Surgical Access to the Internal Nasal Valve

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Objectives: To measure the width of the nasal septum in the region of the internal nasal valve using radiographic images to support use of open septorhinoplasty for alteration of the internal nasal valve and to compare short-term patient satisfaction for open septorhinoplasty vs endonasal septrhino-plasty.

Study Design: Radiographic study and chart review.

Methods: The width of the nasal septum at the level of the inferior turbinates and at the level of maximum septal thickness was measured on computed tomographic scans of 70 patients. Patient satisfaction 12 weeks after treatment was assessed in 113 patients who underwent septrhino-plasty or open septrhinoplasty for nasal obstruction and septal and internal nasal valve abnormalities.

Results: Measures from the computed tomographic scans revealed that the nasal septum was significantly wider at the internal nasal valve than at the inferior aspect of the septum. All 34 patients who underwent septrhinoplasty and all 79 patients who underwent open septrhinoplasty were satisfied with the results at 12 weeks after surgery.

Conclusions: Anatomic evidence supports the need to address the superior septum. Although this may be facilitated by an open septrhinoplasty approach, short-term results showed no difference in patient satisfaction with this technique compared with septrhino-plasty. The differences between the techniques may be evident on long-term follow-up.

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The internal nasal valve is defined as the area between the caudal end of the upper lateral cartilages and the superior cartilaginous septum (Figure 1). The angle between superior septum and the upper lateral cartilage is normally 10° to 15° in the leptorhine nose (typically found in white people) and more obtuse in the platyrhine nose (typically found in black and Asian people). Changes in the angle of the internal nasal valve can result in alterations in airflow and obstructive symptoms. Nasal airflow has been shown to follow a parabolic curve arching superiorly through the internal nasal valve and the nasal cavity (Figure 2). Normally laminar nasal airflow can be altered by structural abnormalities or airway collapse and produce turbulent flow. This turbulence changes the relationship between airflow and resistance and is perceived as nasal obstruction. Conditions that can cause disturbance in airflow include a wide or deviated septum, internal nasal valve collapse, tip ptosis, and loss of support of the upper lateral cartilages. Some evidence exists that reconstruction of the internal nasal valve and the septum improves nasal airflow more than correcting the septum alone. Constantian and Clardy found that postoperative nasal airflow was 5 times greater when the internal nasal valve and septum were addressed. It has been proposed that open septrhinoplasty provides better visualization of the internal nasal valve region, including the superior septum, and allows more precise correction of internal nasal valve deformities than septrhino-plasty.

If repairing the point of maximum width of the superior septum in the region of the internal nasal valve is important to maximizing postoperative nasal airflow, then the level of widest septal thickness must be documented anatomically. It must also be determined if both the open and closed techniques are equally likely to reach that level. Saunders et al have found evidence using magnetic resonance imaging scans on cadavers that the nasal septum reaches maximum thick-
ness at the anterosuperior region. For the present study, because computed tomography (CT) is presently the imaging technique of choice for the nasal cavity, we made measurements of septal width on CT scans to confirm maximum width in the internal nasal valve. Then, to assess whether an endonasal approach can address the superior septum, a cadaver head was used to document the most superior level of visualization through an endonasal approach. It was hypothesized that endonasal access to the widest portion of the superior septum is limited.

Finally, to determine the clinical significance of improved access to and reconstruction of the superior septum and internal nasal valve, the charts of 113 patients who underwent septoplasty or open septorhinoplasty for nasal obstruction were reviewed for complications and patient satisfaction with nasal airway. It was hypothesized that patients undergoing open-approach nasal surgery would experience better results than those undergoing endonasal approach.

**METHODS**

In 70 consecutive sinus CT scans of patients with a narrow septum on clinical examination, measurements were made of the thickness of the septum at the level of the inferior turbinates (w1) at the level of maximum septal thickness (w2) in the superior septum. The respective heights from the floor of the nose (h1, h2) were also measured. To maintain consistency in measurements, the most anterior coronal image that outlined the entire inferior contour of the inferior turbinate was used for measurement (Figure 3). Statistical analyses of the differences between width and height measurements were performed using paired t tests. Within-judge reliability of width and height measures was assessed using Pearson correlations by repeating measurements in 7 randomly selected CT scans (10%).

To determine if the widest aspect of the septum was reachable via an endonasal approach, an anatomic study using a cadaver head was performed. A nasal speculum was inserted to the most superior aspect of the nasal septum that could be visualized transnasally. This level was marked with a metal probe (Figure 4). With this probe in place, a CT scan was performed of the cadaver head, and the height of the probe was measured in reference to the floor of the nose (Figure 5). This measurement was made using the same coronal image that was implemented in the radiographic study.

