Premiere Publications from The Triological Society

Read all three of our prestigious publications, each offering high-quality content to keep you informed with the latest developments in the field.

**The Laryngoscope**
FOUNDED IN 1896

Editor-in-Chief: Samuel H. Selesnick, MD, FACS

The leading source for information in head and neck disorders.

[Laryngoscope.com](http://Laryngoscope.com)

**Laryngoscope: Investigative Otolaryngology**

Editor-in-Chief: D. Bradley Welling, MD, PhD, FACS

Rapid dissemination of the science and practice of otolaryngology-head and neck surgery.

[InvestigativeOto.com](http://InvestigativeOto.com)

**ENTtoday**

Editor-in-Chief: Alexander Chiu, MD

Must-have timely information that Otolaryngologist-head and neck surgeons can use in daily practice.

[Enttoday.org](http://Enttoday.org)

WILEY
The Nasal Swell Body and Septal Perforation Repair

Saba Ghorab, MD; Cullen M. Taylor, MD; Stephen F. Bansberg, MD

**Objectives:** To review our experience with secondary surgery for persistent nasal obstruction following successful septal perforation repair and describe the potential contribution of the nasal swell body (NSB) to obstruction.

**Study Design:** Retrospective chart review.

**Methods:** IRB-approved retrospective chart review of perforation repairs utilizing bilateral mucosal flaps performed by the senior author from October 2008 through April 2019 was performed. Patients who underwent secondary surgery for persistent nasal obstruction were identified. Data regarding patient demographics, perforation characteristics, primary closure technique, and secondary surgical procedures for persistent postoperative obstruction were analyzed. Nasal Obstruction Symptom Evaluation (NOSE) scores were assessed pre and post revision surgery.

**Results:** Thirty-four patients (14.7% of 232 successful repairs) met study criteria. Of those, 30 patients underwent revision septal surgery. An inferiorly advanced NSB was surgically reduced in 9.9% (23/232) of patients following successful closure to improve persistent obstruction. There was no incidence of reperforation. All patients undergoing NSB reduction reported improved nasal airflow postoperatively and 13 completed the NOSE questionnaire. The mean preoperative NOSE score (95% CI) was 52.7 (42.2–63.2; median, 50). The mean postoperative NOSE score (95% CI) was 19.2 (12.8–25.6; median, 15). The difference between the preoperative and postoperative NOSE scores was statistically significant ($P < .001$).

**Conclusions:** Repair of a septal perforation using a superior bipedicle flap carries the potential for the NSB to contribute to persistent postoperative nasal obstruction. The swell body can be surgically reduced, without re-perforation, to relieve obstructive symptoms in the patient with a successful perforation repair.

**Key Words:** Septal perforation repair, nasal swell body, nasal obstruction.

**Level of Evidence:** IV

INTRODUCTION

Patients with a symptomatic perforation of the nasal septum present with varied circumstances that impact management decisions. Although conservative treatments may provide symptom relief, a successful surgical closure provides the best chance for long-term stabilization of a potentially progressive and increasingly problematic lesion. Many rhinologic surgeons have been reluctant to attempt repair because of operative difficulty and historically low success rates. However, the combination of increased surgeon experience and advancement in surgical techniques has improved outcomes. Closure rates exceeding 90% are now commonly reported.1–7 Procedures utilizing bilateral nasal mucosal flaps with an interposition graft have dominated the published literature on perforation repair.

Patients with a successful mucosal flap perforation repair may experience persistent obstructive symptoms after postoperative mucosal swelling subsides.8 Septal deformity, turbinate hypertrophy, nasal valve deformity, or sinusitis/polyps, alone or in combination, may be factors contributing to postoperative obstruction. A sense of dryness with or without crusting may persist following a well-executed and successful flap repair and contribute to a sense of congestion or obstruction.

Closure techniques that develop mucosal flaps superior to the perforation may capture tissue comprising the nasal swell body (NSB, septal turbinate) into the flap. The NSB is a discrete anterosuperior septal prominence that may be mistaken for a high septal deviation (Fig. 1). It measures approximately 2.0–3.0 cm in length and 1.0–1.5 cm in height.9 The anterior inferior extent of the NSB can reach the internal nasal valve angle.10,11 The NSB is a dynamic structure with vasoactive and glandular properties and has the capacity to alter nasal resistance, airflow, and humidiﬁcation.9,10,12,13 As such, the NSB has been implicated in nasal obstruction.

