

# Nasal Batten Grafts

## Are Patients Satisfied?

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**Objectives:** To learn how nasal batten grafts affect patients' assessment of their nasal airway patency and to determine the extent to which patients believe batten grafts altered their appearance.

**Methods:** A prospective survey study of 18 patients in a tertiary veterans hospital who had nasal airway obstruction (NAO) due to nasal valve collapse was completed. Patients had placement of bilateral polyethylene batten grafts during a 36-month study period. The Nasal Obstruction Symptom Evaluation (NOSE) validated survey was used to measure a patient's subjective postoperative change in nasal airway obstruction. In addition, the patients were asked to rate the extent their appearance had changed.

**Results:** All patients presented with complaints of NAO due to nasal valve collapse either in isolation or in combination with another anatomical source of obstruction.

The nasal valve collapse was identified by clinical examination. All patients had preoperative photographs. Most patients had a trial with an intranasal stent before opting for surgical implantation of the batten grafts. The results of the NOSE survey demonstrate significant improvement in nasal obstruction. Patients also reported only a minimal change in appearance. There was 1 patient with implant extrusions and only a few implants were removed.

**Conclusions:** Nasal airway obstruction due to nasal valve collapse can be effectively treated with polyethylene batten grafts. The implants are well tolerated, and patients report a significant improvement in NAO. There is little risk of implant extrusion, exposure, or intolerance. In addition, patients did not note a significant change to their appearance.

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**N**ASAL AIRWAY OBSTRUCTION (NAO) due to nasal valve collapse (NVC) is a common health condition that affects many people. An estimated 13% of the general population has NAO due to NVC.<sup>1</sup> On the basis of US Census data, this translates to approximately 28 million individuals who are 18 years or older with this problem in the United States alone.<sup>2</sup> These patients typically live with this condition for many years before seeking treatment from their primary care physicians. Patients are frequently treated with nasal corticosteroids and decongestants before being referred to an otolaryngologist. It is important to correctly diagnose the cause(s) of NAO in each patient because, in many cases, there is more than 1 underlying cause of the obstruction. To achieve an optimal airway, multiple anatomical abnormalities may need to be surgically treated. The annual cost of medi-

cally treating NAO is estimated to be \$5 billion, and an additional \$60 million is spent on surgical intervention.<sup>3,4</sup>

Nasal airway obstruction can be due to structural obstructions or conditions with inflammatory contributions, such as allergy and infections.<sup>5</sup> Nasal valve collapse is commonly cited as one of the main reasons for NAO. The definition and structural components of the nasal valves have been described with variability in the medical literature.<sup>1,5,6</sup> The nasal valve has been used to describe the main site of nasal resistance. This valve was described as the area between the upper and lower lateral cartilages and cartilaginous septum and the nasal floor inferiorly.<sup>1,5-10</sup> Later, others added the anterior head of the inferior turbinate as part of the internal nasal valve. In recent literature,<sup>6-9</sup> the nasal valve has been described as having internal and external valve components. Some authors<sup>11-15</sup> referred to the valve as a singular dynamic unit.

The internal nasal valve is currently defined as the region anterior to the inferior turbinate, and it is the site of maximal resistance.<sup>6</sup> Anatomically, the structural components form a pyramid. The lateral wall is composed of the caudal aspect of the upper lateral cartilage and the head of the inferior turbinate. The medial wall of the pyramid is the nasal septum, and inferiorly the base of the pyramid is formed by the floor of the nose. The external nasal valve is more caudal to the internal nasal valve. It is formed by the nasal septum, the medial and lateral crura of the lower lateral cartilage, and the premaxilla<sup>9</sup> (**Figure 1**).

Using these definitions, one can compartmentalize the internal and external nasal valve regions and have an understanding of the structural anatomy. However, these are not separate entities, and nasal airway dysfunctions with NVC may be caused by both of these regions acting together. Hence, dysfunction of one valve region can lead to improper function of the other valve region.

