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Revision septoplasty: Review of sources of persistent nasal obstruction

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ABSTRACT

Background: *Patients with nasal obstruction from septal deviation commonly undergo septoplasty to improve nasal airflow. Some patients suffer from persistent obstruction after their primary septoplasty and may undergo a revision septoplasty to improve their nasal passageway. Our objective was to identify patients who underwent revision septoplasty and to identify their sources of persistent nasal obstruction.*

Methods: *Patients who underwent septoplasty at our institution between 1995 and 2005 were reviewed. Data is collected on demographics, comorbidities, age at septoplasty, associated and concomitant procedures, surgical approach, and anatomic site of obstruction.*

Results: *Five hundred forty-seven patients met inclusion criteria including 477 who underwent primary septoplasty and 70 who underwent revision surgery. Nineteen percent of nonrevision patients underwent nasal valve surgery along with their primary septoplasty versus 4% of patients in the revision group. Fifty-one percent of revision patients had nasal valve surgery at revision surgery. Patients who underwent sinus surgery along with primary septoplasty were less likely to undergo revision septoplasty. History of facial trauma, obstructive sleep apnea, site of deviation, and performance of inferior turbinate surgery did not affect the likelihood of revision septoplasty.*

Conclusion: *A significant number of patients who undergo revision septoplasty also have nasal valve collapse. We recommend that in addition to septal deviation and inferior turbinate hypertrophy, nasal valve function be fully evaluated before performing septoplasty. This will help to ensure a complete understanding of a patient's nasal airway obstruction and, consequently, appropriate and effective surgical intervention.*

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Key words: Nasal obstruction, nasal valve, revision, septoplasty, septum, surgery, turbinate

The nasal septum is the key midline support structure of the nose and is composed of the quadrilateral cartilage, perpendicular plate of the ethmoid bone, palatine bone, and vomer. Although anatomic deviation of the septum is common,[1] significant deviation can obstruct the nasal airway and impact patient's overall health and quality of life. Patients who fail medical management of their nasal obstruction may undergo surgical septoplasty to remove the obstructing parts of their septum

Septoplasty is one of the most regularly performed Otolaryngology–Head and Neck Surgery procedures[2] in the United States. The most common indication for septoplasty is to relieve persistent nasal airway obstruction from septal deviation. Although usually performed in isolation, septoplasty is also executed in association with sinus surgery or rhinoplasty, or as part of a transsphenoidal approach to a pituitary mass. Septoplasty may also be performed concomitantly with inferior turbinate resection and nasal valve surgery to relieve nasal obstruction. Techniques for septoplasty vary and include submucous resection, standard septoplasty, and extracorporeal septoplasty. Approaches also vary and include external approaches often used during rhinoplasty, standard endonasal approaches and, more recently, endoscopic approaches.

Success rates for septoplasty range in the literature from 43 to 85%[3–6] and depend greatly on the tool used to measure success. These tools include patient satisfaction questionnaires, physical examination, acoustic rhinomanometry, and change in quantity of medications used to relieve nasal obstruction. Of those patients with persistent nasal obstruction and continued septal deviation, some pursue revision surgery. For those patients who do undergo revision septoplasty, it is unclear if their indication for surgery stems from an incompletely treated septal deviation, overcorrection of the septum, iatrogenic weakening of intrinsic nasal support, or unmasking of such nasal pathology as inferior turbinate hypertrophy, nasal valve obstruction, and allergic mucosal disease. Also undefined in these patients are the physical characteristics of their persistent septal problem, as well as any predisposing factors that might have increased their risk for failure of primary septoplasty. The purpose of this study was to review our institution's experience with patients undergoing revision septoplasty and try to identify the sources of their persistent nasal airway obstruction.

METHODS

After approval by the Human Investigation Committee, all patients with a Current Procedural Terminology code for septoplasty performed at the University of Virginia (UVA), Department of Otolaryngology–Head and Neck Surgery, between 1995 and 2005 were identified. Data were collected on patient gender, age at primary septoplasty, and pertinent comorbidities including obstructive sleep apnea, as well as any history of facial trauma. Data were also recorded on the surgical approach for the septoplasty (closed, open, and endoscopic), and whether any associated procedures were performed (sinus surgery or pituitary gland surgery). Adjunctive

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nasal airway procedures (inferior turbinate and nasal valve surgery) were also documented. Operative notes were reviewed for the side and site of anatomic deviation. Patients undergoing revision septoplasty were identified and data on the age at and the time between primary and revision surgery were collected. A similar set of anatomic and surgical data were collected for revision procedures, as had been collected for primary septoplasties. Statistical analysis was performed using a chi-squared test to compare the percentages between the two groups. Patient age and time to revision was compared using a Student's *t*-test. Logistic regression analysis was used for multivariate analysis.

