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# Validation of a Septoplasty Deformity Grading System for the Evaluation of Nasal Obstruction

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## Abstract

**Objectives:** We develop and validate a septal deformity grading system (SDG) that accounts for anatomic location and grading of deformity severity.

**Methods:** Retrospective cohort study of patients with nasal obstruction presenting to UCIMC. Subjects were given pre-and post-operative NOSE questionnaires and evaluated by a facial plastic surgeon using our SDG system. Validity and reliability analyses were conducted on the SDG results. Statistical analyses were conducted on SDG and NOSE data to assess and compare instruments, and to validate the SDG instrument using the NOSE instrument.

**Results:** 135 patients met inclusion criteria. Cronbach's α was ≥0.7 for SDG and pre-and post-operative NOSE scores. There was a significant difference in pre-and post-op NOSE scores (Z score −7.21, $p<0.001$). Correlations between post-operative NOSE and SDG scores were significant ($p=0.014$), and convergent construct validity was achieved. There was a significant difference in SDG scores between primary vs revision operations ($p<0.001$), history vs no history of nasal trauma, and nasal/septal surgery ($p=0.025$, 0.003 respectively). The odds of having a revision operation were 2.3 times higher for high SDG scores ($p<0.001$), of having a history of nasal trauma were 1.33 times higher for high SDG scores ($p=0.014$), and of having a history of nasal/septal surgery were 2.9 times higher for low SDG scores.

**Conclusion:** Our SDG system addresses the challenge of provides objective anatomic information on the severity of nasal septal deformities and may be valuable when used in conjunction with subjective data gathered from the NOSE questionnaire.

### Keywords

Nasal septal deformity; Septal deformity grading system; NOSE questionnaire; Nasal Obstruction

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## Introduction:

Nasal airway obstruction (NAO) is one of the most common clinical indications for otolaryngology referral and carries an estimated economic burden of greater than $5 billion annually.[1] Numerous studies have sought to improve diagnosis of this condition, however NAO remains a diagnostic challenge due to discrepancies between subjective symptoms and objective findings, whether on physical exam, rhinomanometry, peak nasal inspiratory flow, acoustic rhinometry, or radiographic findings.[1–6] With the current limitations in identifying specific anatomical sites of obstruction, the diagnosis of nasal obstruction, decision to proceed to surgery, and selection of structures to modify largely rely on subjective evaluations to augment surgeon judgement. Nonetheless, among the causes of nasal obstruction, deformity of the nasal septum remains a very common cause.[7–9]

There has been a trend in assessment of nasal obstruction towards the use of patient reported outcome measures, specifically in the form of the Nasal Obstruction Symptom Evaluation (NOSE) scale. Due to the inconsistencies between objective measures and subjective evaluations of nasal obstruction, the consensus has shifted towards weighing subjective evaluations more heavily. Since ultimately it is the severity of the subjective symptom of nasal obstruction that determines treatment success, the NOSE questionnaire has become widely used in the assessment of disease-specific quality of life (QOL) following functional rhinoplasty or septoplasty.[10]

To improve the diagnosis and surgical management of nasal obstruction, this study seeks to develop and validate a standardized nasal septal deformity grading system (SDG) that will address anatomic localization and grading of septal deformity severity. Secondary objectives were to explore differences in NOSE scores between high and low SDG scores. We also evaluate the effect of confounding variables, such as primary or revision surgery, gender, and presence or absence of allergic rhinitis, chronic rhinitis, chronic sinusitis, nasal trauma, and history of previous sino-nasal surgery. Finally, our SDG system was compared with pre-and post-operative NOSE scores to determine the predictive utility of each instrument within our patient population.

## Materials and Methods:

This study was conducted under the review and approval by the Institutional Review Board of the University of California Irvine, in accordance with their guidelines, and all participants were provided written informed consent to the study. This study is a retrospective case series of 137 consecutive patients evaluated between November 2014 to December 2017 at a single tertiary medical center. Patients 16 years of age or older undergoing septoplasty or rhinoplasty met inclusion criteria. Exclusion criteria included inadequate command of the English language, and inability to give informed consent.

