Surgical Management of Nasal Airway Obstruction

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KEYWORDS

• Nasal obstruction • Nasal breathing • Septal deviation • Nasal valve narrowing
• Turbinate hypertrophy

KEY POINTS

- The management and diagnosis of nasal airway obstruction requires an understanding of the form and function of the nose.
- Nasal airway obstruction can be structural, physiologic, or a combination of both.
- Anatomic causes of airway obstruction include septal deviation, internal nasal valve narrowing, external nasal valve collapse, and inferior turbinate hypertrophy.
- Thus, the management of nasal air obstruction must be selective and carefully considered.
- The goal of surgery is to address the deformity and not just enlarge the nasal cavity.

INTRODUCTION

The management and diagnosis of nasal airway obstruction requires an understanding of the form and function of the nose. Nasal airway obstruction can be structural, physiologic, or a combination of both. Thus, the management of nasal airway obstruction must be selective and often involves medical management. The goal of surgery is to address the deformity and not just enlarge the nasal cavity. This article reviews airway obstruction and its treatment.

ANATOMY

The nasal airway is both a dynamic and rigid structure. It begins at the external nasal valve, which is composed of the caudal edge of the lower lateral cartilages, caudal septum, nostril sill, and the soft tissue alae. The septum and the bone walls provide the rigid structure of the nose. The septum is made up of quadrilateral cartilage, nasal spine, frontal spine, perpendicular plate of the ethmoid, vomer, and maxillary crest. The narrowest portion of the nose is the internal nasal valve (10°–15°), which is formed by the septum, the inferior turbinate, and the upper lateral cartilage. Short nasal bones, a narrow midnasal fold, and malposition of the alar cartilages all predispose patients to internal valve incompetence.

The lateral wall of the nose contains 3 to 4 turbinates (inferior, middle, superior, supreme) and the corresponding meatuses that drain the paranasal sinuses. The nasolacrimal duct drains through the inferior meatus, whereas the maxillary, frontal, and anterior ethmoid sinuses articulate with the middle meatus. The posterior ethmoid sinus opens into the superior meatus. The nasal cavity ends at the choanae as the airflow passes into the nasopharynx.

FUNCTION

The nose is not only a conduit for inspired air but also an air conditioner that cleans, humidifies,

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and warms the inspired air. It is also involved in olfaction and speech. Inspired air passes through the nose at 200 kph (125 mph) in a parabolic curve moving vertically through the roof of the nasal vestibule and then through the internal nasal valve. The nose is the site of nearly half of the total respiratory resistance; a third of the resistance occurs at the external valve and two-thirds occur at the internal valve. The gatekeeper of nasal airflow is the internal valve, which aids in respiration by limiting the flow of air so that it does not exceed the nose's ability to process it. On deep inspiration the nostril enlarges and the internal valve narrows, whereas on expiration the nostril narrows and the internal valve enlarges. Complete closure of the internal valve is prevented by the action of the alae, which flare outward and upward exerting a checkrein action on the connective-tissue aponeurosis of the upper lateral cartilages.

CAUSES

Nasal obstruction can be physiologic and/or structural. The differential diagnosis of physiologic nasal obstruction includes infections, allergies, medications, vasomotor rhinitis, endocrine disorders, and chemical irritants.

The common cold is the most frequent cause of physiologic nasal obstruction. It is usually self-limiting and treated with antihistamines and decongestants. Allergic rhinitis can be seasonal or perennial. Seasonal symptoms can be managed with antihistamines, decongestants, and topical and/or systemic steroids. Perennial allergic rhinitis requires a work-up, which includes nasal cytology, blood tests for immunoglobulin E levels, and skin test.

Rhinitis medicamentosa is most frequently seen in patients who use long-term nasal sprays or drops. However, it can also result from oral medications such as reserpine, propanol, and chlorpromazine. Its treatment requires stopping the offending medication and providing airway support with decongestants and systemic and/or topical steroids.

Pregnancy is a common endocrine cause of nasal obstruction. However, rhinitis of pregnancy usually resolves with the end of pregnancy. Interim treatment depends on the stage of the patient's pregnancy and the approach that the patient's obstetrician has toward therapy during pregnancy.

Persistent irritants can cause chronic allergic rhinitis, and pollution is the most common environmental cause. Other causes are primarily occupational, which include dust, fumes, and chemicals. The treatment is preventative and avoidance of the irritants.

