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ARTYKUŁ PRZEGLĄDOWY / REVIEW ARTICLE

Nasal resistance asymmetry as a predictor of satisfaction following nasal airway obstruction surgeries

Asymetria oporów przepływu powietrza jako czynnik predykcyjny satysfakcji po operacjach poprawiających drożność nosa

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ABSTRACT: Patients' subjective assessment of nasal patency often does not correspond to the objective results of functional and imaging examinations. The objective of this study was to identify the rhinometry (AR) and rhinomanometry (RMM) parameters that were best correlated to patients' self-evaluation of nasal patency before and after nasal airway obstruction surgery. The study material consisted of RMM and AR results as well as SNOT-20 self-evaluation questionnaires completed by 233 patients presenting with rhinological problems and routinely diagnosed at the RMM Lab of the Department and Clinic of Otolaryngology of the Medical University of Warsaw. Data were collected from 70 females (31.4%) aged 18 through 81 years and 153 males (68.6%) aged 16 through 81 years. The results were subjected to statistical analysis by a licensed statistician using the Statistica 10 software package. A statistically significant relationship was demonstrated between the subjective perception of nasal patency and RMM results. The higher the asymmetry of air flow within the left and the right nasal cavity, the higher the perceived restriction of nasal patency. Significant differences were observed between patients reporting maximum discomfort regarding impaired nasal patency and the remaining patients: the former were characterized by nasal resistance values being several-fold higher than that observed in the latter while nearly always improving after nasal airway obstruction surgeries. No significant reflection of patients' self-evaluation of nasal patency was found in the acoustic rhinometry measurements.

KEYWORDS: rhinomanometry, acoustic rhinometry, nasal patency, nasal resistance asymmetry, self-evaluation, objectivization

STRESZCZENIE: Drożność nosa oceniana subiektywnie przez chorego często nie pokrywa się z wynikami badań obiektywnych – obrazowych i czynnościowych. Istnieją liczne rozbieżne opinie dotyczące ich przydatności Celem pracy była ocena, które z parametrów rynometrii akustycznej (AR) i rynomanometrii (RMM) najściślej korelują z samooceną pacjenta przed i po operacyjnym udrożnieniu jam nosa. Materiał do badań stanowiły wyniki RMM i AR oraz kwestionariusze samooceny SNOT-20, wypełnione przez 233 pacjentów rutynowo diagnozowanych w Pracowni RMM Kliniki Otolaryngologii Warszawskiego Uniwersytetu Medycznego, zgłaszających problemy rynologiczne. Dane uzyskano od 70 kobiet (31,4%) w przedziale wieku od 18 do 81 lat i 153 mężczyzn (68,6%) w przedziale wieku od 16 do 81 lat. Wyniki przeprowadzonych badań opracowano statystycznie, korzystając z pomocy dyplomowanego statystyka i pakietu Statistica 10. Wykazano, że istnieje istotny statystycznie związek pomiędzy subiektywnie odczuwaną drożnością nosa a wynikiem RMM. Ograniczenie drożności nosa odczuwane jest tym bardziej, im większa jest asymetria przepływu przez prawą i lewą jamę nosową. Pacjenci wskazujący na maksymalny dyskomfort w zakresie upośledzenia drożności nosa istotnie różnią się od pozostałych pacjentów: mają kilkukrotnie wyższe opory przepływu w porównaniu z pozostałymi chorymi i prawie zawsze odczuwają satysfakcję po operacjach poprawiających drożność nosa. Rynometria akustyczna nie znajduje istotnego odzwierciedlenia w samoocenie chorego dotyczącej drożności nosa.

SŁOWA KLUCZOWE: rynomanometria, rynometria akustyczna, drożność nosa, asymetria oporów przepływu, samoocena, obiektywizacja

INTRODUCTION

The final outcome of a therapeutic procedure is a combination of various endpoints assessed by the physician and the patient (Nies); discrepancies between the physician's and the patient's assessment may be due to objective as well as subjective reasons (Kopp). While qualification for curative surgeries in the treatment of rhinosinusitis is quite well described by appropriate management algorithms, appropriate qualification of patients for nasal airway obstruction surgeries remains somewhat problematic. Good anatomical and functional effects are difficult to predict (Abu-Bakra, Pirila, and Tikanto, 2001). Some authors suggest that no strong EBM proofs are available e.g. for the efficacy of septoplasty in nasal airway obstruction (Robin). In 2004, Schumacher ( ) declared rhinomanometry (RMM) to be a potential gold standard in appropriate qualification of patients for septoplasty procedures. RMM allows for a generally repeatable description of the functional status of nasal cavities by means of a physical term, and international consensus has been achieved with regard to the parameter assessment criteria (Clement). However, RMM measurements not always reflect patients' subjective perception of nasal patency (Jessen, Kjaergaard). Nasal resistance as assessed by RMM are reported to be poorly correlated with patients' self-evaluations (Pinkpank, Naito) while the measurement itself is characterized by low repeatability of the results (Courtiss).

