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Original article

OBJECTIVE AND SUBJECTIVE ASSESSMENT OF NASAL PATENCY ON PATIENTS FOR SEPTOPLASTY AND RHINOSEPTOPLASTY

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ABSTRACT

Purpose: Nasal patency can be assessed using the objective and subjective methods on patients before and after functional and aesthetic surgery of the nose. The aim of the study is to evaluate the improvement of nasal obstruction after septoplasty or rhinoseptoplasty and the correlation between objective AR and ARM and subjective VAS sensation of nasal patency.

Material and Methods: Sixty-nine patients were examined in this prospective study. All patients were evaluated by acoustic rhinometry (AR), anterior rhinomanometry (ARM) and visual analogue scale (VAS) before and 12 months after surgery as well as before and after decongestion of the nasal mucosa.

Results: The mean subjective breathing scores improved significantly by 2.62 points (77.4% improvement). In patients with severe/very severe obstruction, all measured values improved significantly by an average of 70% and 89% for MCA and 79% for NAR respectively (0,0001). Patients with normal preoperative MCA and NAR values did not experience any significant changes. Good correlation existed between the acoustic-rhinometric (MCA1, MCA2) and anterior rhinomanometry (NAR) measurements and the subjective nasal patency (VAS) on nondecongested and decongested nasal mucosa preoperatively and postoperatively in deviated subgroup (severe/very severe) (r=0,892; p<0,0001) and subgroup (light/moderate) (r=0,935; p<0,0001). There was no good correlation between the subjective sensation of nasal patency and objective measures before surgery and before decongestion of nasal mucosa in deviated group (light/moderate).

Conclusion: Acoustic rhinometry and anterior rhinomanometry as objective tools and visual analogue scale as a subjective tool are good for assessment of nasal patency on the patient for functional and aesthetic surgery of the nose.

Keywords: nasal septum, acoustic rhinometry, anterior rhinomanometry, visual analogue scale,

INTRODUCTION

Nasal airway obstruction is a common problem, negatively affecting the quality of life for millions. [1] Pharmacologic treatment may be successful, but anatomic abnormalities that require surgical correction are often identified. The decision to proceed to surgery such as septoplasty or rhinoseptoplasty is often based on the surgeon's assessment without the use of objective testing. [2]

In addition to the various procedures used to improve the aesthetic outcomes, today's functional rhinoplasty frequently includes septoplasty to optimize nasal airflow. Cartilage grafts are often used to decrease nasal obstruction/valve collapse and to improve the aesthetic appearance of the nose. [3] Sometimes patients are not satisfied with their postoperative results despite the fact that the surgical correction was successful. [4]

As nasal patency is primarily a subjective sensation, the perception of nasal airflow usually is difficult to quantify. The objective tools are useful for nasal challenge and for quantifying nasal obstruction as well as for monitoring of medical and surgical therapy. The gold standard for monitoring of nasal patency is using of a quantifiable, reproducible and objective test which would be correlated strongly to the subjective perception of nasal airflow. The objective test has advantages in being easy to use and to help us in diagnosing the degree, the location and the cause of nasal obstruction. [5]

Various objective methods for investigation of nasal patency have been described, two of these are most commonly used: rhinomanometry and acoustic rhinometry. Rhinomanometry is a sensitive test of nasal function that calculates nasal airway resistance (NAR) by measuring transnasal pressure and airflow in the nasal airway during respiration. [5] Acoustic rhinometry provides a reflection of the anatomy of the nasal passages, from which the volume and the geometry of the nasal cavity can be measured. The main benefit of nonphysiological measure of nasal patency with acoustic rhinometry is to identify the narrowest part of the nasal cavity (the minimal cross-sectional area - MCA) which usually corresponds to the nasal valve area. [6]

Considering the amount of literature on these tests, and the increasing value that is attributed to them for validating surgical results, it is surprising that relatively little attention has been paid to how the outcomes of these tests relate to subjective symptoms.

