Patients' evaluation for the surgical management of nasal obstruction*

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Summary

Statement of problem: Surgery for nasal obstruction is performed to give a subjective benefit. We aimed to evaluate the surgical management of the nasal obstruction in the patient's perception.

Methods of study: The study was performed prospectively with 134 patients over the age of 18. They were allotted to three groups according to the level of nasal obstruction by clinical examination. The G1 group had only a deviated nasal septum (DNS), G2 had DNS and hypertrophy of inferior turbinates, and G3 had nasal valve problems in conjunction with DNS. All the patients had surgery focused on obstructive pathologies. The study was conducted using three different scoring systems to determine the patients' evaluation of the surgical procedures.

Results: The study included more man than woman, with a mean age around 28 (wide range). Twenty six patients were in G1, 73 patients in G2 and 35 patients in G3. Total and general Glasgow Benefit Inventory (GBI) scores for each group showed improvement postoperatively. There was a significant difference between the groups for general GBI score, and Post-hoc test showed that the improvement of G1 was greater than of G3. The influence of the surgery on physical health, psycho-social function and social interaction scores for each group showed no changes postoperatively. There was a significant improvement in all Nasal Obstruction Septoplasty Effectiveness (NOSE) scores and Likert Scale scores for each group. The improvement of G1 and G2 were greater than G3 on the Likert Scale.

Conclusion: Surgical management targeted to the region of obstruction improves symptoms and benefit in the patient's perception.

Key words: nasal obstruction, septoplasty, turbinoplasty, nasal valve surgery, nasal obstruction septoplasty effectiveness scale, glasgow benefit inventory, likert scale

Introduction

Nasal obstruction is an upper airway condition that can be caused by a variety of problems, such as a deviated septum or an obstruction at the external and internal nasal valves with the adjacent structures. Nasal septal surgery alone or in combination with inferior turbinate manipulations is a commonly performed otolaryngological procedure for the treatment of nasal obstruction [(1)].

Submucosal resection (SMR) was first defined by Freer in 1902, as the resection of quadrangular cartilage, the perpendicular lamina of ethmoid bone and total resection of the vomer. The era of modern septal surgery began in the 1940s with Cottle, Goldman, and Smith who recognised the disadvantages of submucous resection [(2)]. Inadequate surgery for nasal obstruction is still a dilemma. Specialized surgery to the obstructive pathology should be emphasized. The surgical correction of nasal septum does not always guarantee a successful outcome. The literature supports a reevaluation of surgical paradigms in patients with the physical findings of both a septal deviation and turbinate hypertrophy [(3,4)]. Corrective nasal valve surgery results in signi-

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ficant improvement in disease specific quality of life and high satisfaction level [5]. Some other studies have been performed to assess the impact of the surgery for nasal blockage on the quality of life of the patient [6,7].

The aim of this study is to evaluate surgery of nasal obstruction in the patient's perception, and to present our results. We used Nasal Obstruction Septoplasty Effectiveness (NOSE) scale and Glasgow Benefit Inventory (GBI) as validated outcome instruments, and a five-point Likert Scale to indicate the impact of surgery on the obstruction symptom [1,8-10].

Materials and methods

The study was performed prospectively between 2008-2010 in a tertiary hospital. IRB approval was provided by the ethics committee of our hospital. All enrolled patients gave signed informed consent.

Patient samples

This study included 134 patients which met the inclusion criteria as follows:

- At least 18 years old.
- Eligible for corrective nasal surgery for nasal septal deviation with/without additional anatomical causes of nasal obstruction.
- Completed the surveys preoperative and postoperative.
- Had a restored nasal patency postoperatively that did not need revision surgery.

Patients who had any of the following conditions or met any of the following criteria were excluded from the study:

- A history of allergy,
- Adenoid hypertrophy,
- Undergoing concurrent endoscopic sinus surgery, polypectomy or rhinoplasty along with the nasal septal surgery,
- Revision nasal surgery,
- With a main preoperative complaint other than nasal obstruction (e.g. snoring, facial pain, nasal discharge, postnasal drip syndrome, sinonasal malignancy, etc.).

With the above criteria, the patients with a restored nasal patency who completed NOSE preoperatively and NOSE, GBI and a five-point Likert Scale at least 6 months after the surgery were evaluated in this study.