DIAGNOSIS

The diagnosis of nasal obstruction begins with a complete history, including several key elements, including (1) duration and frequency of the symptoms, (2) whether they are unilateral or bilateral, (3) whether they are perennial or seasonal, (4) history of trauma, (5) history of surgery, (6) presence of allergic symptoms, and (7) medication usage. Examination of the patient's nasal cavities requires good illumination and adequate decongestion. The patient is initially observed at rest without a speculum. The external nasal valve is first examined and noted for alar collapse. The internal valve is also evaluated without a speculum, checking for mucosal scarring and the relationship of the upper lateral cartilage to the septum. The Cottle test is used to evaluate nasal valve disorder. While the patient breaths quietly, the cheek is retracted laterally in order to open up the nasal valve. If the patient's breathing is improved, the Cottle test is positive, indicating that the nasal valve is a factor in the patient's respiratory symptoms. However, if the valve is scarred, the maneuver may not alter the symptoms, and the test results are designated as false-negative. In this case, a Q-tip may be used to retract the nasal valve laterally. Although the Cottle test is specific for nasal valve collapse, false-positive tests are seen in patients with flaccid valves. Gruber and colleagues also described the use of a Breathe Right strip test to evaluate the internal and external valves separately.

The nasal structures are then examined with a nasal speculum. The nasal septum is evaluated for deviation, whereas the turbinates are evaluated for hypertrophy (**Fig. 1**). The caudal end of the septum is examined and deviations of the quadrilateral cartilage and bony septum are noted (**Fig. 2**). The nasal mucosa is examined for scarring or thinning. In addition, both inferior and middle turbinates are evaluated.

TREATMENT

Correction of the nasal airway obstruction is directed toward the anatomic source of obstruction. For septal deviation, a septoplasty can be considered. The goal of the septoplasty is the correct septal deviation while at the same time preserving as much of the septum anatomy as possible.

The septum can be approached endonasally through a hemitransfixion or Killian incision. Alternatively, an open approach can be used. In complex nasal airway cases, the septum is best treated with an open rhinoplasty. The open

Fig. 1. Septal deviation and left turbinate hypertrophy.

approach allows the surgeon to simultaneously approach the caudal and dorsal septum. The upper lateral is separated from the septum after a submucosal tunnel is developed on both sides of the nose. The quadrilateral cartilage is usually approached dorsally through a mucoperichondrial flap that is connected to a mucoperiosteal flap. The quadrilateral cartilage is separated from the perpendicular plate of the ethmoid, the vomer, and the maxillary crest. Bilateral mucoperiosteal flaps are developed, isolating the boney septum. The obstructing bone is fractured with double-action scissors and repositioned. Cuts in the boney septum are usually high on the perpendicular plate of the ethmoid and along the floor of the nose. The septal cut on the ethmoid is to prevent fracturing of the cribriform plate.

Once the boney septum is repositioned, the quadrilateral cartilage is approached. The quadrilateral cartilage is usually left attached to the anterolateral mucoperichondrium unless the caudal

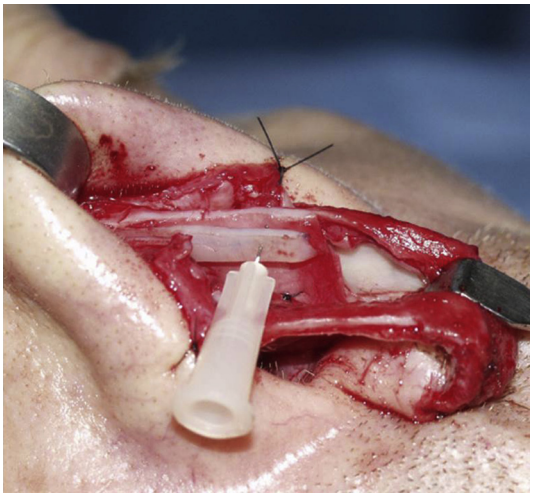

Fig. 3. A spreader graft being placed to correct internal nasal valve dysfunction.

septum needs repositioning. In this case, the caudal septum is freed from the ipsilateral and/or contralateral mucoperichondrium as far as needed. Vertical septal angulation is treated with vertical resection and horizontal angulation with horizontal resection. The thickened cartilage is shaved and, if the deformity persists, it may be necessary to weaken the deformed segment with cross-hatching or conservative morcellation. The area of deflection along the caudal and dorsal borders of quadrilateral cartilages is managed with incisions within 2 mm of the affected border. Although this helps straighten the quadrilateral cartilage it may also weaken it. In order to prevent loss of nasal support, grafts (3 mm $\times$ 10–20 mm) of septal cartilage or ethmoidal bone are sutured to the concave side of the caudal and/or dorsal septal borders, which helps reinforce and straighten the septum as well as fixing it in the midline. The authors have also used absorbable plates made of polylactic and polyglycolic acid (Synthes) (3 mm $\times$ 20 mm) to reinforce or

