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A systematic review of patient reported nasal obstruction scores: Defining normative and symptomatic ranges in surgical patients

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Abstract

Importance—A gold standard objective measure of nasal airway obstruction (NAO) does not currently exist, so patient-reported measures are commonly used, particularly the Nasal Obstruction Symptom Evaluation (NOSE) and the visual analog scale (VAS). However, questions remain regarding how best to utilize these instruments.

Objectives—The goal of this study is to systematically review studies on NOSE and VAS scores in NAO patients and compile and standardize the data to (1) define symptomatic and normative values for (a) pre and post-surgical NAO patients, (b) asymptomatic individuals, and (c) the general population, (2) determine if post-surgery scores are comparable to asymptomatic scores, and (3) determine if there is a clinically useful pre-operative and post-operative score change.

Evidence Review—A systematic review of the literature was performed through PubMed for studies assessing NOSE and VAS scores in patients with chronic NAO. Strict inclusion criteria were applied to focus on anatomic obstruction only. For statistical analysis, the patients were divided into asymptomatic, pre- and post-surgery NAO, and the general population.

Findings—The average NOSE and VAS scores for a patient with NAO were 65 ± 22 and 6.9 ± 2.3 respectively. The average post-surgery NOSE score was 23 ± 20 and VAS score was 2.1 ± 2.2. The average asymptomatic individual NOSE score was 15 ± 17, and VAS score was 2.1 ± 1.6.

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The average NOSE and VAS scores for the general population were 42 ± 27 and 4.6 ± 2.6 respectively. The average pre- to post-surgical change was > 40 for NOSE and > 4 for VAS.

Conclusions and Relevance—We have shown that normative and abnormal value ranges for NOSE and VAS can be established for clinical use. Given the consistency of both scales, we conclude that these measures should be used as a clinically meaningful measure of successful surgical outcomes.

Introduction

Assessing success of surgery for nasal airway obstruction (NAO) can be a challenge. The clinical diagnosis of NAO is based on the patient's subjective feeling, exam findings, and the surgeon's assessment. Treatment is focused on the anatomic source of obstruction as determined by the surgeon, but the ultimate judge of a successful treatment is the patient's reported relief from the sense of obstruction. Since objective evaluation of nasal obstruction by acoustic rhinometry, rhinomanometry, and other methods frequently does not correlate strongly with patients' subjective feelings of patency,[1] physicians and researchers have increasingly focused on patient-reported outcome measures to determine treatment efficacy.[2]

Health-related quality of life (QOL) measures have become important in all fields of medicine.[3] These scales are patient-reported, validated questionnaires that, ideally, reflect the severity of a disease in how it affects or impairs a patient's life. If the validation process is well-performed and targeted, the QOL instrument is thought to be "disease specific." Several QOL measures have been used to assess the burden of NAO over the years.[3] However, the Nasal Obstruction Symptom Evaluation (NOSE) has emerged as a key and frequently used QOL instrument specific to NAO in the surgical patient.[4]

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The NOSE scale has been validated as a QOL instrument for septoplasty and functional rhinoplasty.[4] It asks patients to rate on a 0–4 scale, over the past month, their feelings on five separate questions such as nasal congestion or ability to get air through the nose during exercise. The total score is then multiplied by 5 for a maximum score of 100, with 0 being asymptomatic and 100 being the worst-case scenario.

Another well validated and accepted patient-reported measure is the visual analog scale (VAS). This simple numerical scale is a means of translating a subjective feeling into a number; and in the setting of NAO, VAS can give real-time, immediate subjective feedback on the magnitude of obstruction. The most common VAS used for NAO asks the patient to rate their sensation of airflow on a scale from 0 to 10 with 0 being completely clear and 10 being completely obstructed. Both the NOSE and VAS scales have been used extensively to assess post-surgical outcomes in NAO patients. Furthermore, both scales have also been used in scenarios to assess NAO in random population samples and in patients with no history of NAO.

