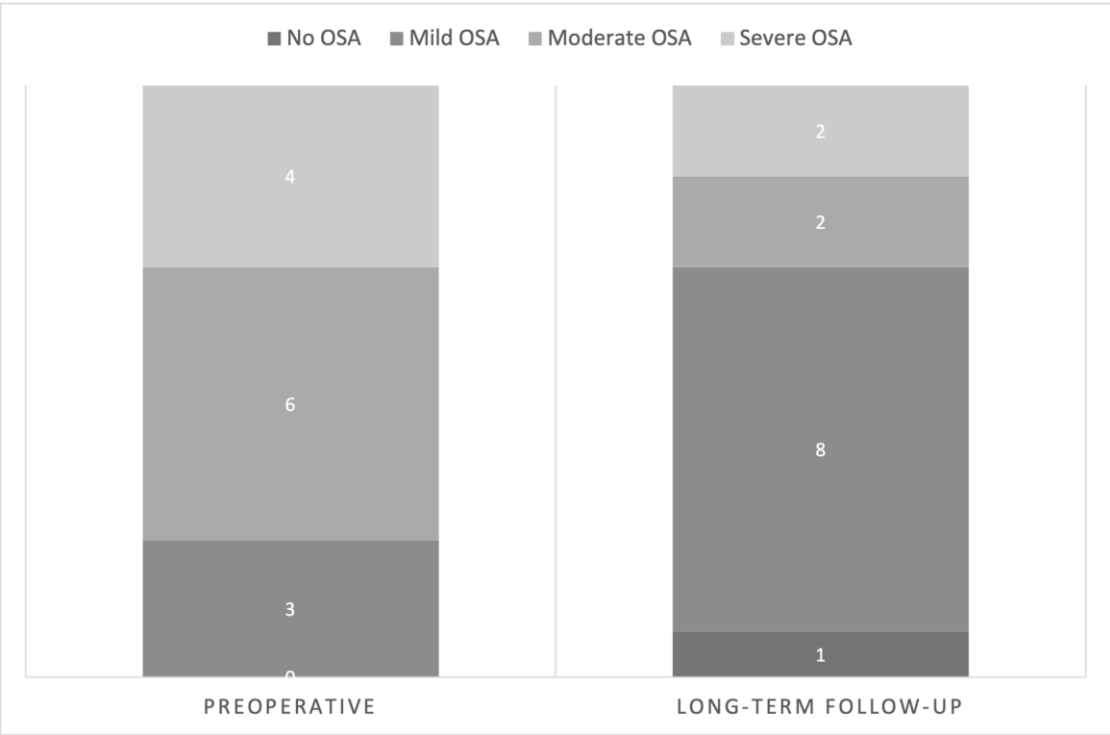


Figure 4: The distribution of obstructive sleep apnoea severity before and after extracapsular tonsillectomy



Retrospective preoperative data from ESS questionnaires were available for 13 patients and 16 responded to our follow-up questionnaires. The ESS score was reduced by an average of 4.6, from a mean of 9.2 (95% CI 6.9–11.5) to 4.6 (95% CI 2.8–6.4) after surgery, p=0.008 (Figure 2b).

All 17 patients responded to the phone interview. Twelve (71%) patients felt that the surgery had helped with the symptoms of OSA. Seven (41%) patients still felt continuing benefits from the TE. Three patients (ID 17, 18, 23) experienced a permanent complication from the surgery: swallowing dysfunction, fluid aspiration, or nasal regurgitation. Four of the seventeen patients currently used a CPAP, and one patient used positional therapy as a treatment for OSA at the time of the interview. None used an oral appliance. When asked if they had to decide again whether or not to have tonsil surgery, 14 patients (82%) confirmed that they would still choose the surgery.

DISCUSSION

In our patient cohort, the AHI and daytime sleepiness were clinically significantly reduced after a 4–17-year follow-up. The minimal clinically important difference (MCID) is generally considered to be a reduction of five events per hour for AHI, and a decrease of 2 to 3 points for ESS [12,13]. In this study, 9 out of 13 (69%) patients had MCID in both AHI reduction and ESS points. Unique to the present study is the long follow-up time with a mean of 12 years (median 13 years) which is, to our knowledge, the longest follow-up to date. Although the surgical success rate was 38.5%, four out of five patients would still choose surgery according to the phone interview.

