Diagnosing and Treating Nasal Septal Perforations

The authors present a comprehensive treatment guide to nasal septal perforations. Successful surgical repair requires vascularized tissue flaps, interpositional tissue scaffolding, and tension-free closure. However, surgical techniques vary with the size of the defect, and there is no single universally effective procedure. (Aesthetic Surg J 2005;25:524-529.)

Nasal septal perforations may be caused by bilateral contiguous interruptions of septal mucoperichondrium and subsequent necrosis or destruction of the underlying quadrangular cartilage or, frequently, by disruption of the mucoperichondrium and the contiguous underlying septal cartilage or bone. Of the many possible causes for this disorder, septal surgery is the most common.

Successful repair is challenging, even for the most experienced nasal surgeon. There is no single procedure or universally effective repair for closure of all septal perforations; however, successful repairs tend to have 3 basic common characteristics: use of vascularized tissue, placement of interpositional scaffolding, and tension-free closure. Here, we will examine the anatomy, physiology, presentation, etiology, diagnosis, and nonsurgical and surgical treatment of nasal septal perforations.

Symptoms

Symptoms are related to the size and location of the septal perforation. As perforations increase in size, laminar airflow is increasingly disrupted, resulting in turbulence, heightened nasal awareness, and a sensation of nasal obstruction. Increased turbulent flow causes a reduction in nasal temperature and humidity, leading to dryness and injury to the mucosa (see Anatomy and Physiology). Mucosal injury often leads to compensatory increase in mucous production and secondary rhinorrhea, frequently producing crusting. Epistaxis occurs at the edge of the perforation in areas in which the mucosa fails to heal overexposed cartilage. Infectious processes, such as mild low-grade chondritis and severe midfacial osteomyelitis may originate from areas of exposed cartilage, resulting in pain.

Patients with small posterior perforations are generally asymptomatic and, in such patients, this condition is diagnosable only with careful nasal endoscopy. However, as the perforation enlarges, these patients may complain of nasal congestion, bleeding, crusting, whistling, foul odor, and pain. In general, patients with larger anterior perforations have a greater degree of nasal awareness and demonstrate obvious external nasal deformities as well as loss of dorsal support (saddle nose).

Etiology

The causes of nasal septal perforations, usually multifactorial, can be classified as iatrogenic, traumatic, inflammatory, infectious, neoplastic, and caustic.

- Iatrogenic. Previous septal surgery is the most common cause of septal perforations, with rates of occurrence reported as high as 25% after submucous resection.1-3 When contiguous mucoperichondrial flaps are injured during surgery, it is likely that a perforation will develop, extending through and through. We recommend immediate detection and repair of any contiguous flap injuries, followed by placement of interpositional scaffolding using cartilage graft, crushed cartilage, postauricular muscle complex, or fascia. Nonautologous scaffolding options include acellular human dermal allograft (Alloderm LifeCell, Branchburg, NJ); Bioglass S53P4 (Porex Surg., Newman, GA); bovine pericardium (Braile Biomedica, Sao Jose do Rio Preto, Brazil); or porcine subintestinal submucosa (Surgisis ES Cook Surgical, Bloomington, IN).4-7 Other iatrogenic causes include nasal cauterization and/or packing for

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• Traumatic. Nasal septal perforations caused by trauma may arise from nasal/septal fractures, untreated septal hematomas, nasal foreign bodies, rhinoliths, and nose picking.

• Inflammatory. Systemic lupus erythematosus, Crohn’s disease, polyarteritis nodosa, pyoderma gangrenosum, dermatomyositis, antiphospholipid syndrome, and rheumatoid arthritis have been reported as causes of septal perforation. Granulomatous diseases causing septal perforations include sarcoidosis, Wegener’s granulomatosis, leprosy, and tuberculosis.

• Infectious. Syphilis, HIV, fungal conditions (mucormycosis, aspergillosis), diphtheria, Mycobacterium kansasii, parasitic infection (leishmaniasis), and varicella zoster are infectious causes of nasal septal perforations.

• Neoplastic. Carcinomas, T-cell lymphomas, and cryoglobulinemias can present with nasal septal perforations. Many patients having these conditions present with pain that is disproportionate to the size of their lesions. Any suspicious mucosal lesion should be biopsied.

• Caustic. Illicit drug use may lead to septal perforation. Of these drugs, cocaine is the worst offender. Septal perforation may occur through the direct action of adulterants, with toxic effects heightened by cocaine’s vasoconstrictive effects. Chronic drug abuse may permanently damage nasal mucosa and lead to heightened nasal awareness and chronic obstruction. Similar physiologic changes in the mucosa can be seen from the abuse of oxymetazoline, phenylephrine, or menthol inhalers. Topical corticosteroids have also been implicated in the formation of septal perforations and so has occupational exposure to certain chemicals or aerosolized dust, such as hexavalent chromium, chromic acid fumes, sulfuric acid fumes, and glass dust. Mercurials and phosphorus have also been implicated.

