

Objective and subjective evaluation of operation success in patients with nasal septal deviation based on septum type

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ABSTRACT

Background: The present study was performed to compare postoperative success and patient satisfaction among patients with septum deviation according to deviation type.

Methods: Eighty-six patients with septal deviation were recruited and divided according to six deviation types as defined previously. Patients were followed up for a mean duration of 6.3 ± 0.9 months. All patients were individually examined by nasal endoscopy and paranasal computed tomography. The tests applied included a visual analog scale (VAS), The Nasal Obstruction Symptom Evaluation (NOSE) scale, acoustic rhinometry (AR), rhinomanometry (RMM), and peak nasal inspiratory flow (PNIF).

Results: All groups showed significant improvement in VAS scores postoperatively ($p = 0.0001$). All groups showed a significant decrease in NOSE scale scores postoperatively. PNIF values of all groups increased postoperatively ($p < 0.05$). AR values of narrow cavities in all groups increased postoperatively, but this increase was observed only for wider cavities in groups 2, 4, and 6. RMM values were higher in the narrow cavities in types 2, 4, and 6 postoperatively, whereas only types 4 and 6 had higher values in the wider cavities.

Conclusion: Patients with septal deviation types 2, 4, and 6 benefited most from septal surgery. These deviation types yielded higher levels of postoperative amelioration and patient satisfaction in terms of quality of life.

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Nasal obstruction is one of the most common symptoms seen in daily otolaryngological practice.¹ This symptom can be the consequence of a functional problem, such as allergic rhinitis or mucosal congestion, or can result from anatomic problems, such as concha bullosa, adenoid hypertrophy, nasal polyps, or septal deviation.² Septum deviation is the most common cause of nasal obstruction, and septoplasty is the third most common type of otolaryngological surgery conducted in the United States.³ Many factors contribute to operative success and reported patient satisfaction ranges between 63 and 90%.^{4,5}

Currently, indication for septoplasty is based on objective and subjective evaluation methods. Subjective evaluation is performed based on symptom scores such as a visual analog scale (VAS) and quality of life as assessed using the Nasal Obstruction Symptom Evaluation (NOSE) scale.^{2,6} Objective evaluation is based on nasal tests, such as rhinomanometry (RMM), acoustic rhinometry (AR), peak nasal inspiratory flow (PNIF), and computed nasal resistance^{6–9}.

Although many methods are available to aid the decision-making process, the decision as to whether patients should undergo the operation remains subjective. This decision depends on cost-effectiveness and on doctor and patient satisfaction as well as on medicolegal issues. Furthermore, few studies have examined patient satisfaction and operative success, and the studies reported in the literature did not assess these issues with regard to septal type.

The present study was performed to evaluate patient satisfaction and postoperative success in terms of subjective and objective parameters in patients classified by septal deviation type according to Baumann *et al.*¹⁰

MATERIALS AND METHODS

This study was performed in the Department of Otorhinolaryngology from July 2011 to July 2013 after approval by the Institutional

Review Board. Informed consent was obtained from 60 patients who underwent septoplasty.

Patients at least 18 years old with nasal obstructions who received topical nasal steroids, antihistaminics and nasal decongestants as medical treatment for rhinitis but did not show any improvement in their symptoms were included in the study. The exclusion criteria included pediatric septoplasty, presence of septal perforation, and revision septoplasty.

Septal Deviation Types

Patients were classified into six groups based on the type of septal deviation as defined by Baumann *et al.* based on their analysis of 1088 patients¹⁰ (Fig. 1). The nasal cavity with the septal deviation was designated as the narrow cavity, and the contralateral side was designated as the wide cavity; results were reported accordingly.

Surgical Technique

All patients underwent septoplasty with submucosal resection after either modified Killian or hemitransfixion incision. The cartilage of the septum was separated from the bony septum by posterior chondrotomy. All deviated cartilage and bony material were resected. The deviated maxillary crest was trimmed with a nasal gouge and hammer. Inferior turbinate radiofrequency, outfracture, and lateralization were performed in addition to septal correction. Mucosal flaps were stabilized by transseptal suturing, and the opened nasal cavity was observed at the end of the operation. Doyle nasal splints were placed after septoplasty and left for 1 week.¹¹ Postoperatively, patients received nasal irrigation and ointments for humidification.