Acoustic rhinometry (AR) is used to assess the geometry of nasal cavities (Dastidar). It is a fast, inexpensive, and noninvasive test that measures the cross-sectional area of nasal cavities as the function of distance from nasal opening (Kjaergaard, Roithman, Lal). According to some authors, AR measurements are more consistent with patients' subjective evaluations of nasal patency (Grymer, Harar, Harar, Hilberg).

Also presented were opinions that objective assessments of nasal patency are useful in the assessment of the efficacy of surgical treatment rather than in qualification for such a treatment (Calderon). Some authors provide evidence that results of an RMM evaluation performed before nasal airway obstruction surgery is perfectly correlated with the subjective assessment of patency on the less patent side while not being correlated with the subjective assessment of patency on the contralateral side (Pirila). Also presented were opinions suggesting that the efficacy of surgical (clinical) evaluation of the location and degree of nasal cavity narrowing is comparable to that of AR and RMM, and that patients' satisfaction did not increase significantly if AR and RMM measurements were performed preoperatively (Dinis). It appears that the relationship between the subjective evaluation and the results of objective examination is stronger when the patient perceives the symptoms of non-patency as opposed to the lack of perceived symptoms, as well as patency of each nasal cavity is being assessed separately (Andre). Thus, despite technological advances in RMM and AR, no clinically efficient and objective criteria are available for prediction of the decision to perform septoconchoplasty being justified by significant deformation of the nasal septum or hypertrophy of the inferior nasal concha (Singh). Combination of patient-specific factors leading to nasal obstruction (location of conchal deformity, type of conchal hypertrophy and anatomical structural defects of ethmoid bone) may also be of importance (Baumann, Dinis, Gray). To sum up, despite the extensive literature background and availability of various methods to assess nasal patency, well-planned and carried-out clinical studies are still lacking in this area (Singh).

OBJECTIVE

The objective of this study was to identify the AR and RMM parameters that were best correlated to patients' self-evaluation of nasal patency before and after nasal airway obstruction surgery. The primary goal was defined as identification of RMM and AR parameters facilitating prediction of the results of patient's self-evaluation of nasal patency. Secondary goals consisted in determination of the power of correlations between individual questions of the SNOT-20 survey and AR or RMM parameters as well as in determining whether good surgical results as defined by subjective improvement were reflected by the results of objective examinations.

MATERIAL AND METHODS

The study material consisted of RMM and AR results as well as self-evaluation questionnaires completed by 233 patients presenting with rhinological problems and routinely diagnosed at the RMM Lab of the Department and Clinic of Otolaryngology of the Medical University of Warsaw. Patients provided answers to questions evaluating nasal patency within a questionnaire identical to the SNOT-20 survey. Polish language version of the questionnaire was completed by patients before and 6 months after surgery. Nasal patency and anatomy of nasal cavities was assessed using Interacoustics AS (Denmark) RhinoMetrics SRE 2100 device that combines the function of a rhinomanometer (RhinoStream) and an acoustic rhinometer (RhinoScan). Data were collected from 70 females (31.4%) aged 18 through 81 years and 153 males (68.6%) aged 16 through 81 years. The results were subjected to statistical analysis by a licensed statistician using the Statistica 10 software package.

The following table presents the numbers of patients within individual subsets of the study material classified according to the type of surgery and patient gender.

Tab. I. Type of surgery vs. patient gender

	FEMALES			MALES			TOTAL		
TYPE OF SURGERY	N	MEAN	STD.	N	MEAN	STD.	N	MEAN	STD.
septoplasty	18	38,6	17,8	72	39,1	13,3	90	39,0	14,2
septoconchoplasty	20	35,5	14,1	35	38,9	15,0	55	37,6	14,6
septoethmoidectomy	16	42,3	13,7	35	47,5	17,8	51	45,9	16,6
ethmoidectomy	16	51,0	13,6	11	52,3	14,2	27	51,5	13,6

1 – septoplasty, 2=septoconchoplasty, 3=septoethmoidectomy, 4=ethmoidectomy

Male patients were characterized by significantly higher rates of septoplasties while female patients were characterized by significantly higher rates of ethmoidectomies.