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The goal of this study was to use a systematic review of the literature to find studies that have used either the NOSE or VAS scores in surgically-treated NAO patients and to compile and standardize the data to (1) define symptomatic and normative values for (a) pre and post-surgical NAO patients, (b) those with no NAO complaint, and (c) the general population, (2) determine if post-surgery scores are comparable to those reported by asymptomatic individuals, and (3) determine if there is a clinically useful quantifiable difference between pre-operative and post-operative scores in NAO patients.

Methods

Article Selection Process

A multi-step search of the web-based PubMed database from the National Library of Medicine was performed using the search terms summarized in Table 1, with limits set to include articles published up to December 2012. Abstracts and full articles were reviewed. Since the objective of this review was to assess the effect of surgery in NAO patients, only studies reporting NOSE and VAS scores for NAO patients, asymptomatic individuals, or the general population were included for further review. Studies on patients with nasal congestion due to other illnesses (e.g., common cold, flu, allergies, recent trauma, or facial nerve paralysis) were excluded. Similarly, studies on non-surgical treatments for nasal obstruction (i.e., pharmacological intervention) were not included (Figure 1).

Subsequently, articles were excluded when the following essential data were not reported: (1) surgical treatment, (2) statistical significance between pre- and post-surgery differences, and (3) actual NOSE and VAS scores. Articles were also excluded if (1) non-standard NOSE survey was employed, (2) VAS score could not be re-scaled to a standard 0 to 10 scale, and (3) insufficient information was given to categorize the cohort as asymptomatic or NAO patients.

Data Extraction

Once the 31 articles that satisfied inclusion criteria were identified (Figure 1), they were separated into those with NOSE scores and those with VAS scores. Data extracted from each article included: study design, interventions performed, NOSE/VAS scores, statistical analysis, length of follow-up, and inclusion/exclusion criteria.

The data in each article were then divided into three groups: 1) Patients treated surgically for nasal airway obstruction, 2) asymptomatic individuals, and 3) general population. This “general population” group consisted of patients that were not seen specifically for a rhinologic complaint (e.g., all patients visiting a physician clinic), and may include patients with and without NAO. This group contrasts to the group of asymptomatic individuals in the sense that the latter was evaluated by a physician and deemed to have no history of nasal obstruction. If an individual article included several distinct groups with separate data sets, these groupings were used separately as appropriate.

There was a wide variation amongst the studies in scaling the VAS – e.g. 0 to 10, 0 to 100, -6 to 6, or 0 to 3. Thus, for the sake of comparison and standardization, all VAS scores were numerically rescaled and standardized to a 0 to 10 scale, with 0 indicating a “clear nose” and 10 indicating “complete obstruction.”

For each of the three groups, weighted-average NOSE and VAS scores were computed using the sample size of each designated study as the weight. Weighted average standard deviations were also calculated for each group using the standard deviations from each study and again using the sample size of each study as the weight. Not all studies reported a standard deviation, so only those with a reported number were used in the calculation. These mean standard deviations are reported in this text as X ± Y, with X being the mean score and Y being the mean standard deviation.

Results

Literature review

Our search generated a total of 533 citations, and identified a total of 183 potentially relevant articles (Figure 1). Of these citations, 65 articles merited full text review. Based on the above-listed inclusion criteria, a total of 31 articles were included in the analysis. Sixteen articles included only NOSE scores, 11 included only VAS scores, and 4 included both. The majority of articles assessed pre-surgery vs. post-surgery scores, with surgical techniques ranging from radiofrequency turbinate ablation to open septorhinoplasty. Post-surgery follow-up ranged from 1 month to more than 3 years, with the majority of articles following up at 2 months or more. Patient age was typically > 18 years with the exception of two articles which included one 16-year-old patient and one 14-year-old patient.

Despite the diversity of interventions and follow-up duration, all articles that assessed pre-surgery vs. post-surgery scores found statistically significant improvement after treatment based on a p-value ≤ 0.05 (Tables 3 and 5).

