Reduced nasal airway resistance following uvulopalatoplasty †*

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SUMMARY *Active anterior rhinomanometry was performed on adult healthy snorers before and after uvulopalatopharyngoplasty or laser uvulopalatoplasty. Significant reduction of the nasal airway resistance both before and after pharmacological decongestion of the nasal mucosa was found in a group of 46 patients. Oedema disappearing after surgery may be an explanation for the results.*

Keywords: snoring, uvulopalatoplasty, nasal airway resistance, rhinomanometry

INTRODUCTION

It has been proposed that nasal obstruction plays an important role in snoring and sleep apnoea (Lavie et al., 1982; Heimer et al., 1984; Petruson, 1990; Metes et al., 1991), and that treatment with nasal surgery or a nasal dilator reduces apnoea and snoring (Lavie et al., 1982; Heimer et al., 1984; Petruson, 1990). A recent study reports results at odds with this. No improvement in apnoea or in blood oxygen desaturations was seen following nasal surgery (septoplasty, turbinectomy and/or polypectomy), despite the fact that nasal airway resistance (NAR) was significantly decreased (Sériès et al., 1992).

Patients with snoring problems often complain of nasal stuffiness during nights and mornings, and some of these patients report improved nasal breathing after surgery with uvulopalatopharyngoplasty or laser uvulopalatoplasty (for short: UPP). The present investigation was performed in order to study nasal airway resistance (NAR) before and after UPP.

MATERIAL AND METHODS

Patients

Fifty-three consecutively operated patients, who had been examined with rhinomanometry before UPP, were selected. Six patients did not appear at the post-operative control. In one patient, NAR for the total nose after decongestion could not be calculated by the computer, since the S-shape of the pressure-flow curve was reversed for one of the separate nose cavities. Thus, the number of patients statistically evaluated was 46 (34 males and 12 females; mean age: 47 years [range: 22-70 years]). None of these 46 patients suffered from allergic rhinitis.

Pre-operatively, the patients were examined by an ENT-surgeon, and rhinomanometry and polysomnography were performed. Patients with more than 20 apnoeic bouts per hour were not selected for surgery. The interval between pre-operative rhinomanometry and surgery was 11±7 months (mean±SD; range: 0-26 months). For 34 out of 46 patients, rhinomanometry was performed during the period from April to September (summertime) and for the remaining 12 patients during October to March (wintertime).

Post-operatively, the interval between surgery and the rhinomanometry was 18±3 months (range: 5-31 months). Post-operative polysomnography was not performed. For 2 out of 46 patients, post-operative rhinomanometry was done during summertime, and for the remaining 44 patients during wintertime.

Questionnaires

Pre-operatively, the patients answered a standard form for patients with nose problems. The post-operative questionnaire was designed for patients with snoring and apnoea.

Rhinomanometry

The rhinomanometric equipment, built at our department, was in all details the same for the pre- and post-operative examinations. Calibration of pressure and flow was done with conventional pressure- and flow meters at regular intervals. All examinations were done in a room with constant temperature and almost constant humidity throughout the year. Before rhinomanometry the patients were resting in a sitting position close to the equipment for 20 min. NAR was measured with active anterior rhinomano-

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metry for each nasal cavity before and 15 min after decongestion with xylometazoline nasal spray (Otrivin®, 1 mg/ml). From those values, NAR for the total nose was calculated automatically by the computer in the rhinomanometer.

When calculating NAR, the computer used Broms' method, which is one of the two methods recommended by the Standardisation Committee of the European Rhinologic Society (Clement, 1984). According to that method, NAR is expressed as a resistance (R_2) at a circle with a radius of 200 Pa at the abscissa and of 200 cm^3/s at the ordinate in a coordinate system (Broms et al., 1982). However, for the statistical calculations, an angle v_2 is used, which is the angle between the Y-axis and a line drawn from origo to the point where the pressure flow curve cuts the above-mentioned circle (R_2=tan v_2 for single cavities, and R_2=0.5*tan v_2 for the total nose). In fact, the presented R_2- and v_2-values are not only obtained from values at the above-mentioned circle, but also from a large number of circles with different radii and from a mean of about five pressure-flow curves. The presented v_2 is calculated by the computer using the equation: v_r=v_0+c*r, where v_0 is the angle between the pressure-flow curve and the Y-axis at origo, *c* the curvilinearity of the curve, and *r* the radius. One advantage with Broms' method, as compared to methods giving NAR at a certain pressure, is that comparisons between curves representing high and low NAR can be made with a high degree of certainty since all curves can be used. Another advantage is that the use of v_2 is more parametrically distributed for both normal subjects and patients, as compared to resistance values such as R_2 or the resistance at e.g. 150 Pa.

Statistics
Data were evaluated using the paired *t* test and the Wilcoxon signed-rank test. Statistical significance was assumed at a p-value of <0.05.

RESULTS
Questionnaire
Thirty-five per cent of the patients reported that they no longer snored, and 24% that they snored less than before the operation. Fifty-seven per cent of the patients reported nasal stuffiness before whereas 48% suffered from this symptom after the operation. Cessation of nasal stuffiness was reported by 15% of the patients initially complaining of that symptom. Three patients complained of nasal stuffiness post-operatively, but not pre-operatively.