Patients' self-evaluation of nasal patency after surgery improved (Table 2) and the differences between the status before and after surgery were statistically significant.

Next, the powers of correlations between the subjective evaluations and RMM/AR results were analyzed.

Since the study aimed at obtaining the measures of monotonic correlation of two random variables, namely the SNOT-20 scores and nasal resistance measurements, the data were subjected to rank analysis with rank distribution being independent of the distribution of ranked variables (no tied ranks existed within the data sets), and therefore determination of significance required no special assumptions regarding the distribution of sample data. Spearman's rank correlation coefficient and Kendall's tau coefficients for the relationship between SNOT-20 scores before and after surgery and minimum cross-sectional area (MCA) and nasal cavity volume (VOL) as measured by AR did not reach the limit of statistical significance. Therefore, subsequent analyses focused on RMM results alone.

Tab. II. Patients' self-assessment of nasal patency before and after surgery vs. patients' gender.

PARAMETER	BEFORE SURGERY		AFTER SURGERY	
	F (N=70)	M (N=153)	F (N=47)	M (N=97)
mean	3,53	3,42	1,28	1,35
SD	1,07	1,31	1,25	1,32

Tab. III. Kendall's tau correlation coefficients between nasal airway resistance and patients' self-evaluation of nasal patency as indicated by the survey score

Before decongestion					After decongestion				
R-exL	R-exP	R-inL	R-inP	R-op	R-exL	R-exP	R-inL	R-inP	R-op
0,06	**0,18**	0,05	**0,18**	0,24	-0,01	**0,13**	-0,01	**0,12**	**0,13**
0,19	**0,21**	**0,19**	**0,18**	**0,34**	**0,19**	**0,15**	**0,18**	**0,13**	**0,24**

Significant correlations ($p<0.05$) are in bold.
Abbreviations:
R-exL – resistance upon expiration on the left
R-exR – resistance upon expiration on the right
R-inL – resistance upon inspiration on the left
R-inR – resistance upon inspiration on the right
R-avg – average resistance

Tab. IV. Resistance asymmetry vs. gender. Mann-Whitney's U-test.

		BEFORE SURGERY			AFTER SURGERY		
PARAMETER		F	M	P	F	M	P
Before decongestion	asex	1,49	2,04	0,0002	1,35	1,67	0,0413
	asin	1,45	2,15	0,0001	1,34	1,80	0,0361
	avg	1,46	2,13	0,0001	1,35	1,74	0,0430
after decongestion	asex	1,35	1,82	0,0015	1,25	1,39	0,1312
	asin	1,39	1,82	0,0006	1,27	1,50	0,1131
	avg	1,34	1,84	0,0011	1,27	1,46	0,1476

Table 3 presents the results of the analysis of RMM outcomes. Contrary to the assumptions, weak or very weak correlations could only be demonstrated between the studied variables, with statistical significance levels being achieved only in some of the cases.

A new method for analyzing the data set was attempted to obtain stronger, potentially clinically significant, correlations. To this end, derived variables were defined as functions of primary variables including the asymmetry of airflow upon inspiration (asin) the asymmetry of airflow upon expiration (asex). The variables were defined as follows:
asex = R-ex L/R-ex R if R-ex L>R-ex R;
asin = R-in L/R-in R if R-in L>R-in R
or
asex = R-ex R/R-ex L if R-ex R>R-ex L;
asin = R-in R/R-in L if R-in R>R-in L

Where L and R correspond to the left and the right nasal cavity, respectively.

Table 4 presents the results obtained in individual subgroups and genders.

Airflow resistance asymmetry was shown to be higher in male than in female patients; the difference was statistically significant. In addition, higher asymmetry was found to correspond with poorer responses in nasal patency self-evaluation surveys.

Next, the power of correlations between asymmetry indices and self-evaluation scores was assessed. Table 5 presents the results of the Spearman's rank test.

The power of correlations obtained in this manner was still low and not all correlations were statistically significant. However, it was observed that in the subgroup of patients reporting the nasal patency impairment grade 5, average asymmetry of airflow resistance was several times higher than that in other subgroups' airflow. The difference was examined for statistical significance.