Our experience with septal perforation repair utilizing a bilateral mucosal flap technique highlights the potential contribution of the NSB to persistent postoperative nasal obstruction.

MATERIALS AND METHODS

An IRB-approved, retrospective chart review was conducted for nasal septal perforation repair utilizing bilateral mucosal flaps performed by the senior author (S.F.B.) from October 2008 through April 2019. Patients who underwent secondary surgery for persistent postoperative nasal obstruction following

---

From the Department of Otolaryngology–Head and Neck Surgery (S.G., C.M.T., S.F.B.), Mayo Clinic, Phoenix, Arizona, U.S.A.

Podium presentation at Triological Society Annual Meeting at the Combined Otolaryngology Spring Meeting (COSM); Austin, Texas, U.S.A.; May 5, 2019.

Editor’s Note: This Manuscript was accepted for publication on February 21, 2020.

The authors have no funding, financial relationships, or conﬂicts of interest to disclose.

Send correspondence to Stephen F. Bansberg, MD, Department of Otolaryngology – Head and Neck Surgery, Mayo Clinic, 5777 East Mayo Boulevard, Phoenix, AZ 85054. E-mail: bansberg.stephen@mayo.edu

DOI: 10.1002/lary.28621
successful (100%) closure at the time of last follow-up were identified. Those cases were evaluated for patient demographics, perforation characteristics, primary surgical closure technique, secondary procedures, and outcomes.

**Surgical Technique**

Perforation repair: Perforation length and height are measured. Septal perforation repair is performed endonasally through a right hemitransfixion incision. Mucoperichondrial and peristomal elevation proceeds on the left side of the septum through the perforation and then superiorly to the attachment of the upper lateral cartilage. Mucosal elevation then proceeds inferiorly, determined by perforation size and location, to the floor of the nose and laterally to the inferior meatus. Mucosal elevation is then performed on the right side through the perforation and extended onto the nasal floor to the inferior meatus. Mucosal elevation superior to the perforation’s superior margin on the right side is avoided. This elevation technique and subsequent flap design results in a repair asymmetry between the left and right side. Mucosal flap development is first performed on the left side where complete closure is achieved using superior and (if necessary for moderate- to large-sized perforations) inferior bipedicle flaps (Fig. 2). Incisions are extended up to 2 cm beyond the perforation’s posterior margin to allow the flaps to release and advance for a tension-free closure using interrupted 4-0 chromic sutures. An intercartilagenous incision can be incorporated into the superior flap design to widen the flap with mucosa from the undersurface of the upper lateral cartilage for the repair of larger perforations. On the right side the hemitransfixion incision is extended posteriorly to create an inferior bipedicle flap. The flap is advanced superiorly to oppose the left suture line, is rarely fixated with sutures, and for most moderate to large perforations does not completely cover the

**Fig. 1.** Paranasal sinus computed tomography demonstrates a prominent nasal swell body.

**Fig. 2.** Endonasal technique for septal perforation repair. (A, B) Left superior and, if necessary, inferior bipedicle mucosal flaps are developed and advanced for a tension-free closure of the perforation. (C) Right inferior bipedicle mucosal flap is created by extending the hemitransfixion incision posterolaterally on the nasal floor. (D) Right inferior mucosal flap is positioned to oppose the left-sided suture line. (E) An interposition graft (arrow) is placed against the left-sided closure. (F) Polymeric silicone (Silastic) sheeting is placed bilaterally to protect the repair.
defect. Autogenous tissues are used for the interposition graft. Graft selection is based on clinical circumstances. In general, gently crushed septal cartilage or septal bone is used for small perforations. Temporalis fascia is used for larger perforations and those repairs in which a large amount of septal cartilage and bone were removed during prior surgery. Auricular perichondrium from the medial surface of the conchal cartilage is used when that cartilage is harvested for valve or nasal contour grafting procedures. The repair is protected with 0.02 in polymeric silicone (Silastic) sheeting secured with a single nylon suture and bolstered with pads of folded Telfa gauze placed bilaterally. The packs are removed in 2 days and the sheeting in 10–14 days.

