

# Long-term Complications after Multilevel Surgery for Sleep-related Breathing Disorders

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**Abstract:** Multi-site collapse of the upper airway in sleep-related breathing disorders can be treated with multilevel surgery. Multilevel surgery is defined as simultaneous interventions at two or more levels of the upper respiratory tract. The aim of the present study is to analyse long-term complications of multi-level surgery with or without hyoid suspension.

A group of 192 patients with multilevel surgery with hyoid suspension and 79 patients with multilevel surgery without hyoid suspension were followed prospectively at 3, 12 and 24 months postoperatively. We used a questionnaire asking for foreign body sensation, disorders of swallowing, speech disorders, taste disorders, undesired weight loss and pain. The answers were given in a yes/no mode, severity was not graded.

Foreign body sensation was the most common complication after multilevel surgery with and without hyoid suspension. Hyoid suspension did not contribute to a higher complication rate. All undesired side effects were reduced with time except swallowing disorders.

**Keywords:** Multilevel surgery, hyoid suspension, long-term complication, foreign body sensation, obstructive sleep apnea.

## INTRODUCTION

Multilevel surgery is a well-accepted treatment option for sleep-disordered breathing with multi-site obstruction. It is defined as a one-stage intervention at least two levels of the upper airway [1]. Three levels of the upper airway are distinguished namely the level of the nose, the isthmus faucium (soft palate / tonsils) and the base of the tongue.

Knowledge of the site of obstruction is crucial for surgical treatment of obstructive sleep apnea syndrome (OSAS). It is based on clinical ENT examination, sleep nasendoscopy or nocturnal upper airway manometry [2].

In counselling patients before surgery, complications play an important role. Numerous articles have been published concerning complications after uvulopalatopharyngoplasty (UPPP). However, only sparse studies are reported on complications of multilevel surgery with hyoid suspension. The aim of the present study is to assess the long-term complications after multilevel surgery and to evaluate if hyoid suspension adds to the complication rate. Only long-term complications (>3 months postoperatively) are reported. The hypothesis is that the long-term complications can be attributed predominantly to the surgery at the level of the isthmus faucium and are not substantially increased by additional hyoid suspension.

## METHODS AND PATIENTS

The site of obstruction was assessed by clinical ENT examination and nocturnal upper airway manometry using

the ApneaGraph® device [3]. Multilevel surgery was indicated for patients with upper airway resistance syndrome (UARS) and OSAS with intolerance or refusal of continuous positive airway pressure (CPAP) therapy. The site of obstruction was assessed by clinical ENT examination and nocturnal upper airway manometry using the ApneaGraph® device [3]. In all patients, UPPP using radiofrequency technique and tonsillectomy was performed, if tonsils were still present, irrespective of tonsil size. An additional hyoid suspension was performed in case of significant (>40%) retrolingual obstruction demonstrated in nocturnal upper airway manometry or Friedman tongue position grade III or IV, using the technique described by Hörmann [4] and modified by Tschopp [5]. In case of impaired nasal breathing, nasal surgery (septoplasty or turbinoplasty) was conducted if indicated by clinical ENT examination and rhinomanometry.

At 3, 12 and 24 months postoperatively, prospective control was established for patients with multilevel surgery including hyoid suspension (group A) since 2005 and for patients with multilevel surgery without hyoid suspension (group B) since 2007. From the beginning of systematic controls until 2009, 192 patients and 79 patients were operated in group A and B, respectively. Complete data were obtained in 176 patients and 49 patients of group A and B, respectively at 3 months postoperatively. However, less patients could be analysed at 12 and 24 months postoperatively due to either loss of follow-up or more recent date of surgery. For group B, only 17 patients could be evaluated at 12 and 24 months postoperatively. No statistical analysis was performed for group B concerning that postoperative period because of the low number of patients and a possible selection bias. See Fig. (1) for overview of patient flow.

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Complications and side effects were routinely assessed using a questionnaire at 3, 12 and 24 months postoperatively. The questions were developed at the ENT clinic Liestal taking the most common side effects of multilevel surgery into account. It was asked for namely the following side effects: foreign body sensation, disorders of swallowing, speech disorders or taste disorders, undesired weight loss and pain. The answers were given in a yes/no mode. However, severity of complication was not graded. Additionally, the question was asked if the patient would undergo the intervention again and would recommend it to someone else.