All patients underwent a detailed physical examination by a board-certified facial plastic surgeon (B.J.F.W.) and otolaryngology residents. Complete physical exam of the septum, turbinates, meati, internal and external nasal valves, including anterior rhinoscopy, diagnostic nasal endoscopy before and after decongestion, Cottle and modified Cottle

maneuvers were performed. Using our SDG sheet (Figure 1), septal deformities were characterized and graded from information gathered on physical exam, and from direct intraoperative visualization of the anatomy. Additional patient information collected included history of nasal obstruction, allergic rhinitis, chronic sinusitis, chronic rhinitis, nasal trauma, previous nasal surgery, age, sex, and BMI. Patients were given a NOSE questionnaire to complete at each post-operative follow-up visit.

## Development and Validation of the Septal Deformity Grading Sheet

The SDG system was designed with the seven landmarks identified by Wong et al[11], listed in Table 1. These seven regions pertain to anatomical landmarks that have been previously shown to be significantly deviated from the theoretical straight septum in patients with septal deformities. Each of the seven regions is further stratified by laterality, and on a 4-point Likert scale to grade deformity severity from 0–3 (Figure 2). Content validity was ensured during design of the instrument through review by a board-certified facial plastic surgeon. Confirmatory analyses were performed using principle components analysis (PCA) on all items with orthogonal varimax rotation of factors to confirm hypothesized factor loadings of the SDG items by their respective constructs. All factors with an eigenvalue of greater than 1 were retained for potential inclusion in the final rotated factor solution. Internal consistency reliability for each of the constructs was assessed through Cronbach's $\alpha$ coefficient, and noting item-total correlations of each construct of the SDG. Internal consistency reliability was considered adequate if $\alpha \geq 0.70$. Items that did not contribute to the overall internal consistency of the instrument were marked for possible elimination. Convergent construct validity analysis was conducted through a series of linear regression models against the NOSE questionnaire, which has been extensively validated[12–17]. To confirm internal consistency reliability of the NOSE questionnaires within our study population, Cronbach's $\alpha$ was calculated, and an $\alpha \geq 0.70$ was used as the threshold for adequate internal consistency reliability.

## Statistical Analysis

Disease-specific change in quality of life in patients undergoing rhinoplasty or septoplasty was determined by using Wilcoxon signed-rank test to compare pre-and post-operative follow-up NOSE scores. To identify variables from the SDG sheet significantly associated with NOSE scores, a series of univariate linear regression analyses were performed to evaluate the association between pre-and post-operative NOSE scores, and the SDG score. $\beta$- coefficients were determined to assess significant relationships between these variables. A p-value of $<0.05$ was used to evaluate univariate linear regression models comparing individual NOSE scale items with SDG scores. SPSS version 21.0 (IBM Inc., Armonk, NY) was used for all statistical analyses. To account for potential confounding variables, Mann-Whitney U was used to compare between groups with and without a history of allergic rhinitis, chronic rhinitis, chronic sinusitis, nasal trauma, and previous nasal surgery. These variables have been identified as potential contributors to nasal obstruction.[18–21] Mann-Whitney U was also used to compare between primary and revision operation groups, male and female groups, and high and low NOSE score groups (threshold of 55).[22]

## Results:

135 patients met inclusion criteria, and 15 lacked any completed forms and were excluded from analysis. In the remaining 120 patients, 109 had completed pre-operative NOSE, 87 had completed post-operative NOSE, and 95 had completed SDG sheets. A total of 84 patients had a complete set of pre-and post-operative NOSE, and SDG sheets. Patient demographics are summarized in Table 1. Prevalence of each septal deformity in our study population is summarized in Figure 3.

### Septal Deformity Grading System Validation

The factor structure of the items of the SDG system were scored in the same direction on a 0 to 3 scale, where higher scores represent higher levels of deformity. The theoretical minimum and maximum total scores were 0 and 42 respectively (Figure 1). A visual inspection of Eigenvalues was performed after generating a scree plot from which four components are indicated. To assess for reliability of the SDG instrument Cronbach's $\alpha$ coefficients were determined to be 0.756. Cronbach's $\alpha$ coefficients for preoperative NOSE questionnaires, postoperative NOSE questionnaires were calculated as well, and were 0.848 and 0.920 respectively. Pre-operative NOSE scores ranged from 0 to 100 (n=109; mean, 67.75; SD, 24.77), and post-operative NOSE scores ranged from 0 to 90 (n= 87; mean 25.14; SD, 27.02). Wilcoxon signed-rank test comparing pre-and post-operative NOSE scores resulted in a Z-score of −7.21 (p<0.001).