It is our practice to endeavor to obtain at least 6 months of clinical follow-up after perforation repair. Patients who continue to describe symptoms of problematic nasal obstruction after postoperative swelling would have been expected to have resolved, and have examination findings on anterior rhinoscopy suggestive of nasal obstruction, are offered a revision procedure aimed at improvement of nasal obstruction. Commonly, this includes a left-sided NSB reduction.

Swell body obstruction is diagnosed on anterior rhinoscopy visualization and palpation of an elongated mucosal swelling, constrained inferiorly by the scar from the prior superior flap suture line closure and frequently extending anteriorly to the internal valve area (Fig. 3). Marked shrinkage of swell body tissue is noted after the application of topical decongestant. Reduction of the NSB is performed with sharp instruments and spares mucosa. An incision is made with a #15 blade immediately anterior to the mucosal mound and curves along its inferior border. The scalpel blade is advanced to undermine the mucosa, generally for a distance of 1–2 cm. Submucosal scalpel advancement and undermining are guided by direct intranasal visualization to minimize the risk of mucosa violation. A deeper plane of elevation (facilitated by underlying septal structure, if present) is then performed and the swell body submucosal tissue isolated by the superficial and deep elevations is removed with the scalpel or piecemeal with a tru-cut sinus forceps. Grossly, swell body tissue is soft and compressible. A thin layer of scar or temporalis fascia interposition graft may be encountered deep to the NSB and can be carefully removed. A chondrotomy is made when underlying

![Fig. 3. Swell body reduction, endoscopic view. (A) NSB before decongestion. (B) NSB after decongestion. (C) Mucosa incision (arrows). (D) Swell body tissue (*) separated from overlying mucosa. (E) Soft tissue and cartilage specimens. (F) Nasal airway following NSB reduction.](image)
cartilage is present at the superior aspect of the overlapping NSB mound to access the undisturbed right side of the superior septum. Subperichondrial elevation then proceeds posteriorly on the right. Limited resection of the isolated cartilage and bone can then be performed to further flatten the septum. Rigid splints are positioned to cover the incision and compress the septal space, secured with a nylon suture, and removed in 5 days.

**Statistical Analysis**

Statistical analysis comparing preoperative and postoperative Nasal Obstruction Symptom Evaluation (NOSE) scores was performed using the Wilcoxon Signed Rank Test. JMP statistical software (version 14; SAS Institute Inc.) was used for analysis. \( P < .05 \) was considered to be statistically significant.

**RESULTS**

Over the 10.5-year study period 232 patients had complete perforation closure at the time of last follow-up. The average follow-up time was 6.1 (range 1–61) months. Subsequent surgery for persistent postoperative nasal obstruction was performed in 36 of these patients. Two patients were eliminated from the study for continued obstructive crusting mediated by chronic mucosal ulceration and inflammation despite a successful repair and subsequent secondary procedure. Therefore, 34 patients who underwent secondary surgery for nasal obstruction following successful perforation repair were reviewed. (Table I) Three patients underwent external valve surgery alone and one patient had sinus surgery with

---

**TABLE I.**

Demographic and Clinical Data of Study Patients.