Several articles included the use of various objective methods of assessing NAO including acoustic rhinometry and rhinomanometry to compare with the subjective scores, but their correlations were inconsistent and beyond the scope of this review. Multiple articles used alternative subjective assessments concurrent with either VAS or NOSE scores, but these were also outside the scope of this review.

NOSE scale

The 20 articles with NOSE scores included 17 subject groups that underwent surgical treatments and 2 more subject groups that had pre-operative assessment but no post-operative assessment (Table 3). There were 7 non-surgical subject groups either fitting general population or no NAO (Table 2). NOSE scores were all obtained with the standard NOSE questionnaire.

The 19 pre-treatment subject groups had a total n = 725 patients, and the 17 post-treatment groups had a total n = 643 patients. The NOSE scores for individual studies are listed in tables 2 and 3. All treatment groups showed statistically significant difference between pre-surgery and post-surgery scores. The weighted average NOSE score was 65 ± 22 pre-surgery, decreasing to 23 ± 20 post-surgery, with a mean drop of 42 points (Table 6).

Of the 7 subject groups of non-surgical patients, 5 included NOSE scores for asymptomatic individuals with no NAO (n = 163) and 2 included NOSE scores for a general population (n

= 382). The weighted average NOSE score was 15 ± 17 for asymptomatic individuals and 42 ± 27 for the general population (Table 6).

VAS scores

The 15 articles with VAS scores included 10 subject groups that underwent surgical treatments, and 9 subject groups with no treatment. It should be noted that there were several different VAS scales used, but the majority using a variation of either 0–10 or 0–100, with 0 being a clear nose and 10 or 100 being complete obstruction. All were adjusted to 0–10 prior to any data analysis. It should also be noted that all of the included studies used bilateral, not unilateral nasal patency when assessing VAS.

The 10 subject groups with pre-surgery and post- surgery VAS had a total n = 265, and all but one of the groups showed a statistically significant difference between pre-treatment and post-treatment scores. The VAS scores for individual studies are listed in tables 4 and 5. The weighted pre-treatment mean VAS was 6.7 ± 2.3 and the post-treatment mean was 2.1 ± 2.2, with a mean change of 4.6 (Table 6).

Of the 8 subject groups of untreated patients, 5 included VAS for asymptomatic individuals with no nasal obstruction symptoms (n = 186), and 3 included VAS for the general population (n = 3,063). The weighted average VAS for individuals with no NAO was 2.1 ± 1.6, and for the general population it was 4.6 ± 2.6 (Table 6).

Discussion

Surgery for NAO is among the most commonly performed in the field of otolaryngology, yet reported failure rates can vary from 20 to 50 percent.[5–8] Because of the lack of a gold standard objective measure for nasal patency, patient-reported, disease-specific measures have emerged as perhaps the most clinically meaningful assessment tools to quantify treatment success. The importance of establishing normative and symptomatic ranges and defining meaningful clinical numerical changes to the scores is paramount in measuring the success of an intervention. By performing a systematic review and pooling and standardizing the data, we have been able to demonstrate that normative and abnormal value ranges can be established for meaningful clinical use.

The NOSE and VAS scores for NAO in the included studies showed a surprising amount of consistency amongst the studies despite the diversity of patient populations, interventions, and surgical techniques. This consistency, with tight groupings of scores in each category, lends credibility to the category means listed in table 6 as a categorization for normative values for NAO.

The average NOSE score for patients who sought NAO corrective surgery was 65, and no individual study had an average value below 57 (Tables 3 and 6). Similarly, the average VAS score for patients with NAO was 6.7, and the lowest individual study average was 5.2 (Tables 5 and 6). As expected, the average scores for populations with no history of NAO (i.e. asymptomatic) were significantly lower, with a NOSE average of 15 and VAS average of 2.1 (Table 6). No individual study's NOSE score was higher than 18 for asymptomatic individuals, and only one of the VAS studies had an average score higher than 2.0 (Tables 2 and 4). There was no score overlap between obstructed and non-obstructed study populations, showing a clear demarcation based on the patient-reported measures, thus defining normative and symptomatic values.

