

Nasal Valve Suspension Revisited

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Objectives: Nasal valve suspension (NVS) is a simple technique to correct nasal valve obstruction or collapse by providing a lateral vector of pull on the nasal sidewall. The purpose of this research was to review our experience with NVS in a cohort of patients with nasal valve collapse, including a subset of patients with facial paralysis. The objectives were to determine patient satisfaction and complication rates after NVS.

Study Design: A retrospective review of patients 18 years and older who had NVS from 2003 to 2006 with a follow-up of at least 1 month was performed.

Methods: Data were collected on diagnosis, surgical outcomes, complications, and treatments required. Complications included adverse outcomes, infections, and the need for repeat surgery or treatments.

Results: In 17 charts reviewed, 9 patients (53%) had nasal valve collapse as a result of facial paralysis, and 8 (47%) had previous nasal surgery. Follow-up ranged from 1 to 30 months, with a mean of 16.5. Moderate to complete resolution of obstruction was reported by 82% of patients, or for 88% of procedures. Sustained relief was observed in two of eight patients who had previous nasal surgery and six of nine who had no previous nasal surgery ($P = .1$). Infection occurred in four (24%) patients and five (21%) total suspensions and ranged from 1.5 to 7 months. Six (35%) patients experienced a loss of suspension at 6 to 22 months.

Conclusions: NVS is a technically straightforward, relatively reversible procedure particularly useful in the patient with facial paralysis. The efficacy is excellent in the short term yet appears to diminish with time.

Key Words: Facial paralysis, nasal valve, nasal obstruction, suture suspension.

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INTRODUCTION

The nasal valve is described as the narrowest portion of the human airway.¹ It is anatomically limited by the nasal septum and the upper lateral cartilage (ULC). The upper cartilage that defines this valve is positioned such that it should rest with relative rigidity in relation to the lower lateral cartilage (LLC). Airflow across a valve

causes an increase in velocity and a drop in pressure, termed Bernoulli forces. On inspiration, the high velocity of air passing through a narrowed space, the nasal valve, will cause a decrease in pressure, and a force is exerted onto the ULCs. These Bernoulli forces create a vacuum, such that, when it overcomes the rigidity of the lateral nasal structures, causes collapse of the ULC, thus obstructing the airway. This area can be vulnerable in general as a byproduct of a narrow nose or a deviated septum. Likewise, it can be weakened as result of previous trauma, surgery, or secondary to loss of tone in the associated facial musculature from age or paralysis.

Support of the nasal valve is achieved by several different treatment methods. One commonly practiced nonsurgical method is the use of Breathe Right Nasal Strips (CNS, Inc., Minneapolis, MN). Attempts at surgical correction have been classically performed by placement of cartilage in this area to either strengthen the lateral nasal wall or widen the valve dimensions.^{2–7} Conversely, others have proposed repositioning of the ULC^{8–10} or the LLC¹¹ laterally to correct this problem.

In 1996, Paniello¹² introduced a new surgical technique, the nasal valve suspension (NVS), whereby the ULCs were suspended by placement of a permanent suture at the site of collapse that was then retracted laterally and fixed by anchoring it to the inferior orbital rim. Since then, only three other reports in the literature have focused on this technique. Of these, only Friedman et al.¹³ in 2004 addressed complication rates and persistence of results with a follow-up of 6 months.

There is a long-standing controversy about the use of alloplastic material in nasal surgery. Godin et al.¹⁴ demonstrated how Gortex is effectively used as an implant in nasal surgery with a low complication rate. However, this risk was significantly higher in revision surgery. It is well known that the use of implanted material in nasal surgery runs a high risk of infection and implant rejection. In Friedman's report on NVS, all cases of postoperative infection were attributed to the use of an applied hemostatic agent and not to the procedure or anchoring device itself.¹³ We have at this institution experienced postoperative infection without the use of hemostatic agents and believe a broader representation of this procedure is warranted. The purpose of this research was to review our experience with the use of a bone anchored suture technique to address nasal valve collapse. The objectives were to determine patient satisfaction and complication rates after NVS surgery.