To assess for convergent construct validity, a series of univariate linear regression analyses were performed to compare pre-and post-operative NOSE scores with each of the components of the SDG scores. Post-operative NOSE scores were found to have a $\beta$ *of* −0.302 (p=0.014), however none of the other univariate linear regressions achieved statistical significance (Table 2). Subgroup analysis was performed using independent samples t-test for continuous variables and Fisher's exact test for dichotomous variables to determine relationships in the data between high and low SDG score groups. NOSE and SDG scores were recoded into high or low septal score groups using the 75$^{th}$ and 25$^{th}$ percentiles respectively. There was a statistically significant difference comparing high and low SDG score groups with revision operations (p=0.039), between history of nasal trauma and previous nasal/septal surgery (p=0.005 and 0.045 respectively). For the remaining variables, no statistically significant differences were found between high and low SDG score groups (Table 3).

Bivariate logistic regression using high SDG scores against the covariates of high pre-and post-operative NOSE score, male gender, primary operation, and history of allergic rhinitis, chronic sinusitis, chronic rhinitis, nasal trauma, and previous nasal or septal surgery were performed to determine the odds of a high SDG score given each variable. Multivariate logistic regression using a high SDG score and the above covariates was performed to determine an adjusted odds ratio. From the univariate logistic regression model comparing type of operation (primary vs revision) with SDG score (high vs low), the odds of having a revision operation were 2.3 times higher for high SDG scores than low SDG scores (p<0.001). The odds of having a history of nasal trauma were 1.33 times higher for high SDG scores than low SDG scores (p=0.014), and the odds of having a history of nasal/septal

surgery were 2.9 times higher for low SDG scores than high SDG scores. In the multivariate logistic model, the odds of having a history of nasal trauma were 1.2 times higher for high SDG scores than low SDG scores (95% CI 1.21, 9.14; p=0.019). The remaining variables no longer reached statistical significance in the multivariate logistic model (Table 4).

### Comparison of SDG, Pre- and Post-Operative NOSE Results

A series of non-parametric Mann-Whitney U tests were performed between SDG scores, pre-and post-operative NOSE scores, and the following groups of variables: male vs female, primary vs revision, and history vs no history of: allergic rhinitis, chronic sinusitis, chronic rhinitis, nasal trauma, and nasal/septal surgery (Table 5). There were statistically significant differences in mean composite SDG scores between primary and revision operations (p<0.001), for history of nasal trauma and no history of nasal trauma (p=0.048), as well as for history of nasal/septal surgery and no history of nasal/septal surgery (p<0.001). For mean pre-operative NOSE scores, there were statistically significant differences between primary and revision operations (p=0.015), and between history of chronic sinusitis and no history of chronic sinusitis (p=0.017). There were no statistically significant differences detected in mean SDG, pre-, or post-operative NOSE scores between remaining group comparisons.

## Discussion:

Contemporary septal deformity classification systems are limited in their ability to address both the anatomic location and the degree of deformity. The ability to correctly localize and grade the severity of septal deformities will greatly augment decision-making in formulating the optimal treatment strategy for nasal obstruction, justifying proposed treatments to payers, and streamlining communication between providers.

The gold standard measure of nasal obstruction would be quantifiable, reproducible, and have a strong correlation with subjective measures of nasal airflow. However, such a measure has not been developed to date. The finding of nasal obstruction is complicated by the lack of objective measures (physical exam, imaging findings, rhinometry, and nasal airflow) that are well correlated to subjective measures of symptom severity.[2,3,6,23] It is critical to have a precise anatomic assessment that includes deformity severity grading to guide the surgeon in treatment planning, both in selection of the optimal procedure for correction, and to predict which patients may benefit most from rhinoplasty or septoplasty.

There has been a trend in medicine toward evaluating quality of life (QOL) in the assessment of disease processes and efficacy of treatment.[24] The NOSE questionnaire, a patient reported outcome measure (PROM) has become the most relevant structurally based disease-specific quality of life instrument developed for the assessment of nasal obstruction, and has a body of evidence to support its validity, reliability, and sensitivity.[14,15,13,25,26] The American Academy of Otolaryngology-Head and Neck Surgery’s consensus statement in 2010 concluded that patient oriented outcomes are more important than objective outcomes, recognizing the ambiguities and disparities that exist in the objective evaluation of nasal obstruction.[27,10] It has also been proposed that the different objective assessments may be capturing different aspects of the nasal airway, and may provide complementary

information.[6] Therefore, the ideal approach for the evaluation of nasal obstruction may be a combination of testing methods with both subjective and objective components.