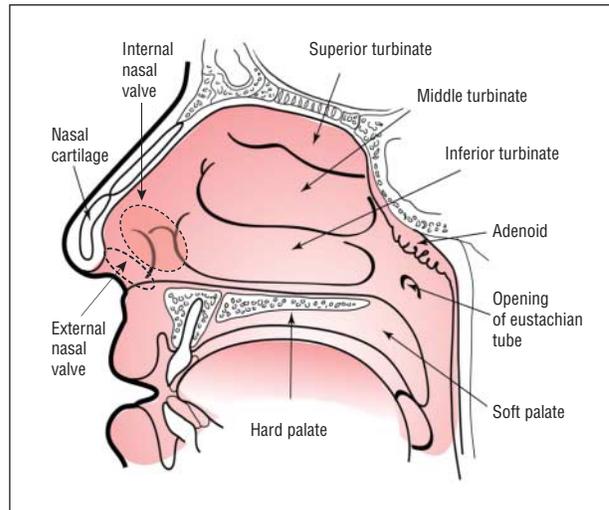
When evaluating a patient with suspected NVC, physical examination is of critical importance and will lead to appropriate treatment. The Cottle test is a useful clinical maneuver to aid in the diagnosis of NVC, but it is not specific only to NVC. An improvement in the nasal airway with the Cottle test may also be seen in isolated septal deviation and other causes because lateral displacement of the lateral nasal structures with the Cottle test will increase the nasal passage to some degree in most cases.

The objectives of our study were to (1) learn how nasal batten grafts affect patients' assessment of their nasal airway patency and satisfaction and (2) determine the extent to which patients believe batten grafts altered their appearance.

## METHODS

The institutional review board–approved study included 18 patients with NAO due to NVC in a tertiary care veteran's hospital who were treated from August 1, 2008, through August 31, 2011. These 18 patients received porous polyethylene batten grafts (**Figure 2**) (Porex Surgical Inc) during the 3-year study period. The Nasal Obstruction Symptom Evaluation (NOSE) validated survey was used to measure patients' subjective postoperative change in NAO using a Likert scale. The 1- to 4-point Likert scale scores were defined as follows: 0, no problem; 1, very mild problem; 2, moderate problem; 3, fairly bad problem; and 4, severe problem. In addition, patients were queried about the use of a continuous positive airway pressure (CPAP) device, the use of intranasal stents, the extent to which their appearance had changed, and their postsurgical treatment satisfaction. The NOSE validated surveys and questions were completed through telephone interviews with patients.

Our technique of batten graft placement appears to differ somewhat from techniques that have been reported in the literature. Therefore, our technique is described in this article. If other concurrent nasal procedures are planned, such as septoplasty or turbinate outfracture, these operations are performed before placement of the batten graft. All the patients received an intravenous dose of antibiotics before incision, and they were all discharged home with a prescription for oral antibiotics. After the patient is prepared and draped, the porous polyethylene graft is placed on the external part of the nose at

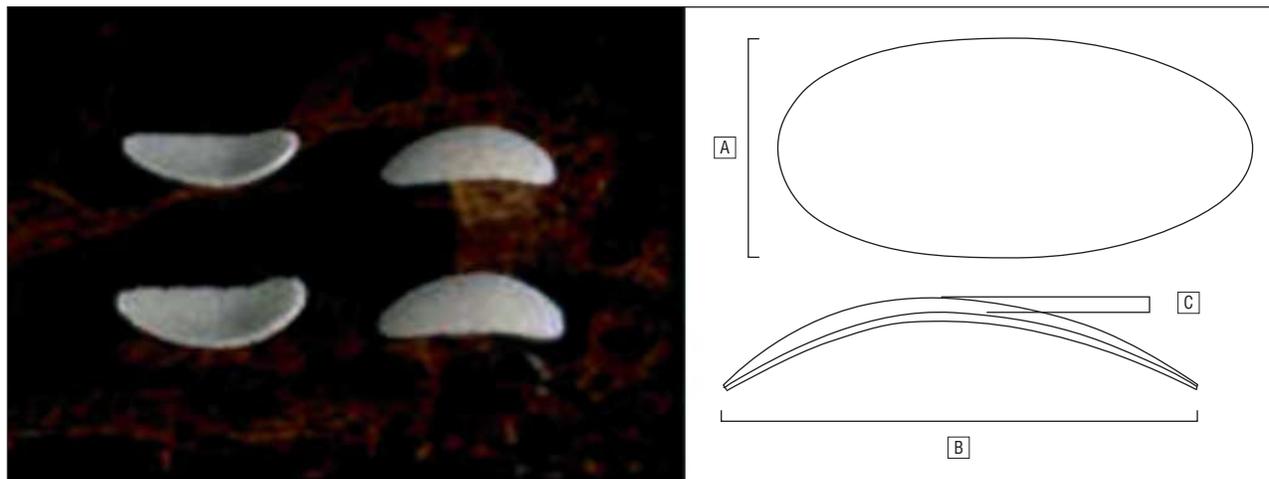


**Figure 1.** The internal nasal valve is the cephalic area between the upper and lower lateral cartilages and cartilaginous septum and the nasal floor inferiorly. The external nasal valve is caudal in relation to the internal valve and formed by the nasal septum, the medial and lateral crura of the lower lateral cartilage, and the premaxilla.

