Evaluation of Improvement in Nasal Obstruction Following Nasal Valve Correction in Patients With a History of Failed Septoplasty

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**IMPORTANCE** Patients with a septal deviation and concerns about nasal obstruction often undergo septoplasty to improve nasal airflow. Following primary septoplasty, however, some patients have persistent symptoms due to nasal valve dysfunction and may require nasal valve surgery.

**OBJECTIVES** To evaluate the change in disease-specific quality of life for patients who undergo nasal valve correction after failed septoplasty using the Nasal Obstruction Symptom Evaluation (NOSE) survey and to determine whether identifiable anatomical risk factors are more common in patients with a history of failed septoplasty.

**DESIGN, SETTING, AND PARTICIPANTS** Prospective observational outcomes study conducted at a tertiary care medical center. Forty patients who underwent nasal valve correction through an open approach from January 1, 2012, through December 31, 2014, with a history of septoplasty for nasal obstruction were included. Data analysis was conducted from January 1, 2013, through May 1, 2015.

**INTERVENTIONS** Demographic information, a standardized nasal examination, and preoperative and postoperative NOSE scores were collected and reviewed.

**MAIN OUTCOMES AND MEASURES** Comparison between preoperative and postoperative NOSE scores at 2, 4, and more than 6 months after surgery.

**RESULTS** Forty patients were included in the study; 23 (57%) were male and 17 (43%) were female. The mean age was 39.3 years. Findings from preoperative nasal examination demonstrated moderate or severe internal nasal valve narrowing in 38 (95%) patients, internal nasal valve collapse in 19 (48%), external nasal valve narrowing in 18 (45%), or external nasal valve collapse in 16 (40%). The most common anatomical cause of obstruction was internal nasal valve narrowing in 38 (95%) patients, dorsal septum deflection in 26 (65%), and narrowed middle vault in 16 (40%). The mean (SD) preoperative NOSE score was 75.7 (20.1). Mean (SD) postoperative NOSE scores at 2, 4, and greater than 6 months were 31.4 (27.2), 34.0 (19.8), and 22.1 (18.8), respectively, with significantly improved NOSE scores at each time point compared with before surgery ($P < .001$).

**CONCLUSIONS AND RELEVANCE** Nasal valve dysfunction remains an underdiagnosed entity and should be considered in all patients with septal deviation before septoplasty, especially in patients with a severe dorsal deflection and a narrow middle vault. In this study, surgical nasal valve correction demonstrated a significant reduction in nasal obstruction, as measured by a validated outcome measure, in patients for whom a previous septoplasty had failed.

**LEVEL OF EVIDENCE** 4.
Nasal obstruction is a common presenting concern in oto-laryngology practice. Patients may experience symptoms of obstruction at rest or with activity. Patients may also complain of nasal congestion, sleep disturbance, snoring, or the inability to tolerate continuous positive airway pressure. Although the severity of symptoms vary, nasal obstruction has been linked to significantly decreased quality of life in nearly all measurable domains. Many causes of nasal obstruction exist, including septal deviation, turbinate hypertrophy, and nasal valve dysfunction (NVD). Surgical options are available for symptomatic patients whose nasal obstruction is not alleviated by medical management.

Septoplasty is one of the most commonly performed procedures for nasal obstruction in the United States and Europe and may be performed in isolation or during turbinate resection, rhinoplasty, or sinus surgery. Overall success rates of septoplasty range from 43% to 85% but are based on different assessment tools, including patient questionnaires, validated quality-of-life scores, findings from physical examination, and acoustic rhinomanometry. The subset of patients whose symptoms fail to improve after septoplasty may undergo revision surgery. However, to our knowledge, the causes of persistent nasal obstruction following septoplasty have not been extensively studied.

Increasingly, NVD has become an important identifiable source of nasal obstruction and therefore a potential source of persistent obstruction for failed septoplasty. The purpose of this study was to evaluate disease-specific quality of life in patients who underwent nasal valve correction after failed septoplasty using the Nasal Obstruction Symptom Evaluation (NOSE) survey and to determine whether identifiable anatomical risk factors for failed septoplasty exist. The NOSE scale was selected because it is a validated, disease-specific, quality-of-life instrument that can quantify patient symptoms and interventional effect.