All patients had cardio-respiratory polygraphy preoperatively and at 3, 12 and 24 months postoperatively. Data were analysed with respect to possible correlations with side effects.

Patients were asked if they would undergo the procedure again at 3, 12 and 24 months postoperatively. For OSA patients, defined as preoperative AHI >10/h, the answers were analysed with respect to responders or non-responders according to the Sher-criteria [6]. Using the Sher-criteria, a decrease of preoperative AHI by >50% and a postoperative AHI <20/h was classified as a responder. Data were analysed for correlation between repeat rate and complication rate.

All patients had ENT examination preoperatively and at 3, 12 and 24 months postoperatively. Special attention was paid to velopharyngeal stenosis or insufficiency and injury to lingual or hypoglossal nerve.

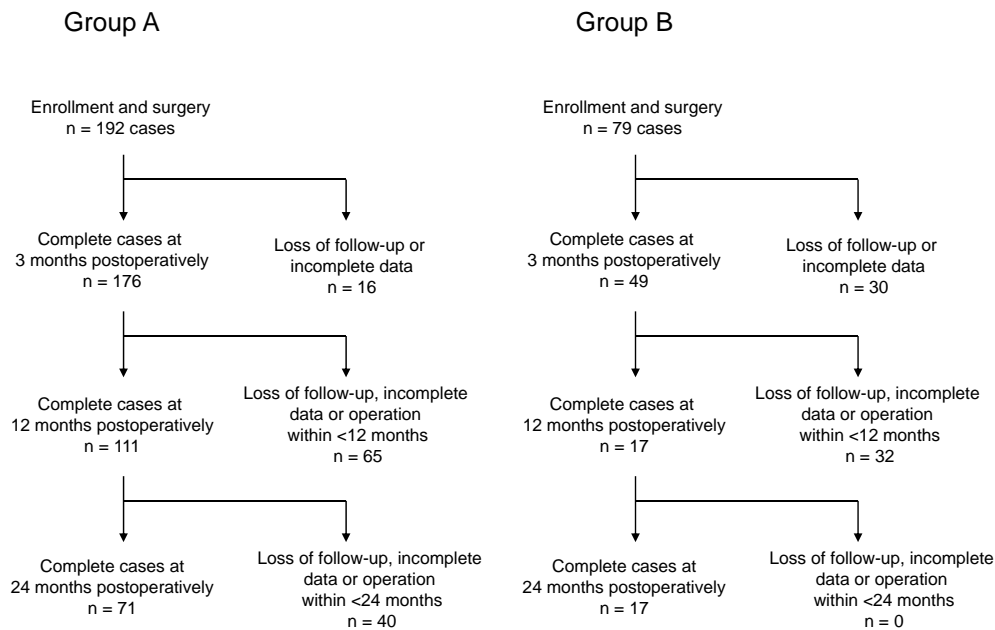
Additionally, data were stratified depending on whether a tonsillectomy had been performed or not. Fisher's exact test and Chi-square test were used for statistical analysis using InStat 3 program. The level of significance was defined as  $p < 0.05$ .

**RESULTS**

Male sex was clearly preponderant with 93.7% and 77.2% in group A and B, respectively. The average age was 50.5 yrs (Stdev +/-10.6 yrs) and 43.9 yrs (Stdev +/-11.7 yrs) in group A and B, respectively. There was no significant difference between groups for sex and age.

The rate of long-term complications at 3 months after surgery is listed in Table 1.

Foreign body sensation was the most frequent long-term complication. About 20% of the patients experienced a foreign body sensation which was usually weak and not disturbing. Swallowing disorders were the second frequent complication, mostly experienced as slight velopharyngeal insuffi-



**Fig. (1).** Flow chart of patients in group A (multilevel surgery with hyoid suspension) and group B (multilevel surgery without hyoid suspension). After enrolment and surgery, patients were examined at 3, 12 and 24 months post operation. Data of group B at 12 and 24 months postoperatively were not further analysed because of limited number.