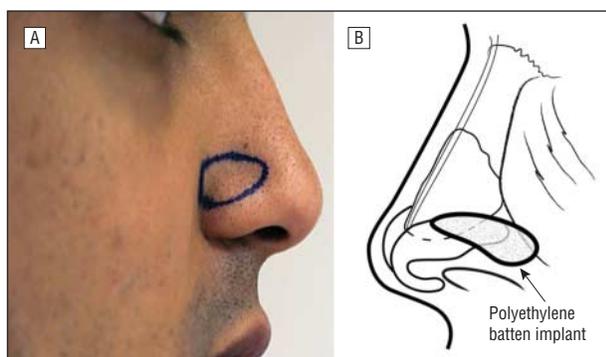
the region of the alar crease (**Figure 3A** and **B**), and the perimeter is traced on the nose with a surgical marking pen to outline the precise subcutaneous pocket. The marginal incision is also identified and marked. Two to three milliliters of 1% lidocaine with 1:100 000 epinephrine is injected into the marginal incision and planned subcutaneous pocket. The porous polyethylene grafts are soaked in antibiotic solution (eg, gentamicin or cefazolin). After the marginal incision is made with a No. 15 blade, the subcutaneous pocket is created in the plane just superficial to the lower lateral cartilage and extended laterally to the bony maxilla. Bipolar cautery is applied to any areas of bleeding in the pocket, and the wound is irrigated with saline. It is important to ensure that the pocket spans to the medial and superficial edge of the bony maxilla, the scroll region between the upper lateral and lower lateral cartilage, and the lower lateral cartilage. Most patients will have symmetrically traced planned pockets on the external surface of the nose. The positioning of the grafts is placed if possible to improve aesthetic nasal deformities without compromising the treatment of NAO, such as in one patient with a stenotic and medialized ala from prior cleft lip disease and surgery. Care is taken to avoid an excessively large pocket to minimize migration of the implant. The posterolateral base of the implant is situated on the bony ledge of the maxilla. This placement is done to ensure proper graft position during healing and allows the stability of the nasal aperture to support and counteract valve collapse. Insulated bipolar cautery is used to manage any bleeding. The wound is irrigated and blotted to remove any remaining fluid. The incisions are carefully approximated with 4-0 chromic in an interrupted fashion.

## RESULTS

The patients ranged in age from 27 to 77 years, and 17 of 18 (94%) were male. Many of the patients (8 of 18 [44%]) reported the use of a CPAP device. Trial use of removable intranasal stents or baskets before placement of the batten grafts was common among the patients (9 of 18 [50%]). Most of the patients had undergone prior nasal surgery (13 of 18 [72%]) by other surgeons. Only 1 patient (6%) had unilateral placement of the porous



**Figure 2.** Porous polyethylene batten implant dimensions. A, 25 mm; B, 11 mm; C, 0.85 mm. The implant has a base that should rest on the maxillary bone. The apex near A is directed anteriorly.



**Figure 3.** Porous polyethylene graft placed on the external part of the nose at the region of the alar crease. A, Preoperative markings of the implant pocket. B, Artist rendition showing proper placement of the implant, resting on the bony maxilla. The edge of the implant is situated on a bone, stabilizing the sidewall to help resist against collapse during inspiration.

polyethylene implant, and the other 17 patients (94%) had bilateral placement of the implants. The 1 patient with unilateral placement (right side) was unique because he had a history of cleft lip repair in childhood and preoperatively had severe asymmetry in his nasal appearance and patency.