### Methods

This single-center, prospective, observational study was conducted at a tertiary care medical center under a protocol approved by the Massachusetts Eye and Ear Infirmary Institutional Review Board. The study period included enrollment, treatment, and follow-up and spanned 2 years (January 1, 2012-December 31, 2014). Data analysis was conducted from January 1, 2013, through May 1, 2015. Patients who presented to the facial plastic surgery clinic at Massachusetts Eye and Ear Infirmary for evaluation of nasal obstruction and had previously undergone septoplasty for nasal obstruction were eligible. Eligible participants were those who had a diagnosis of surgically treatable NVD, did not have isolated septal deviation that could be treated by a septoplasty alone, and desired surgical intervention. Once written patient consent and Health Insurance Portability and Accountability Act statements were obtained, the patients completed an electronic or paper preoperative NOSE questionnaire in the clinic and underwent a standardized nasal examination. All data were collected using REDcap (Research Electronic Data Capture), an electronic data-capture platform designed for academic clinical and translational database development. All patients underwent open functional rhinoplasty by the senior author (R.W.L.), with graft placement determined by the location of the patient’s NVD. Grafted material consisted of costal cartilage, polydioxanone plates, conchal cartilage, and/or septal cartilage. A full description of the surgical technique used for each location of obstruction has been previously published.

After surgery, all patients had the opportunity to complete the NOSE questionnaire at 2, 4, and 6 months, either via an automated email from the REDcap database or in the clinic at their follow-up appointment. For the analysis of differences between preoperative and postoperative NOSE scores, a repeated-measures analysis of variance was conducted.

### Results

Forty patients were included in the study (Table 1). A total of 23 patients (57%) were male and 17 (43%) were female. The mean age was 39.3 years (range, 12-69 years). Preoperative nasal examination demonstrated internal nasal valve narrowing in 38 patients (95%), internal nasal valve collapse in 19 patients (48%), external nasal valve narrowing in 18 patients (45%), and external nasal valve collapse in 16 patients (40%). The mean (SD) preoperative NOSE score was 75.7 (20.1).

Common anatomical causes of obstruction that were identified intraoperatively included moderate or severe dorsal septum deflection in 26 patients (65%), narrowed middle vault in 16 patients (40%), and medial crural flare in 10 patients (25%). Table 2 shows the surgical procedures that were performed.

<table>
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<tr>
<th>Characteristic</th>
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<tbody>
<tr>
<td>Sample size</td>
<td>40</td>
</tr>
<tr>
<td>Age, mean (range)</td>
<td>39.3 (12-69)</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
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<tr>
<td>Female</td>
<td>17 (43)</td>
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<tr>
<td>Male</td>
<td>23 (57)</td>
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<tr>
<td>History of nasal trauma</td>
<td>15 (38)</td>
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<td>Nasal examination findings</td>
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<tr>
<td>INV narrowingb</td>
<td>38 (95)</td>
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<tr>
<td>INV collapseb</td>
<td>19 (48)</td>
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<tr>
<td>ENV narrowingb</td>
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<tr>
<td>ENV collapseb</td>
<td>16 (40)</td>
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<tr>
<td>Saddle nose</td>
<td>4 (10)</td>
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<td>Cephalic malrotation</td>
<td>7 (18)</td>
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<tr>
<td>Obstruction site</td>
<td></td>
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<tr>
<td>Narrowed middle vault</td>
<td>16 (40)</td>
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<tr>
<td>High dorsal deflectionb</td>
<td>26 (65)</td>
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<tr>
<td>Inner recurvature of the lower lateral cartilage</td>
<td>5 (13)</td>
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<tr>
<td>Medial crural flare</td>
<td>10 (25)</td>
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Abbreviations: ENV, external nasal valve; INV, internal nasal valve.

* Data are presented as number (percentage) of patients unless otherwise indicated.

b Indicates moderate or severe degree only.
The most common surgical procedures included spreader grafts in 39 patients (100%), columellar strut grafts in 23 patients (59%), lateral crural strut grafts in 20 patients (51%), flaring sutures in 6 patients (15%), and alar rim grafts in 5 patients (13%). The material used for grafting included native costal cartilage in 34 patients (87%), a polydioxanone plate in 5 patients (13%), and conchal cartilage in 2 patients (5%). After surgery, 33 patients (81%) completed NOSE surveys during long-term follow-up. The Figure demonstrates preoperative and postoperative NOSE scores at different time intervals. The mean (SD) postoperative NOSE scores at 2, 4, and more than 6 months were 31.4 (27.2), 34.0 (19.8), and 22.1 (18.8), respectively, with significantly improved NOSE scores seen at each time point compared with the preoperative values (P < .001). No difference between postoperative NOSE scores at 2 months and more than 6 months was identified (P = .16).