Although we were only able to demonstrate adequate convergent construct validity using the post-operative NOSE data, we have demonstrated sufficient internal consistency reliability and content validity of our SDG instrument. Convergent construct validity is dependent on the demonstration of statistically significant correlations between our objective SDG scores and the subjective pre-operative NOSE scores. A lack of correlation between our SDG data and the pre-operative NOSE data is similar to the evidence from previous studies examining the relationship between objective and subjective measures of nasal obstruction, and therefore should come as no surprise.[3,4,6,23,28,29] Nonetheless, this may also indicate that our SDG system and pre-operative NOSE questionnaires evaluate non-overlapping aspects of nasal obstruction, and therefore may provide a more complete evaluation of nasal obstruction when used together for pre-operative assessments.

The differences in mean SDG scores between primary and revision operations as well as between patients with or without a history of nasal trauma, and nasal or septal surgery may be potentially explained by the fact that these variables each reflect significant anatomical changes. The remaining variables included in the analysis, such as history of allergic rhinitis, chronic rhinitis, etc. may or may not have a significant anatomical component, and thus would not likely be assessed by our SDG system. The statistically significant differences in SDG scores between patients with and without a history of nasal trauma, and with and without a history of nasal or septal surgery suggests that our SDG scores are sensitive to anatomical changes. For nasal traumas, the actual incidence may even be higher than reflected in this study, due to under reporting. Nasal traumas often develop at birth, from direct nasal trauma, or due to abnormal intrauterine posture and difficulties during delivery, and thus may go unnoted throughout life.[30] Nonetheless, our SDG score is still able to distinguish between patients with and without a history of nasal trauma. The anatomic discrimination by the SDG system, in conjunction with the subjective information provided by the NOSE survey lends additional support for the concurrent use of objective and subjective evaluations for nasal obstruction.

## Limitations

Our methodology was limited in several aspects. First, there are numerous contributing factors to nasal obstruction, and the differential diagnosis is quite broad. One such example is the variation in each patient's nasal cycle—the natural, alternating swelling of the inferior turbinate. This is one of many factors that are difficult to control for, and one that has potential confounding effects on the subjective assessment of nasal patency.[31] Secondly, although precise anatomic localization of septal deformities is critical for treatment planning and the success of surgical interventions, it does not account for dynamic sources of nasal obstruction. Nasal obstruction due to INV or ENV collapse is a dynamic process, whereas anatomic grading and classification is a static assessment at a single time point. Finally, since we are a tertiary academic center, our patient population may be biased towards having major surgery. This is reflected in the high pre-operative NOSE scores, and may bias the design of our study.

The development of a systematic, anatomic grading system for the evaluation of septal deformities is a valuable contribution towards improving the diagnosis and surgical management of nasal obstruction. Currently, there are only a few classification systems developed for this purpose in the literature, including Mladina's system[7,32,33,34], and subsequent modifications by Guyuron[35], Bauman[32] and others[9]. Although each of these classification systems defines anatomic variations in the shape of the nasal septum, none are able to precisely localize areas of deformity, or provided information on the degree of deformity at each anatomic location. Our SDG system addresses the challenge of providing a reliable and consistent method for surgeons to characterize septal deformities for perioperative evaluation.

### Future Directions

Our findings will require additional evaluation and validation with a larger cohort. We will include the results of our evaluations of dynamic nasal obstruction as a measure to capture additional information that is currently lacking in our grading system. We will also assess inter-rater reliability by asking additional available physicians who are trained in the evaluation of nasal septum deformities, and also obtain post-operative SDG scores from each patient to provide data to quantify our surgical interventions. Obtaining post-operative SDG scores, in conjunction with the NOSE questionnaire results may also allow for the determination of a minimally clinically significant change in septal deformity grading score. To address any potential bias in our study due to patient population, future work will take into account any history of nasal airway surgery.