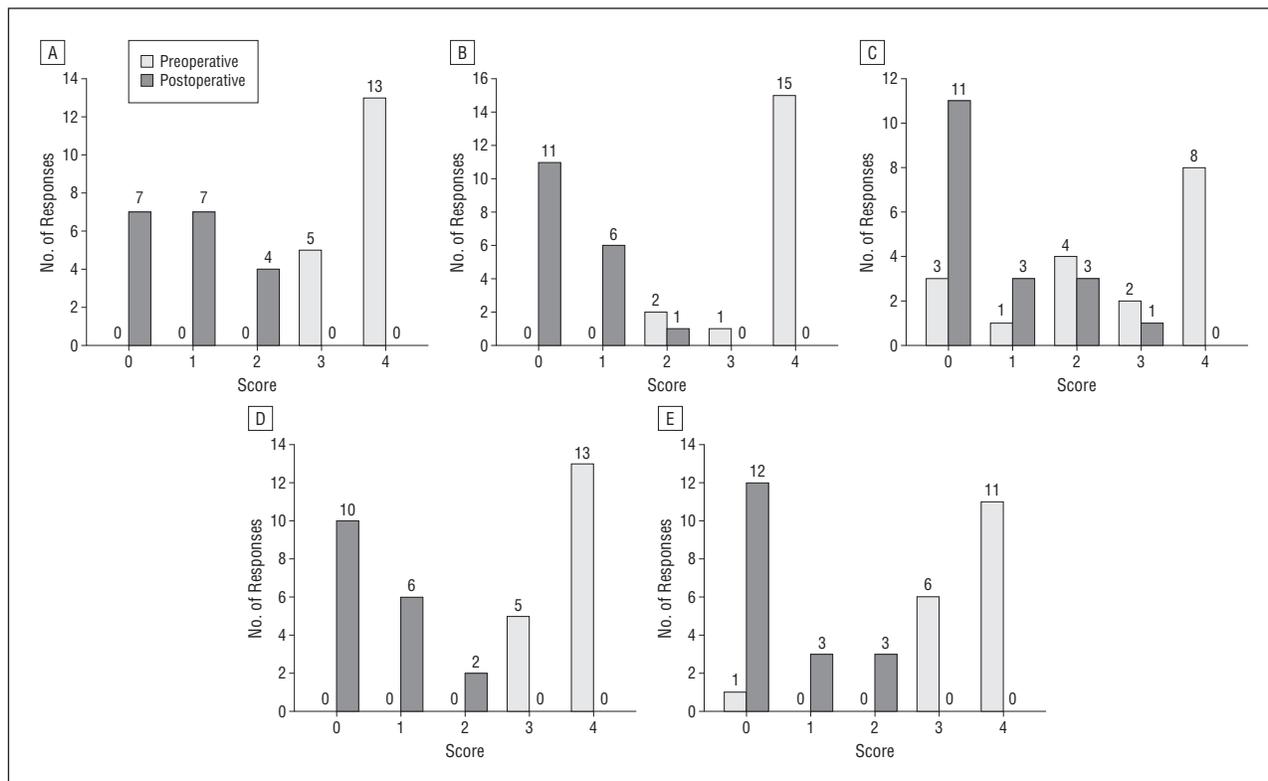
Many of the patients underwent other concurrent nasal procedure(s) at the time of graft placement because of findings in addition to NVC that contributed to a dimensional reduction in nasal passage. A total of 60 patients received surgical intervention for NAO during our 36-month study period, 42 (70%) of whom underwent nasal airway surgery without batten graft placement. Eighteen of these patients had batten graft placement alone or combined with other surgical procedures. Two patients (11%) underwent batten graft placement only, 14 (78%) underwent batten graft placement, septoplasty, and outfracture, and 1 (6%) underwent batten graft placement and outfracture. Septoplasty (either revision or primary) was performed concurrently in 15 of the 18 patients (83%). Inferior turbinate outfracture with or without coblation was performed in 16 of the 18 patients (89%). Sinus surgery was performed in 1 of the 18 patients (6%).

Using a series of 2-tailed paired *t* tests for the NOSE validated survey data, we found that the posttest ratings were significantly improved from ratings of their preoperative state across all comparisons (nasal congestion or stuffiness:  $t_{17}=11.985$ ,  $P<.001$ ; nasal blockage or obstruction:  $t_{17}=16.827$ ,  $P<.001$ ; trouble breathing by nose:  $t_{17}=15.668$ ,  $P<.001$ ; trouble sleeping:  $t_{17}=5.596$ ,  $P<.001$ ; and unable to get enough air through my nose during exercise or exertion:  $t_{17}=10.313$ ,  $P<.001$ ) (**Figure 4**).