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METHODS AND MATERIALS

Design

A retrospective review of patient charts from February 2003 to February 2006 was performed. Satisfaction included patient report of improved airway/breathing as well as tolerance to the procedure and recovery. Initial outcomes were determined by reports of the immediate postoperative period assessed at 1-week follow-up appointments. Further follow-up occurred at varying intervals as indicated in the results. Complications included documentation of adverse outcomes, infections, and the need for repeat surgery or treatments. Prior to chart collection or review, approval and waiver of consent was received from the internal review board at the University of Utah Hospital and the Salt Lake City Veterans Affairs Health Center (SLCVA).

Patient Selection Criteria

Individuals 18 years or older with documented nasal valve collapse or nasal obstruction who underwent NVS at either the University of Utah or the SLCVA were included. Patients were all evaluated preoperatively by the senior author (S.M.). Preoperative evaluation included complete history and physical examination. Physical examination findings included documentation of nasal valve collapse by direct intranasal inspection and dynamic observation with and without lateral force applied to the ULC with a small earwax curette. Patients undergoing NVS in addition to other nasal surgery were included to determine whether this is a contributing factor to outcomes. In addition, other comorbidities were evaluated for the potential of added risk. Patients with a follow-up period of less than 1 month were excluded. Evaluation of patients preoperatively revealed either static narrowing of the internal nasal valve or dynamic collapse of the nasal valve with deep inhalation. This includes patients who experienced obstruction as a direct result from a facial nerve paralysis, most notably when the nonparalyzed side was asymptomatic.

Surgical Technique

The surgical technique was adopted largely from Friedman et al.¹⁵ It will be detailed here briefly to illustrate any differences. The area of greatest collapse is marked preoperatively just prior to the patient entering the operative suite. Patients are either under general anesthesia or monitored anesthesia care with intravenous sedation. A 15-blade is used to incise the cheek skin

down to the maxillary face medially to the inferior orbital nerve and along the inferior orbital rim. Two Freer elevators are used to retract the soft tissue and peel back the periosteum, exposing the bone of the infraorbital rim (Fig. 1). The Mitek drill and screw system (1.3 mm Micro Quick Anchor, Depuy Mitek, Raynham, MA) is then used to create a port within the maxillary face. The self-retaining Mitek screw is then inserted into the maxillary face and its accompanying suture engaged into the nasal valve.

As described by Friedman,¹⁵ a curved Keith needle is first used to create a suture from the incised maxillary face and screw through the subcutaneous tissue and up the nasal valve. A straight Keith needle is then used on the second arm of the suture that travels from the endonasal valve area through the skin and exits the left maxillary skin and the left cheek skin. This suture is then tied down and the nasal valve appropriately suspended. This area is then closed with 5-0 PDS and 6-0 polypropylene or a 6-0 fast-absorbing gut suture.

Statistical Methods, Data Analysis, and Interpretation

The health information obtained from medical records provides a brief description of the population (i.e., age, sex, diagnosis, comorbidities) for which these findings are applicable. The documented surgical outcomes, complications, and treatments required are the variables evaluated in the study. Direct inspection and dynamic observation were also performed at postoperative follow-up. A successful outcome was based on the patient's report of resolution in nasal obstruction symptoms and repeated dynamic observations. Patients rated the response as complete, moderate, fair, or poor.

RESULTS

Eighteen patients were identified who had undergone NVS during the study period from 2003 to 2006. One patient was excluded because of loss to follow-up with no available information regarding surgical outcomes. The remaining 17 patients' medical records were reviewed. There were 10 (59%) males and 7 (41%) females, and their age ranged from 29 to 74, with a mean age of 49 (SD 11) years.