RESULTS

Five hundred forty-seven patients were identified, comprised of 214 (39%) female and 333 (61%) male patients. Of these 547 patients, 477 underwent primary septoplasty and 70 underwent revision septoplasty. Forty-five (8%) patients had a diagnosis of obstructive sleep apnea, including 36 (8%) in the primary group and 9 (13%) in the revision group. One hundred ninety (35%) patients had a history of facial trauma before their first septoplasty, including 158 (33%) in the primary group and 32 (46%) in the revision group (Table 1). The overall mean age for all 547 patients at septoplasty was 37 years (SD, 14). The mean age of the 477 patients in the nonrevision group was 38 (SD, 14). In the revision group, the mean age at their primary septoplasty was available for 61 of the 70 patients and was 31 years (SD, 13). The mean age of the 70 revision patients at the time of their revision procedure was 39 years (SD, 14). For patients who underwent revision septoplasty, the average time between their primary and revision procedures was 6.5 years (SD 9; Table 2).

One hundred seventy-four (36%) patients in the nonrevision group underwent endoscopic sinus surgery (ESS) at the time of their septoplasty, compared with and 9 (13%) patients in the revision group who underwent ESS at the time of their primary septoplasty. Eighty-seven (18%) of the 477 patients in the nonrevision group underwent rhinoplasty at the time of their septoplasty compared with 14 (20%) of the revision patients who underwent rhinoplasty at the time of their primary septoplasty. Seven (1%) of the 477 patients in the nonrevision group underwent surgery of the pituitary gland at the time of their septoplasty compared with none of the revision patients at the time of their primary septoplasty. On univariate analysis, patients who were >29 years old at the time of their primary septoplasty were significantly ($p < 0.001$) less likely to undergo revision surgery. Patients who underwent ESS at the time of their primary surgery were also significantly less likely to undergo revision surgery ($p < 0.001$). Patients who had suffered facial trauma before their primary surgery were more likely to undergo revision surgery ($p = 0.038$) on univariate analysis. Gender, obstructive sleep apnea, rhinoplasty, and pituitary surgery were not significant factors in patients who underwent revision septoplasty. On multivariate analysis, age >29 years ($p = 0.014$; odds ratio [OR] = 0.486) and ESS ($p = 0.002$; OR = 0.226) remained significant factors, while trauma lost its significance ($p = 0.312$; OR = 1.38) (Table 3).

Because 25 of the 70 patients who underwent revision septoplasty had their primary septoplasty performed at the

Table 1 **Demographics (n = 547)**

No. of patients	Primary	Revision	Total
Primary septoplasty			477
Revision septoplasty			70
Total (all septoplasty)			547
Gender (no./percent)			
Female primary			183 (38)
Female revision			31 (44)
Female total			214 (39)
Comorbidities			
OSA	36 (8)	9 (13)	45 (8)
Facial trauma	158 (33)	32 (46)	190 (35)

OSA = obstructive sleep apnea.

Table 2 **Age at surgery**

		n
Mean age at surgery for all patients	37 (SD, 14)	547
Mean age at surgery for nonrevision patients	38 (SD, 14)	477
Mean age at surgery for revision patients		
Primary septoplasty	31 (SD, 13)	61
Revision septoplasty	39 (SD, 14)	70
Time (yr) between primary and revision procedures	6.5 (SD, 9)	61

Table 3 **Univariate analysis of factors**

	Primary No. (%)	Revision No. (%)*	*p* Value
Age ≥30 yr	331 (69)	29 (48)#	<0.001
Sinus surgery	174 (36)	9 (13)	<0.001
Trauma	158 (33)	32 (46)	0.038§
OSA	36 (8)	9 (13)	0.852
Pituitary surgery	7 (1)	0 (0)	0.307
Rhinoplasty	87 (18)	14 (20)	0.722

**Refers to data on the primary septoplasty in patients who underwent revision surgery.*

#Age at primary surgery available only on 61 of the 70 revision patients.