In regard to patient satisfaction and aesthetic results, approximately one-third of the patients (6/18 [33%]) reported minimal change in their appearance and the remaining patients (12 of 18 [67%]) indicated no perceived change. The 6 patients who recognized a minimal change in their appearance invariably noted that the change in appearance was an improvement. There was no dissatisfaction with postoperative outcomes despite 1 of the 18 patients (6%) experiencing delayed implant extrusions without evidence of infection and another 2 patients (11%) experiencing pain more than 1 year after treatment who underwent removal of implants. Thus, a total of 3 patients (17%) had an implant complication that resulted in removal of the implant. None of the patients experienced infections, with the possible exception of the 2 patients with pain, who may have had an unconfirmed subacute infection. Most patients (17 of 18 [94%]) reported that, given the option, they would undergo the procedure again if necessary.

#### COMMENT

The previously published literature indicates that autologous cartilage from the conchal bowl or septum is commonly used or recommended in the treatment of NVC. Although the use of porous polyethylene implants is mentioned in the literature, there is only one study, to our knowledge, that reported outcomes associated with their use in NVC.<sup>16</sup> The sole advantage of autologous cartilage is the use of an individual's own tissue, which possibly reduces the risk of infection and extrusion compared with a synthetic implant. The dis-



**Figure 4.** Nasal Obstruction Symptom Evaluation validation survey results. The 1- to 4-point Likert scale scores were defined as follows: 0, no problem; 1, very mild; 2, moderate; 3, fairly bad; and 4, severe. Most patients reported significant improvement postoperatively ( $P < .001$ ). A, Nasal congestion or stuffiness; B, nasal blockage or obstruction; C, trouble sleeping; D, trouble breathing through nose; and E, effect of exertion on nasal airflow.

advantages of autologous cartilage for the treatment of NVC include creation of a donor site wound (if septoplasty is not necessary), which has inherent risks (ie, pain, hematoma, infection, abnormal scarring, ear asymmetry); relative weakness of the conchal cartilage, with risk of further weakness from fissures during graft harvest and insertion; size or shape of conchal cartilage and septal cartilage, which is frequently suboptimal for this purpose; possible inadequate amount of donor cartilage from these sites; and increase in operative time to harvest grafts. The advantages of porous polyethylene implants include the lack of donor site wound or morbidity; consistency of grafts and higher stiffness compared with conchal cartilage grafts and most septal cartilage grafts; curvature and size, which are consistent and rarely require modifications; and the limitless supply of these implants. The disadvantages of these synthetic implants may be a higher infection or extrusion rate compared with autologous cartilage implants and the cost of the implants. Unfortunately, a literature search did not yield any randomized prospective studies that compared outcomes between the use of autologous cartilage and porous polyethylene for the treatment of NVC by the same surgeon.

Most of our patients had undergone previous nasal operations in either community or Veterans Administration institutions. Previous procedures included septoplasty, inferior turbinate surgery, and sinus surgery. These patients continued to be symptomatic for NAO despite having previous surgical intervention. Our diagnosis of NVC was made based on visual and physical examination of the external and internal nose. During the clinical

examination, all patients had a positive response to the Cottle maneuver, indicating that there was obstruction during inspiration, which was improved either in part or in total. In cases of severe septal deviation or deformity, it may be difficult to assess the extent of NVC because the lateral nasal structures (ie, ala, lower lateral cartilage, anterior extent of inferior turbinate, or scroll region) approximate against the deviated septum, and there is no space for possible medial movement of the lateral nasal wall (comprising the internal and external nasal valve) during inspiration. In this situation, the patient should be informed before surgery of this dilemma. We have found that the presence or absence of NVC in the contralateral side of the nose does not consistently mirror or predict the presence of NVC in the other side. Therefore, we recommend that the patient be informed preoperatively and counseled regarding the possibility of NVC and the possible need for subsequent treatment for NVC if NVC cannot be definitely determined due to the presence of a severe septal abnormality approximating the nasal valve.

Most of our patients had concurrent surgical treatment to the septum and turbinates while under anesthesia for treatment of NVC. Our goal was to provide the patient with the most optimal nasal airway possible. If there were septal spurs or deflections and/or hypertrophy or medialized positioning of the turbinates in addition to NVC, then it made sense to treat these findings at the same time. The contribution from any one of these findings or treatments cannot be isolated from NVC, which means the outcome for each patient must be credited to the composite treat-

ment received and not only to the batten grafts. In reality, patients frequently have multiple abnormal anatomical nasal findings, and it is logical to treat them concurrently. A patient may opt to stage treatment if the contribution of one anatomical abnormality cannot be isolated. Our patients are counseled before surgery about this dilemma and about the option of staging the batten grafts from septal or turbinate procedures whenever the contribution of NVC cannot be completely isolated from other abnormalities. Those patients who elected to defer or stage batten grafts are not described in this study, which only includes patients who underwent treatment of batten graft placement. However, it would be of interest to examine the entire population of patients, including those who elected to stage or defer NVC surgery in the hope that septal and/or turbinate surgery will provide them with an adequate nasal airway.