The subjective sensation of nasal obstruction is of great importance to the patient and surgeon because the symptom is that causes the patient to present for investigation and treatment.

While the objective measurement may be accomplished through rhinometric techniques, sensation of nasal obstruction is measured through validated questionnaires or visual-analogue scale (VAS). [7]

The aim of the study is to evaluate the improvement of nasal obstruction after septoplasty or rhinoseptoplasty and the correlation between the objective and subjective sensation of nasal patency.

MATERIAL AND METHODS

This prospective study, was performed on 69 cases, 30 males and 39 females. The study was conducted at the University ENT Clinic and University Clinic of Respiratory Disease and Allergology in Skopje in the period from 2011 to 2014. The patients admitted to hospital with complains of nasal obstruction more than 6 months seeking for septoplasty or rhinoseptoplasty.

Each subject who enrolled in the study gave his written informed consent. Only patients with normal cognitive function and preserved reading skills were included. The study was carried out according to the Declaration of Helsinki and it was previously approved by the Institutional Review Boards of the involved hospitals.

In this study the inclusion criteria was nasal obstruction complaints to persist for more than 6 months. The exclusion criteria were: nasal septal perforation, complete nasal obstruction in one side, hypothyroidism and those who took aspirin, patients who suffered from allergic rhinitis, tumours and nasal polyps.

The patients were asked about their medical history. Anterior rhinoscopic examination and nasal endoscopy were performed in all patients before surgery. The decision for surgery was based on clinical evaluation and the persistence of nasal obstruction for more than 6 months.

The nasal geometry of total sixty-nine patients was investigated objectively by acoustic rhinometry (Acoustic Rhinometer A1; GM Instruments, U.K.). The nasal physiology was evaluated objectively by anterior nasal rhinomanometry (Interacoustic, Denmark). Each of the nasal cavity was decongested with 0.05% oxymetazoline after 15 minutes of rest. The measurements were performed before and 15 minutes after decongestion. The mean value of three measurements was calculated. Unilateral minimal cross-sectional area MCA (the smallest part in the nasal cross-sectional area in the nasal meatus) and bilateral minimal cross-sectional area (MCA total) were measured with acoustic rhinometry. Unilateral and bilateral nasal resistance (NAR) were measured with anterior rhinomanometry.

Nasal visual analogue scale (VAS) was used for evaluating patients' subjective experience of nasal obstruction. Subjective symptom score of nasal obstruction before and after decongestion of nasal mucosa was classified as mild, moderate, severe or very severe. The nasal symptom is scored on a scale of 0 (excellent, unobstructed breathing) to 10 (totally obstructed).

A follow-up visit was arranged after 12 months for postoperative objective measurements and subjective symptom score' evaluation.

Statistical analysis

Statistical analysis was performed using the SPSS software, version 18.0. After definition of a benchmark between physiological (non-deviated) and pathological (deviated) nasal resistance (NAR) and minimal cross-sectional areas (MCA1 and MCA2) group differences were calculated and correlations analysed. Percentage differences in the subjective breathing scores and side to side percentage differences in the objective measurements pre and postoperatively were analysed with the paired t-test. The Spearman's correlation coefficients and P values were determined between the objective measurements of acoustic rhinometry (unilateral MCA1, MCA2 and total MCAT values) and anterior rhinomanometry (unilateral NAR and total NAR) and subjective symptom score (VAS).

RESULTS

Sixty-five patients of the total sixty-nine who were included in the study completed the postoperative evaluation during the follow-up visit performed after 12 months. The mean average age was 24.7±9.1 years with 35 (53, 85%) females and 30 (46, 15%) males.