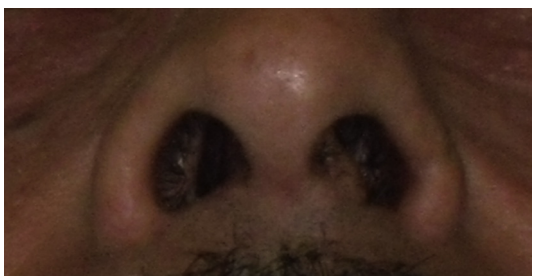

Fig. 2. Caudal septal deflection obstructing the left nasal cavity.

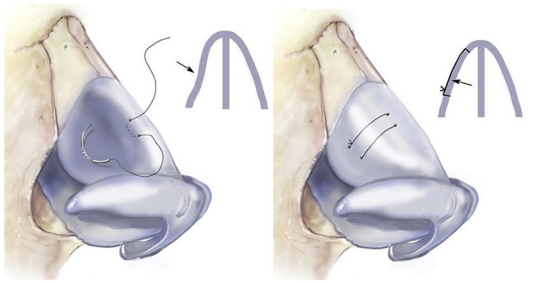

Fig. 4. A suspension suture can also be used to correct internal nasal valve narrowing.

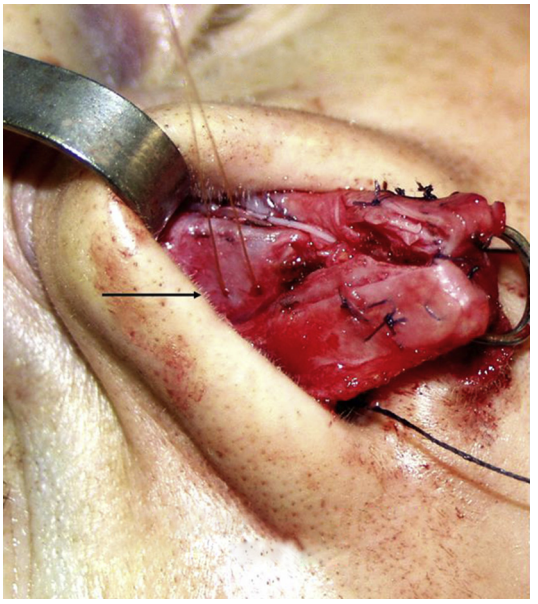

Fig. 5. A mattress suture is placed to improve the internal nasal valve.

straighten the deviated septum. The plates are sutured through preexisting holes to the quadrilateral cartilages with through-and-through polydioxanone sutures. Following the septoplasty, a septal suture of 4-0 plain on a Keith needle is used to coapt the mucosal flaps.

After the septum is corrected, the upper lateral cartilages and internal valve are approached. The lower lateral cartilages have already been separated submucosally from the septum. Abnormalities of the medial portion of the upper laterals may require conservation resection. If the internal valve has collapsed, a spreader flap and/or spreader grafts are used to laterally displace the cartilages, in order to open up the internal valve. The spreader grafts maybe be harvested from the septum, ear, and/or rib in order of preference. The grafts (2–4 mm × 20–30 mm) are sutured 2 mm below the septal border with polydioxanone sutures (**Fig. 3**). Subsequently, the upper laterals are sutured back to the septum with the same suture. A composite graft from the ear is used in patients with internal nasal collapse from mucosal scarring. An alternative method to correct internal nasal valve narrowing is to use a permanent mattress suspension suture (**Figs. 4** and **5**).