Nine (53%) patients had nasal valve collapse as a result of facial paralysis, and eight (47%) patients had previous nasal surgery. Of those with facial paralysis, only

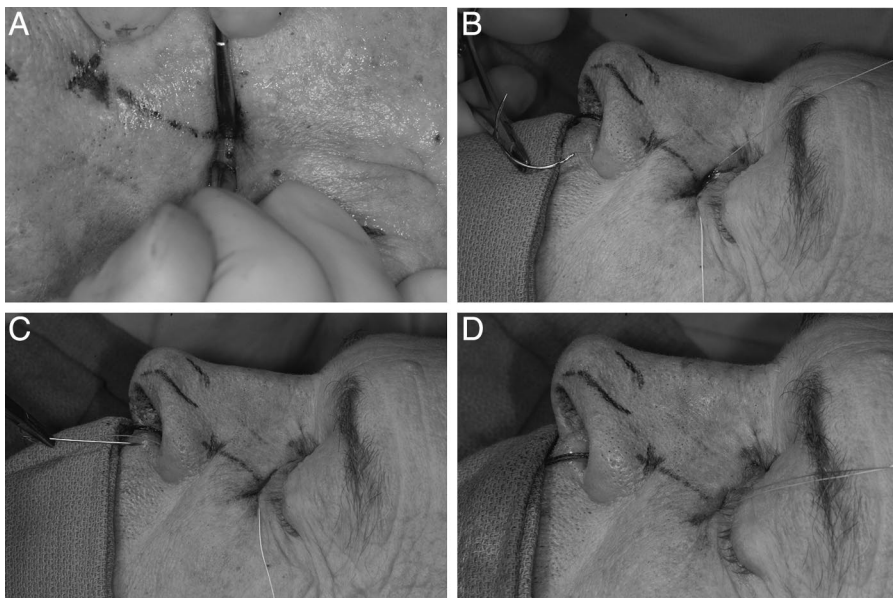


Fig. 1. Nasal valve suspension technique. (A) Two Freer elevators are used to expose the bone of the infraorbital rim through a small stab incision. (B and C) The anchor is positioned and a curved Keith Needle is used to pass one suture through soft tissue into the nasal valve. A straight Keith needle is then used to pass the suture back through the valve area and toward the anchor. (D) The two suture ends are secured and tightened to the appropriate tension to create the desired effect on the nasal valve.

TABLE I.
Nasal Valve Suspension Case Series.

Patient	Diagnosis/History of Previous Nasal Surgery		Procedure	Initial Relief of Obstruction	Follow-Up		Additional Therapy
					Results	Months	
1	Nasal valve collapse	Y	Bilateral NVS	Complete	Sustained	6	
2	Nasal valve collapse	Y	Unilateral NVS	Complete	Sustained	28	
3	Nasal valve collapse	Y	Bilateral NVS	Complete	Return of symptoms on left 12 mo after surgery following nasal trauma; right side sustained	29	Revision NVS with polypropylene suture
4	Nasal valve collapse	Y	1. Rib cartilage graft to nose; 2. revision rhinoplasty; 3. bilateral spreader graft placement; 4. bilateral NVS	Complete	Mild return of symptoms on left	22	
5	Nasal valve collapse	Y	1. Bilateral NVS; 2. revision aesthetic rhinoplasty	Complete on right, moderate on left	Gradual loss of suspension over 6–12 mo on left	16	
6	Nasal valve collapse	N	1. Bilateral NVS; 2. SMR inferior turbinate	Poor on right, complete on left	1. Loss of suspension at 2 mo on left; 2. infection at site of left anchor at 2 mo; 3. recurrent infection at right anchor at 7 mo	11	1. Bilateral spreader and alar batten grafts at 7 mo; 2. antibiotics × 3 wk; left stitch removed at 10 wk; right stitch removed at 7 mo
7	Nasal valve collapse	Y	1. Bilateral NVS; 2. UPPP	Complete on left, poor on right	Discomfort at left anchor site at 1 mo; infection at 4 mo	8	Stitch removed and open septorhinoplasty with spreader grafts performed at 8 mo
8	Nasal valve collapse	Y	1. Bilateral NVS; 2. SMR inferior turbinate	Complete	1. Infection at right anchor site at 4 mo; 2. loss of suspension at 12 mo	21	1. Antibiotics, steroid injection, small suture tail excised in office at 8 mo; 2. revision SMR inferior turbinates, removal of stitch, and scar revision at anchor site at 21 mo
9	Facial paralysis	N	Unilateral NVS	Complete	Sustained	13	
10	Facial paralysis	N	1. Unilateral NVS; 2. temporalis flap midface suspension	Complete	Sustained	25	
11	Facial paralysis	N	Unilateral NVS	Complete	Sustained	26	
12	Facial paralysis	N	Unilateral NVS	Fair	Sustained	30	
13	Facial paralysis	N	Unilateral NVS	Complete	Sustained	1	Patient died of comorbid condition at 6 mo
14	Facial paralysis	N	1. Unilateral NVS; 2. static facial sling with Pelvicol	Complete	Sustained	5	Patient died of comorbid condition at 6 mo
15	Facial paralysis	N	Unilateral NVS	Complete	Loss of suspension at 18 mo	18	Planned bilateral spreader grafts, cancelled because of illness
16	Facial paralysis	N	1. Masseter muscle transfer to orbicularis oris; 2. sternocleidomastoid muscle flap; 3. unilateral NVS	Moderate	Progressive loss of suspension over 6–12 mo	20	Revision midface suspension with Pelvicol and masseter muscle flap at 20 mo
17	Facial paralysis	Y	Unilateral NVS	Complete	Infection at anchor site at 6 wk	2	Antibiotics × 4 wk; removal of stitch at 2 mo