§Trauma loses statistical significance on multivariable analysis.

OSA = obstructive sleep apnea.

Table 4 **Concomitant surgical procedures**

Nasal valve surgery		
Nonrevision patients (primary surgery)*	93 (19%)	$p = 0.034$
Revision patients (primary surgery)#	1 (4%)	
Revision patients (revision surgery)#	10 (42%)	$p = 0.002$
Revision patients (revision surgery)§	36 (51%)	
Inferior turbinate urgery		
Nonrevision patients (primary surgery)*	99 (21%)	$p = 0.198$
Revision patients (primary surgery)#	6 (24%)	
Revision patients (revision surgery)#	2 (8%)	$p = 0.122$
Revision patients (revision surgery)§	6 (8%)	

*$n = 477$.
#$n = 25$.
§$n = 70$.

UVA, complete data and surgical details on the primary procedure were available for these 25 revision patients. Evaluation of adjunctive nasal airway procedures showed that 93 (19%) of the 477 nonrevision patients underwent nasal valve surgery at the time of their primary septoplasty compared with 1 (4%) of the 25 patients in the revision group who underwent nasal valve surgery at the time of primary septoplasty. Multivariate analysis confirmed that patients who underwent nasal valve surgery at the time of their primary septoplasty were significantly less likely ($p = 0.034$; OR = 0.104) to undergo revision septoplasty than patients who did not undergo a nasal valve correction procedure at the time of primary septoplasty. It was also noted that 10 (40%) of the 25 patients requiring revision septoplasty had their nasal valve addressed during the revision surgery, which is a significantly higher percentage than the 1 (4%) who had the nasal valve addressed at the primary septoplasty ($p = 0.002$). Data on the 70 revision patients also showed that 36 (51%) of these patients had nasal valve surgery at the time of their revision septoplasty (Table 4).

Table 5 **Surgical approach**

	Nonrevision Primary Surgery ($n = 477$)	Revision Group	
		Primary surgery ($n = 25$)	Revision surgery ($n = 25$)
Closed	386 (81)	19 (76)	12 (48)
Open	60 (13)	2 (8)	13 (52)
Endoscopic	31 (6)	4 (16)	0 (0)

Table 6 **Site of septal deviation**

	Nonrevision Primary surgery ($n = 472$)	Revision Group	
		Primary surgery ($n = 25$)	Revision surgery ($n = 25$)
Caudal	40 (8)	1 (4)	7 (28)
Dorsal	22 (5)	1 (4)	2 (8)
Posterior	132 (28)	15 (60)	2 (8)
Multiple	269 (57)	8 (32)	12 (48)
No deviation	9 (2)	0 (0)	0 (0)

Regarding surgery on the inferior turbinates, 99 (21%) of the patients in the nonrevision group underwent reduction procedures on their turbinates at the time of primary septoplasty compared with 6 (24%) of 25 patients in the revision group who underwent reduction surgery on their turbinates at the time of primary septoplasty. On multivariate analysis, there was no statistical significance associated with this difference ($p = 0.151$). Only 2 (8%) of the 25 patients in the revision group underwent reduction of the turbinates at the revision surgery, which was not significantly different from the 6 (24%) who underwent reduction during the primary surgery ($p = 0.122$). Six (8%) of the 70 total revision patients underwent inferior turbinate surgery at the time of their revision septoplasty (Table 4).

Overall data on time between primary and revision surgery was available for 61 of the 70 patients who underwent revision and were 6.5 years of age (SD, 9). Additional analysis of the time between primary and revision surgery included site of obstruction (septal deviation alone versus nasal valve obstruction with or without septal deviation) and was based on the 50 patients for whom the site of obstruction and surgery dates were known. Of the 25 of these 50 revision patients who had septal deviation alone at the time of their revision, mean time to revision was 3.52 years (SD, 7.00). The remaining 25 of these 50 revision patients had nasal valve obstruction with or without septal deviation at the time of their revision. Mean time to revision for this latter group was 7.23 years (SD, 7.66; $p = 0.074$