Visual Analog Scale

Nasal obstruction was evaluated preoperatively and postoperatively. Patients were evaluated in terms of the narrow nasal cavity, wide nasal cavity, and the whole nose separately. VAS scores were based on a scale of 0 (total obstruction) to 10 (no obstruction).

NOSE Scale

The NOSE scale was used to compare preoperative and postoperative nasal obstruction symptomatology to evaluate the improvement achieved by septoplasty.² Patients completed the NOSE scale preop-

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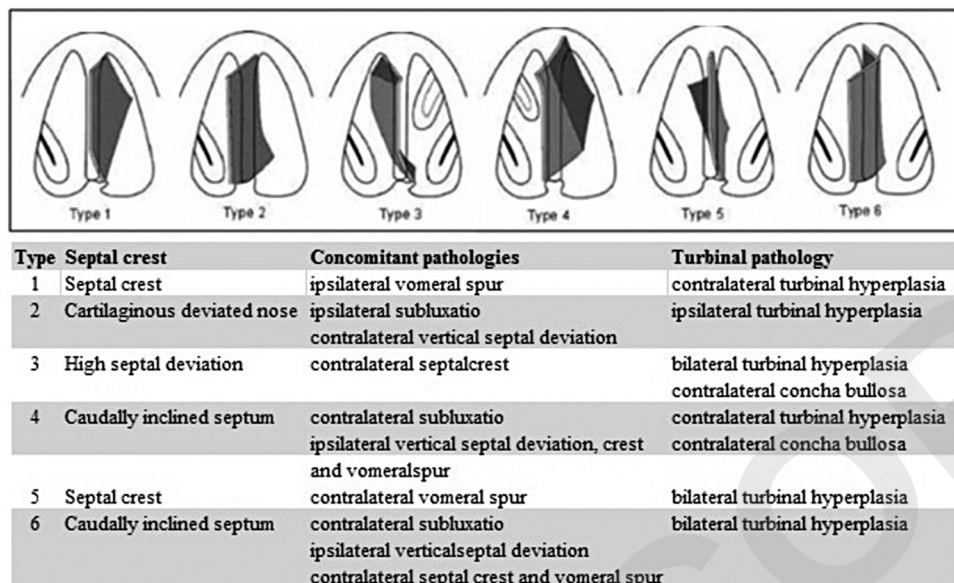


Figure 1. Six types of nasal septal deviation (Baumann et al. 2007¹⁰).

eratively and at the 6th postoperative month. The raw scores on the final instrument ranged from 0 to 20. The instrument was then scaled to total scores of 0–100 by multiplying the raw score by 5, where a score of 0 indicated no problems with nasal obstruction and a score of 100 indicated the worst possible problems with nasal obstruction.

Acoustic Rhinometry

AR (Acoustic Rhinometer A1; GM Instruments, Ltd., Kilwinning, Scotland, U.K.) was conducted according to the guidelines defined by the Standardization Committee.¹² Both nasal cavities were decongested with 2 puffs of 0.05% oxymetazoline after 15 minutes of rest. Patients rested for 15 minutes after decongestion. A standard anatomic nasal applicator was used for measurements. Patients were asked to hold their breath during the measurements. The mean value of three measurements was calculated. Unilateral minimal cross-sectional area (MCA) was calculated, and 0- to 7-cm nasal cavity volume (VOL) was measured.

Rhinomanometry

RMM was performed after AR. During measurements, the contralateral nasal cavity was obstructed, and inspiratory resistance was measured according to the Bross model.¹² Active anterior RMM was performed with a Rhinomanometer NR6 (GM Instruments, Ltd.).

Peak Nasal Inspiratory Flow

PNIF measurement was performed bilaterally three times with the PNIF apparatus (Clement Clarke International, Harlow, Essex, UK). The highest of the three measurements was recorded in terms of liters per minute.