NVS = nasal valve suspension; SMR = submucosal resection; UPPP = uvulopalatopharyngoplasty.

one patient had previous nasal surgery. Ten (59%) patients had unilateral NVS, whereas the remaining 7 (41%) had bilateral procedures, for a total of 24 suspension procedures in 17 patients. Eight (47%) patients underwent

NVS in combination with one or more additional procedures involving the midface or nose (Table I).

Follow-up ranged from 1 month to 30 months, with a mean of 16.5 (SD 9.7) months. Twelve (71%) patients had

a complete resolution of nasal obstruction at 1 week. Three additional patients had complete resolution on one side with continued symptoms on the contralateral side. Two of those with continued nasal obstruction reported the symptomatic side as poor and one as moderate. One patient with unilateral NVS for facial paralysis reported a fair response, and one reported a moderate resolution of obstruction. Three of 24 (13%) suspension procedures were unsatisfactory at 1 week. Moderate to complete resolution of obstruction was reported by 82% of patients, or for 88% of procedures.

Eight (47%) patients had sustained relief of the symptoms at their last follow-up, which ranged from 1 to 30 months, with a mean of 17 months. Two patients died of comorbid disease 6 months from surgery. Not including the two patients who died, the sustained relief rate is estimated at 40% of patients (n = 6 of 15) and 50% of procedures at a mean follow-up of 21 (range, 6–30) months. One additional patient had return of symptoms only after she suffered a significant nasal trauma at 12 months after surgery. She noted complete relief of nasal obstruction prior to the nasal trauma with return of obstruction immediately after the injury. Sustained relief was observed in two of eight patients who had previous nasal surgery and six of nine who had no previous nasal surgery.

A one-sided Fisher's exact test was used to compare sustained relief experienced by those patients who had no previous nasal surgery with those who had and for patients who had NVS combined with other nasal or facial procedures. Sixty percent of those with no history of surgery obtained sustained relief versus 20% of those with a history of surgery ($P = .08$). Furthermore, 67% of those without an additional procedure obtained sustained relief versus 18% of those with an additional procedure ($P = .04$). There were no occurrences of hematoma, poor esthetic outcome, nerve injury, or anesthesia complications.

Loss of relief occurred for one of two identifiable reasons, infection or loss of suspension. Infection occurred in four (24%) patients and five (21%) total suspensions and ranged from 1.5 to 7 months after the procedure. Three of the four patients had a history of previous nasal surgery, and three of four had a concurrent second procedure. In each case, infection was first noted at the anchor site. Antibiotics were attempted in all cases where infection was noted and were given for a period of 1 to 4 weeks. Despite medical intervention, all patients who had developed infection eventually had the stitch removed; one patient required both sides to be removed secondary to infection, separated by 5 months (Fig. 2).