The patients scored their subjective nasal symptom using a visual analogue scale (VAS) before and after decongestion, pre- and postoperatively

The preoperative and postoperative differences in the subjective breathing scores were analysed with the paired t-test. The mean subjective symptom score for nasal obstruction decreased postoperatively on the predecongested as well as on the postdecongested nasal mucosa. The percentage of differences of the subjective symptom score increased postoperatively on the predecongested nasal mucosa on the right, left and total side by 85; 84,3 and 89,4 respectively as well as on the posdecongested nasal mucosa on the right, left and total side by 93,6; 90,3 and 91,7 respectively. The percentages of improved subjects for the nasal patency were significantly ($p < 0, 0001$). (Table1)

Table 1. Differences of percentage of subjective breathing score (VAS) before and after surgery

VAS		Preoperative	Postoperative	Postoperative		P Value
		Mean		% Difference	% of the improved subjects	
	Right	3.77	0.56	**-85.0**	**61.5**	**P=0.000 S**
	Left	4.57	0.72	**-84.3**	**81.3**	**P=0.000 S**
Pre-Decongestion	**Total**	4.45	0.47	**-89.4**	**92.3**	**P=0.000 S**
	Right	2.42	0.15	**-93.6**	**41.5**	**P=0.000 S**
	Left	3.18	0.31	**-90.3**	**53.1**	**P=0.000 S**
Post-Decongestion	**Total**	2.86	0.24	**-91.7**	**77.4**	**P=0.000 S**

VAS (visual analogue scale)

When obtaining the mean postdecongestion acoustic rhinometry and rhinomanometry values of all 65 patients postoperatively and compared with preoperative values, the mean difference of MCA1, MCA2 increased and resistance NAR decreased on the deviated side in the two deviated group.

In the 13 and 28 sides (each side of patients' noses evaluated independently) of unilateral obstruction, defined by an abnormally low MCA (very severe/severe obstruction) (MCA1 < 0.28 $cm^{2,}$ and MCA2 < 0.42 cm^2), postoperative MCA increased significantly by an average of 70% and 89% respectively ($P = 0.001$) (Table 2.) In 41 sides with very severe/severe nasal resistance (NAR > 0. 60 Pa/l/s) postoperatively decreased significantly by 79% of difference. All measured values in this subset had the largest percentage of change/improvement compared with any other subset. The percentage change in all values was also greater than the overall mean values for all 65 patients.

In the 20 and 12 sides (each side of patients' noses evaluated independently) with moderate/mild obstruction (MCA1 > 0.29 < 0.49 cm^2) and (MCA2 > 0, 43 < 0, 69 cm^2), the postoperative MCA1 and MCA2 increased significantly (Table 2). However, the changes in these values (27, 5% and 35, 5% respectively) were less than those of the groups with severe obstruction. In the 16 sides with moderate/mild resistance (NAR > 0, 50 Pa/l/s) postoperatively decreased significantly by 19, 9% of difference. In the 97 and 90 sides with normal MCA1 and MCA2 values (MCA1 >0.50 cm^2, MCA2 > 0, 70 cm^2) and in 73 sides with normal NAR values (< 0, 50 Pa/l/s) there were no significant changes in the percentage of differences. (Table 2).

Percentages of the improved subjects were significantly after surgery in two groups (severe/very severe and mild/moderate). (Table 2)

Table 2. Side to side differences of the nasal obstruction for the values of NAR, MCA1 and MCA2 in the group of very severe/severe deviation, moderate/mild deviations and no deviation before and after surgery

Parameters	Preoperative		Postoperative	Postoperative		
	N (different sides of nose)	Mean	Mean	% Difference	% of the improved subjects	P Value
Sides with very severe/severe deviations						
NAR	41	2.26	0.46	**-79.6**	**92.0**	**P=0.000 S**
MCA1	13	0.24	0.41	**70.8**	**88.0**	**P=0.001 S**
MCA2	28	0.37	0.70	**89.1**	**95.1**	**P=0.000 S**
Sides with moderate/mild deviations						
NAR	16	0.56	0.45	**-19.9**	**87.5**	**P=0.001 S**
MCA1	20	0.40	0.51	**27.5**	**85.0**	**P=0.000 S**
MCA2	12	0.55	0.74	**35.5**	**91.7**	**P=0.003 S**
Sides with no deviations						
NAR	73	0.36	0.33	**-0.9**	**27.4**	**P=0.235 NS**
MCA1	97	0.53	0.54	**0.7**	**51.5**	**P=0.196 NS**
MCA2	90	0.89	0.86	**3.4**	**44.4**	**P=0.133 NS**