Data on the surgical approach showed that in the nonrevision group, 386 (81%) patients underwent a closed approach, 60 (13%) patients underwent an open approach, and 31 (6%) patients underwent an endoscopic approach. Of the 25 revision patients who underwent both their primary and their revision procedures at the UVA, 19 (76%) underwent a closed approach for their primary surgery, 2 (8%) underwent an open approach, and 4 (16%) underwent an endoscopic approach. For the revision procedures in this same group of 25 patients, 12 (48%) underwent a closed approach and 13 (52%) underwent an open approach (Table 5). Multivariate analysis indicates that patients who underwent endoscopic septoplasty at their primary surgery were significantly more likely to require revision surgery ($p = 0.001$; OR = 106) compared with patients who underwent a standard closed approach. Confidence intervals (6, 1850) for this comparison are extremely large as a result of the small numbers of endoscopic septoplasties performed, indicating that this analysis must be interpreted with caution.

Data on the anatomic site of nasal airway obstruction were available for 472 of the 477 nonrevision patients and are presented along with data on the 25 revision patients who had both their primary and revision surgery at the UVA (Table 6). The data show that a majority of patients in the nonrevision group and the revision group at the time of their revision surgery had multiple sites of deviation. Although many of the revision patients had multiple sites of deviation at their primary surgery, a majority had posterior septal deviation at their initial septoplasty.

DISCUSSION

Surgical treatment of the nasal septum in the form of submucous resection of the deviated bony and cartilaginous septum to relieve nasal airway obstruction was first described by Ingals[7] in 1882 and later modified in 1902 by Freer[8] and in 1904 by Killian.[9] Attention to increased cartilage preservation and selectively raising submucoperichondrial flaps was the focus of studies by Metzenbaum,[10] Cottle,[11] Goldman,[12] and Converse[13] with their descriptions of septoplasty. Since these descriptions of septoplasty in the middle of the 20th century, multiple variations have been proposed. Closed, open, and endoscopic approaches are all now accepted methods to access the nasal septum. Cross-hatching, vertical and horizontal strip excision, suture techniques utilizing the premaxilla, and variations on the swinging door technique are just some of the many modifications described to address the deviated nasal septum. Septoplasty may also be used to focally address deformities of the dorsal and caudal struts—areas off limits for the standard submucous resection.

Prior studies have indicated that septal deviation is a common anatomic finding. By some estimates, only 20–25% of individuals have nasal anatomy devoid of abnormalities.[14] Patient selection for septoplasty, therefore, is of preeminent importance, because many patients who complain of nasal obstruction may have septal deviation that masks another, more significant, source of their obstruction such as inferior turbinate hypertrophy, or nasal valve collapse. In fact, evaluation of patient outcomes after septoplasty report only moderate success rates. In a study by Dinis and Haider,[15] only 42% of patients responding to a satisfaction questionnaire sent by mail reported a good to excellent result while the majority reported either a slight to moderately successful result (35%) or a poor to mediocre result (23%). These authors found a significant correlation between anterior septal deviation and patient-reported postoperative satisfaction. Sipila and Suonpaa[16] reported an 85% postoperative patient satisfaction at 6 months in patients who had been screened with acoustic rhinomanometry and determined to have high preoperative nasal resistance. Stewart *et al.*,[17] in a prospective, multicenter observational study showed improvement after septoplasty by means of a validated quality-of-life questionnaire. Using a questionnaire scaled to 100, where higher scores indicate worse nasal obstruction, patients who underwent septoplasty went from a mean preoperative score of 70 (SD, 19) to a mean score of 39 (SD, 26) after septoplasty.

Our data showed that patients who underwent ESS were less likely to undergo revision septoplasty. This might occur in patients who have obstruction due not only to their septum but also to other significant anatomic abnormalities such as concha bullosa and nasal polyps, which would be resected during ESS. An alternative explanation would be that, in ESS, patients without a preoperative complaint of nasal obstruction may undergo septoplasty not to improve their nasal airway, but rather to allow mechanical access to the paranasal sinuses, which require surgical intervention for chronic sinonasal disease. Simply put, these patients would be unlikely to require revision septoplasty because they never had nasal airway obstruction to begin with. Our study lacks the power to attribute certainty to either of these likely explanations.