Six (35%) patients experienced a loss of suspension without infection. Loss of suspension was gradual in four patients and immediate in two (12%) patients. In cases of immediate loss, blunt force to the nose preceded the loss. Gradual loss of suspension occurred in 24% of patients. When bilateral procedures are considered separately, 17% of suspension procedures underwent gradual loss. Three patients who had bilateral NVS had return of obstruction on only one side while maintaining suspension on the contralateral side. One patient had loss of suspension in conjunction with drainage from infection at the anchor site. This particular patient lost suspension at only 2 months

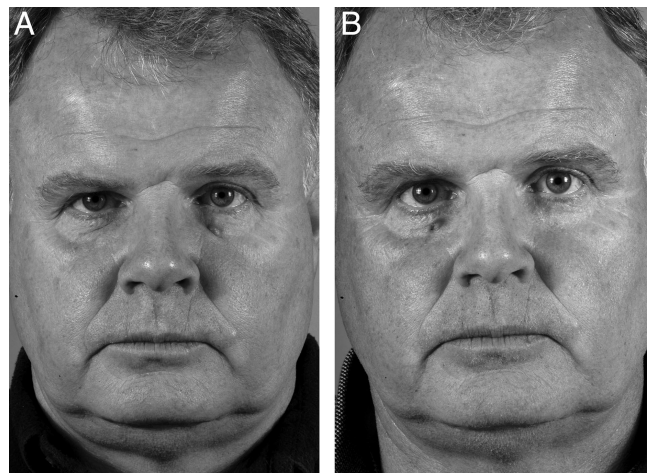


Fig. 2. A patient with bilateral nasal valve suspension developed infection with loss of suspension at left 2 months postoperatively (A) and a subsequent infection at right at 7 months postoperatively (B).

from surgery, the earliest in this series. The remaining four patients lost suspension at 6 to 22 months after the procedure. The patient series is illustrated in detail in Table I.

DISCUSSION

The nasal valve is a complex anatomic area that lends a particular challenge to the nasal surgeon. Obstruction can occur directly from a narrow angle between the septum and the lateral nasal wall. This can result from an overall narrow middle vault or secondarily to a septal deviation. This is referred to as a static obstruction. Conversely, a dynamic obstruction can also occur whereby the drop in pressure generated by inhalation produces excess forces on the lateral nasal wall, including both cartilage and soft tissue, causing a collapse and thus narrowing of the nasal valve and subsequent obstruction (Fig. 3).

The surgical options to address this area are based on a few physical concepts. Spreader grafts are placed between the septum and ULC to widen the angle between them, thus

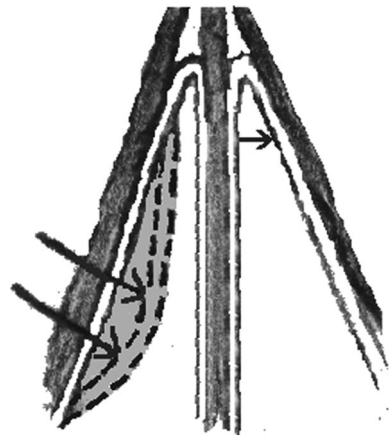


Fig. 3. Schematic illustrating the concept of dynamic nasal valve collapse. On the right nostril, the gray area represents the medial excursion of the upper lateral cartilage during inhalation because of the negative pressure created by Bernoulli forces.

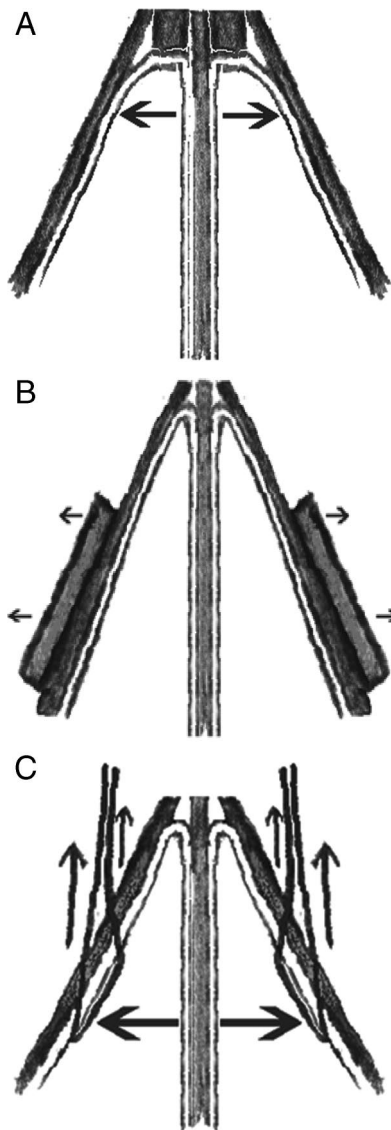


Fig. 4. Schematic demonstrating the effects of surgical techniques for improving nasal airway or enhancing nasal valve stability. (A) Spreader grafts. (B) Batten grafts. (C) Nasal valve suspension.