NS – Non-significant p ≥ 0, 1; S – Significant p < 0, 05

Correlations between subjective nasal patency and measurements by AR and ARM were calculated by linear regression (Spearman's Rank Correlation Coefficient)

Table 3. Correlation between VAS vs MCA and NAR in deviated group (light/moderate)

VAS	preoperation				postoperation			
	non decongestion		decongestion		non decongestion		decongestion	
	r	p	r	p	r	p	r	p
MCA1D	0,024	0,173	0,538	0,0001	0,782	0,0001	0,843	0,0001
MCA1L	0,315	0,024	0,491	0,0001	0,642	0,0001	0,698	0,0001
MCA2D	0,238	0,050	0,505	0,0001	0,676	0,0001	0,750	0,0001
MCA2L	0,079	0,198	0,544	0,0001	0,658	0,0001	0,743	0,0001
MCA1T	0,136	0,155	0,465	0,0001	0,722	0,0001	0,824	0,0001
MCA2T	0,289	0,180	0,498	0,0001	0,429	0,0581	0,836	0,0001
NARD	-0,358	0,025	-0,561	0,0001	-0,710	0,0001	-0,854	0,0001
NARL	-0,246	0,086	-0,490	0,0001	-0,698	0,0001	-0,820	0,0001
NART	-0,143	0,125	-0,628	0,0001	-0,342	0,0562	-0,935	0,0001

Correlation is significant at p < 0, 05

VAS (visual analogue scale), MCA1D (first minimal cross-sectional area right), MCA1L (first minimal cross-sectional area left), MCA2D (second minimal cross-sectional area right), MCA2L (second minimal cross-sectional area left), MCAT1 (first minimal cross-sectional area total), MCA2T (second minimal cross-sectional area total), NARD (nasal airway resistance right), NARL (nasal airway resistance left), NART (nasal airway resistance total)

Comparison between subjective nasal patency and measurements by AR and ARM showed a good correlation, preoperatively as well as postoperatively. There was no correlation between the subjective sensation of nasal patency and objective measures of MCA and NAR before surgery and before decongestion of nasal mucosa, except for MCA1L, MCA2D and NARD in deviated group (light/moderate). There was a good correlation between subjective sensation of nasal patency and objective measures of MCA and NAR before surgery on decongested nasal mucosa as well as after surgery, on non-decongested and decongested nasal mucosa, except for MCA2T and NART on non- decongested nasal mucosa in deviated group (light/moderate).

Table 4. Correlation between VAS vs MCA and NAR in deviated group (severe/very severe)

VAS	preoperation				postoperation			
	non decongestion		decongestion		non decongestion		decongestion	
	r	p	r	p	r	p	r	p
MCA1D	0,624	0,0001	0,698	0,0001	0,748	0,0001	0,892	0,0001
MCA1L	0,565	0,0001	0,606	0,0001	0,767	0,0001	0,835	0,0001
MCA2D	0,448	0,0061	0,521	0,0003	0,675	0,0001	0,775	0,0001
MCA2L	0,501	0,0004	0,592	0,0001	0,621	0,0001	0,728	0,0001
MCA1T	0,528	0,0001	0,632	0,0001	0,764	0,0001	0,814	0,0001
MCA2T	0,371	0,0062	0,545	0,0001	0,611	0,0001	0,856	0,0001
NARD	-0,382	0,0087	-0,539	0,0001	-0,643	0,0001	-0,742	0,0001
NARL	-0,589	0,0001	-0,679	0,0001	-0,773	0,0001	-0,887	0,0001
NART	-0,626	0,0001	-0,752	0,0001	-0,781	0,0001	-0,811	0,0001

