Development of a Severity Classification System for Subjective Nasal Obstruction

Michael J. Lipan, MD; Sam P. Most, MD

Nasal airway obstruction (NAO) is a common presenting symptom in otolaryngology and facial plastic surgery practices, and the potential for multiple contributing causes requires extensive evaluation. Many objective and subjective instruments are available to quantify the severity of the obstruction. One subjective quality-of-life instrument is the Nasal Obstruction Symptom Evaluation (NOSE) scale. The NOSE scale is a brief, valid, reliable, and responsive survey to measure disturbances in quality of life specific to nasal obstruction. The results of objective measures of obstruction and subjective NOSE scores correlate poorly. As a consequence, many recent studies use the NOSE survey as a primary outcome measure for surgical treatment of nasal obstruction.

The NOSE survey consists of 5 items, each scored using a 5-point Likert scale to make a total score range of 0 through 100 (Figure 1). Higher scores indicate worse obstruction. Studies that report outcomes using the NOSE scale often demonstrate improvement after surgery. Unfortunately, there is no severity-based classification scheme to provide a context to patient scores. This lack of a severity classification system hampers communication among physicians, patients, and third-party payers, as well as others. In the future, a standardized classification system would benefit studies designed to evaluate effectiveness of interventions to correct nasal obstruction.

We hypothesize that a NOSE scale–based nasal obstruction severity classification system can be created using patients’ scores at their initial consultation. We describe a sever-
A total of 426 patients met our initial inclusion criteria. They were seen in our clinic during 11 months for an initial consultation. The study was conducted at Stanford University from July 2011 through May 2012, with approval of the university’s Human Subjects Research Committee. Patients were included in our study if they were seen in consultation for cosmetic rhinoplasty or treatment of nasal obstruction. NOSE surveys are routinely completed during these visits and are included in the medical record. NOSE scores from patients presenting for cosmetic nasal surgery and reporting no nasal obstruction served as the comparison group. NOSE scores from patients presenting for treatment for nasal obstruction served as the study group. Patients from this group who also desired cosmetic nasal surgery and reporting no nasal obstruction served as the comparison group. NOSE scores from patients presenting for cosmetic nasal surgery and reporting no nasal obstruction served as the comparison group. NOSE scores from patients presenting for treatment for nasal obstruction served as the study group. Patients from this group who also desired cosmetic nasal surgery and reporting no nasal obstruction served as the comparison group.

A distribution analysis was performed using NOSE scores from patients with and without nasal obstruction. A receiver operating characteristic (ROC) curve analysis was performed using NOSE scores from patients with and without nasal obstruction to determine a cutoff point to best separate the groups. Once this threshold was identified, the nasal obstruction group was further divided by equal intervals to define severity classes. SPSS (IBM) and MedCalc (MedCalc Software) software programs were used for statistical analysis.

Figure 1. Nasal Obstruction Symptoms Evaluation Instrument

ID# __________________ Date ____________

Nasal Obstruction Symptoms Evaluation Scale

To the Patient: Please help us to better understand the impact of nasal obstruction on your quality of life by completing the following survey. Thank you!

Over the past 1 month, how much of a problem were the following conditions for you?

Please Circle the Most Correct Response

<table>
<thead>
<tr>
<th>Problem</th>
<th>Not a Problem</th>
<th>Very Mild Problem</th>
<th>Moderate Problem</th>
<th>Fairly Bad Problem</th>
<th>Severe Problem</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Nasal congestion or stuffiness</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>2. Nasal blockage or obstruction</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>3. Trouble breathing through my nose</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>4. Trouble sleeping</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5. Unable to get enough air through my nose during exercise or exertion</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

This questionnaire is given to patients at their initial visit.