As expected, the average scores for the general population fell into the range between the average scores of NAO patients and asymptomatic individuals, with the full range of NAO symptoms (none to severe) represented. This was true for both NOSE and VAS general population averages, with scores of 42 and 4.6 respectively (Table 6).

In addition, we wanted to determine the mean NOSE and VAS scores for post-surgical NAO patients. We suspected that post-operative scores might demonstrate a bias, or placebo effect, with patients anticipating and reporting lower scores than a non-obstructed, untreated patient. Interestingly, we found that post-operative patients reported the same average VAS as asymptomatic individuals at 2.1 (Table 6). Similarly, the post-operative mean NOSE score was close to the non-obstructed, untreated group, though the score was slightly higher at 23 for post-operative patients, as compared to 15 for the asymptomatic individuals. The similarity of post-surgical NAO scores and asymptomatic scores indicate that the goal of surgery may realistically be to achieve “normal” breathing as perceived by the patient.

It is important to note that the scores reported in tables 2–6 are average scores, and that there was a small percentage of patients in most studies who did not have post-surgical improvement in NOSE and/or VAS scores. However, the majority of patients reported significant improvement, as demonstrated by the statistical significance of pre- to post-surgery differences.

The average pre- to post-surgery NOSE score change was 42 points, and the change in VAS was 4.6. No individual study reported a pre- to post-surgery drop <30 for NOSE or <3.0 for VAS (Tables 3 and 5). All but one of the included studies showed statistically significant change from pre- to post-surgery scores. Thus, one clinically meaningful measure of surgical success may be considered a change of ≥30 for NOSE and ≥3.0 for VAS. This threshold of change does not necessarily mean that lesser post-operative changes are not successful – the ultimate measure is patient specific – however, the results of this study would suggest that a quantifiable target may potentially be set by the surgeon and patient in terms of a successful outcome.

There are numerous potential implications and applications from the findings of this study. Normative and symptomatic values may help stratify the severity of NAO – e.g. normal, mild, moderate, and severe. This information can also be used to educate patients and give realistic expectations for improvement of NAO symptoms following procedures. These values may also help guide treatment. For example, a patient with a NOSE score of 60, with enlarged inferior turbinates and a deviated septum could reasonably be expected to have a score improvement of >30 with surgery. This numerical expectation of improvement can be compared to alternatives to surgery such as a nasal steroid treatment.

There are some potential areas of inconsistency and weakness in this review. The timing of initial patient-reported testing was not always clear, and the follow-up varied greatly, ranging from only one month to several years. There was also a large amount of variability amongst the studies in how the VAS was scaled, with score ranges from -6 to 6, from 0 to 3, 0 to 10 and 0 to 100. Though these scores were converted and standardized into a uniform scale before data analysis, a single standardized VAS scale would have been preferable as in the case of the NOSE scores. For standardization, we recommend that future studies should use a 0–10 scale with 0 being a clear nose and 10 being a completed obstructed nose.

Another possible weakness of this study is the possibility of reporting bias in the literature – i.e. researchers may preferentially report good outcomes. In addition, the surgical procedures reported in the studies were also widely variable, though this diversity of procedures speaks to the individualized nature of surgery for NAO and the varying expertise and preferences of the treating surgeon. Finally, the fact that we focused solely on surgical treatment for NAO gives this study a specific niche, and makes our results less applicable to NAO that has non-surgical causes (e.g., allergic rhinitis) and treatments (e.g., pharmacological treatment).