Statistics

Statistical analysis was performed using SPSS Version 13.0 software for Windows (SPSS, Inc., Chicago, IL). All quantitative variables were estimated using measures of central location (*i.e.*, mean and median) and measures of dispersion (*i.e.*, SD). The normality of the data was checked using the Kolmogorov–Smirnov test of normality.

Pre- and postoperative comparisons were performed by paired *t*-test when parameters were normally distributed. Otherwise, Wilcoxon's test was used. Demographic characteristics were evaluated with Kruskal–Wallis test and chi-square test for mean age and gender

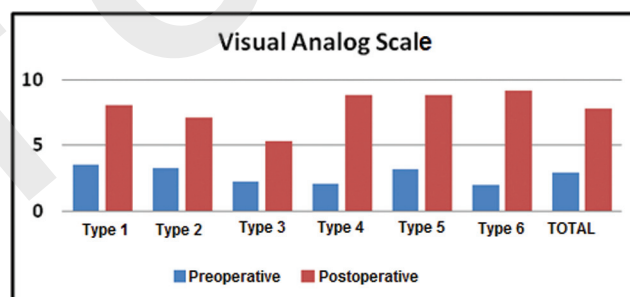


Figure 2. Preoperative and postoperative visual analog scale (VAS) scores.

distribution, respectively. Correlations were evaluated with Pearson's correlation test. In all analyses, $p < 0.05$ was taken to indicate statistical significance.

RESULTS

Eighty-six subjects were recruited for the study; these patients were divided into groups of similar age, gender, and follow-up duration ($p = 0.319$, $P = 0.563$, and $P = 0.425$, respectively; Table 1).

Subjective Evaluations

Visual Analog Scale. The wider nasal cavity had a significantly higher VAS score compared with the narrow nasal cavity in all groups ($p = 0.0001$). The postoperative VAS score was significantly higher compared with the preoperative score in all groups ($p = 0.0001$; Fig. 2). The postoperative increases were highest in groups 4 and 6.

Nasal Obstruction Symptom Evaluation. Postoperative NOSE scores were significantly lower compared with the preoperative scores in all groups ($p < 0.05$). The highest scores were seen in groups 2, 4, and 6, and the greatest changes in NOSE scores after surgery were observed in these three groups (Fig. 3).

Objective Evaluations

Acoustic Rhinometry. The mean MCA values of narrow nasal cavities in all groups increased postoperatively ($p < 0.05$; Table 2). The mean MCA values of the wider nasal cavities decreased postoperatively in

Table 1 Demographic characteristics (age, gender, and duration of follow-up)

Groups	n	Gender (Male)	Gender (Female)	Age (yr) Mean $\pm$ SD	Follow-up Time (mo) Mean $\pm$ SD
Type 1	22	18	4	33.3 $\pm$ 13.2	6.2 $\pm$ 1.3
Type 2	15	9	6	27.9 $\pm$ 12.6	6.5 $\pm$ 0.4
Type 3	13	10	3	39.8 $\pm$ 10.7	6.3 $\pm$ 0.9
Type 4	14	10	4	30.3 $\pm$ 11.0	6.7 $\pm$ 1.2
Type 5	11	7	4	27.2 $\pm$ 9.0	6.1 $\pm$ 0.7
Type 6	11	8	3	33.0 $\pm$ 13.4	6.4 $\pm$ 1.5
Total	86	62	24	32.4 $\pm$ 12.4	6.3 $\pm$ 0.9

Table 2 AR: Preoperative and postoperative MCA values (cm²)