**Table 1. Rate of Long-term Complications (Given in % of Patients) in Group A (Multilevel Surgery with Hyoid Suspension) and Group B (Multilevel Surgery Without Hyoidsuspension) at 3 Months Postoperatively. There was no Significant Difference Between Groups (Fisher's Exact test  $p > 0.05$ )**

	No of Patients	Foreign Body Sensation	Swallowing Disorders	Taste Disorders	Speech Disorders	Pain	Undesired Weight loss
Group A	176	21.0	11.4	10.8	10.3	1.1	1.1
Group B	49	22.4	18.4	14.3	8.2	2.0	0.0

ciency with hasty drinking or coughing after inconsiderate swallowing of food or liquids. About 11-18% of patients complained of swallowing problems at 3 months postoperatively. The third frequent complication was taste disorders, experienced as taste impairment or parageusia mostly with metallic or changed taste quality. This complication was indicated by 11-14% of the patients at 3 months postoperatively. Speech disorders were observed in about 10% of the patients at 3 months postoperatively. The most frequent complaint concerning speech was a different sound of [r] and [ç] after surgery. The voice changes were minor and did not really bother the patients. Pain and undesired weight loss was observed in 1-2% of the patients. Undesired weight loss was attributed to prolonged healing after tonsillectomy. However, pain in the throat at 3 months postoperatively was not clearly related to the surgery but probably to myofascial pain syndrome of the head and neck. No significant differ-

ence in complication rate was observed between group A and B ( $p > 0.05$ ). Therefore, the complications may be attributed mainly to the UPPP<sup>+</sup>/ tonsillectomy and not to the hyoid suspension.

The complication rate at 12 and 24 months postoperatively was analysed only for group A. The data are depicted in Fig. (2).

Some patients refused follow-up visits in order to save costs which they would have had to cover privately due to Swiss insurance regulations. They did so especially if they were satisfied with the surgical results and free of side-effects and therefore saw no benefit from further controls.

Data at 3 months postoperatively were further stratified for patients with and without tonsillectomy. The results are shown in Table 2.

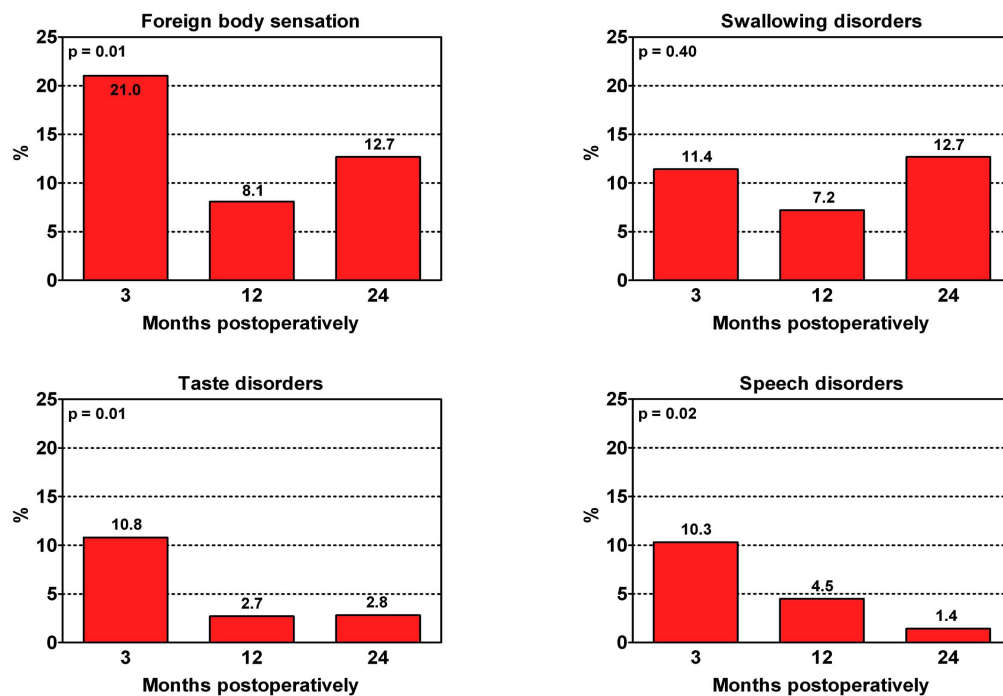


Fig. (2). Incidence of side-effects in group A (multilevel surgery with hyoid suspension) at 3, 12 and 24 months postoperatively.