Tab. V. Spearman's rank correlation coefficients between nasal airway resistance and patients' self-evaluation of nasal patency as indicated by the survey score

PARAMETER	BEFORE SURGERY	AFTER SURGERY
asex-0	0,11	**0,33**
asin-0	**0,15**	**0,4**
avg-0	0,12	**0,37**
asex-1	**0,17**	0,05
asin-1	0,12	0,11
avg-1	**0,15**	0,08

asex – asymmetry of airflow resistance upon expiration
asin – asymmetry of airflow resistance upon inspiration
avg – average asymmetry of airflow resistance ((asin+asex)/2)
-0 - before decongestion
-1 - after decongestion

Since the number of subjects reporting grade 5 patency impairment was as low as 3, no statistically significant difference was observed between subgroup 5 and subgroup 2, although in a manner similar to that observed before surgery, average asymmetry in subgroup 5 was several times higher than the average asymmetry in other subgroups. Due to the low number of subjects in subgroup 5, no cut-off value was identified as was the case before surgery.

All patients in whom the asymmetry of airflow resistance upon inspiration was found to be higher than 3.92 marked the score of 5 (most intense) when answering the first question of the SNOT-20 survey. The mean airflow resistance asymmetry within the subgroup of patients who marked the score of 5 for the symptoms in question was statistically significant compared to other subgroups. No such differences could be observed between the remaining subgroups (Table 7).

Tab. VI. Asymmetry of airflow resistance upon inspiration as tested before surgery and decongestion in subgroups classified according to the response to the first question of the SNOT-20 survey as well as in the overall population

PARAMETER	ASIN							
01SNOT-0	MEAN	N	STD.	MIN.	Q25	MEDIAN	Q75	MAX.
0	2,23	10	1,60	1,00	1,22	1,38	2,75	6,00
1	2,36	8	1,35	1,08	1,38	1,92	3,25	4,71
2	4,35	15	8,93	1,00	1,19	1,45	2,15	35,98
3	3,70	65	6,66	1,01	1,26	1,62	3,29	49,43
4	5,85	76	13,60	1,00	1,35	1,86	3,56	94,63
5	16,29	30	35,21	1,00	1,28	2,49	6,45	141,03
Total	6,27	204	16,85	1,00	1,28	1,80	3,74	141,03

Tab. VII. Numbers of patients in individual subgroups classified according to the nasal airflow resistance asymmetry coefficients as well as to the responses to the survey question. Patients were divided into two subgroups: P=5 (all patients who marked the score of 5) P<5 (all patients who marked the score of 0-4).

EXAMINATION AFTER SURGERY	ASIN > 3,92	ASIN ≤ 3,92	OGÓŁEM
P = 5	**13**	**17**	30
P <5	**34**	**140**	174
total	47	157	204
EXAMINATION AFTER SURGERY	**ASIN > 3,92**	**ASIN ≤ 3,92**	**OGÓŁEM**
P=5			
P <5			
total			

Tab. VIII. Analysis of variance (NIR test) results for the mean airflow resistance asymmetry coefficient within individual subgroups vs. the answers to questions regarding nasal patency.

RESPONSE SCORE	0	1	2	3	4	5
0		0,9870	0,7531	0,7939	0,5153	**0,0206**
1	0,9870		0,7828	0,8288	0,5700	**0,0350**
2	0,7531	0,7828		0,8899	0,7486	**0,0231**
3	0,7939	0,8288	0,8899		0,4412	**0,0007**
4	0,5153	0,5700	0,7486	0,4412		**0,0037**
5	**0,0206**	**0,0350**	**0,0231**	**0,0007**	**0,0037**	

Tab. IX. Differences in the asymmetry of airflow resistance before and after surgery

PARAMETER	MEAN	SD	P	
Before decongestion	asex-6 – asex-0	-2,538	13,302	**0,0431**
	asin-6 – asin-0	-4,483	19,781	**0,0166**
	avg-6 – avg-0			
after decongestion	asex-6 – asex-0	-1,881	5,927	**0,0009**
	asin-6 – asin-0	-4,217	20,582	**0,0286**
	avg-6 – avg-0	-3,067	12,483	**0,0093**

Test of averages against a constant reference value. Reference = 0
asex – asymmetry of airflow resistance upon expiration
asin – asymmetry of airflow resistance upon inspiration
avg – mean asymmetry of airflow resistance ((asin+asex)/2)
-0 – before surgery, -6 – 6 months after surgery

Chi-square-test analysis revealed statistically significant numbers between numbers in individual table cells (p=0.0043).