The external valve is usually obstructed because of a malposition of the lower lateral cartilage, inadequate underlying support, and/or mucosal scarring. Reconstruction of the external valve and nasal tip begins with a columellar strut, which is harvested from the septum, ear, or rib. It is sutured

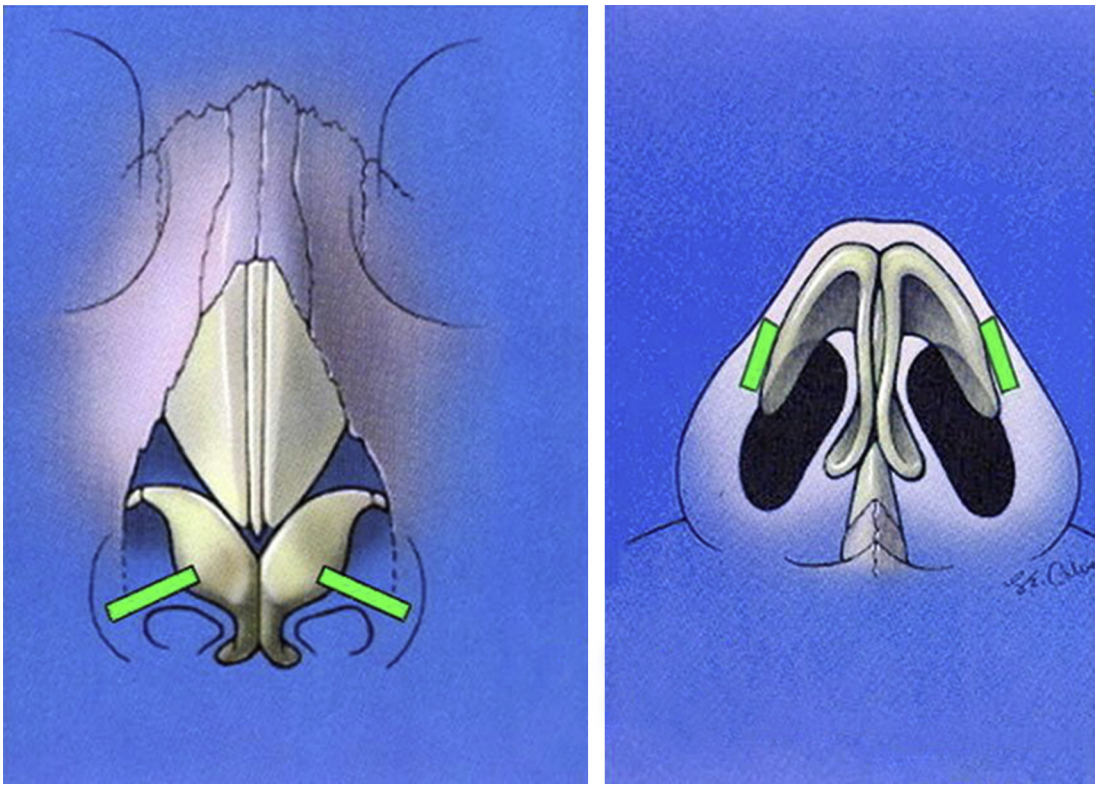

Fig. 6. Rim grafts can be used to treat external nasal valve collapse.

Fig. 7. Rim grafts can be considered when concavity of the rim exists.

between the medial crura with a polydioxanone suture. Once the central limb of the tripod is stabilized, attention is directed to its lateral limbs. In patients with adequate lower lateral cartilage, repositioning of the lower lateral cartilage to the upper lateral cartilages and septum often stabilizes the lower lateral cartilages and opens up the valve. If the lateral crura are over-resected or weak, they are reinforced with lateral crura spanning grafts from the septum or ear. These grafts are placed lateral to the dome running one-half to one-third the length of the lateral crura (1.0–1.5 cm) and sandwiched between the lower lateral cartilages and the nasal lining. They are sutured with polydioxanone sutures. Rim grafts have also been advocated for supporting the external nasal valve (**Figs. 6–8**).

If its external valve needs further opening or support, a lateral crural spanning graft is used. The graft is usually harvested from the septum or the ear (2 mm × 16–18 mm) and helps expand the intercrural space. The position of the nasal valve and lateral crural spanning grafts are adjusted by stabilizing the structures with two 27-gauge needles and redraping the retracted skin. When both vestibular skin and cartilage are needed, a composite graft from the ear is used.

The inferior turbinate often plays a major role in nasal obstruction. The anterior third of the turbinate forms the internal valve, the narrowest portion of the nasal airway. A multitude of destructive and nondestructive turbinotomy techniques have been

Fig. 8. Preoperative (*left*) and postoperative (*right*) results with rim graft placement. The arrow shows the area of preoperative external nasal valve narrowing.