<table>
<thead>
<tr>
<th>Patient #</th>
<th>Sex</th>
<th>Age (yrs)</th>
<th>Perf. Size L x H (mm)</th>
<th>Left Closure Flap Used (#)</th>
<th>Side Obstructed R</th>
<th>Side Obstructed L</th>
<th>Surgical Procedure NSB</th>
<th>SEPTO</th>
<th>ITR</th>
<th>NVR</th>
<th>ESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>M</td>
<td>69</td>
<td>21 x 18</td>
<td>2</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>F</td>
<td>37</td>
<td>16 x 12</td>
<td>2</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>M</td>
<td>54</td>
<td>14 x 12</td>
<td>2</td>
<td>x</td>
<td></td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>M</td>
<td>60</td>
<td>25 x 17</td>
<td>2</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>M</td>
<td>50</td>
<td>16 x 11</td>
<td>2</td>
<td>x</td>
<td></td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>M</td>
<td>53</td>
<td>22 x 19</td>
<td>2</td>
<td>x</td>
<td></td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>M</td>
<td>39</td>
<td>10 x 8</td>
<td>2</td>
<td>x</td>
<td></td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>M</td>
<td>52</td>
<td>26 x 17</td>
<td>2</td>
<td>x</td>
<td></td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>M</td>
<td>51</td>
<td>15 x 13</td>
<td>2</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>F</td>
<td>35</td>
<td>25 x 15</td>
<td>2</td>
<td>x</td>
<td></td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>F</td>
<td>42</td>
<td>20 x 15</td>
<td>2</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>M</td>
<td>48</td>
<td>17 x 16</td>
<td>2</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>F</td>
<td>35</td>
<td>16 x 6</td>
<td>2</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>F</td>
<td>30</td>
<td>9 x 6</td>
<td>1</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>F</td>
<td>27</td>
<td>28 x 19</td>
<td>2</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>F</td>
<td>33</td>
<td>7 x 6</td>
<td>1</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>M</td>
<td>63</td>
<td>19 x 17</td>
<td>2</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>F</td>
<td>57</td>
<td>16 x 14</td>
<td>2</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>F</td>
<td>64</td>
<td>10 x 8</td>
<td>1</td>
<td>x</td>
<td>x</td>
<td></td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>F</td>
<td>32</td>
<td>12 x 10</td>
<td>1</td>
<td>x</td>
<td>x</td>
<td></td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>M</td>
<td>48</td>
<td>14 x 18</td>
<td>2</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>F</td>
<td>59</td>
<td>30 x 16</td>
<td>2</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>M</td>
<td>54</td>
<td>17 x 13</td>
<td>2</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>M</td>
<td>20</td>
<td>21 x 15</td>
<td>2</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>M</td>
<td>61</td>
<td>9 x 8</td>
<td>1</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>F</td>
<td>61</td>
<td>18 x 15</td>
<td>2</td>
<td>x</td>
<td></td>
<td></td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>F</td>
<td>49</td>
<td>14 x 12</td>
<td>2</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>F</td>
<td>62</td>
<td>14 x 10</td>
<td>2</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>F</td>
<td>74</td>
<td>13 x 9</td>
<td>2</td>
<td>x</td>
<td>x</td>
<td></td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>M</td>
<td>19</td>
<td>15 x 12</td>
<td>2</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>F</td>
<td>66</td>
<td>18 x 10</td>
<td>2</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>F</td>
<td>44</td>
<td>20 x 11</td>
<td>2</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>F</td>
<td>20</td>
<td>15 x 8</td>
<td>1</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>F</td>
<td>67</td>
<td>8 x 6</td>
<td>2</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ESS = endoscopic sinus surgery; ITR = inferior turbinate reduction; NSB = nasal swell body submucosal reduction; NVR = nasal valve repair; SEPTO = septoplasty.
inferior turbi nate reduction. The remaining 30 (12.9%) patients who underwent a secondary septal procedure were the focus of our interest.

Thirteen males and 17 females, with mean age of 49.4 (range 19–74) years, comprised the revision septal surgery cohort. Mean perforation length was 16.2 mm (range, 7–30), and height was 12.0 mm (range, 6–18). Left-sided closure was performed using both a superior and inferior flap in 24 (80.0%) patients. A right-sided inferior flap was used for all attempted closures.

Left-sided nasal obstruction predominated in the study group, occurring solely on the left in 17 patients or in combination with the right side in 12 patients. An inferiorly advanced NSB was determined to be a contributing factor for obstruction on the left side in 76.6% (23/30) patients undergoing revision septal surgery. Therefore 9.9% (23/232) of all successful repairs over the study period required revision due to nasal obstruction related to displacement of the NSB. In patients with NSB obstruction, 18 had their perforations closed with superior and inferior flaps on the left side, mean perforation height 13.2 mm. Five patients had a superior flap repair only, mean perforation height 8.0 mm. A temporalis fascia interposition graft was used in 18 of these patients, septal cartilage in 3, and auricular perichondrium in 2. There were 14 females and 9 males in the NSB cohort.