In conclusion, this review demonstrated that both NOSE and VAS scores are consistent and reliable patient-reported scales when used for evaluation of NAO. We have shown that normative and symptomatic value ranges can be established for meaningful clinical use. Furthermore, we conclude that physicians, researchers, and other stakeholders may consider using these patient-reported measures as a reliable and clinically meaningful measure of successful surgical outcomes.

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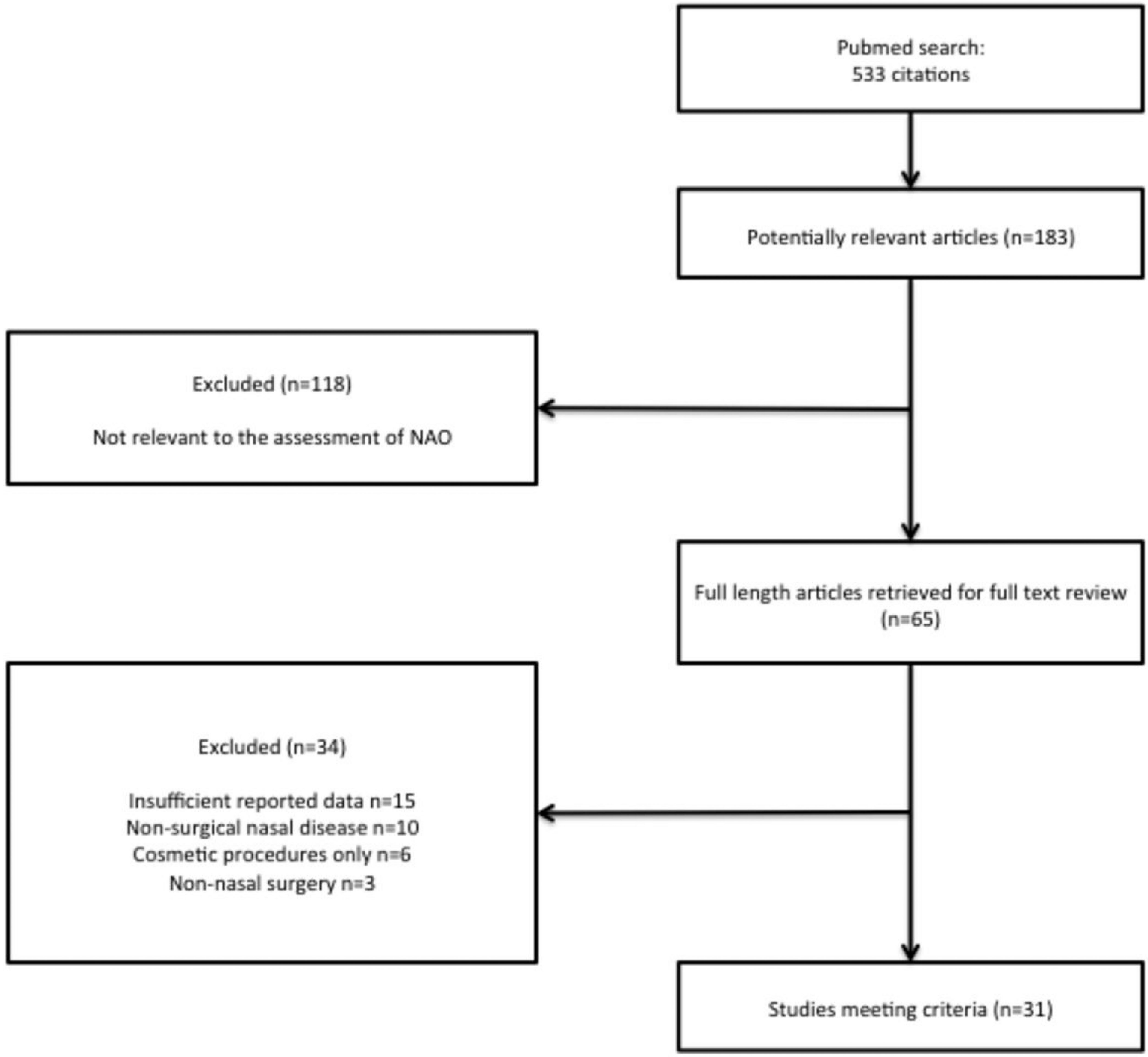

Figure 1.
Summary of literature review for nasal obstruction terms listed in table 1, including papers published until December 2012.