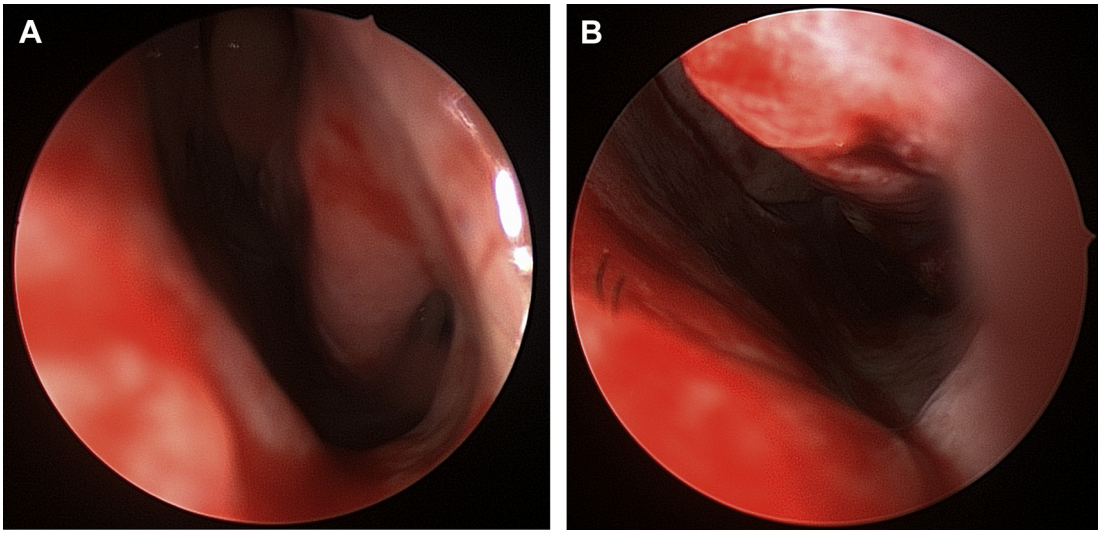

Fig. 9. Intranasal view before (*A*) and after (*B*) septoplasty and turbinate reduction.

described to treat the enlarged turbinates. Treatment approaches include turbinectomy, submucous resection (**Fig. 9**), turbinate outfracture (**Fig. 10**), radiofrequency ablation, submucous diathermy, laser cautery, cryosurgical reduction, and septoturbinotomy.

Septoturbinotomy is a noninvasive procedure used to correct turbinate hypertrophy and septal deviation. It can expand the nasal vault with insertion of a large and long speculum that outfractures the turbinates and also centralizes the bony septum when the handles are compressed. Alternatively, a large clamp can be passed into the nasal cavity and expanded (in reverse nutcracker fashion) to achieve a similar result. Mechanical dilation (expansion) of the nasal vault with the speculum or large clamp improves the airway diameter of the nasal vault and may preclude the need for further work on the turbinates. The nasal vault is not necessarily expanded to the maximal diameter that could be achieved with resection procedures, but it may be to achieve satisfactory air flow.

An enlarged middle turbinate can also cause nasal obstruction and necessitate endoscopic surgery. In some patients, nasal obstruction results from the loss of boney support. In these patients medial and lateral osteotomies with bilateral spreader grafts are used to lateralize the upper lateral cartilages and nasal bones. In some cases, a cantilever costochondral graft is required.

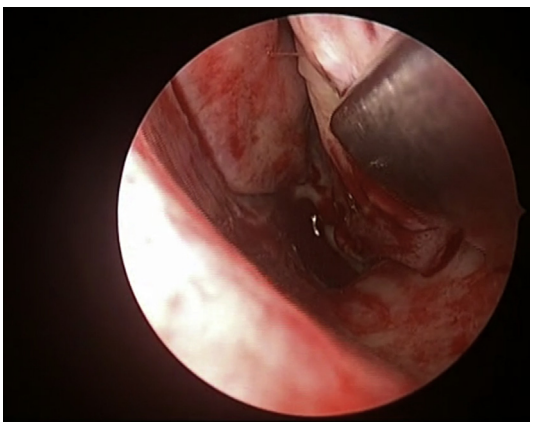

Fig. 10. Turbinate outfracture is performed by lateralizing the turbinate.

SUMMARY

The management of nasal obstruction requires a clear understanding of nasal anatomy and function. Nasal obstruction can be physiologic, anatomic, or a combination of both. The operative treatment is aided by the open approach, which allows clear visualization of the nasal structures, and enables surgeons to precisely address the underlying anatomic deformities. Even though the septum is the key to treating nasal obstruction, attention must also be given to the internal and external nasal valves and the turbinates.