Table 2. Rate of Complications (Given in % of Patients) 3 Months Postoperatively Stratified for UPPP with TE and Without TE

	Foreign Body Sensation	Swallowing Disorders	Taste disorders	Speech Disorders	Pain	Undesired Weight Loss
<b>Group A (n=176)</b>						
with TE (n=121)	24.0	13.3	15.7	10.7	1.7	1.7
without TE (n=55)	14.6	7.3	0	9.3	0	0
	$p = 0.17$	$p = 0.31$	$p = 0.001$	$p = 1.00$	$p = 1.00$	$p = 1.00$
<b>Group B (n=49)</b>						
with TE (n=40)	22.5	20.10	17.5	7.5	2.5	0
without TE (n=9)	22.2	11.1	0	1.1	0	0
	$p = 1.00$	$p = 1.00$	$p = 0.32$	$p = 0.57$	$p = 1.00$	$p = not applicable$

Complications such as foreign body sensation, swallow and taste disorders and speech disorders were more prevalent in UPPP with tonsillectomy compared to UPPP alone. However, the difference did not reach the level of significance except for taste disorders in group A. As mentioned above, UPPP alone was performed only when patients' tonsils had already been removed previously.

Data for AHI are given in Fig. (3) for group A and Fig. (4) for group B. Mean preoperative AHI was 24.1 /h and 14.3/h for group A and B, respectively. The difference to postoperative values is significant ( $p < 0.05$ ). No correlation could be found between preoperative AHI and the complication rate in both groups ( $p > 0.05$ ). However a significant decrease in AHI was measured after the surgery in both groups.

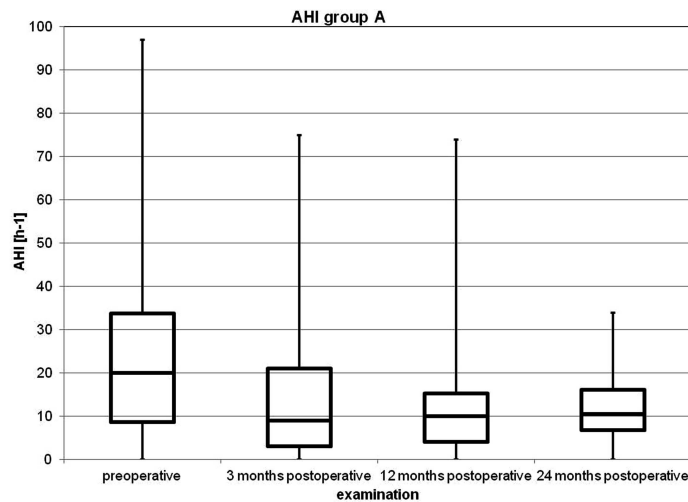
At 3 months postoperatively, the question if the patient would undergo the intervention again and recommend it to someone else was answered with yes in 85% and 77% in group A and B, respectively. Still 85% of patients of group A answered with yes at 12 months postoperatively. Patients which were responders according to the Sher-criteria were

not more likely to give a positive answer ( $p > 0.05$ ). And complications did not influence the repeat rate ( $p > 0.05$ ). Therefore it was neither the lack of successful outcome nor the complications, which brought patients to regret having undergone the procedure. At postoperative ENT examination no velopharyngeal stenosis or injury of the lingual or hypoglossal nerve was observed. Indirect laryngoscopy showed no abnormalities.

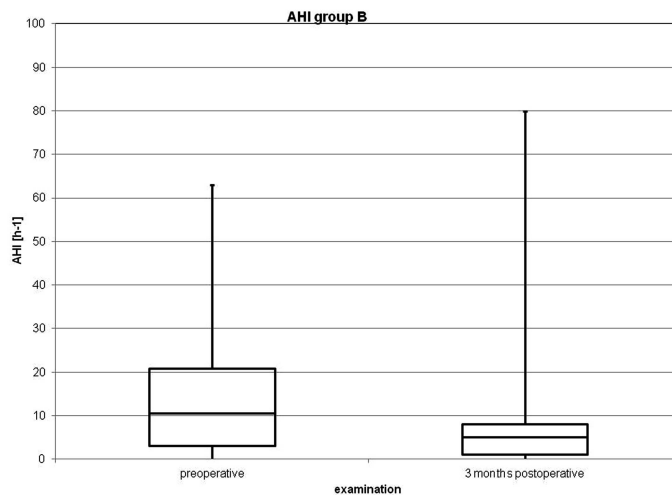
**DISCUSSION**

Foreign body sensation is the most common long-term side effect of multilevel surgery with an incidence of 21-22% at 3 months postoperatively in both group A and group B. Hyoid suspension did not contribute to a higher rate. Therefore, foreign body sensation may be attributed mainly to the surgery at the level of the isthmus faucium. 10% of patients still experienced foreign body sensation two years after surgery.