Correlation is significant at p < 0, 05

VAS (visual analogue scale), MCA1D (firs minimal cross-sectional area right), MCA1L (firs minimal cross-sectional area left), MCA2D (second minimal cross-sectional area right), (second minimal cross-sectional area left), MCA1T (firs minimal cross-sectional area total), MCA2T (second minimal cross-sectional area total), NARD (nasal airway resistance right), NARL (nasal airway resistance left), NART (nasal airway resistance total)

Correlation between the subjective sensation of nasal patency and objective measures of MCA and NAR before and after surgery and before and after decongestion of nasal mucosa was statistically significant in deviated group (severe/very severe).

DISCUSION

The nasal obstruction is a very common symptom observed in otorhinolaryngological practice. It can be associated with chronic diseases such as rhinitis and rhinosinusitis or only related to the nasal cycle. Septum deviations can impact the nasal patency for directly obstructing the air flow, commonly seen in the caudal nasal septum, or in cases where the deviated septum touches the anterior area of the inferior nasal conchae when it is congested due to the nasal cycle. [8]

Very common discussion between rhinosurgeons is if it is reasonable to routinely perform objective measurements of nasal patency pre or post-operatively. The main argument against objective measurements is a huge discrepancy between objective and subjective nasal obstruction found in many studies, while other authors report the opposite.

All 65 patients in this study had significant subjective improvements in breathing after septoplasty and functional rhinoplasty. When patients' symptom score was evaluated with visual analogue scale (VAS) percentage of mean differences was statistical significance in all patients postoperatively. When patients' functional breathing was evaluated with anterior rhinomanometry and acoustic rhinometry, resistance decreased and cross – sectional area increased on the deviated side in two deviated subgroup and percentage of differences were statistical significance. In patients with severe/very severe obstruction, septal surgery provides the greatest improvement in nasal patency. These patients constituted the only subgroup with significant improvement in all objective measurements. Patients with severe obstruction derive the greatest benefit from this procedure. In patients with moderate/mild obstruction, the cross-sectional area of their nasal cavities increased and the resistance decreased but did not objectively improve as much as in patients with severe/very severe obstruction. In patients with normal preoperative MCA values, their nasal patency did not change with surgery. Our values indicate a gradation of benefit that depends on preoperative MCA values in which those of lower initial MCA values benefit the most from the surgery.

The combination of the increase in nasal cavity area, the decrease in overall resistance, creates entirely new boundaries for airflow in patients after septoplasty or septorhinoplasty. In our analysis, we find significant subjective improvement overall in those patients who have this new geometry. The MCA may serve as a rate-limiting factor, but decreases in overall resistance and increases in nasal cross-sectional areas may give the patient an overall improvement in nasal patency.

In the study of Zoumalan patients with preoperative severe obstruction have the best overall improvement of the objective measurements as well as the subjective breathing score postoperatively. [9]

Some studies have shown the significant correlations between the symptom score on the visual analogue scale and rhinometric results. However, opposite results have also been reported. Umihanic et al. reported discrepancy between subjective and objective findings after septoplasty. [10]

In the present study, VAS scores showed no significant correlation with total and ipsilateral MCA1, MCA2 and NAR of nasal cavities before decongestion, except for MCA1L, MCA2D and NARD in deviated group (light/moderate) but the changes in VAS scores and changes in total and ipsilateral MCA1, MCA2 and NAR after decongestion significantly correlated before surgery. These results suggest that MCA and NAR is more sensitive to the mucosal change of decongested than to non-decongested mucosa and changes in MCA and NAR may reflect changes in subjective symptoms.