One patient had delayed extrusion of the implant 1 year postoperatively. The patient indicated that his CPAP nasal appliance was ill-fitted and pressed on the nasal tip and alar regions. In addition, he also noted that he was physically active during his sleep and the CPAP appliance was frequently dislodged on waking. These factors may have contributed to the bilateral, partial, noninfected implant extrusions in this case. An additional 2 patients had delayed onset of pain in the implant site, without evidence of extrusion. These patients also wore a CPAP nasal appliance and subsequently had the implants removed. The use of CPAP appliances that apply pressure to the nasal valve region may be a risk factor for implant extrusion or discomfort in patients who undergo nasal batten grafting with porous polyethylene implants. A literature search did not identify any studies that noted this association between CPAP appliances and surgical treatment of NVC. We recommend that the use of CPAP facial appliances be solicited during medical history intake and that patients be made aware of its possible associated risk in NVC surgery.

Our technique and results differ from a previously published study<sup>16</sup> regarding the use and outcomes of porous polyethylene implants. This referenced study used an open rhinoplasty approach for placement of implants in 12 patients. The reported extrusion rate was 21%, with all episodes occurring within 10 months after surgery. This earlier study had a follow-up period that averaged 5 years, which was longer than that in our study (23.8 months). The fact that the extrusions all occurred within 10 months after surgery in the earlier study and occurred at a slightly higher rate than in our study suggests that perhaps differences in surgical technique or patient factors should be considered. The overall revision rate was 42% in the previously published study, which the authors report was due to postoperative complications. This high revision rate suggests there were additional complications in other patients beyond those who contributed to their 21% extrusion rate. The other reasons for the revision surgery and whether the 21% of extrusions were included in the 42% of revisions was not stated in the article. None of the patients in our study had revision surgery. The higher extrusion rate in the prior study may be due to the open rhinoplasty approach, which enlarges the field of dissection, eliminating the possibil-

ity of a precise pocket that is achieved with the endonasal approach. This prior study also noted that a retaining suture was placed through the nasal mucosa, which may have been a nidus or tract for infection.

Our study did not show similar high rates of complications, extrusions, or revisions. Our follow-up period essentially doubles the high-risk, 10-month postoperative period identified in this previous series; therefore, our lower extrusion rate compares favorably. We believe that the keys to successful NVC implant surgery are the formation of a precise pocket that is not seemingly possible with an open rhinoplasty approach, adequate hemostasis, wound irrigation, avoidance of a retaining suture, and careful wound reapproximation. The importance of having a tight-fitting pocket has been reported previously.<sup>8</sup> The graft is porous, and ingrowth of tissue occurs.<sup>17</sup> After this tissue ingrowth occurs, stabilization of the implant is achieved.

The placement of a batten graft in our study was in a subcutaneous pocket created endonasally through a marginal incision in a plane just superficial to the lower lateral cartilage that extended to the maxillary bone. We believe that the positioning of the graft that spans from the maxillary bone margin to the lower lateral cartilage provides the postoperative improvement realized in our patients. Dysfunction in both segments of the nasal valve is either partially or completely treated as a result of support provided by the implant by spanning from the margin of the maxillary bone and part of the lower lateral cartilage and functions as scaffolding, which prevents collapse of the area during nasal inspiration.

In conclusion, NAO due to NVC can be surgically treated with polyethylene batten grafts. It is frequently not possible to isolate and determine the relative contribution of NVC to a patient's NAO if septal and turbinate abnormalities are present. Patients should be counseled on these considerations and associated options for achieving an optimal nasal airway. The successful reduction in NAO and associated symptoms using polyethylene batten grafts compares favorably with that of autologous cartilage grafts without disadvantages associated with the use of autologous ear or septal cartilage. Overall, patients have been satisfied and report a significant improvement in NAO and associated symptoms that affect quality of life. Our study indicates that there is a small risk of implant extrusion, exposure, or need for revision surgery. In addition, patients did not note a significant change to their appearance, and when a minimal change was noted, they invariably thought their appearance had improved.

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