Treatment and patient groups

The type of surgery was based on the level of obstruction, the degree of turbinate hypertrophy, existence of alar collaps and the stenosis of pyriform aperture by clinical examination. The patients were assigned to 3 groups with regard to the level of the anatomical obstruction. All patients had septoplasty, and as the anatomical pathology causing nasal obstruction is increased, the extent of the surgical procedure is expanded. Since the turbinoplasty has short- and long-term complications, such as post-operative bleeding, crusting, foul odour, pain, hyposmia and synechiae, the patients who underwent turbinoplasty were assigned to a separate group. The surgical procedures such as alar batten grafts, pyriform crest resection and caudal septal manipulations (e.g tongue-in-groove, riding spine, door stop) may impose additional discomfort on the patient. For this reason those patients were evaluated in an another group.

The patients with only deviated nasal septum (DNS) were assigned to G1, the cases with DNS along with hypertrophy of inferior turbinates to G2, and with nasal valve problems in conjunction with DNS to G3. The septoplasty (SP) operation performed to G1, SP and turbinoplasty operations to G2, SP and any of additional valve surgery procedures to G3. The patient groups and surgical procedures are summarized in Table 1.

Septal deviation is assessed with anterior rhinoscopy and endoscopical examination. Septoplasty performed with maxilla-premaxilla approach, Killian inscisions and endoscopically. The surgery intended to straighten the nasal septum, addressing all areas of deviation with reshaping including scoring, morselization, supporting, crushing and/or reconstructing of the deviated cartilage after straightening.

Hypertrophy of the inferior turbinate was defined with anterior rhinoscopy and endoscopical examination whether causing nasal obstruction or not. Turbinoplasty is defined as a surgical procedure on the inferior nasal turbinate, with outfracture and resection of the lower part that contacts the nasal floor.

A contemporary, three-dimensional description of the nasal valve area includes the upper lateral cartilages superiorly, cartilaginous septum medially, head of the inferior turbinate posteriorly, nasal floor inferiorly, and nasal alar and bony pyriform aperture laterally [11]. Nasal valve insufficiency is defined with anterior rhinoscopy, endoscopic examination and forced inspirium through the nose. When there is an inspiratory collapse, a Bachmann Test had been used to have positive predictive value. Prior to topicalization of the internal nose, the back end of a Q-tip or some other small instrument used to elevate the alar sidewall of the nose approximately 1–2 mm [12]. If the patient reported definite benefit from this maneuver, an alar batten graft is used. Alar batten grafts are applied caudal to the existing lateral crura and extended from the lateral one third of the lateral crura to the pyriform aperture in a precise pocket via a limited endonasal incision [13]. Pyriform crest resection is performed, when there is a stenosis at the nasal floor involving pyriform aperture. The caudal septal manipulation techniques performed to G3 patients were tongue-in-groove [14] (suturing the caudal septum between the middle cruras), riding spine [15] (binding the postero-caudal septal angle on the nasal spine with a niche), and door stop [16] (Table 1).

After completion of the surgery, we applied bilateral intranasal

packing with Merocel® per nasal cavity for about 48 hours. When subpericondrial and subperiosteal four tunnels are opened bilaterally, a silicone splined splint is applied for about one week.

Outcome measures

The study was conducted using three cross-sectional questionnaire surveys. The NOSE scale as a validated disease specific instrument, the GBI and a five-point Likert scale to indicate the impact of surgery on the obstruction symptom.

The patients completed the NOSE scale before and at minimum 6 months after the surgery. NOSE scores included (i) nasal congestion or stuffiness, (ii) nasal blockage or obstruction, (iii) trouble breathing through the nose, (iv) trouble sleeping, and (v) unable to get enough air through the nose during exercise or exertion. The raw values between 0-20 were multiplied by 5 to obtain 0-100 scores.

The other main outcome measurement GBI is an 18-item post-intervention questionnaire, as a validated measure developed especially for otolaryngological operations. It consists of three sub-scales, which assess:

- The patient's perception of the success of surgery (general benefit)
- The influence of the surgery on the patients' physical health (physical benefit)
- Psycho-social function and social interaction(social support)[17].