## Conclusions:

We have developed a septal deformity grading system that improves upon currently available septal deformity classification systems by addressing the challenge of providing a reliable and consistent method for surgeons to characterize septal deformities for perioperative evaluation. Our SDG scores provide anatomic information on the severity of nasal septal deformities, and may be valuable when used in conjunction with subjective data gathered from the NOSE questionnaire.

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Dr. Wong had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

*Study concept and design:* Wong.

*Acquisition, analysis, or interpretation of data:* Gu, Kaplan, Greenfield.

*Drafting of the manuscript:* Gu, Calloway, Wong

*Critical revision of the manuscript for important intellectual content:* All authors.

*Statistical analysis:* Gu.

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Patient Name: Date: Surgeon:

| Septal Deformity Grading Sheet | | 0 | 1 | 2 | 3 |
|---|---|---|---|---|---|
| Spur | | None | Mild, may not require treatment | Intermediate | Touches turbinate |
| | Right | | | | |
| | Left | | | | |
| Caudal Deviation | | None | Within columellar footprint | Slightly deviates columella | Resides in nares |
| | To Right | | | | |
| | To Left | | | | |
| Dorsal Curvature (Mid Vault- C Shape) | | None | Non-surgical | Requires Spreader Graft | Adjacent/ touches the ULC |
| | Concave Right | | | | |
| | Concave Left | | | | |
| Dorsal Deviation off Angle | | None | Non-surgical | Requires Spreader Graft | Adjacent/ touches the ULC |
| | Straight to Right | | | | |
| | Straight to Left | | | | |
| PP-Vomer- QC Junction | | None | Non-surgical | Obstructive | Touches turbinate |
| | Obstruction Right | | | | |
| | Obstruction Left | | | | |
| PSA | | None | Within columellar footprint | Slightly deviates columella | Resides in nares |
| | To Right | | | | |
| | To Left | | | | |
| ASA | | None | Slight deviation of tip | Moderate deviation of tip | Severe deviation of tip |
| | To Right | | | | |
| | To Left | | | | |
| | | | **1** | **2** | **3** |
| | | **Sum:** | | | |
| | | **Grand Total:** | | | |

**Figure 1. Septal deformity grading sheet.**

ASA = Anterior Septal Angle; PP = Perpendicular Plate; PSA = Posterior Septal Angle; QC = Quadrangular Cartilage; ULC = Upper Lateral Carilages.