The mean time from perforation closure to secondary surgery for the 30 revision septal surgery patients was 11.1 (range, 3–27) months. Swell body soft tissue reduction was usually combined with limited, underlying cartilage/bone excision to further flatten the septum. Reduction of the NSB alone was performed in 12 patients with the complaint of left-sided obstruction. Septoplasty was defined as a procedure performed through the prior right hemitransfixion scar to address a substantial postoperative structural deformity. Eleven patients underwent formal septoplasty and NSB soft tissue reduction was performed in four of these patients. Inferior turbinate reduction was a common adjunctive procedure and adjacent nasal structural deformity. The mean postoperative NOSE score (95% CI) was 19.2 (12.8–25.6; median, 15.0). The difference between the preoperative and postoperative NOSE scores was statistically significant (P < .001) using the Wilcoxon Signed Rank Test. The mean symptom score reduction (95% CI) was 63% (40–80%).

DISCUSSION

Our approach to septal perforation repair was consistent over the study period. Complete, tension-free closure on the left side is a priority. A superior bipedicle flap is used for all repairs and an inferior bipedicle flap is developed, if necessary. The septum inferior to the perforation and adjacent nasal floor provides the mucosa for an inferior bipedicle flap on the right side. Right side superior mucosa is not used so as to eliminate a condition of bilateral cartilage exposure after flap advancement inferiorly with the risk of cartilage devascularization, necrosis, and re-perforation superiorly.

The left-sided superior flap is the most consequential flap in our technique. The superior flap advances farther than the inferior flap. The ventral surface of the upper lateral cartilage can provide additional mucosa to widen the flap to facilitate a complete, tension-free closure for perforations of relatively large height. The superior flap is thick and well vascularized owing to its bipedicle design and the presence of the NSB. We have never witnessed superior flap necrosis.

Our use of a superior flap only on the left side creates a consistent, technique-driven repair asymmetry. This asymmetry can be exacerbated by a thick NSB. A difference in repair thickness between left and right side is usually appreciated intraoperatively and at the time of pack and sheeting removal. Patients usually note left-sided obstruction compared to the right side during the early postoperative period. In our experience, postoperative mucosal swelling generally subsides by 4 months and repair asymmetry frequently persists. Not all patients have a thick NSB. Septal thinning with NSB narrowing is often noted on CT scans of patients who have had prior septal surgery, a frequent occurrence in patients with a perforation. Over the study period, NSB reduction was performed in 9.9% of the patients with a complete perforation closure to improve left-sided obstruction.

The presence of a septal deformity can complicate perforation repair. Surgical correction of deviations posterior to the perforation are not a concern with repair techniques that utilize longitudinally directed flaps. Numerous techniques are available to correct a deformity or absence of the caudal septum at the time of perforation repair. A straight, but weakened, caudal end subjected to contractile forces of secondary intention healing on the right side can result in an obstructive caudal end deformity. Revision caudal end surgery was performed on five patients.

We have become more conservative when resecting deviations superior and inferior to the perforation. The free margin of advanced flaps overlapping septal structure theoretically improves the security of our three-layer closure. However, an NSB overlapping a residual superior septal deformity increases the risk for postoperative obstruction. Six septal deformities posterior to the caudal end were addressed through the prior hemitransfixion incision scar.

One study concluded the NSB to be more prominent on the contralateral side of a septal deformity as determined by CT scan analysis. Depending on superior flap design and incision placement, this “compensatory hypertrophy” of a septal turbinate could play a role in postoperative...
obstruction following perforation repair. We do not routinely scan our perforation patients preoperatively and could not determine whether high right-sided deformities were prevalent in our study group. Hypertrophy of the NSB has been described in patients with allergic rhinitis and chronic sinusitis. Swell body reduction has been successfully performed for nasal obstruction. The potential effect of septal perforation on the NSB has not been studied.