The response to each question is based on a five-point Likert scale where a score of 1 is given to the answer with the worse change in the status and 5 to the answer with the best change in the status. There is a total score and three subscales: a general subscale (12 questions), a social support subscale (3 questions) and a physical health subscale (3 questions). It gives a total score (18–90) and profile scores for general benefit (12–60), social support (3–15) and physical health (3–15). Each scale score constructed to range between 0-100. A score of 41-60 implies no change in the patient's perception of his/her health status [1,18]. All the patients completed the GBI at least 6 months after the surgery.

An another five-point Likert scale (much worse = 1, slightly worse = 2, same = 3, better = 4, much better = 5) was used to indicate the impact of nasal surgery on the obstruction symptom. The patients were asked to indicate the symptom by their response to that scale at least 6 months after the surgery. A mean score < 1 accepted as much worse, between ≥ 1and < 2 as slightly worse, between ≥ 2 and < 3 as same, between ≥ 3 and < 4 as better, and ≥ 4 and < 5 as much better.

Data collection

All of the patients met the criteria above and signed the consent form. The treating physician collected the preoperative data, covering medical history as well as the physician's assessment of the level of obstruction, the status of inferior turbinate hypertrophy, and the existence of alar colaps. Preoperative NOSE scale questionnaires were collected by the physician's secretary for data entry, and the patients were contacted to complete the NOSE scale, GBI and Likert scale at least 6 months after the surgery.

Statistical analyses

Analyses were conducted in NCSS (Number Cruncher Statistical System) 2007 & PASS 2008 Statistical Software (UT, USA).

The predictors of improvement for quantitative data, parameters showing normal distribution between groups compared with the One-way Anova test, and to detect the group causing difference Tukey's HSD Post-hoc test is used. As well as descriptive statistical methods (mean, standard deviation) are used. For parameters, which are not showing normal distribution between groups compared with the Kruskal-Wallis test and to detect the group causing difference, the Mann-Whitney U test is used. To assess the qualitative data, the chi-square test is used. The relationship between parameters is assessed with Spearman's Rho analysis. A $p < 0.05$ is considered as statistically significant.

Results

The study was designed with 134 patients (103 male, 31 female). The mean age was 28.62 ± 10.54 (ranging from 18-67). The demographic characteristics of the patients are shown in Table 2.

Table 1. The study groups, involved obstructive pathologies and the surgical procedures performed with respect to the patient groups.

Groups	Anatomic Pathology	Surgical Procedure
G1	• Only deviation of nasal septum	• Septoplasty
G2	• Deviation of nasal septum • And hypertrophy of inferior turbinate	• Septoplasty • And turbinoplasty

G3	• Deviation of nasal septum
	• With valve obstruction and/or alar colaps
	  • Dislocation of posterior caudal septum
	  • Caudal or dorsal deviations
	  • Hypertrophy of inferior turbinate
	  • Alar collaps
	  • Stenosis of pyriform aperture
		• Septoplasty
		-and any of-
		• Additional valve surgery procedures
		  • Alar batten grafts
		  • Pyriform aperture floor resection
		  • Caudal septal manipulations
		  • *Tongue-in-groove*
		  • Binding the postero-caudal septal angle on the nasal spine with a niche (*Riding spine*)
		  • *Door stop*

Table 2. The demographic distribution of the patients.

		G1	G2	G3	Total	[+]p
		Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	
Age		31.42 ± 10.23	27.72 ± 10.04	28.42 ± 11.66	28.62 ± 10.54	0.307
		n / %	n / %	n / %	n / %	[++]p
Gender	Female	5 /19.2	20 / 27.4	6 /17.1	31 / 23.13	0.433
	Male	21 / 80.8	53 / 72.6	29 / 82.9	10 / 76.86	
Total		26 / 19.4	73 / 54.5	35 / 26.1	134 / 100	

[+] One-way ANOVA test; [++] chi-square test; SP: septoplasty

Table 3. Surgical procedures performed in conjuction with septoplasty for nasal valve collapse in G3 patients (n = 35).