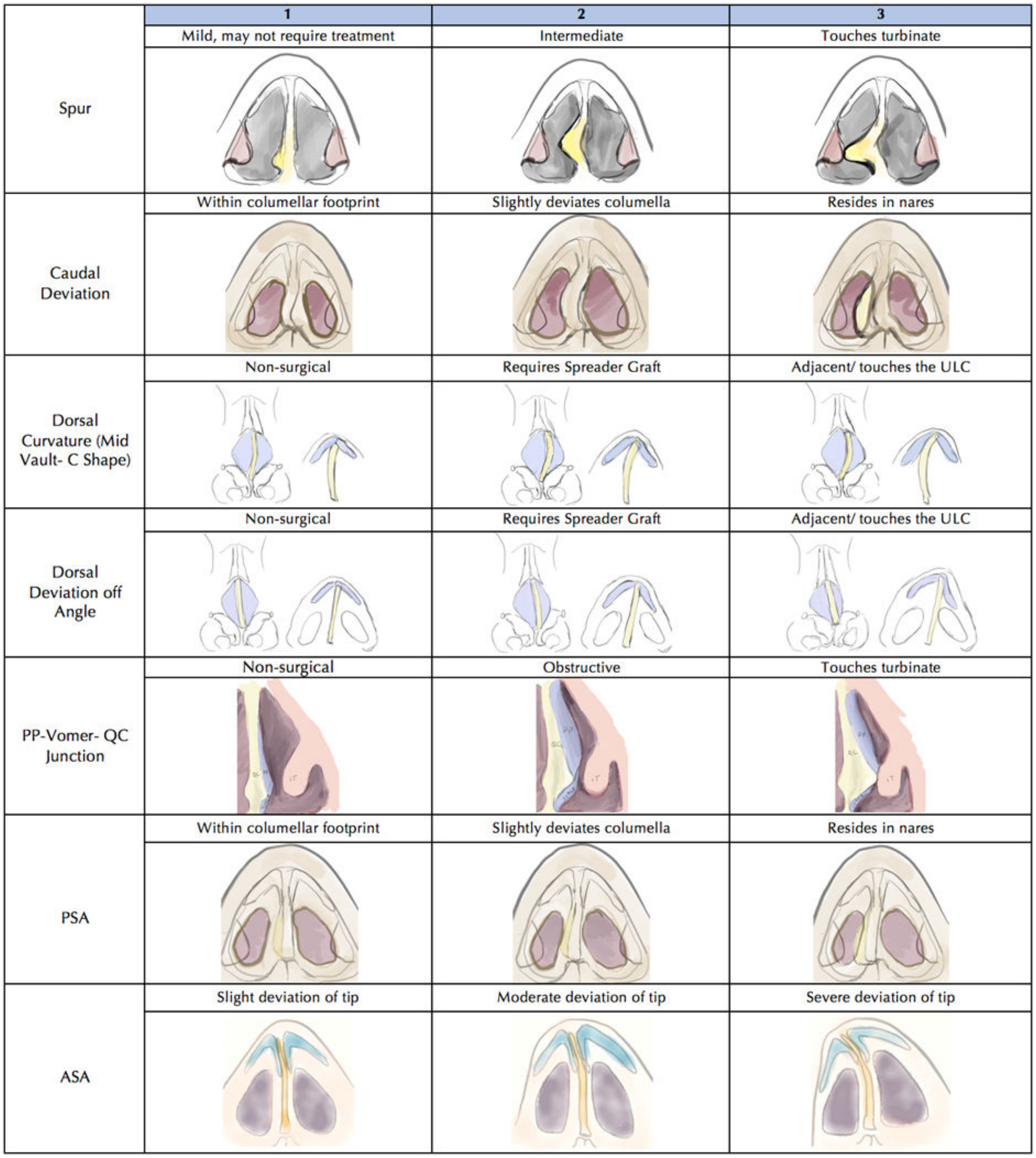


**Figure 2. Graphical depiction of septal deformity severity grading at each of the seven anatomical locations.**

ASA = Anterior Septal Angle; PP = Perpendicular Plate; PSA = Posterior Septal Angle; QC = Quadrangular Cartilage; ULC = Upper Lateral Cartilages.