To our knowledge our study is the first reporting systematically about long-term complications after multilevel surgery. Most publications focus on effectiveness of this type of



**Fig. (3).** Box plot of AHI values for group A. The horizontal bar and the boxes give the median value and interquartile range. The vertical bars depict the minimum and maximum measured of AHI value. Postoperative decrease of AHI is significant ( $p < 0.05$ ).



**Fig. (4).** Box plot of AHI values for group B. The horizontal bar and the boxes give the median value and interquartile range. The vertical bars depict the minimum and maximum measured value of AHI. Postoperative decrease of AHI is significant ( $p < 0.05$ ).

procedure. Neruntarat described only transient complications which resolved within four weeks [7]. A long-lasting hypoglossal paresis probably due to sutures around the hyoid had been reported by Richard *et al.* [8]. Baisch *et al.* found a rate of 51% voice disorders and 34% swallowing disorders four weeks after multilevel-surgery [9]. However, there was only a short-term follow-up.

Our results suggest that the long-term complications may be attributed to UPPP<sup>+</sup>/ tonsillectomy and not to hyoid suspension. In the literature numerous articles have been reported regarding side-effects of UPPP with a similar incidence as we found in our study. A rate of 16-36% for foreign body sensation, 13-35% for swallowing difficulty, 7-14% for voice changes and 1-7% for taste disorders following UPPP has been reported in a review article [10]. Goh *et al.* found even 17-20 years after UPPP an incidence of 20% for foreign body sensation, 24% for swallowing difficulty and 16% for voice changes [11]. Those patients were operated using the original technique described by Fujita [12]. However, more modern techniques such as radiofrequency and laser-assisted techniques (LAUP) did not differ regarding complications to original UPPP in a large-scale study of 415 patients [13]. Radiofrequency-assisted uvulopalatoplasty (RAUP) showed less foreign body sensation than LAUP with a rate of 8.5% and 35%, respectively, in a randomized trial [14]. However, conventional UPPP<sup>+</sup>/ tonsillectomy proved to be more effective regarding reduction of snoring and apneas compared to RAUP [15].

Lysdahl pointed out that patients who were satisfied with the general outcome of UPPP were less bothered by side-effects than those whose surgery was unsuccessful [16]. 12% of patients regretted having been subjected to surgery. However, long-term complications after UPPP were generally minor as in our study population after multilevel surgery [16]. The rate of patients regretting surgery was 16% after multilevel surgery in the article of Baisch *et al.* which is similar to our study and that reported for UPPP alone [9]. In a two-years follow-up study continued snoring after UPPP was closely correlated to dissatisfaction with the general result [17].

The incidence of side-effects was reduced at 12 and 24 months postoperatively except for swallowing disorders. This may be attributed to the shortening of the soft palate induced by UPPP. The reduction of foreign body sensation with time is probably due to a habituation process.

Patients who had undergone tonsillectomy along with UPPP reported more side-effects. However, the differences were not significant except for taste disorders. The increased rate of taste disorders following tonsillectomy may be explained by thermal injury to the lingual nerve using bipolar cautery at the lower pole of the tonsillar fossa. Heiser *et al.* reported a frequency of 20% foreign body sensation and 8% taste disorders at 6 months postoperatively following tonsillectomy alone [18]. This study supports our opinion that long-term complications are related to surgical procedures at the level of the isthmus faucium rather than hyoid suspension. To our knowledge our study is the first communication which evaluates the contribution of tonsillectomy to long-term side-effects of UPPP.

We are aware that there are certain limitations to our study. The severity of complications were not graded but rather collected in a yes/no mode. However, the side-effects were only minor for most patients and did not really bother them in daily life. For group B only data at 3 months post-operatively could be analysed with a sufficient number of patients. This was due to later onset of prospective follow-up in that patient group. A selection bias may be considered especially for follow-up controls at 12 and 24 months. Patients would have to cover part of the costs of those controls due to Swiss insurance regulations. Some patients therefore refused follow-up visits in order to save money especially when they were satisfied with the result and had no further complaints.

Surgeons should be aware of the incidence and risk factors for long-term complications when counselling patients for surgery in sleep related breathing disorders. The frequency of side-effects in multilevel surgery is similar to that known from UPPP and concomitant tonsillectomy has been identified as a risk factor for taste disorders.

## CONFLICT OF INTEREST

None declared.

## ACKNOWLEDGEMENTS

None declared.

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