providing a larger cross-sectional area to accommodate the necessary airflow (Fig. 4A). Although having an indirect effect on dynamic collapse by increasing overall capacity, spreader grafts do nothing to stabilize the soft tissue of the lateral nasal wall, which will still be subject to the inward dynamic collapse generated with inspiration. The area of fibrocartilaginous extending laterally from the ULC to the medial buttress of the maxilla is, in our opinion, particularly vulnerable to collapse.

Batten grafts are placed laterally in the area of the middle vault to provide support and relative stiffness to the sidewall in an effort to prevent collapse (Fig. 4B). Spreader grafts or batten grafts will be sufficient to address the majority of nasal valve collapse situations.

In the setting of facial paralysis, however, different forces of collapse are at play. Because the cartilaginous batten itself simply adds more volume to the area, it

brings extra volume and weight and, without the influences of facial tone, has the potential to cause further inward collapse of these fleshy, soft, noncartilaginous tissues of the pyriform aperture. The NVS allows a static and somewhat permanent lateral pull of these noncartilaginous fleshy tissues of the pyriform aperture region, thus lateralizing them and resulting in an opening of this area that is difficult to achieve with either spreader or batten grafts (Fig. 4C).

NVS was introduced one decade ago as a novel technique to correct nasal valve obstruction or collapse by providing a lateral vector of pull on the nasal sidewall.¹² It is a relatively simple procedure that can be performed quickly, requiring only local anesthesia if needed. In the authors' experience, it can be helpful for lateralizing the hard to correct fleshy lateral nasal sidewall noncartilaginous tissues and particularly so in the treatment of patients with facial paralysis as a contributing factor to their nasal valve collapse. In this group of patients, collapse is secondary to a loss of dilator muscle control, which allows the soft tissue of the nasal sidewall to succumb to the forces of inhalation.

Since its introduction in 1996, only four articles have reported on the efficacy of NVS in improving patient symptoms.^{13,15–17} Friedman et al.¹⁵ introduced the modification used here, which includes the use of the Mitek anchor. One year later, Friedman reported that 91.7% of patients had subjective improvement at 6 months in a cohort of 240 patients, whereas 8.3% had no improvement.¹³ These results were further validated with the use of the Sino-Nasal Outcome Test-20 quality of life assessment in a smaller subset of patients. Our results differed, with an initial complete resolution in 71% of patients. Moderate or better results in regard to obstruction symptoms were, however, observed for 88% of procedures. Long-term satisfaction at a mean follow-up 16.5 months decreased to less than half of patients.

The efficacy of spreader grafts and NVS in improving quality of life were separately evaluated using the validated Nasal Obstruction Symptom Evaluation scale.¹⁷ In this small series, spreader grafts ($n = 31$) and NVS ($n = 7$) had similar outcomes with regard to quality of life improvement. Khosh et al.¹⁸ reported on 11 patients with batten grafts and 25 patients with spreader grafts who reported improvement of 100% and 88%, respectively, at greater than 1 year follow-up. These results are similar to the initial rate of improvement in our series, yet this fails to persist at long-term follow-up after NVS. There was no reference to the use of these procedures in patients with facial paralysis in either of these studies.

Loss of suspension over time occurred in 29% of patients. This occurrence had not been reported in the other series. When no other contributing complication occurred, loss occurred anywhere from 6 to 18 months after the procedure, which was mostly gradual in nature. Lee and Glasgold¹⁶ presented data with use of two sutures in a series of patients who had collapse as a result of previous rhinoplasty. It was their conclusion that two sutures are less likely to fail than one; in addition, more of the valve area can be suspended.