Rhinomanometry
NAR, represented by the mean v_2 (±SD) and the mean R_2 before and after UPP, and before and after decongestion for separate cavities as well as for the total nose, is given in Table 1. NAR was reduced both with undecongested and decongested mucosa and both for the right nasal cavity and the total nose according to both tests, except for decongested total nose with the Wilcoxon test (p=0.07). For the left nasal cavity, the mean values were lower post-operatively before as well as after decongestion, but there was no significant reduction. NAR pre- and post-operatively for the total nose with decongested mucosa is given in Figure 1. Following surgery, 29 out of the patients (63%) showed a decreased NAR for the total nose after decongestion. In this group, 15 patients (52%) reported less or no snoring, while this was the case in 12 out of 17 patients (71%) who had unchanged or higher NAR.

There was no correlation between nasal stuffiness and rhinomanometry values, nor between improved NAR and subjective improvement of nasal flow. The three patients who reported nasal stuffiness post- but not pre-operatively all showed decreased NAR.

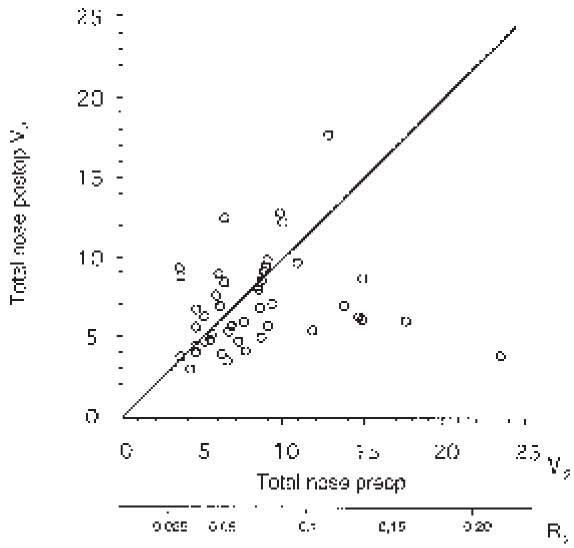

Figure 1. NAR before and after UPP, expressed as v_2. The straight line describes unchanged NAR, decreased values (improved NAR) lie below and increased values above this line.

Table 1. NAR expressed as mean v_2 (±SD) and mean R_2 before and after UPP.

	pre-operatively		post-operatively		paired *t* test	Wilcoxon
	v_2 ±SD	R_2	v_2 ±SD	R_2	p-value	p-value
undecongested						
right side	22.4±17.8	0.41	15.0±9.7	0.27	0.002**	0.0004***
left side	21.0±15.8	0.38	17.9±14.6	0.32	0.288	0.385
total nose (n=46)	17.9±8.6	0.16	13.5±6.0	0.12	0.029**	0.003**
decongested						
right side	9.6±6.8	0.17	7.5±3.4	0.13	0.025*	0.024*
left side	10.0±8.1	0.18	8.1±5.2	0.14	0.136	0.157
total nose (n=45)	8.4±4.1	0.07	7.0±2.9	0.06	0.045*	0.067

DISCUSSION

A significant reduction of NAR, assessed by active anterior rhinomanometry, was seen in patients operated with UPP. The reduction appeared both with undecongested and with decongested nasal mucosa. In a recent study on patients rhinomanometrically examined during October, November or December and during April or May, NAR after decongestion of the nasal mucosa was significantly higher during the first period; i.e. in wintertime (Jessen et al., 1995). It was suggested that infection is more common during winter, causing an inflammatory oedema that was not noticed at the test occasion. In the present study, the majority of patients had post-operative rhinomanometry performed in wintertime, which was not the case with the pre-operative measurements (96% as opposed to 26%). This fact may strengthen the results.

Several authors have claimed that nasal obstruction plays an important role in the pathogenesis of snoring and sleep apnoea, and that treatment of nasal obstruction results in relief of this disorder (Lavie et al., 1982; Heimer et al., 1983; Petruson, 1990). Nasal obstruction was not objectively evaluated in any of these investigations, and it has been shown that symptoms of nasal stuffiness do not always correlate with rhinomanometry results, pointing out the need for rhinomanometry to evaluate nasal flow before nasal surgery (Jessen and Malm, 1984). In another report, where rhinomanometry was performed on patients with snoring and sleep apnoea, no correlation between snoring/apnoea and rhinomanometric results could be seen (Miljeteig et al., 1992). Likewise, no correlation was seen between variations in NAR and snoring pattern when concomitantly registered in eight non-apnoeic snorers (Miljeteig et al., 1993). Nasal surgery (septoplasty, turbinectomy, or polypectomy) in 20 patients with obstructive sleep apnoea did not have any effect on snoring or apnoea, despite the fact that rhinomanometry showed a decreased NAR (Sériès et al., 1992).

The results in the present study show that treatment with UPP reduces NAR. The reason for this reduction is not obvious: Rubinstein (1995) found signs of nasal inflammation in patients with obstructive sleep apnoea. Oedema caused by such an inflammation is a possible explanation for the observation that NAR was higher pre- than post-operatively in our study. A less likely explanation is that NAR is influenced by the shortened soft palate.

Since our results show a decreased NAR following UPP, we suggest that patients with snoring should be subjected to UPP as an initial procedure, rather than to nasal surgery. It is yet to be shown whether these results can be applied to patients with a pathologically elevated NAR (Jessen and Malm, 1988), since only one of the patients in this investigation had a pre-operative NAR after decongestion, which could be considered pathological (Jessen and Malm, 1988).

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