The data showed clearly, that there is a good correlation between the acoustic rhinometric and rhinomanometry measurements and the subjective nasal patency on non-decongested and decongested nasal mucosa after surgery in deviated group (severe/very severe).

Studies of the sensation of nasal patency and MCA of bilateral nasal cavities have shown a poor correlation between these variables. Roithmann et al. demonstrated that there was a significant negative correlation between unilateral VAS and MCA in a group of patients suffering from nasal obstruction, but there was no significant correlation between VAS and MCA of the bilateral nasal cavities. Szucs et al. demonstrated that no correlation was found between MCA and VAS, and that VAS correlated better with nasal resistance than with MCA. [11] Kim et al. demonstrated that there was no correlation between the changes in VAS scores and changes in nasal resistance and each cross sectional areas before and after topical application of the nasal decongestant. [12]

In the meta-analysis study of André et al. can be learned that the chance of correlation between objective and subjective variables is greater on a side with obstructive symptoms. Any correlation is lost when MCA values of both sides are taken together, which corresponds to the findings of the authors that subjects' sensation of nasal patency corresponds more likely to nasal resistance or MCA when only unilateral measurements are performed. [13]

Further, in many 'studies the subjective feeling of nasal obstruction has been difficult to correlate to patency of the nasal passages. However, in the majority of 'studies a significant correlation has been found between subjective scoring and test methods. Significant correlations ($p < 0.001$) have been reported in large groups between the objective and subjective assessments of nasal patency, but with low r-values (0.3). There is not a direct correlation to the subjective evaluation of stuffiness, probably because the location of NAR is in the valve region while the sensation of nasal obstruction can also be related to congestion in other areas. However, several studies of both skeletal and mucosal obstruction show a fair correlation. In the study by Hirschberg and Rezek, the correlation between subjective obstruction and airway resistance on the narrow side reached a higher level of significance compared to this correlation on the wide side. [14] Similar results were reported by Clarke who found that RM was better than patients' subjective sensations in detecting subtle side differences in resistance. In another study, the same authors found that VAS results correlated better to ARM when evaluating unilateral obstruction as compared to total nasal evaluation. [15] Kim at al indicated that the symptoms of nasal air obstruction seem to be related more to the unilateral nasal resistance than to the total nasal resistance. [16]

It is important to take this into account, and measures should always be done on each side separately. Due to the wide variation in nasal mucosal swelling, the test corresponds better, on an individual level, to the subjective feeling of obstruction after, rather than before, decongestion. Sipila found mild but significant correlation between total nasal resistance and nasal obstruction symptoms. [17] Pirila and Tikanto found an inverse correlation between the postoperative satisfaction and the decrease in MCA1 on the wide side ($r = -0.21$, $p = 0.03$) and positive correlations between the postoperative satisfaction and the increase in MCA1 on the deviation side ($r = 0.26$, $p = 0.0042$). [18]

Yepes-Nunez JJ et al. in their study showed that the correlations between the objective techniques were moderate to strong, between the subjective techniques were moderate and between the subjective and objective techniques were weak. These findings suggest that each of the techniques assesses different aspects of nasal obstruction, thus making them complementary. [19]

Hsu HC at al. concluded that the VAS and NOSE scores did not significantly correlate with total nasal resistance preoperatively or postoperatively. The VAS and nasal resistance in the deviated nasal cavity correlated significantly preoperatively ($P < 0.05$), but not postoperatively. [20]

Murrell noted statistically significant correlation between the subjective and objective functional improvements after nasal surgery. [21]

On a group level, however, the VAS or subjective patient evaluation regarding nasal obstruction has a good correlation to AR-measures and there is a significant correlation between AR and the doctor's evaluation of septal deviation.