While there are relatively few studies focusing on TE alone in the treatment of OSA and the sample sizes tend to be small, the results have been in favour of TE as an effective treatment for selected patients [5–7,14]. A systematic review and meta-analysis of TE alone in the treatment of OSA in adults included 17 studies (n=203) with follow-up times ranging from 1 to 15 months [5]. The mean AHI was reduced from 40.5 to 14.1 and the ESS score decreased from 11.6 to 6.1, which is in line with our findings. Other studies with similar results have been published after the meta-analysis [6–8,14]. Consensus among all these studies is that isolated TE can be a successful treatment for OSA in adults with tonsillar hypertrophy.

In the literature, surgical success has been defined as a decrease of > 50% in the AHI and an AHI of < 20 postoperatively [7,11]. Previously, surgical success rates have ranged between 47.6% and

94.7% [14,15]. Complete surgical cure rates (AHI<5) have varied between 38.1% and 64% [6,14]. In our study, the surgical success rate was 38.5% and a complete surgical cure was achieved in 7.7%, both of which are noticeably lower compared to studies with shorter follow-ups. It is possible that the effectiveness of TE reduces over the years, as has been reported in patients after e.g. uvulopalatopharyngoplasty (UPPP) [16]. However, Sher's criteria do not provide a complete view of the outcomes. Considering that the postoperative AHI mean was <20 with a 48.0% reduction, and 69.2% of patients achieved the MCID, it can be concluded that the overall outcomes may be more favourable than those indicated by Sher's criteria for surgical success.

Two patients (ID 2, 3) with a change from moderate to mild OSA, were using continuous airway positive pressure (CPAP) as treatment for sleep apnoea for reasons that remain unclear. It is likely that these patients continued to experience some residual symptoms of sleepiness. Weight change is a significant factor that can influence the outcomes. One patient (ID 24) with a change from moderate to severe OSA, had a weight gain of 18.8% and used CPAP. Two other patients (ID 9, 23), despite a significant weight gain (>10%), still showed surgical success. However, ten of the thirteen patients had a decrease in the AHI in the long-term follow-up, while only one of them had a significant weight loss (<10%).

Daytime sleepiness was reduced after the follow-up with patients' long-term ESS score improving from an average of 9.2 to 4.6 which is in line with earlier studies [5,7]. The average long-term follow-up ESS score is comparable to the average score of a healthy population [17]. Based on the phone interview, a majority of the patients were satisfied with the results of their surgery. Comparison can be made with satisfaction rates in UPPP patients after a long-term follow-up, which in some reports have been low [18]. The incidence of long lasting or permanent side effects in UPPP patients is comparatively high as well [18–20]. We decided to include TE patients with or without partial uvulectomy or RFTA of the soft palate, because we believe these procedures have been proven to have minimal to no long-term effect on the AHI [19,21]. The patient (ID 23) with soft palate RFTA and the patient (ID 18) with partial uvulectomy were two out of the three patients reporting a permanent complication (swallowing dysfunction and nasal regurgitation), which may have contributed to these complications. Additionally, modified UPPP has not been proven to be more effective than TE alone in treating patients with tonsillar hypertrophy [8]. Considering the above, we recommend TE as a more tissue- and time-preserving approach with less morbidity compared to UPPP, for managing OSA patients with hypertrophic tonsils.

Limitations

The limitations of this study are related to its small sample size and partly retrospective study design. No large data sets concerning the treatment of adult sleep apnoea with TE have been published, since tonsillar hypertrophy is less common in adults than in children. Due to our partly retrospective data, we rely on patient chart information for the size of tonsils. Drug-induced sleep endoscopy (DISE) could have offered valuable information on the remaining causes of upper airway collapse in patients who did not respond to surgery. For instance, lingual tonsil hypertrophy may have developed in some patients after TE during the long-term follow-up. Unfortunately, our clinic currently lacks the resources to perform DISE, so we could not rule this out. Further studies with larger sample sizes and prospective controlled study designs are needed. In addition, the effect of intracapsular tonsillectomy in the treatment of adult OSA with tonsillar hypertrophy should be studied in the future.

CONCLUSION

The severity of OSA and daytime sleepiness were reduced with tonsillectomy. Most of the patients were satisfied with the long-term outcome of the surgery. However, OSA was resolved in fewer than half of the patients, indicating that additional treatments may be necessary later. The benefits of tonsillectomy may diminish over time. Despite this, extracapsular tonsillectomy can be considered an effective long-term treatment option for obstructive sleep apnoea in selected adult patients with tonsillar hypertrophy.

Acknowledgments

We thank Elizabeth Nyman for reviewing the language of the manuscript.

Conflict of interest

The Authors declare that they have no conflict of interest.

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