Procedures	n / %
• Alar batten grafts	4 / 11.43
• Pyriform aperture floor resection	7 / 20.00
• Caudal septal manipulations	
• *Tongue-in-groove*	9 / 25.71
• Binding the postero-caudal septal angle on the nasal spine with a niche (*Riding spine*)	18 / 51.43
• *Door stop*	7 / 20.00

There were 26 (19.4%) patients in G1 group, who underwent septoplasty alone, 73 (54.5%) patients in G2 group, who underwent septoplasty along with inferior turbinoplasty, and 35 (26.1%) patients in G3 group, who had nasal valve problems in conjunction with DNS and underwent septoplasty along with additional valve surgery procedures. These procedures were bilateral alar batten grafts (4/35, 11.43%), pyriform crest resection (7/35, 20.00%) and caudal septal manipulations including tongue-in-groove (9/35, 25.71%), riding spine (18/35, 51.43%), and door stop (7/35, 20.00%) techniques (Table 1 and 3). The mean follow-up time was calculated on the basis of the last visit of the patients at which they completed surveys postoperatively. None of the patients needed revision surgery, and the mean follow-up time was 7.42 months (range: 6 to 11).

GBI Scores

Total and general GBI scores for each group improved postoperatively. Although there was no significant difference ($p > 0.05$) between the patient groups considering total GBI score, there was a significant difference ($p < 0.05$) between the groups for general GBI score, and Post-hoc test showed that the improvement of G1 was greater than G3. There was no change in patient's perception of postoperative health status in physical benefit and social support for all groups ($p > 0.05$). Postoperative changes in total GBI scores and subscales for patient groups are summarized in Table 4.

Table 4. Postoperative GBI scores for patient groups.

GBI	G1	G2	G	p	post hoc
	Mean ± SD	Mean ± SD	Mean ± SD		
Total GBI	66.55 ± 8.21	63.58 ± 9.40	60.92 ± 9.00	0.051	ns
General benefit	70.87 ± 9.23	66.81 ± 10.58	61.23 ± 9.93	0.044*	G1 > G3
Physical benefit	56.41 ± 14.39	55.36 ± 16.63	52.38 ± 17.33	0.579	ns
Social support	59.93 ± 13.94	55.42 ± 12.48	54.71 ± 13.31	0.223	ns

One-way ANOVA test; *$p < 0.05$; ns: not significant

NOSE Scores

Greater scores indicates more severe nasal obstruction problems. There was a significant improvement in all NOSE scores after the surgery for all groups ($p < 0.01$). The baseline NOSE scores for all groups and the difference after the surgery are shown in Table 5.

Table 5. The baseline NOSE scores for groups and the differences between preoperative and postoperative.

NOSE		G1		G2		G3		p
		Mean (SD)	Median (range)	Mean (SD)	Median (range)	Mean (SD)	Median (range)	
Nasal congestion or stuffiness	Preop	2.65 (0.56)	3 (2-4)	2.51 (0.67)	2 (2-4)	2.68 (0.71)	3 (2-4)	0.257
	Postop	0.38 (0.75)	0 (0-2)	0.55 (0.87)	0 (0-3)	0.88 (1.05)	0 (0-3)	0.069
	Diff β	2.26 (0.77)	2 (1-4)	1.96 (0.77)	2 (1-4)	1.80 (0.79)	2 (0-4)	
	#Preop-Postop	0.001**		0.001**		0.001**		
Nasal blockage or obstruction		3.11 (0.51)	3 (2-4)	3.11 (0.39)	3 (2-4)	3.05 (0.41)	3 (2-4)	0.806
		0.84 (0.61)	1 (0-2)	1.12 (0.95)	1 (0-3)	1.43 (0.94)	1 (0-3)	0.050*
		2.26 (0.96)	2 (0-4)	1.98 (1.02)	2 (0-4)	1.63 (0.94)	2 (0-3)	
	#Preop-Postop	0.001**		0.001**		0.001**		
Trouble breathing through my nose		3.03 (0.19)	3 (3-4)	2.94 (0.49)	3 (2-4)	3.05 (0.48)	3 (0-3)	0.405
		0.73 (0.67)	1 (0-2)	0.76 (0.89)	1 (0-3)	1.26 (0.92)	1 (0-3)	0.014*
		2.01 (0.61)	2 (1-3)	2.17 (0.85)	2 (0-3)	1.80 (0.83)	2 (0-3)	
	#Preop-Postop	0.001**		0.001**		0.001**		
Trouble sleeping		2.34 (0.68)	2 (2-4)	2.20 (0.85)	2 (1-4)	2.23 (0.91)	2 (1-4)	0.442
		0.46 (0.90)	0 (0-3)	0.51 (1.09)	0 (0-4)	0.68 (1.23)	0 (0-4)	0.784
		1.88 (1.14)	2 (-1-4)	1.69 (0.95)	2 (-1-4)	1.54 (1.01)	2 (-1-4)	
	#Preop-Postop	0.001**		0.001**		0.001**		
Unable to get enough air through nose during exercise		2.73 (0.67)	3 (2-4)	2.62 (0.83)	3 (1-4)	2.68 (0.79)	3 (1-4)	0.753
		0.81 (1.05)	0 (0-3)	0.71 (0.99)	0 (0-3)	1.11 (1.18)	1 (0-3)	0.205
		1.92 (1.16)	2 (-1-3)	1.89 (0.87)	2 (-1-3)	1.57 (1.09)	2 (-1-3)	
	#Preop-Postop	0.001**		0.001**		0.001**		