We determined 77% of the patients in our revision septal surgery cohort had a swell body that was contributing to their sense of postoperative obstruction on the left side. Patients with NSB obstruction for which left-sided superior and inferior flaps were used for perforation repair averaged 13.2 mm in vertical height. In our experience larger perforations require a superior flap design that will capture the entire NSB (Fig. 4). The superior incision may need to extend anteriorly through the valve angle to allow for flap release and inferior advancement that will result in a complete, tension-free closure. Alternative designs incorporating mucosa superior to the perforation for repair have been described. Mucosa from the ventral surface of the upper lateral cartilage was used to widen the superior flap in nine of our patients. Mucosa lining the upper lateral cartilage is notably thinner than the adjacent superior septal mucosa containing the NSB and is not obstructive. The silastic sheeting is sized to extend into the valve angle devoid of mucosal lining to protect against problematic valve angle scarring. We have never seen a thick valve area synchia, but infrequently note mild blunting of the internal valve angle. This condition was not noted in our study cohort.

A theoretical advantage of perforation repair techniques using nasal mucosa is that the use of “physiologic” tissue, assuming a successful repair, should optimize symptom resolution. It is not known whether repair techniques using bilateral nasal mucosal flaps are superior to other techniques (unilateral mucosal flaps, buccal mucosa flaps, substrate scaffolding grafts) in resolving perforation symptoms. A validated perforation symptom questionnaire is not currently available to measure septal perforation treatment outcomes. Our experience suggests inferior displacement of the NSB can disrupt nasal airflow physiology and cause obstruction. Miman’s study of the internal nasal valve found the anterior extent of the NSB was the most frequent cause of valve angle narrowing in his study population. The closure of a circular or horizontally oriented elliptical perforation ensures positioning of the anterior end of the inferiorly advanced NSB into the three-dimensional internal valve area in some patients. We note a trend toward swell body reduction in the female nose. Thinning of the NSB soft tissue is done conservatively and preserves overlying mucosa. Limited removal of septal bone or cartilage, whether deviated or not, deep to the NSB can be done in an attempt to further “thin” the perforation repair and improve the nasal airway without re-perforation. The risk of re-perforation following surgical revision may be decreased in three-layer repairs.

A superior flap was the only left-sided flap used in five of our NSB reduction patients. Perforation vertical height averaged 8 mm in these patients. We will consider attempting left-sided closure solely with an inferior flap in future patients with smaller perforations. However, we believe the patient’s best chance for a successful outcome rests with the current repair attempt, and we are comfortable with our technique and low rate of revision in

Fig. 4. (A) Sinus computed tomography scan demonstrating a thick NSB opposite a high right-sided deviation superior to a perforation. (B) Intraoperative photo of the superior bipedicle flap containing the NSB.
light of our perforation repair success rate exceeding 95% over this study period.

Perforation size, prior septal surgery, and septal deformity increase the challenge of achieving success in both complete closure and symptom resolution in perforation surgery. Revision surgery addressing persistent obstruction may include more than one procedure. This was noted in several of our study patients. Postoperative improvement was subjectively determined over the early period of this retrospective study. We believe the preponderance of left-sided obstruction corroborated by exam findings, and the significant findings from the available NOSE data, provides strong evidence for the role of an inferiorly advanced NSB in persistent obstruction following perforation repair. The follow-up period was less than 3 months in 9 of our 30 septal revision patients. Mucosal sparing NSB reduction combined with intact right-sided mucosa following all the septal revision procedures minimizes the risk of a delayed re-perforation.

CONCLUSION
Our experience with a bilateral mucosal flap technique for septal perforation repair demonstrates a small percentage of patients with a successful repair will experience persistent nasal obstruction. Inferior advancement of a superior flap containing the nasal swell body can be an important contributor to this obstruction. The swell body can be thinned to improve obstruction as an isolated procedure, or in combination with other procedures, without septal re-perforation. The rhinologic surgeon dedicated to septal perforation repair should be aware of the structural and functional characteristics of the nasal swell body and its potential for contributing to persistent postoperative nasal airway obstruction. Further experience with this challenging procedure may provide reliable repair alternatives which eliminate NSB manipulation and provide improved outcomes related to nasal obstruction.

BIBLIOGRAPHY