As shown by statistical analyses, responses to the question regarding nasal patency were significantly correlated with RMM results. Patients reporting maximum discomfort upon inspiration (score of 5 marked as the answer to question 1) were characterized by airflow resistance asymmetry coefficients being several times higher than the average coefficients calculated for the remaining patients (who marked the scores of 0-4). The value of the asymmetry coefficient determined to be the cut-off point for subjects marking the score of 5 was established at 3.92. This means that very high discomfort can be expected upon inspiration in patients achieving this value in RMM examinations. This group of patients should be the first to be qualified for patency restoration procedures; best treatment satisfaction outcomes are also to be expected in this group.

Differences in the asymmetry of airflow resistance before and after surgery were observed for all parameters and were statistically significant (Table 9).

An additional variable, dasin, was introduced for a more precise analysis of distribution of responses to the question regarding nasal patency. The dasin variable was defined as the difference in the asymmetry of airflow resistance as measured before and after surgery in the same patient. Distribution of responses to the question regarding nasal patency as compared to the value of the dasin variable is presented in Table 10.

The analysis of variance was carried out for data presented in Table 10. The results are listed in Table 11.

Next, the results obtained for the dasin variable were accumulated in two subgroups according to the patients' response to the first question of the SNOT-20 survey, namely to the scores of 0-4 vs. the scores of 5. Results are presented in Table 12.

The significance of the difference between the first group (scores of 0-4) and the second group (scores of 5) were analyzed using the two-sided Mann-Whitney U-test. The difference was shown to be significant (p=0.00268).

The number of subjects who answered the question regarding nasal patency after surgery was smaller due to the fact that some patients did not report for follow-up visits. At the same time, no RMM measurements were performed after surgery in these patients, and thus the dasin variable was assessed in a smaller population of subjects. One may speculate that not reporting for follow up was indicative of the lack of any nasal patency impairment following the procedure. Most probably, the procedures were effective and patients saw no point in returning for follow-up after the symptoms had resolved.

Tab. X. Values of the dasin variable in subgroups defined according to the responses to the question regarding nasal patency.

RESPONSE SCORE	DASIN							
	MEAN	N	STD.	MIN.	Q25	MEDIAN	Q75	MAX.
0	-0,56	8	1,88	-3,93	-1,81	0,14	0,55	1,71
1	-0,19	8	1,27	-2,53	-0,82	-0,02	0,53	1,64
2	-3,24	11	10,55	-34,19	-2,01	0,05	1,49	3,23
3	-0,54	53	3,54	-11,40	-1,03	-0,13	0,56	10,12
4	-3,02	68	14,63	-93,48	-1,07	-0,11	0,49	18,56
5	-15,02	28	36,07	-139,30	-5,58	-0,89	0,13	4,27
Ogół	-3,95	176	17,82	-139,30	-1,78	-0,13	0,51	18,56

Tab. XI. Analysis of variance (NIR test) results for the values of dasin variable in subgroups from Table 10

RESPONSE SCORE	0	1	2	3	4	5
0		0,9661	0,7405	0,9976	0,7052	**0,0393**
1	0,9661		0,7063	0,9577	0,6635	**0,0346**
2	0,7405	0,7063		0,6399	0,9694	0,0582
3	0,9976	0,9577	0,6399		0,4369	**0,0005**
4	0,7052	0,6635	0,9694	0,4369		**0,0024**
5	**0,0393**	**0,0346**	0,0582	**0,0005**	**0,0024**	

Tab. XII. Values of the dasin variable in two subgroups defined according to the responses to the first question of the SNOT-20 survey.

RESPONSE SCORE	DASIN							
	MEAN	N	STD.	MIN.	Q25	MEDIAN	Q75	MAX.
0–4	-1,86	148	10,55	-93,48	-1,07	-0,10	0,55	18,56
5	-15,02	28	36,07	-139,30	-5,58	-0,89	0,13	4,27
Ogół	-3,95	176	17,82	-139,30	-1,78	-0,13	0,51	18,56

DISCUSSION

No material for reasonable conclusions was provided by the analysis of AR results and thus the method was demonstrated to be of no use in our study material. The results of AR assessments were shown to be out of any correlation with patients' self-evaluation of nasal patency, either before, or after the procedure. This was in contrast to the results of some studies suggesting that AR is very useful for the assessment of nasal cavity when septoconchoplasty is being considered (Grymer). However, it appears that AR facilitates objective identification of the location of the narrowing as the potential target of surgical intervention rather than being correlated with the resistance in airflow as perceived by the subjects.