Subjective analysis of nasal patency is generally based on patient self-assessment with visual analogue scales and D or questionnaires. In relatively recent publications validated questionnaires such as the 'sino-nasal outcome test' (SNOT-22) and the 'nasal symptom evaluation test' (NOSE) have been described with the specific goal of evaluating nasal symptoms including subjective obstruction. [22] The non-use of validated questionnaires may be explained by the fact that most of the studies pre-dated the publications of the SNOT-22 and NOSE tests. The use of these now available validated subjective scoring tools is strongly advised for future studies on this subject so as to enhance the reliability of conclusions concerning the correlation between objective and subjective outcomes.

CONCLUSION

Objective measurements of nasal patency are frequently used to validate the results of surgical interventions. This study demonstrated that the septoplasty or rhinoseptoplasty provides a significant improvement in nasal breathing. In patients with severe/very severe obstruction, septal surgery provides the greatest improvement in nasal patency. When patients' functional breathing was evaluated with anterior rhinomanometry and acoustic rhinometry, resistance decreased and cross – sectional area increased on the deviated side in two deviated subgroup and percentage of differences were statistical significance.

The perception of nasal patency is a subjective and therefore is difficult to quantify. Visual Analogue Scale (VAS) was used in the study to quantify the subjective sensation of nasal obstruction. When patients' symptom score was evaluated with visual analogue scale (VAS) percentage of mean differences was statistical significance in all patients postoperatively. The gold standard for assessment of nasal patency is to use a quantifiable, reproducible, objective test with a strong correlation to the subjective perception of nasal patency. Acoustic rhinometry and active anterior rhimomanometry which presents these characteristics, were used in the present study to quantify objectively the nasal patency.

In the present study the results suggest that NAR and MCA are more sensitive to the mucosal change of decongested than to non-decongested mucosa and changes in NAR and MCA may reflect changes in subjective symptoms. There are a greater correlation between unilateral symptoms and unilateral objective measurements than between bilateral symptoms and bilateral nasal resistance or bilateral cross-sectional areas. However good correlation exists between the acoustic-rhinometric and rhinomanometry measurements and the subjective nasal patency.

REFERENCES:

1. Rhee JS, Book DT, Burzynski M, Smith TL. Quality of life assessment in nasal airway obstruction. *Laryngoscope*. 2003 Jul; 113(7):1118-22. [PubMed] [Crossref]

2. Mozzanica F, Gera R, Bulgheroni Ch, Ambrogi F, Schindler A, Ottaviani F. Correlation between Objective and Subjective Assessment of Nasal Patency. *Iran J Otorhinolaryngol.* 2016 Sep; 28(88):313-319. [PubMed]

3. Andre RF, D'Souza AR, Kunst HP, Vuyk HD. Sub-alar batten grafts as treatment for nasal valve incompetence; description of technique and functional evaluation. *Rhinology.* 2006 Jun;44(2):118-22. [PubMed]

4. Gamerra M, Cantone E, Sorrentino G, et al. Mathematical model for the preoperative identification of obstructed nasal subsites. *Acta Otorhinolaryngol Ital* 2017; 37:410-5

5. André RF. Surgical procedures of the nasal valve area: operative techniques and functional evaluation. [dis-

sertation] [S.l.: s.n.] [Radboud Universities Nijmegen]: University of Nijmegen. 2010. p.162

6. Cantone E, Ricciardiello F, Oliva F, De Corso E, Iengo M. Septoplasty: is it possible to identify potential “predictors” of surgical success? Acta Otorhinolaryngologica Italica 2018; 38:528-535

7. Singh A, Patel N, Kenyon G, Donaldson G. Is there objective evidence that septal surgery improves nasal airflow? *J Laryngol Otol.* 2006 Nov; 120(11):916-20. [Crossref]

8. Davis SS, Eccles R. Nasal congestion: mechanisms, measurement and medications. *Clin Otolaryngol Allied Sci.* 2004 Dec; 29(6):659-66. [PubMed] [Crossref]