Table 1

Pubmed search terms and resulting citations.

Search term	Number of papers
1. "NOSE score"	16
2. "nasal obstruction symptom evaluation"	41
3. "visual analog scale + nasal obstruction"	245
4. "visual analog scale + nasal patency"	61
5. "VAS + nasal obstruction"	144
6. "VAS + nasal patency"	26
Total	533

Table 2

NOSE scores for cohorts with no treatment.

Asymptomatic individuals		
Study	**Sample size and characteristics**	**NOSE score**
Stewart 2004[4]	12 patients with non-rhinologic complaints	11 (NA)
Lindemann 2010[9]	40 patients mean age 27 with no NAO	13 ± 14
	40 patients mean age 70 with no NAO	18 ± 21
Yoo 2011[10]	21 patients with no NAO	13 ± 16
Marro 2011[11]	50 patients with no NAO	16 ± 18
General population		
Study	**Sample size and characteristics**	**NOSE score**
Lam 2006[12]	270 adults referred for polysomnogram	41 ± 25
Ishii 2011[13]	112 patients visiting facial plastics department for any complaint	45 ± 32

Table 3

NOSE scores pre- and post-treatment for nasal airway obstruction.

			NOSE score		
Study	**Sample size and characteristics**	**Intervention**	**Pre-surgery**	**Post-surgery**	**Significance**
Stewart 2004[4]	32 patients with NAO	None	65 (NA)	NA	NA
Stewart 2004[14]	59 patients with NAO	septoplasty with or without partial turbinectomy	68 ± 20	27 ± 24	p < 0.0001
Egan 2005[14]	7 patients with nasal valve stenosis	nasal valve stenosis repair	67 ± 10	21 ± 15	p = 0.0003
Rhee 2005[15]	20 patients with NAO	mix of septal, turbinate and rhinoplasty procedures determined by surgeon	69 ± 21	16 ± 18	p < 0.0001
Most 2006[16]	41 patients with NAO	mix of septal, turbinate and rhinoplasty procedures determined by surgeon	58 ± 13	16 ± 16	p < 0.01
Most 2006[17]	12 patients with NAO	septoplasty or septoplasty with ITR	77 ± 15	13 ± 14	p < 0.01
Harrill 2007[18]	77 patients with inferior turbinate hypertrophy and septal deviation	ITR (n=68) ITR + septoplasty (n=9)	65 ± 26 70 ± 22	35 ± 24 41 ± 31	p < 0.001 p = 0.023
Islam 2008[19]	11 adults with NAO	nasal valve splay graft	74 ± 15	18 ± 10	p = 0.003
Dolan 2010[20]	24 patients with nasal valve stenosis	nasal valve stenosis repair	67 ± 17	32 ± 17	p < 0.001
Garzaro 2010[21]	40 patients with rhinitis and inferior turbinate hypertrophy	radiofrequency inferior turbinate reduction (ITR)	59 ± 20	19 ± 12	p < 0.001
Marro 2011[11]	50 patients with NAO	None	59 ± 25	NA	NA
Yoo 2011[10]	17 patients with NAO	functional rhinoplasty	57 ± 21	17 ± 13	p < 0.001
Kahveci 2011[22]	27 patients with septal deviation	Septoplasty	60 ± 18	11 ± 11	p < 0.01
Mondina 2012[23]	100 patients with NAO	Septoplasty	58 ± 25	23 ± 24	P < 0.00001
Bezerra 2012[24]	46 patients with NAO	Septoplasty	75 ± 26	10 ± 20	P < 0.001
Lavinsky-Wolff 2012[25]	49 patients randomized to septorhinoplasty with ITR or septorhino alone	septorhinoplasty alone (n=24) septorhinplasty with ITR (n=25)	71 ± 23 77 ± 19	24 ± 24 25 ± 20	p < 0.001 p < 0.001
Saleh 2012[26]	113 patients with NAO	functional rhinoplasty	65 (NA)	25 (NA)	p < 0.01

Table 4

VAS scores for cohorts with no treatment.