Groups	Narrow Side Mean $\pm$ SD Preoperatively	Narrow Side Mean $\pm$ SD Postoperatively	Paired tTest	Wide Side Mean $\pm$ SD Preoperatively	Wide Side Mean $\pm$ SD Postoperatively	Paired tTest
Type 1	0.65 $\pm$ 0.20	0.81 $\pm$ 0.24	$p = 0.034$	0.76 $\pm$ 0.21	0.87 $\pm$ 0.30	$p = 0.063$
Type 2	0.57 $\pm$ 0.16	0.79 $\pm$ 0.14	$p = 0.003$	0.80 $\pm$ 0.21	0.97 $\pm$ 0.40	$p = 0.046$
Type 3	0.51 $\pm$ 0.14	0.76 $\pm$ 0.17	$p = 0.032$	0.77 $\pm$ 0.29	0.89 $\pm$ 0.23	$p = 0.073$
Type 4	0.37 $\pm$ 0.15	0.68 $\pm$ 0.23	$p = 0.001$	0.66 $\pm$ 0.20	0.84 $\pm$ 0.13	$p = 0.007$
Type 5	0.71 $\pm$ 0.91	0.86 $\pm$ 0.13	$p = 0.014$	0.75 $\pm$ 0.16	0.94 $\pm$ 0.33	$p = 0.085$
Type 6	0.38 $\pm$ 0.11	0.74 $\pm$ 0.29	$p = 0.001$	0.67 $\pm$ 0.20	0.89 $\pm$ 0.22	$p = 0.027$
Total	0.53 $\pm$ 0.20	0.77 $\pm$ 0.18	$p = 0.001$	0.73 $\pm$ 0.21	0.95 $\pm$ 0.29	$p = 0.001$

AR = acoustic rhinometry; MCA=minimal cross-sectional area.

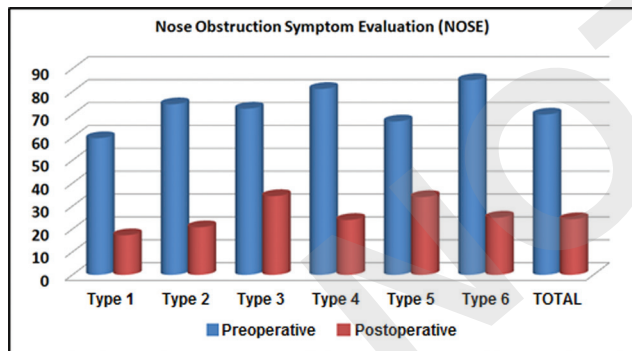


Figure 3. Preoperative and postoperative nasal obstruction symptom evaluation (NOSE) scores.

deviations types 2, 4, and 6 ($p < 0.05$; Table 2). Although similar, the decreases were not significant in the remaining groups ($p > 0.05$; Table 2). The greatest postoperative increases in mean MCA value occurred in the types 4 and 6 deviation groups, and minimum values were observed in the type 1 group (Table 2). VOL values of narrow cavities in all groups increased postoperatively ($p < 0.05$). The VOL values of the wider cavities increased significantly in groups 2, 4, and 6 ($p < 0.05$); although increases were also seen in the other groups, they were not significant (Table 3). The highest percentage increases in mean VOL value were seen in groups 4 and 6, and the smallest increase was seen in group 2 (Table 3).

RMM. Nasal airway resistance (NAR) values of narrow nasal cavities decreased significantly in groups 2, 4, and 6 ($p < 0.05$; Table 4). Similar decreases occurred in the remaining groups but they were not significant ($p > 0.05$; Table 4). NAR values of wider nasal cavities decreased significantly in groups 4 and 6 ($p < 0.05$; Table 4). Although similar decreases were seen in the remaining groups, they were not significant ($p > 0.05$; Table 4).

Peak Nasal Inspiratory Flow. The mean preoperative PNIF value was 80.2 ± 26.8 L/min, which increased to 123.6 ± 34.2 L/min postoperatively. Statistically significant increases were seen in all septal deviation types ($p < 0.05$; Fig. 4).

Correlation Analysis

Positive correlations were observed between objective AR and RMM values and subjective evaluations ($p < 0.05$). PNIF was significantly correlated with NOSE and VAS scores ($p < 0.05$).

DISCUSSION

Many factors affect surgical outcome in septoplasty surgery. One of the most important factors is the type of septal anatomic deformity. The decision to perform septoplasty is based on patients' subjective symptomatology and the results of nasal examination and paranasal tomography. The most common cause of postoperative patient dissatisfaction is the lack of clear indication for surgery.^{13,14} This study was performed to determine the septal deviation type(s) for which the operation shows the greatest benefit. The most current classification of septal deviation types, that of Baumann *et al.*,¹⁰ was used; six septum types were evaluated individually and compared. Operative success was evaluated in terms of both subjective and objective outcomes.