Discussion

Most patients who undergo septoplasty for nasal obstruction report improvement in symptoms following surgery; however, a subset of patients have persistent nasal obstruction and may require revision surgery.11 Potential causes of persistent nasal obstruction after septoplasty include undiagnosed nasal valve narrowing and/or collapse. While this fact may represent underappreciation of the anatomical deficit on initial evaluation, in some cases, dysfunction may be unmasked by increasing nasal airflow after therapeutic septoplasty. In other cases, surgical overresection of the nasal septum can lead to nasal valve compromise over time as a saddle nose develops owing to a lack of structural support, causing internal nasal valve narrowing as the middle vault collapses; however, such cases are rare. In a retrospective series by Becker et al11 examining patients who presented for revision septoplasty, 51% had significant NVD that required functional septorhinoplasty. The extent and anatomical cause of NVD in all patients who presented with nasal obstruction is unknown but an important topic for future study.

On our standardized preoperative nasal examination, internal nasal valve narrowing (95%), high dorsal deflection (65%), and internal nasal valve collapse (48%) were the most common causes of NVD in our patient population. This finding is similar to the finding by Gillman et al12 who performed a prospective study of patients with failed primary septoplasty and found that the most common site of residual septal deviation was a dorsal cartilaginous septum in 92% of their patients; however, this study excluded patients with nasal valve collapse. In our patient population, internal nasal valve collapse was found in 48% of patients and external nasal valve collapse was found in 40%; therefore, different management strategies were used. The most common anatomical defect on external nasal examination of our patients was middle vault narrowing (40%). Excluding high dorsal deflection, NVD, and a narrowed middle vault as anatomical causes of obstruction before septoplasty may improve the overall success rate of septoplasty by altering the surgical plan in these patients.

Our study demonstrated significant nasal functional improvement, as quantified by the NOSE survey, in the context of prior septoplasty with continued symptoms of nasal obstruction. The mean preoperative NOSE score was 75.7 in this study and improved to 22.1 at 6 months or more after surgery, with statistically significant improvement noted at 2 months (P < .001), 4 months (P < .001), and more than 6 months (P < .001). This improvement in the mean NOSE score by 53 points is consistent with a recent systematic review by Rhee et al14 of expected NOSE score improvement following surgery for nasal airway obstruction that found a mean NOSE score improvement of 43. Our findings are also consistent with previous studies supporting the notion that patients with NVD may benefit from surgery.3,12,15-17 Following the improvement seen at 2 months, no change in NOSE scores was seen at 6 months (P = .16), suggesting stable results during the follow-up period. Our data clearly indicate that surgical nasal valve correction is effective in alleviating the symptoms of nasal valve obstruction after previous septoplasty.

Despite the effectiveness of nasal valve surgery in this context, the patients were subjected to 2 surgical procedures when a single procedure would have been preferable. The lack of treatment of NVD during the initial surgical procedure results in a missed opportunity to use nasal septal cartilage as autologous...
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Nasal Valve Correction in Patients With Failed Septoplasty

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Conflict of Interest Disclosures: None reported.

Previous Presentation: This study was presented in part at the American Academy of Facial Plastic and Reconstructive Surgery Spring Scientific Meeting; April 22, 2015, Boston, Massachusetts.

Correction: This article was corrected on October 23, 2015, to fix incorrect dates in the Abstract and the Methods section.

REFERENCES

graft material for the treatment of the nasal valve. Therefore, failure to appreciate NVD during evaluation for nasal valve obstruction not only commits the patient to 2 surgical procedures but also increases morbidity by necessitating remote cartilage harvest or implant (rib, conchal, or cadaveric cartilage) during the second stage. Our identification of common anatomical substrates for this scenario (high dorsal deflection and narrowed middle vault) supports the notion that patients with combined nasal septal deflection and NVD may be identifiable during preoperative evaluation, allowing for appropriate procedural selection and full relief of obstructive symptoms. A prospective study of surgical therapy of the septum using a standardized anatomical nasal examination seems warranted.

The strengths of this study are the use of a prospective cohort study design, a standardized nasal examination, electronic data capture, and a validated, disease-specific, patient-reported outcomes instrument. However, this study also has a number of limitations. Although follow-up information exists for several patients up to 2 years after surgery, the long-term durability of the results beyond this time is not yet known. Furthermore, the findings from the nasal examination before the primary septoplasty were not known, limiting our ability to quantify the findings during the initial evaluation.

Conclusions
Nasal valve dysfunction likely remains an underdiagnosed entity and should be considered in all patients with septal deviation before they undergo septoplasty, especially in patients with a severe dorsal deflection and a narrowed middle vault. In this study, surgical nasal valve correction demonstrated significant improvement in nasal obstruction in patients for whom septoplasty had previously failed.