Results

A total of 426 patients met our initial inclusion criteria. They were seen in our clinic during 11 months for an initial consultation or a follow-up visit. The records from each patient’s initial consultation were reviewed, and responses on the NOSE survey were recorded. Patients were excluded (n = 81) for being younger than 18 years, missing NOSE questionnaires, or having incomplete answers on the questionnaire. Therefore, data analysis was performed using results from 345 patients. The population was initially divided into 2 groups, depending on whether they reported having NAO. The group without NAO consisted of patients considering cosmetic rhinoplasty. The group without NAO (27.0%) had a mean (SD) NOSE score of 11.3 (15.3). The group with NAO (73.0%) had a mean (SD) NOSE score of 64.8 (21.1) (Figure 2). Results of the ROC curve analysis identified a NOSE score of 30 as a cutoff to best differentiate between the 2 groups, with a sensitivity of 93.7% and a specificity of 90.3% (95% CI, 89.9%-96.3% and 82.4%-95.5%, respectively). We defined this as the threshold to distinguish both groups. Any patients with NAO symptoms but scoring below 30 were then defined as the mild nasal obstruction group.

The distribution of scores of the NAO group was further subdivided. The threshold of 30, determined by the ROC curve analysis, allowed creating classes with ranges of equal intervals. Dividing the group into 4 classes of severity and integrating the threshold resulted in the following classes and ranges: mild (range, 5-25), moderate (range, 25-50), severe (range, 50-75), and extreme (range, 80-100) nasal obstruction (Table). The class mean scores (percentages) of the total nasal obstruction population are as follows: mild, 17.5 (6.4%); moderate, 43.5 (21.4%); severe, 66.3 (42.5%); and extreme, 87.9 (29.8%). Stewart et al attempted to calculate the minimal clinically important change, which they defined as 0.2 to 0.3 times the SD of
the baseline distribution. In our population, that would be 4.2 to 6.3 on the NOSE scale. The smallest difference in the mean between groups was 21.6, indicating robust clinical differences in the classes.

Patients with NAO were also divided into those seeking functional improvement alone (57.9%) and those who were interested in combined functional and cosmetic surgery (42.1%). Mean (SD) NOSE scores for each group were similar at 65.6 (21.4) and 63.7 (20.8), respectively.

**Discussion**

The NOSE score has become a valuable outcome measure of nasal obstruction treatment. It is a brief, simple, and easily administered quality-of-life instrument specific to nasal obstruction. No normative data or classification system are reported using the NOSE survey. This information would be helpful in many ways. First, patients who do not report nasal obstruction often score above zero on the NOSE questionnaire. Results from these patients provided a context to scores from people who reported nasal obstruction. Second, structuring the NOSE scores of patients with NAO within a classification system gives them a better understanding of the severity of their condition. Third, future studies using the NOSE scale as an outcome measure could use this severity classification system to better define their study population and describe treatment responses.

Several factors were important in the development of this classification system. The primary goal was to determine a threshold score between patients with and without nasal obstruction. A ROC analysis indicated that a NOSE score of 30 is the best threshold to differentiate between the 2 groups. Patients with nasal obstruction who scored below 30 were defined as the mild severity class. These patients have symptomatic nasal obstruction but score similarly on the NOSE scale to patients who do not have nasal obstruction. We then used this threshold along with equal intervals to further divide the nasal obstruction group into severity classes. The threshold score of 30 is used as the minimum score in the range for the moderate severity class. One benefit in defining these ranges in this manner is that they are more easily applied in a clinical setting.

We purposefully avoided using a quartile classification system to determine ranges for the severity classes. This study was conducted at a tertiary medical center, which may bias the distribution of NOSE scores toward more severe obstructive symptoms. Using a quartile system would have skewed the class distribution of NOSE scores toward more severe obstructive symptoms. Using a quartile system would have skewed the class distribution of NOSE scores toward more severe obstructive symptoms. Using a quartile system would have skewed the class distribution of NOSE scores toward more severe obstructive symptoms. Using a quartile system would have skewed the class distribution of NOSE scores toward more severe obstructive symptoms. Using a quartile system would have skewed the class distribution of NOSE scores toward more severe obstructive symptoms. Using a quartile system would have skewed the class distribution of NOSE scores toward more severe obstructive symptoms. Using a quartile system would have skewed the class distribution of NOSE scores toward more severe obstructive symptoms. Using a quartile system would have skewed the class distribution of NOSE scores toward more severe obstructive symptoms. Using a quartile system would have skewed the class distribution of NOSE scores toward more severe obstructive symptoms. Using a quartile system would have skewed the class distribution of NOSE scores toward more severe obstructive symptoms.