The present study revealed that both objective (AR, RMM, and PNIF) and subjective (VAS and NOSE) surgical improvements occurred, particularly in deviation types 2, 4, and 6. Especially, groups 4 and 6 showed maximum improvement postoperatively, and postoperative patient satisfaction was highest in these two groups. Thus, these two groups benefited most from the surgery.

Stewart *et al.* developed the NOSE scale to evaluate levels of nasal obstruction.² NOSE can be used for assessment of disease-specific quality of life and comparison of surgical techniques and postoperative results.² Therefore, NOSE was used to compare preoperative and postoperative nasal obstruction symptoms. Although the NOSE score increased significantly in all groups, the increases were most pronounced in groups 2, 4, and 6. This was probably because of the presence of anterior septal subluxation. Minimal changes were seen in group 1. The NOSE scale is a useful tool to aid in deciding which patients are likely to benefit from the operation.¹⁵

Contradictory results have been reported regarding the use of AR as a decision-making tool for septoplasty; some studies have shown good correlations, whereas others have not.^{16–21} Although preoperative and postoperative assessment of MCA and VOL values of narrow

Table 3 AR: Preoperative and postoperative VOL values (0–7 cm; cm³)

Groups	Narrow Side Mean $\pm$ SD Preoperatively	Narrow Side Mean $\pm$ SD Postoperatively	Paired <i>t</i> Test	Wide Side Mean $\pm$ SD Preoperatively	Wide Side Mean $\pm$ SD Postoperatively	Paired <i>t</i> Test
Type 1	8.27 $\pm$ 3.80	12.01 $\pm$ 3.80	<i>p</i> = 0.001	10.28 $\pm$ 3.56	12.37 $\pm$ 6.31	<i>p</i> = 0.118
Type 2	7.48 $\pm$ 2.30	10.15 $\pm$ 1.58	<i>p</i> = 0.025	9.86 $\pm$ 4.21	13.22 $\pm$ 1.90	<i>p</i> = 0.012
Type 3	7.08 $\pm$ 2.32	10.93 $\pm$ 5.92	<i>p</i> = 0.040	11.45 $\pm$ 2.12	13.04 $\pm$ 5.01	<i>p</i> = 0.210
Type 4	6.20 $\pm$ 1.29	10.53 $\pm$ 3.35	<i>p</i> = 0.001	8.33 $\pm$ 1.56	11.21 $\pm$ 2.21	<i>p</i> = 0.001
Type 5	8.62 $\pm$ 1.83	12.52 $\pm$ 1.15	<i>p</i> = 0.001	9.97 $\pm$ 1.96	11.49 $\pm$ 3.14	<i>p</i> = 0.264
Type 6	6.34 $\pm$ 1.65	11.28 $\pm$ 3.38	<i>p</i> = 0.001	8.96 $\pm$ 3.17	10.90 $\pm$ 2.80	<i>p</i> = 0.095
Total	7.41 $\pm$ 2.63	11.06 $\pm$ 3.75	<i>p</i> = 0.001	9.18 $\pm$ 3.02	12.33 $\pm$ 4.19	<i>p</i> = 0.001

AR = acoustic rhinometry; VOL = volume.

Table 4 RMM: Preoperative and postoperative NAR values (Pa/mL per s)