On the other hand, the analysis of RMM data provided some valuable findings that can be arranged in a logical sequence. Statistically significant differences were observed in relation to the average airflow resistance and to the patients' self-assessment both before and after surgery. This was consistent with the literature data. According to most authors, long-term improvement in nasal patency is achieved in 70.5-86% of subjects undergoing surgeries (Samad, Denholm, Bohlin, Sherman, Stocksted) while improvement in nasal resistance following nasal airway obstruction surgeries is reported in a significant majority of clinical studies (Singh). Assessments carried out 9 months after septoplasty suggest a reduction in the resistance of the preoperatively narrower cavity in both assessments as well as preoperative reduction in the resistance of the preoperatively wider cavity and the entire nose (Jessen). As shown in RMM-supported studies, patients with reduced respiratory resistance were more likely to report satisfaction with the outcomes than patients in whom the resistance was shown to be increased (Broms).

In this study, correlations between the airflow resistance as measured by RMM and patients' self-evaluation were weak and not always significant. Similar results were obtained by other researchers. In 2006, Zhao et al. ( ) attempted determination of the importance of AR and RMM in the assessment of outcomes of surgical treatment of inferior nasal conchal hypertrophy by means of conchoplasty and septoconchoplasty. They concluded that the correlation between subjective perception of symptoms and RMM results required further examination. Similar conclusions were formulated by Magnusson et al. ( ) who studied changes in nasal resistance following surgical treatment of nasal conchal hypertrophy. Also in this case, no significant correlation could be demonstrated between the subjective and the objective results of treatment.

Reber et al. ( ) assessed the effects of septoplasty surgery using a visual analog scale and acoustic rhinometry measurements before as well as after decongestion. No significant correlation could be demonstrated between MCA or VOL and the subjective assessments of nasal patency either before or after the procedure, and thus the conclusion was drawn that acoustic rhinometry is of no use as a tool for determining the necessity of procedures or for assessing the efficacy of nasal airway obstruction surgeries.

Suonpaa et al. ( ) used active anterior RMM to perform measurements in 88 patients having undergone septoplasty 6 months before, as well as assessed patients' satisfaction with the surgical outcomes 3 to 5 years after the procedure. Slight but statistically insignificant decrease in patients' satisfaction was observed several years after the procedure. As shown by the results, patients with high or normal preoperative nasal resistance were most satisfied with the surgical outcomes. Therefore, it was concluded that pre-operative RMM measurements are helpful in preselection of patients in whom the best post-surgical outcomes would be achieved. Thanks to that, surgeries in patients who suffer the most can be performed earlier (Sipilä J., Suonpa J).

Introduction of a new analytical parameter of airflow asymmetry was shown to be well-substantiated since correlation with subjective perception and the basis for prediction of functional outcomes of surgery were identified. The prediction that the larger the asymmetry, the larger the patient's discomfort (probably due to the stronger disturbance of nasal cycle and mucosal function) was shown to be accurate. Although our results contradict those obtained by Broms et al. who claim that the intensity of symptoms before surgery is not a reliable predictor of post-operative satisfaction (Broms), no analysis of the difference in airflow resistance between both nasal cavities was performed in the latter study. Our methodology appears to be confirmed by the results by Sipilä et al. (Sipilä) who suggested that 85% of patients with very significant airflow obstruction qualified for nasal airway obstruction surgeries reported being satisfied with the outcomes; this percentage was higher compared to that in the group of patients with normal airflow resistance values (69%). Our results confirm those obtained by Pirila et al. ( ) who observed a clear correlation between the objective preoperative examinations and postoperative patient satisfaction assessments. Pirila et al. showed that the large difference in the airflow between individual nasal cavities (airflow asymmetry coefficient) corresponds to higher satisfaction following surgery. However, the authors did not identify any repeatable parameter such as the asymmetry index or any cut-off point above which airflow asymmetry would be well correlated with the subjective perception of discomfort. The cut-off value defined in this study may be of significant prognostic importance.