No nasal airway obstruction		
Study	**Sample size and characteristics**	**VAS scores***
Clarke 1992[27]	50 patients with no history of NAO and normal exam	1.7 (NA)
Clarke 1995[28]	20 patients with no history of nasal disease	4.5 (3.0–5.9)
Roithmann 1998[29]	51 with no NAO	1.9 (NA)
Zhao 2011[30]	44 healthy volunteers	2.0 (NA)
Yoo 2011[10]	21 patients with no NAO complaint	1.2 ± 1.6
General population		
Study	**Sample size and characteristics**	**VAS scores***
Jones 1989[31]	250 subjects chosen as random population sample	4.6 ± 0.7
Lam 2006[12]	290 adults referred for PSG	3.8 ± 3.0
Kjaergaard 2008[32]	2523 patients referred for sleep disorders or chronic nasal complaints	4.7 ± 2.7

*VAS scores were rescaled to a 0–10 scale, with 0 being no obstruction and 10 being the most obstructed.

Table 5

VAS scores pre- and post-treatment for nasal airway obstruction.

Study	Sample size and characteristics	Intervention	Pre-surgery*	Post-surgery*	Significance
Reber 1998[33]	27 patients with NAO	septoplasty and various other nasal airway procedures	6.7 (3–10.0)	1.7 (0.0–5.5)	Not reported
Van Delden 1999[34]	48 patients with NAO	mix of endonasal procedures for nasal obstruction	6.6 (NA)	1.9 (NA)	p < 0.0001
Utley 1999[35]	10 patients with NAO refractory to medical management	mix of endonasal and external procedures for nasal obstruction	5.15 (NA)	1.45 (NA)	p < 0.0001
Nease 2004[36]	16 patients with NAO primarily caused by inferior turbinate hypertrophy	radiofrequency ITR	7.6 (NA)	4.1 (NA)	p = 0.028
	12 more patients in a placebo crossover to surgery		7.6 (NA)	3.7 (NA)	p < 0.05
Most 2006[16]	41 patients with functional obstruction	mix of endonasal and external procedures for nasal obstruction	7.6 ± 1.7	2.2 ± 2.1	p < 0.01
Li 2008[37]	45 adult patients with NAO and OSA	Septomeatoplasty	6.8 (6.2 –7.4)	1.6 (1.2 – 2.2)	p < 0.001
Yoo 2011[10]	17 NAO patients	functional rhinoplasty	5.7 ± 2.2	1.8 ± 1.4	p < 0.001
Lavinsky-Wolff 2012[25]	49 patients	24 with septorhinoplasty alone	6.17 ± 2.8	1.97 ± 2.7	p < 0.001
		25 with septorhinplasty with ITR	6.36 ± 2.8	2.24 ± 2.5	

*VAS scores were rescaled to a 0–10 scale, with 0 being no obstruction and 10 being the most obstructed.

Table 6

Average NOSE and VAS scores*

Compiled NOSE weighted means	
Pre-treatment	65 ± 22
Post-treatment	23 ± 20
Pre-treatment to post-treatment change	42
Healthy	15 ± 17
General population	42 ± 27

Compiled VAS weighted means	
Pre-treatment	6.7 ± 2.3
Post-treatment	2.1 ± 2.2
Pre-treatment to post-treatment change	4.6
Healthy	2.1 ± 1.6
General population	4.6 ± 2.6

*Scores reported as X ± Y, with X being the weighted mean score and Y being the weighted mean standard deviation