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Patients in the mild class score less than 30 on the NOSE scale. Patients in this class report NOSE scores that overlap with scores from patients with no nasal obstruction. One key difference is that the mean score is higher. Despite having mild symptoms, their symptoms should not be dismissed. If a cause of their obstruction can be determined, they should be treated appropriately.

The extreme NAO class is composed of 29.8% of patients with nasal obstruction. These are patients whose symptoms most adversely affect their quality of life. It has been previously reported that patients with the highest scores had the highest improvement in NOSE scores after treatment. Future studies are vital to expand these findings and determine how much of a change on the NOSE scale patients in this and all other classes achieve after treatment.

Our results have certain implications for patients who undergo cosmetic rhinoplasty and do not report nasal obstruction. Most of this group report NOSE scores below 30. However, a few of these patients reported NOSE scores within the moderate and severe classes. These patients should be carefully scrutinized to make sure they truly have no nasal obstruction. It would be helpful to use the NOSE questionnaire as a screening tool for all patients undergoing nasal surgery. Patients with scores of 30 and above who seek cosmetic rhinoplasty may require focused nasal obstruction histories and physical examinations to help identify those prone to postoperative obstruction complications.

Patients with nasal obstruction often ask about the expected degree of improvement from various treatment options. If treatment-oriented studies define treatment responses specific to each severity class, it will provide useful prognosticative information. For example, it may be useful for a patient in the severe class to know that a specific functional surgical technique has helped patients reclassify into the mild severity class postoperatively. We occasionally have patients with persistent nasal obstruction despite what clinically seems to be successful nasal surgery. Determining whether there was a change in the NOSE score class may give a better context to the patient’s postoperative symptoms.

A secondary finding of our analysis is the similarity between patients with nasal obstruction solely interested in functional improvement and those seeking cosmetic changes as well. The mean NOSE scores were separated by fewer than 2 points, which is lower than our minimal clinically important change. This finding implies that cosmetic concerns are gen-

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**Table. Severity Classification System for 252 Patients With Nasal Obstruction**

<table>
<thead>
<tr>
<th>Severity Class</th>
<th>No. (%) of Respondents</th>
<th>Mean (SD) NOSE Survey Score</th>
<th>NOSE Survey Score Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild</td>
<td>16 (6.3)</td>
<td>17.5 (6.8)</td>
<td>5-25</td>
</tr>
<tr>
<td>Moderate</td>
<td>54 (21.4)</td>
<td>43.5 (6.8)</td>
<td>30-50</td>
</tr>
<tr>
<td>Severe</td>
<td>107 (42.5)</td>
<td>66.3 (7.0)</td>
<td>55-75</td>
</tr>
<tr>
<td>Extreme</td>
<td>75 (29.8)</td>
<td>87.9 (6.7)</td>
<td>80-100</td>
</tr>
</tbody>
</table>

Abbreviation: NOSE, Nasal Obstruction Symptom Evaluation.
erally a secondary motivator to pursue nasal surgery in the latter group. The effect of nasal obstruction on their quality of life is just as great as in people who refuse cosmetic changes, and they should be treated accordingly.

Procedures for nasal obstruction are among the most common in otolaryngology and facial plastic surgery practices. Using the NOSE survey as an outcomes measure will allow well-established and novel techniques to be assessed for effectiveness. The classification system outlined in this study will provide a valuable context to better understand these studies and give our patients a foundation to better understand their symptoms. We also hope that this may provide a framework for evaluating treatment responses across physicians and institutions.

ARTICLE INFORMATION

Author Contributions: Study concept and design: All authors. Acquisition of data: Lipan. Analysis and interpretation of data: Lipan. Drafting of the manuscript: All authors. Critical revision of the manuscript for important intellectual content: Lipan. Statistical analysis: Lipan. Administrative, technical, and material support: Most. Study supervision: Most.

Conflict of Interest Disclosures: None reported.

REFERENCES