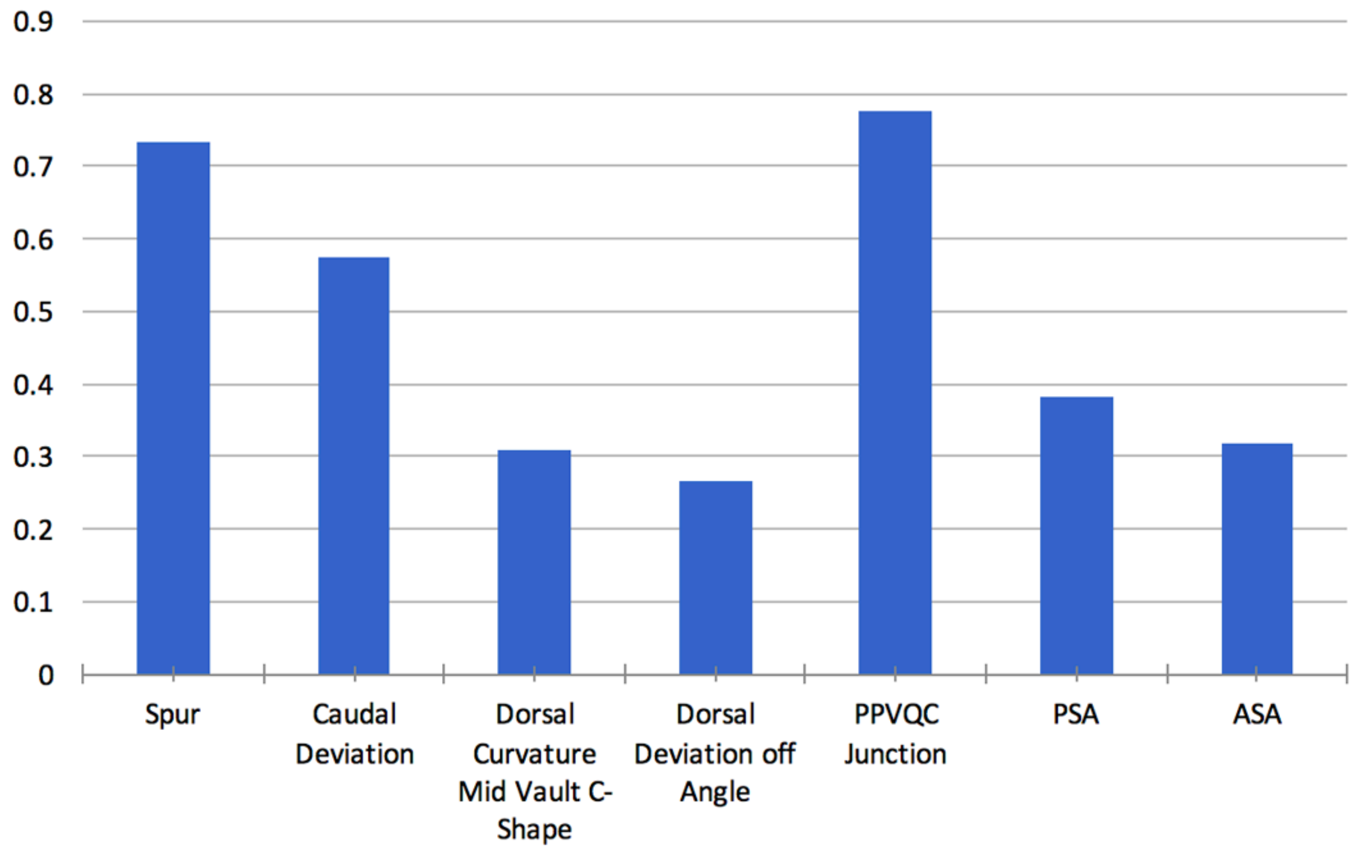


**Figure 3. Prevalence of nasal septal deformities.**

ASA = Anterior Septal Angle; PSA = Posterior Septal Angle; PPVQC = Perpendicular Plate Vomer Quadrangular Cartilage. [Color figure can be viewed in the online issue, which is available at www.laryngoscope.com.]

**Table 1.**

Baseline characteristics and patient demographics.

| Characteristic | Overall No./No. (%) |
|---|---|
| Age, mean (range), y | 39.1 (16–71) |
| Gender | |
| Female | 82/135 (60.7) |
| Male | 53/135 (39.3) |
| BMI, mean (range) | 25.2 (15.9–41.1) |
| Primary operation | 80/135 (59.3) |
| Revision operation | 55/135 (40.7) |
| History | |
| Nasal obstruction | 131/132 (99.2) |
| Allergic rhinitis | 23/132 (17.4) |
| Chronic sinusitis | 24/132 (18.2) |
| Chronic rhinitis | 20/132 (15.2) |
| Nasal trauma | 70/132 (53.0) |
| Previous nasal or septal surgery | 53/132 (40.2) |
| Preop NOSE Total Score, mean (SD) | 67.75 (24.77) |
| Postop NOSE Total Score, mean (SD) | 25.14 (27.02) |
| SDG Score, mean (SD) | 22.07 (15.91) |

**Table 2.**

Linear regression models of pre-and post-operative NOSE scores with SDG components.

| | Pre-operative NOSE vs. SDG | | Post-operative NOSE vs. SDG | |
|---|---|---|---|---|
| **Variable** | $\beta$ | **p-value** | $\beta$ | **p-value** |
| Spur | −0.135 | 0.238 | −0.234 | 0.060 |
| Caudal Deviation | 0.172 | 0.132 | −0.222 | 0.075 |
| Dorsal Concave | 0.170 | 0.137 | 0.240 | 0.054 |
| Dorsal Straight | −0.033 | 0.775 | −0.230 | 0.066 |
| PPVQC Junction | 0.042 | 0.713 | 0.113 | 0.372 |
| PSA | 0.144 | 0.209 | −0.235 | 0.060 |
| ASA | −0.003 | 0.976 | −0.166 | 0.187 |
| Total SDG Score | 0.125 | 0.274 | −0.302 | **0.014*** |

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**Table 3.**

Subgroup analysis between high and low SDG score groups, and covariates.