Infection was reported by Friedman et al.¹³ to occur in 8 of 240 (3.3%) patients and was attributed entirely to the

use of a hemostatic agent. Conversely, in our series, 22% of patients developed infection at the infraorbital anchor site. No hemostatic agents were applied. It is unclear what may be different between their technique and ours to account for this. One modification that we did not perform was to make a small incision in the intranasal mucosa to allow the suture to set deep into it. This was done with the intention to avoid a stitch granuloma at the nasal site, which was experienced in only two of our patients. Perhaps this modification also safeguards against infection along the suture from microbial migration to the anchor site or against a more pronounced foreign body reaction.

The infections observed were not severe and in all cases presented as local inflammation and discomfort with or without drainage from the anchor site. This may represent a suture reaction primarily given the thin skin overlying the anchor site. The suture material used was altered in one patient to determine whether it itself was a contributing factor. This was performed after an initial failure in which the patient was so satisfied with the result prior to its failure that she requested it to be redone. In the revision surgery, the Ethibond suture material was removed and replaced with a 4-0 polypropylene. At 4 months follow-up, the patient remains satisfied, with a complete relief of obstruction.

Nasal obstruction in the facial paralysis patient in whom tone is low or absent can be particularly difficult to address. Alex and Nguyen¹⁹ report their experience in using a combination of suture vectors to provide global suspension of the face, including the nasal area, and report similar results in improved nasal breathing at 14 months of follow-up (83% significant improvement). In their experience, suture failure occurred in 3 of 12 (25%) patients, which compares well with our experience in the nasal valve. They had better results when polypropylene sutures were used rather than the Ethibond sutures that come with the Mitek anchor (Ethibond, Inc., Somerville, NJ). We would agree with their conclusion that suture-based procedures have the advantage of being possible under local anesthesia and are easily reversible, making them attractive choices as temporizing measures in facial paralysis management. Two facial paralysis patients in our series died of comorbid conditions within 1 year of NVS. NVS provided necessary quality of life improvement in that timeframe without the need for more invasive or lengthy surgery. In this series of nine patients with facial paralysis, one required revision surgery for loss of suspension, and one patient required suture removal after chronic infection had developed. Six of 9 (67%) had sustained relief. None of the facial paralysis patients who had not had previous nasal surgery experienced infection.

Understanding the management of complications of NVS can aid in physician counseling for this procedure. It is the authors' opinion that, in the properly selected patient, NVS can achieve a static lateralization of the flesh of the pyriform aperture that is difficult to achieve with other currently used surgical modalities. The long-term efficacy appears best when it is performed as a stand-alone procedure for patients with no previous nasal surgery. Because facial paralysis will lead to a collapse of

tissue in this anatomic location in a patient who had otherwise normal nasal airflow prior to development of paralysis, this patient population may represent the ideal for NVS. For this reason, in the properly selected patient, this can be an excellent surgical technique to use, but only with the understanding that this procedure carries a higher risk of infection than other nasal valve reconstruction procedures that rely on the use of autologous cartilage implants. However, if the NVS does become infected, there is relatively low morbidity, is reversible, and the patient is usually no worse off than prior to the procedure. This information provides the surgeon and patient with the ability to consider the patient's treatment options, knowing that when NVS works, both patient and physician can enjoy a high level of satisfaction.

CONCLUSIONS

Nasal valve surgery is a challenging task for the functional nasal surgeon. Identification of the cause of obstruction or collapse is important in surgical planning. Several surgical options exist that can address different aspects of the nasal valve. NVS is a quickly performed, relatively simple procedure that can be performed under local anesthesia to address the problem of nasal valve collapse. In our experience, as well as in other's in the literature, there have been no major complications. NVS is sometimes met with the minor complication of infection or foreign body reaction, yet it is easily reversible by removal of the stitch material alone. It is particularly useful in the patient with facial paralysis, as a stand-alone nasal procedure, and is easily added as an adjunct or temporizing procedure in combination with other facial reanimation procedures not involving the nose. The efficacy is excellent in the short term yet appears to diminish with time. The risk of foreign body reaction or infection is a point of moderate consideration and, at least as shown in this study, may be greater in the patient who has had previous or other concurrent nasal surgery. Larger studies with long-term results are required to determine these effects.

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