Kruskal Wallis test is used; #: Wilcoxon Signed Ranks test; Diff β: Difference between preoperative and postoperative; *p < 0.05; **p < 0.01

Table 6. The evaluation of postoperative Likert Scale with respect to patient groups.

	Postoperative Likert Scale		p	post hoc
	Mean score ± SD	Median		
G1	4.30 ± 0.61	4		G1 > G3
G2	4.11 ± 0.66	4		G2 > G3
G3	3.51 ± 0.95	4	0.001**	G1 vs G2 no difference

Kruskal Wallis test is used; **p < 0,01 < 1 much worse, ≥ 1and < 2 slightly worse, ≥ 2 and < 3 same, ≥ 3 and < 4 better, and ≥ 4 and < 5 much better.

Likert Scale

The improvement in nasal obstruction symptom for each group was statistically significant in the Likert Scale (p < 0.01). The mean postoperative Likert Scale scores for groups are summarized in Table 6. Postoperative G1 and G2 scores were statistically greater than G3 (p: 0.001; p: 0.001), while there was no difference between G1 and G2 scores (p > 0.05).

Discussion

Nasal obstruction surgery is a common procedure in otolaryngology to improve QoL. The etiology of nasal obstruction is polyfactorial, and the differential diagnosis of nasal obstruction is wide, including physiological and anatomical pathology. It is important to remember that patients may have a combination of these factors contributing to the symptom of nasal obstruc-

tion [19]. Surgery is the current treatment for anatomico-pathological problems such as septal deviation, constant turbinate hypertrophy, existence of alar collapse and pyriform aperture obstruction. When the surgery is limited to the nasal septum, the obstruction symptom may persists postoperatively. Therefore it is often accompanied by inferior turbinate reduction or any additional manipulation [3,20].

Most of the patients with septum deviation deserve turbinoplasty and/or nasal valve surgery in addition to septoplasty. This may be the reason of the reduced number of only septoplasty patients (19%) and increased number of septoplasty with turbinoplasty patients (54%) in the current study.

Many methods of nasal airway evaluation including rhinomanometry, acoustic rhinometry and nasal peak flow have been used in the past [21-23]. These methods do not always correlate consistently with patient-reports of nasal obstruction [1]. The critical element on the success of nasal obstruction surgery is patients' satisfaction. Many authors have reported the impact of the surgery of nasal obstruction in the patients' perception with the NOSE and GBI scales [1,4,6,9,17,18,24-26]. They found those scales were correlated with examination findings and they were useful tools to evaluate the effectiveness of nasal obstruction surgery. Uppal, et al. [1] evaluated 75 patients undergoing septal surgery ± inferior turbinate reduction for nasal obstruction to determine the usefulness of GBI to assess the patient's perception of benefit derived from nasal septal surgery. They found a significant correlation between the GBI total score, subjective postoperative nasal obstruction, postoperative nasal symptoms score and change in nasal symptoms score. They concluded that GBI is a valuable tool for the assessment of benefit from nasal septal surgery for nasal obstruction and supported that it may be applicable in clinical practice.