| Variable | High SDG Score (n=36) | Low SDG Score (n=49) | p-value |
|---|---|---|---|
| High Preop NOSE Score | 25 (69%)[†] | 29 (59%) | 0.416 |
| Low Postop NOSE Score | 23 (64%) | 29 (59%) | 0.286 |
| Revision | 10 (28%) | 24 (49%) | **0.039** [*] |
| Hx of Allergic rhinitis | 8 (22%) | 6 (12%) | 0.249 |
| Hx of Chronic sinusitis | 4 (11%) | 8 (16%) | 0.547 |
| Hx of Chronic rhinitis | 7 (19%) | 3 (6%) | 0.088 |
| Hx of Nasal Trauma | 26 (72%) | 20 (41%) | **0.005** [*] |
| Hx of Previous Nasal/septal surgery | 10 (28%) | 25 (51%) | **0.045** [*] |

[*] p-values computed using independent samples t-test for continuous variables and Fisher's exact test for dichotomous variables

[†] Table entries are counts (percentage)

**Table 4.**

Unadjusted and adjusted odds ratios given a high SDG score.

| Variable | Unadjusted Odds Ratio† | p-value | Adjusted Odds Ratio (95% CI) † | p-value |
|---|---|---|---|---|
| High Pre-op NOSE Score | 0.55 | 0.339 | 0.42 (0.46, 4.99) | 0.491 |
| High Post-op NOSE Score | −1.02 | 0.229 | | |
| Male | 0.68 | 0.127 | | |
| Revision | **2.30** | **<0.001*** | 0.84 (0.06, 3.10) | 0.404 |
| Hx of Allergic rhinitis | 0.72 | 0.226 | | |
| Hx of Chronic sinusitis | −0.45 | 0.497 | | |
| Hx of Chronic rhinitis | 1.31 | 0.073 | | |
| Hx of Nasal Trauma | **1.33** | **0.014*** | **1.20 (1.21, 9.14)** | **0.019*** |
| Hx of Previous Nasal/Septal surgery | **−2.88** | **0.003*** | 0.18 (0.16, 8.75) | 0.859 |

† Predictive model was determined using logistic regression analysis.

**Table 5.**

Comparison within groups of dichotomous variables for SDG, pre-and post-operative NOSE scores.

| Variable | SDG Mean (SD) | p-value | Pre-op NOSE Mean (SD) | p-value | Post-op NOSE Mean (SD) | p-value |
|---|---|---|---|---|---|---|
| Male | 8.17 (4.38) | 0.177 | 68.97 (23.87) | 0.713 | 27.50 (28.99) | 0.642 |
| Female | 6.89 (4.02) | | 67.07 (25.40) | | 23.70 (25.92) | |
| Primary | 8.63 (4.30) | **<0.001*** | 63.77 (23.77) | **0.015*** | 23.51 (28.00) | 0.225 |
| Revision | 5.50 (3.26) | | 73.63 (25.32) | | 27.57 (25.71) | |
| Hx of allergic rhinitis | 8.25 (3.79) | 0.216 | 69.00 (26.19) | 0.730 | 32.36 (30.13) | 0.250 |
| No Hx of allergic rhinitis | 7.28 (4.29) | | 67.47 (24.59) | | 23.26 (26.06) | |
| Hx of chronic sinusitis | 6.71 (3.97) | 0.410 | 79.50 (19.73) | **0.017*** | 31.76 (28.39) | 0.092 |
| No Hx of chronic sinusitis | 7.57 (4.26) | | 65.11 (25.11) | | 23.54 (26.64) | |
| Hx of chronic rhinitis | 6.62 (2.60) | 0.571 | 76.56 (17.48) | 0.152 | 29.00 (27.67) | 0.415 |
| No Hx of chronic rhinitis | 7.57 (4.41) | | 66.24 (25.59) | | 24.64 (27.08) | |
| Hx of nasal trauma | 8.26 (4.36) | **0.041*** | 69.55 (23.52) | 0.411 | 29.11(30.14) | 0.452 |
| No Hx of nasal trauma | 6.53 (3.88) | | 65.56 (26.02) | | 20.89 (22.83) | |
| Hx of nasal/septal surgery | 5.55 (3.51) | **<0.001*** | 69.90 (28.80) | 0.218 | 29.66 (28.26) | 0.162 |
| No Hx of nasal/septal surgery | 8.70 (4.18) | | 66.44 (21.89) | | 21.80 (25.85) | |