Groups	Narrow Side Mean $\pm$ SD Preoperatively	Narrow Side Mean $\pm$ SD Postoperatively	Paired <i>t</i> Test	Wide Side Mean $\pm$ SD Preoperatively	Wide Side Mean $\pm$ SD Postoperatively	Paired <i>t</i> Test
Type 1	0.75 $\pm$ 0.41	0.66 $\pm$ 0.56	<i>p</i> = 0.516	0.68 $\pm$ 0.27	0.55 $\pm$ 0.43	<i>p</i> = 0.214
Type 2	0.98 $\pm$ 0.39	0.70 $\pm$ 0.26	<i>p</i> = 0.020	0.73 $\pm$ 0.20	0.57 $\pm$ 0.46	<i>p</i> = 0.155
Type 3	0.89 $\pm$ 0.33	0.72 $\pm$ 0.32	<i>p</i> = 0.151	0.73 $\pm$ 0.30	0.58 $\pm$ 0.23	<i>p</i> = 0.087
Type 4	1.44 $\pm$ 0.23	0.81 $\pm$ 0.36	<i>p</i> = 0.001	0.94 $\pm$ 0.34	0.67 $\pm$ 0.19	<i>p</i> = 0.005
Type 5	0.83 $\pm$ 0.47	0.74 $\pm$ 0.24	<i>p</i> = 0.390	0.76 $\pm$ 0.41	0.66 $\pm$ 0.22	<i>p</i> = 0.491
Type 6	1.36 $\pm$ 0.79	0.84 $\pm$ 0.47	<i>p</i> = 0.008	0.81 $\pm$ 0.12	0.72 $\pm$ 0.18	<i>p</i> = 0.135
Total	1.01 $\pm$ 0.51	0.7 $\pm$ 0.40	<i>p</i> = 0.001	0.77 $\pm$ 0.29	0.61 $\pm$ 0.33	<i>p</i> = 0.001

RMM = rhinomanometry; NAR = nasal airway resistance.

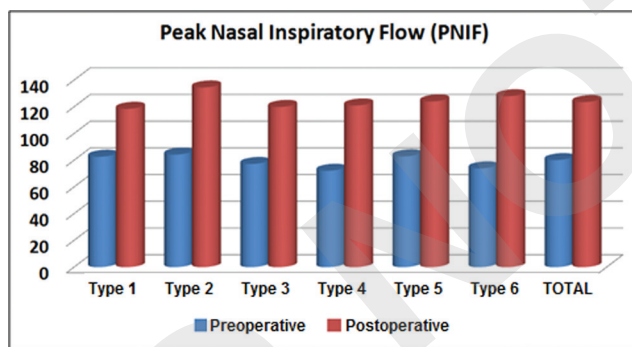


Figure 4. Preoperative and postoperative peak nasal inspiratory flow (PNIF) values.

nasal cavities revealed increases in all groups in the present study, values for the wider nasal cavity increased significantly only in groups 2, 4, and 6 (Table 2). The most pronounced increases in mean MCA and VOL after surgery occurred in groups 4 and 6. These objective evaluations showed maximal benefit of surgery for these two groups.

The AR values and subjective symptom scores were significantly correlated. NAR values decreased significantly in groups 2, 4, and 6 for narrow cavities and in groups 4 and 6 for wider cavities (Table 4). AR and RMM values were significantly correlated. Rhinomanometric evaluation revealed the greatest improvement and the lowest NAR in groups 4 and 6.

PNIF measurements can be easily repeated. It is not suitable to use PNIF measurements as a means of deciding which patients should undergo surgery, but they can be used for follow-up.¹⁸ PNIF values improved significantly in all groups, with the greatest improvements seen in groups 4 and 6. This was interpreted as a consequence of septal subluxations that were corrected postoperatively. PNIF measurements were strongly correlated with subjective symptoms.²² Our PNIF values were significantly correlated with NOSE scores, which was consistent with previous reports.

When evaluating nasal obstruction, the various tools complement one another, and the surgeon must make best use of the available data in the decision-making process. The present study was performed to investigate and compare the objective and subjective outcomes of different septal deviation types. The results indicated that deviation types 2, 4, and 6 benefit more from surgery than do the other types. This should be taken into consideration during management of patients with septal deviation. Therefore, surgery should be reconsidered in patients with deviation types 1, 3, and 5. Patients should be warned about variable surgical outcomes and postoperative patient satisfaction.

The most commonly used objective and subjective tests were used in a complementary way in the present study. Septal deviation types were studied individually and compared. Although patients were followed up for 6 months in the present study, longer follow-up periods will yield more valuable information. Additional studies are needed to substantiate strategies for managing patients with septal deviation.

CONCLUSIONS

Operative outcomes of nasal septum types were compared using objective and subjective measures. Septal deviation types 2, 4, and 6 benefited most from septoplasty surgery as assessed by objective and subjective measures. These deviation types are likely to result in greater patient satisfaction and postoperative amelioration in terms of disease-related quality of life.

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