In a recent study, 27 patients were studied with NOSE to evaluate the efficiency of this scale for septoplasty (without turbinate reduction). A very significant improvement in mean NOSE scores was achieved. They concluded that it was a very useful tool to evaluate the effectiveness of pure septoplasty [24]. Because of their utility, we used GBI and NOSE surveys in the patients who underwent septoplasty, turbinoplasty and nasal valve surgery. Rhee et al. [5] indicated that patients with nasal obstruction and a diagnosis of nasal valve compromise have a significant improvement in their disease-specific QoL after undergoing nasal valve surgery on the NOSE scale. The maximum improvement was seen at 6 months postoperatively due to resolution of oedema. The comparison between 3 and 6 month scores was not statistically significant indicating stability of mean scores [5,27]. We conducted the questionnaires at least 6 months after the surgery. We did not study postoperative clinical outcomes of anatomical obstructing pathology with fluid dynamic on nasal airflow. As the patients who needed a revision surgery were excluded in the study, every patient included in the study had a restored nasal patency.

Croy et al. [28] indicated social functioning was still impaired after surgery in septum patients. They investigated changes in quality of life (QoL) after nasal surgery in a total of 788 patients following sinus, septum, and combined nasal surgery. They used the Rhinosinusitis Disability Index (RSBI) and the SF-36 survey. Subjective improvement of symptoms was found in more than 80% of the patients. They also found an equal improvement in sinonasal symptomatology after the operation, but less influence on the general QoL for septal surgery. They associated this to the fact that QoL was not greatly affected in septoplasty patients before surgery. The patient's perception of the success of surgery was improved in total and general GBI scores, and patients rated their physical and social functioning are still impaired after the surgery in current study.

In the current study, total and general GBI scores for each group showed improvement postoperatively, meaning that our surgical approaches provided subjective benefit for all patient groups. General GBI scores for G1 group was statistically greater than G3. It means that the improvement in the patient's perception of the success of surgery for G1 was greater than G3.
There was a significant improvement in all NOSE scores for all three groups. Nasal congestion/stuffiness, nasal blockage/obstruction, trouble breathing through the nose, trouble sleeping, and unable to get enough air through the nose during exercise symptoms showed improvement for all patient groups.
Although mean Likert scores showed statistically significant increases for all groups, the increase in G1 and G2 were statistically greater than in G3. The cause of relatively less improvement for G3 scores might be due to possible worse pathology before the surgery that was not the subject of this study. We used alar batten grafts, pyriform aperture floor resection and caudal septal manipulations such as tongue-in-groove, riding spine, and door stop for nasal valve collapse. Those patients might be evaluated more meticulously.

The strengths of the present study include the prospective design, the use of three validated (one general health and two disease-specific) QoL scales. The weaknesses of this study may be the lack of a control group. As mentioned in former studies, there is no alternative medical option for anatomico-pathological nasal obstruction, so it is difficult to form a control group [6,7].
A lack of study is missing data on the particular clinical outcomes of the patient groups.
The validated, disease-specific, multi-item instruments allow a more dimensional assessment of the surgical managements

of the anatomico-pathological nasal obstruction. The surgical procedure specified to the pathology, improves obstruction symptoms and benefit.

We did not study the surgical outcomes with rhinomanometry, acoustic rhinometry or nasal peak flow, because they were not available. Therefore, the effectiveness of surgical procedures on the anatomical stenosis is not evaluated accurately.
Although the surgery is performed to give a subjective benefit in relieving nasal obstruction in many patients, there are still some patients that complain of persistent symptoms after surgery, despite a restored nasal patency. With regard to this controversial aspect, the studies evaluating the surgical approaches specified to the anatomical obstructing area in conjunction with the studies of fluid dynamic on nasal airflow, at the same time commenting on QoL with validated, disease-specific, multi-item surveys may give a more effective contribution.

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Authorship contribution

DA, MY and MH made the research, reviewed the literature, and wrote the majority of the manuscript. All operations performed by DA, MH, and FD. ZS examined all the patients, had responsibility for conducting surveys, also wrote one part of the materials and method section. FD is head of the project, contributed to the study design.

Conflict of interest

The authors have no actual or potential conflict of interest in relation to this paper.

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