A notable negative finding in this study is the lack of correlation between those patients who had facial trauma before their primary septoplasty and those who underwent revision septoplasty. It is a common experience that septoplasty in trauma patients can be quite difficult because of the multiply fractured bony and cartilaginous septum as well as the abundant scar tissue often encountered. The fact that these patients are no more likely than other patients to undergo revision surgery is encouraging. It is also notable in this study that anatomic site of septal deviation did not affect the need for revision. Most patients have multiple sites of deviation—both at primary and at revision surgery—and no site should be ignored as inconsequential.

Nasal valve collapse is a commonly missed diagnosis. A recent study points out that, even among otolaryngologists, there continues to be "uncertainty and unease of sorts in defining the nasal valve component regions."[18] When recognized by the surgeon, correction of collapse at the internal nasal valve, as well as at the intervalve area can be performed by a variety of methods. The most common and effective methods to improve collapse at the internal valve and the intervalve area include spreader grafts and alar batten grafts. Multiple articles document the effectiveness of these techniques.[19–22] Review of the 70 patients in our study who underwent revision septoplasty showed that over one-half (51%) underwent simultaneous surgery to correct nasal valve collapse at their revision, compared with only 19% of the nonrevision patients. Moreover, of the 25 patients who underwent both their primary and revision surgery at the UVA, only 1 patient (4%) underwent nasal valve surgery at the primary procedure. Additionally, in those patients who did require nasal valve surgery, time to revision was over twice as long than those patients who underwent revision septoplasty alone (7.5 years versus 3.2 years). These data appear to confirm that nasal valve collapse continues to be a missed diagnosis, and that approximately one-half of patients who require revision septoplasty also have nasal valve collapse. Although we might assume that diagnosis of valve collapse was missed in these patients, it is also possible—although less likely—that their collapse developed over time with weakening of their cartilage caused by aging. In any case, it is apparent that surgeons performing septoplasty would be wise to evaluate the nasal valve function of their patients before surgery and, if indicated, perform surgery to correct a collapsed valve in conjunction with primary septoplasty.

The head of the inferior turbinate also contributes to the nasal valve opening and may lead to nasal obstruction if hypertrophied. Surgical reduction of the head of the inferior turbinate to increase the cross-sectional area at the nasal valve may be undertaken by multiple techniques including submucous resection, resection and cauterization, and turbinate out-

fracture. The effectiveness of turbinate reduction to improve nasal airway obstruction is supported by multiple studies.[23–27] In our patient population, whether or not patients underwent turbinate reduction at primary septoplasty had no impact on whether or not they underwent revision septoplasty. This is likely because inferior turbinate reduction—unlike nasal valve collapse—is a commonly diagnosed problem and most otolaryngologists feel comfortable with surgical maneuvers to decrease the size of the turbinate. This is supported by the fact that over 20% of patients in the nonrevision and in the revision group underwent inferior turbinate reduction at their primary surgery, and that only 8% required treatment of the turbinates at the time of revision septoplasty.

Surgical approach in this study was difficult to analyze. Although our statistical analysis indicates that patients who underwent endoscopic approaches were >100 times more likely to undergo revision surgery than those who underwent an initial closed approach, these data must be interpreted with caution. The total number of endoscopic septoplasties performed were small, and the confidence interval for this analysis was unusually large (6, 1850); thus, these results can not be seen as solid. Although it may in fact be true that endoscopic septoplasty is less successful than other methods, additional studies will be required to make any definitive judgements regarding this matter.

Limitations of this study revolve around its retrospective nature. Because we evaluated a large number of cases over a lengthy time period, there are inevitable pieces of missing or incomplete data. We were dependent on the accuracy and completeness of dictating physicians' clinic and operative notes—characteristics that may vary among physicians. Nevertheless, this study highlights the importance of complete evaluation of the nasal airway to identify and treat the appropriate cause of nasal obstruction at the primary surgery.

CONCLUSION

This study shows that a significant number of patients who undergo revision septoplasty also have nasal valve collapse. We recommend that, in addition to septal deviation and inferior turbinate hypertrophy, nasal valve function be fully evaluated before performing septoplasty. This will help to ensure a complete understanding of a patient's nasal airway obstruction and, consequently, appropriate and effective surgical intervention.

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