CONCLUSIONS

- A statistically significant relationship exists between the subjective perception of nasal patency and RMM results.
- The higher the asymmetry of air flow within the left and the right nasal cavity, the higher the perceived restriction of nasal patency.
- Significant differences were observed between patients reporting maximum discomfort regarding impaired nasal patency and the remaining patients: the former were characterized by nasal resistance values being several-fold higher than that observed in the latter while nearly always improving after nasal airway obstruction surgeries.
- No significant reflection of patients' self-evaluation of nasal patency was found in the acoustic rhinometry measurements.

References

1. Abu-Bakra M., Jones N.S.: Prevalence of nasal mucosal contact points in patients with facial pain compared with patients without facial pain. J. Laryngol. Otol. 2001; 115: 629–632.
2. André R.F., Vuyk H.D., Ahmed A., Graamans K., Nolst Trenité G.J.: Correlation between subjective and objective evaluation of the nasal airway. A systematic review of the highest level of evidence. Clin. Otolaryngol. 2009; 34, 518–525.
3. Baumann I., Baumann H.: A new classification of septal deviations. Rhinology. 2007; 45, 220–223. 25.

4. Bohlin L., Dahlqvist A.: Nasal airway resistance and complications following functional septoplasty: A ten-year follow-up study. Rhinology. 1994; 32: 195–197.
5. Broms P., Jonson B., Malm L.: Rhinomanometry. IV. A pre- and postoperative evaluation in functional septoplasty. Acta Otolaryngol. 1982; 94: 523–529.
6. Calderón-Cuéllar L.T., Trujillo-Hernández B., Vásquez C., Padilla-Acero J., Cisneros-Preciado H.: Modified mattress suture technique to correct anterior septal deviation. Plast. Reconstr. Surg. 2004; 114, 1436–1441.
7. Carney A.S., Bateman N.D., Jones N.S.: Reliable and reproducible anterior active rhinomanometry for the assessment of unilateral nasal resistance. Clin. Otolaryngol. Allied. Sci. 2000; 25: 499–503.
8. Clarke J.D., Hopkins M.L., Eccles R.: Evidence for correlation of objective and subjective measures of nasal airflow in patients with common cold. Clin. Otolaryngol. 2005; 30: 35–38.
9. Clement P.A.: Committee report on standarisation of rhinomanometry. Rhinology. 1984; 22: 151–155.
10. Courtiss E.H., Goldwyn R.M.: The effects of nasal surgery on airflow. Plast. Reconstr. Surg. 1983, 72, 9–19.
11. Dastidar P., Numminen J., Heinonen T., Ryymin P., Rautiainen M., Laasonen E.: Nasal airway volumetric measurement using segmented HRCT images and acoustic rhinometry. Am. J. Rhinol. 1999; 13: 97–103.
12. Denholm S.W., Sim D.W., Sanderson R.J., Mountain R.E., Marais J., Maran A.G.: Otolaryngological indicator operations: one year's experience. J. R. Coll. Surg. Edinb. 1993; 38: 1–3.
13. Dinis P.B., Haider H.: Septoplasty: Long-term evaluation of results. Am. J. Otolaryngol. 2002; Mar-Apr; 23 (2): 85–90.
14. Grymer L.F., Pedersen O.F., Hilberg O., Elbrønd O.: Acoustic rhinometry: Evaluation of the nasal cavity with septal deviations, before and after septoplasty. Laryngoscope. 1999, Issue 11, 1180–1187.
15. Harar R.P., Kalan A., Kenyon G.S.: Assessing the reproducibility of nasal spirometry parameters in the measurement of nasal patency. Rhinology. 2001; 39: 211–214.
16. Harar R.P., Kalan A., Kenyon G.S.: Improving the reproducibility of acoustic rhinometry in the assessment of nasal function. ORL J. Otorhinolaryngol. Relat. Spec. 2002; 64: 22–25.
17. Hilberg O.: Objective measurement of nasal airway dimensions using acoustic rhinometry: methodological and clinical aspects. Allergy. 2002; 57 (70): 5–39.
18. Jessen M., Ivarsson A., Malm L.: Nasal airway resistance and symptoms after functional septoplasty: comparison of findings at 9 months and 9 years. Clin. Otolaryngol. Al. Sci. 1989, 14, 231–234.