9. Zoumalan RA, Constantinidis M. Subjective and Objective Improvement in Breathing After Rhinoplasty. *Arch Facial Plast Surg.* Nov/Dec 2012; 14(6):423-428

10. Umihanic S, Brkic F, Osmic M, Umihanic S, Imamovic S, Kamenjakovic S. The Discrepancy Between Subjective and Objective Findings After Septoplasty. *Med Arch.* 2016 Oct; 70(5):336-338. [PubMed] [Crossref]

11. Szucs E, Clement PA. Acoustic rhinometry and rhinomanometry in the evaluation of nasal patency of patients with nasal septal deviation. *Am J Rhinol.* 1998 Sep-Oct;12(5):345-52. [PubMed]

12. Kim CS, Moon BK, Jung DH, Min YG. Correlation between nasal obstruction symptoms and objective parameters of acoustic rhinometry and rhinomanometry. *Auris Nasus Larynx.* 1998 Jan;25(1):45-8. [PubMed]

13. Andre RF, Vuyk HD, Ahmed A, Graamans K, Nolst Trenite GJ. Correlation between subjective and objective evaluation of the nasal airway. A systematic review of the highest level of evidence. *Clin Otolaryngol.* 2009 Dec;34(6):518-25. [PubMed] [Crossref]

14. Hirschberg A, Rezek O. Correlation between objective and subjective assessments of nasal patency. *ORL J Otorhinolaryngol Relat Spec.* 1998 Jul-Aug;60(4):206-11. [PubMed] [Crossref]

15. Clarke JD, Hopkins ML, Eccles R. How good are patients at determining which side of the nose is more obstructed? A study on the limits of discrimination of the subjective assessment of unilateral nasal obstruction. *Am J Rhinol.* 2006 Jan; 20(1): 20-24. [Crossref]

16. Kim SK, Heo GE, Seo A, Na Y, Chung SK. Correlation between nasal airflow characteristics and clinical relevance of nasal septal deviation to nasal airway obstruction. Respir Physiol Neurobiol. 2014 Feb; 1(192): 95-101. [PubMed] [Crossref]

17. Sipila J, Suonpaa J, Silvoniemi P, Laippala P. Correlations between subjective sensation of nasal patency and rhinomanometry in both unilateral and total nasal assessment. *ORL J Otorhinolaryngol Relat Spec.* 1995; Sep-Oct;57(5):260-3. [PubMed] [Crossref]

18. Pirilä T, Tikanto J. Unilateral and bilateral effects of nasal septum surgery demonstrated with acoustic rhinometry, rhinomanometry, and subjective assessment. *Am J Rhinol.* 2001 Mar-Apr; 15(2):127-33. [PubMed]

19. Yepes-Nuñez JJ, Bartra J, Muñoz-Cano R, Sánchez-López J, Serrano C et al. Assessment of nasal obstruction: correlation between subjective and objective techniques. *Allergol Immunopathol (Madr).* 2013 Nov-Dec; 41(6):397-401 [PubMed] [Crossref]

20. Hsu HC, Tan CD, Chang CW, Chu CW, Chiu YC, Pan CJ, et al. Evaluation of nasal patency by VAS/NOSE questionnaires and anterior active rhinomanometry after septoplasty: a retrospective one-year follow-up cohort study. *Clin Otolaryngol.* 2017 Feb;42(1):53-59. [PubMed] [Crossref]

21. Murrell GL. Correlation between subjective and objective results in nasal surgery. *Aesthet Surg J.* 2014 Feb;34(2):249-57. [PubMed] [Crossref]

22. Erickson B, Hurowitz R, Jeffery C, Ansari K, El Hakim H, Wright ED. Acoustic rhinometry and video endoscopic scoring to evaluate postoperative outcomes in endonasal spreader graft surgery with septoplasty and turbinoplasty for nasal valve collapse. *J Otolaryngol Head Neck Surg.* 2016 Jan;12:45:2. [PubMed] [Crossref]

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