To assess patient satisfaction with these 2 procedures, a chart review was done of 113 consecutive patients scheduled for surgery for nasal obstruction. All of the patients whose charts were reviewed had undergone a complete nasal airway evaluation, including history and physical examination, prior to surgery. A history of efficacy of prior medical therapy for nasal obstruction was elicited. The nasal airway was assessed for presence or absence of septal deviation. The internal and external nasal valves were evaluated by direct inspection, and internal nasal valve patency was examined during quiet and forced inspiration. The intranasal examination was conducted before and after decongestion with oxymetazoline. Patients with symptoms and signs of reactive mucosal disease and those with dynamic external valve abnormalities such as flaccid or absent structural support of the sidewall were excluded. Thirty-four patients underwent a standard septoplasty through a transnasal approach. Of the 79 patients who underwent an open septorhinoplasty, 23 had reported persistent obstruction after previous septoplasty by other surgeons. Patient satisfaction with nasal airway improvement and complication rate was assessed via questionnaire in all patients at 12 weeks after surgery.
RESULTS

Radiographic analysis revealed that the width of the septum at the level of the inferior turbinates (w1) was 0.30±0.12 cm at a height (h1) of 1.10±0.25 cm from the floor of the nose. The level of maximum septal thickness (h2) in the superior septum was measured as 2.44±0.37 cm from the floor of the nose and the width (w2) was 1.15±0.36 cm. The measures of the heights and widths were normally distributed allowing the use of parametric testing. Within-judge reliability of measures was computed with Pearson correlations. The correlations ranged between 0.82 and 0.91, suggesting adequate measurer reliability (h1, 0.82; h2, 0.90; w1, 0.91; and w2, 0.88). Maximal septal thickness (w2) was statistically significantly wider than the septal width at the inferior turbinates (w1) (P<.001, paired t test). The height of the maximum septal thickness (h2) was statistically significantly higher than the height at the inferior turbinates (h1) (P<.001, paired t test).

Measurements from the CT scan of the cadaver head showed that the metal probe at its highest level on the nasal septum of the cadaver head was measured at 1.85 cm (hp) from the floor of the nose. The level of the inferior turbinates was 1.25 cm from the floor, and the level of maximum septal thickness in the superior septum was 2.80 cm from the floor (hs), comparing favorably with the respective heights, 1.10 cm and 2.44 cm, from the radiographic study. Therefore, the probe was 0.95 cm below the measured level of maximum thickness in the superior septum.

Of the 34 patients who underwent septoplasty, all (100%) were moderately to very satisfied with the nasal airway improvement at the 12-week follow-up visit. There were no short-term complications such as epistaxis, perforation, or persistent nasal obstruction. All (100%) of the 79 patients who underwent open septorhinoplasty with grafting were moderately to very satisfied 12 weeks post-operatively. One patient, who was an industrial solvent cleaner, developed a septal perforation 4 weeks after returning to work. Of the 23 patients who underwent revision open septorhinoplasty after previous septoplasty, all (100%) were satisfied at short-term follow-up.

COMMENT

Through radiographic review, it was shown that the superior septum in the region of the internal nasal valve is statistically significantly wider than the inferior aspects of the septum normally seen on clinical examination. This finding shows that the widest portion of the nasal septum lies in the region of the internal nasal valve and within the superiorly arching airflow parabola. According to Poiseuille’s law, airflow is directly proportional to radius to the fourth power, and thus a narrowing in the internal nasal valve region from a wide septum would have a significant impact on nasal airway resistance and result in decreased flow. Consequently, surgical maneuvers that increase the patency in this critical region should improve airflow.

Cadaveric analysis revealed that the transnasal approach may provide limited visualization of the superior septum in the region of the internal nasal valve. Measurement of the height of the metal probe in the nasal septum showed that the most superior level accessible transnasally is almost 1 cm inferior to the level of
maximim septal thickness on CT scan. This finding suggests that the access to the widest portion of the septum through an endonasal approach may be possible, but likely provides limited visibility compared with the open approach.

Anatomically, an open approach may address deformities in the superior septum and internal nasal valve more effectively than the closed approach. Open septorhinoplasty allows broad access to the entire septum and internal nasal valve region without limitation of visibility. The most superior aspect of a widened septum can be shaved and thinned without weakening dorsal support or violating the delicate mucosal angles lining the upper lateral cartilage-septal junction. Midseptal deflections can be excised and cartilage can be reshaped and reinserted into the septum. The open approach also provides exposure for techniques such as placement of spreader grafts and tip struts without violating nasal mucosa. Spreader grafts are harvested septal grafts sutured in place along the length of the upper lateral cartilage from the cephalic border to the caudal margin that increase the cross-sectional area of the internal nasal valve. They also serve to support the nasal dorsal structure, preventing nasal collapse. A tip strut is a septal cartilage graft that is sutured between the medial crura of the lower lateral cartilage to reinforce and maintain tip support, preventing future tip ptosis due to aging. Other nasal valve and nasal airway enhancement procedures include alar batten grafts that augment flaccid or absent lower lateral cartilages or sidewalls and flaring sutures that dilate the scroll region through suture placement across the nasal dorsum. The open approach offers enhanced visualization allowing precise suture placement and graft positioning. Although many of these techniques can be performed endonassally, the novice nasal surgeon will likely appreciate the enhanced visibility afforded by the external rhinoplasty approach.

Review of patient satisfaction revealed that both procedures had very good short-term results. However, those patients who required revision surgery after persistent nasal obstruction after septoplasty by other surgeons enjoyed improved nasal breathing after open septorhinoplasty. This suggests that the long-term treatment efficacy of these 2 techniques needs to be studied and perhaps the open septorhinoplasty will have better long-term outcomes.

In conclusion, despite CT evidence of a widened superior septum and cadaveric analysis revealing the potential anatomic limitations of endonasal septoplasty, this short-term review did not show differences in patient satisfaction between the open and closed approaches. To further study the effectiveness of open septorhinoplasty, an investigation of long-term results is indicated.

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