19. Kjaergaard T., Cvancarova M., Steinsvag S.K.: Does nasal obstruction mean that the nose is obstructed? Laryngoscope. 2008; 118: 1476–1481.
20. Kopp I., Müller W., Lorenz W.: Die zentrale Rolle von Outcome in Leitlinien und Disease-Management Programmen. HNO Informationen. 2003; 28, 350–354.
21. Lal D., Corey J.P.: Acoustic rhinometry and its uses in rhinology and diagnosis of nasal obstruction. Facial Plast. Surg. Clin. North Am. 2004; 12, 397–405.
22. Magnusson A., Bjerklin K., Nilsson P., Jönsson F., Marcusson A.: Nasal cavity size, airway resistance, and subjective sensation after surgically assisted rapid maxillary expansion: a prospective longitudinal study. Am. J. Orthod. Dentofacial Orthop. 2011; 140: 641–651.
23. Naito K., Cole P., Chaban R., Oprysk D.: Nasal resistance, sensation of obstruction and rhinoscopic findings compared. Am. J. Rhinol. 1988; 2: 65–69.
24. Nies C., Celik I., Lorenz W., Koller M., Plaul U., Krack W., Sitter H., Rothmund M.: Outcome nach minimal-invasiver Chirurgie – Qualitative Analyse und Bewertung der klinischen Relevanz von Studienendpunkten durch Patient und Arzt. Chirurg. 2001; 72, 19–29.
25. Pinkpank A.: Beziehungen zwischen Selbsteinstufung der Nasenatmung, Rhinoskopie und Rhinomanometrie. HNO. 1986, 34, 194–197.
26. Pirilä T., Tikanto J.: Unilateral and bilateral effects of nasal septum surgery demonstrated with acoustic rhinometry, rhinomanometry, and subjective assessment. Am. J. Rhinol. 2001; 15: 127–133.
27. Pirilä T., Tikanto J.: Acoustic rhinometry and rhinomanometry in the preoperative screening of septal surgery patients. Am. J. Rhinol. Allergy. 2009 Nov-Dec; 23 (6): 605–609.
28. Pirilä T., Tikanto J.: Unilateral and bilateral effects of nasal septum surgery demonstrated with acoustic rhinometry. rhinomanometry, and subjective assessment. 2001; 15: 127–133.
29. Reber M., Rahm F., Monnier P.: The role of acoustic rhinometry in the pre- and postoperative evaluation of surgery for nasal obstruction. Rhinology. 1998 Dec; 36 (4):184–187.
30. Roblin D.G., Eccles R.: What, if any, is the value of septal surgery? Clin. Otolaryngol. Allied. Sci. 2002; 27: 77–80.
31. Samad I., Stevens H.E., Maloney A.: The efficacy of nasal septal surgery. J. Otolaryngol. 1992; 21: 88–91.
32. Sherman A.H.: A study of nasal airway function in the postoperative period of nasal surgery. Laryngoscope. 1977; 87: 299–303.
33. Singh A., Patel N., Kenyon G., Donaldson G.: Is there objective evidence that septal surgery improves nasal airflow? J. Laryngol. Otol. 2006, 120, 916–920.
34. Singh A., Patel N., Kenyon G., Donaldson G.: Is there objective evidence that septal surgery improves nasal airflow? J. Laryngol. Otol. 2006; 120, 916–920.
35. Sipilä J., Suonpää J.: A prospective study using rhinomanometry and patient clinical satisfaction to determine if objective measurements of nasal airway resistance can improve the quality of septoplasty. Eur. Arch. Otorhinolaryngol. 1997; 254: 387–390.
36. Stewart M.G., Smith T.L., Weaver E.M., Witsell D.L., Yueh B. et al.: Outcomes after nasal septoplasty: Results from the Nasal Obstruction Septoplasty Effectiveness (NOSE) study. Otolaryngology – Head and Neck Surgery. 2004, 130.
37. Stocksted P.: Long-term results, following plastic septum surgery. Rhinology. 1969; 7: 53–61.
38. Suonpa J., Sipilä J., Laippala P.: Do rhinomanometric findings predict subjective postoperative satisfaction? A longterm follow-up after septoplasty. Am. J. Rhinol. 1993; 7: 71–75.
39. Zhao W., Sun J.W., Wang Y.L., Guo T.: Significance of acoustic rhinometry and rhinomanometry in the evaluation of submucous correction of nasal septum and submucous resection of inferior turbinate. J. Laryngol. Otol. 2006; 120: 916–920.

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