Anatomy and Physiology
The nasal septum has bony and cartilaginous segments that are covered by mucoperiosteum and mucoperichondrium. The mucous membranes of the nasal septum contain pseudostratified columnar respiratory epithelium. The vomer (inferior) and the perpendicular plate of the ethmoid (superior) contribute to the septum posteriorly. The quadrangular cartilage develops embryologically as a single unit with the upper two thirds of the upper lateral cartilages. The quadrangular cartilage varies greatly in size, shape, and dimension. The septal quadrangular cartilage provides dorsal form and support from the rhinion to the lobule in the supratip area.

The blood supply of the nasal septum is derived from both the internal and external carotid systems. The superior aspect of the nasal septum is supplied through the medial internal branch of the anterior ethmoid artery and the septal branch of the posterior ethmoid artery. The sphenopalatine artery supplies parts of the mid and posterior nasal septum through its posterior septal branch. The greater palatine artery supplies the inferior and mid septum. The septal branches of the superior labial artery supply the anterior septum. These vessels anastomose interiorly at Kesselbach’s plexus. Nasal septal sensation is provided by the anterior ethmoid nerve and the nasopalatine nerve. The nasal septum divides the nasal passages, creating an environment for laminar airflow which optimizes the warming, humidification, and filtration of air.

Vasculitis, such as Henoch-Schonlein, microscopic polyangiitis, and Osler-Weber-Rendu’s disease, has also been implicated.

Clinical Insights

Figure 1. CT scan of a large nasal septal perforation.
Diagnosis Assessment

For the most accurate diagnostic assessment, focus history-taking and physical examination on etiology, size, dimension, and anatomic location of the nasal septal perforation:

- Perform a nasal endoscopy, meticulously examining the septum and nasal cavity.
- Assess the quality and quantity of the remaining mucosa and examine the residual cartilage and the borders of the perforation.
- Perform computed tomography (CT) imaging of the paranasal sinuses and nasal cavity (Figure 1).
- Biopsy suspicious lesions.
- In the presence of an inflammatory process, consider aerobic, anaerobic, acid-fast bacillus, and fungal cultures.
- When there is strong suspicion of rheumatologic disorder, or connective tissue disease, or strong family history, we recommend serologic testing. This includes erythrocyte sedimentation rate, rheumatoid factor, angiotensin-converting enzyme (sarcoidosis), anti-neutrophilic cytoplasmic antibodies (Wegener’s granulomatosis), and fluorescent treponemal antibody-absorption (syphilis). Precede surgical intervention with treatment of any predisposing systemic illness and stabilization of acute/chronic rhinosinusitis.

Nonsurgical Management

Generally, patients with nasal septal perforation will benefit from a regimen of nasal hygiene including routine saline lavage. Sodium hypochlorite can be added, used nightly with 1-liter irrigation. Humidification of the environment with application of nasal emollients such as petroleum jelly, Ayr saline nasal gel (BF Ascher, Lenexa, KS), Bactroban (Glaxo SmithKline, Research Triangle Park, NC)) may reduce nasal crusting. Topical estrogens can reduce mucosal squamous metaplasia and increase the nasal vasculature. Premarin cream or topical spray (Wyeth Pharmaceuticals, Philadelphia, PA), 25 mg/60 mL normal saline, may be used with dosing determined by clinical response.8

Patients with chronic diseases, persistent illicit drug usage, or those who are poor surgical candidates should be offered nasal septal obturation. However, only 50% of patients with nasal obturation report long-term compliance and satisfaction. Obturator placement may be done in the office setting under local anesthesia or in the operating room under “twilight anesthesia.” Prostheses can eliminate epistaxis, whistling, and reduce nasal awareness. Obturators are available in a variety of materials including silastic, silicone, and acrylic and can be custom made using information from 3-dimensional CT imaging. Crusting may increase with nasal septal obturation.

Surgical Management

The goal of repair is not simply defect closure, but restoration of normal form and function. To accomplish this, the surgeon must select a correct approach, interpositional scaffolding material, and a technique utilizing healthy vascularized tissue.

Successful closure of septal perforations depends primarily on the size of the perforation and the availability of native nasal mucosa. It is always better, whenever possible, to replace tissue with similar tissue. The lack of healthy nasal mucosa may make it impossible to close large defects without recruiting tissue from outside the nose. The greatest wound tension is typically from floor to dorsum, and perforations that extend from floor to dorsum are the most difficult to close.

Nasal septal perforations heal more consistently if a connective tissue scaffold is placed between the repaired septal flaps. The scaffold acts as a barrier in the mucoperichondrial flaps during healing and decreases the risk of incisional dehiscence and reperforation. Multiple authors have documented greater than 90% closure rates using bilateral mucoperichondrial advancement flaps and interposition scaffolding grafts of cartilage, fascia, pericranium, acellular human dermis, porcine small intestine submucosa, bovine pericardium, and bioactive glass.4-6,9-12

Surgical approach and exposure are also considerations. Multiple successful techniques have been described including endonasal, endonasal with alar-plasty, endoscopic, and external transcolumellar.1,3,11-15 The external (open) approach offers improved surgical access with the advantage of binocular visualization for mucoperichondrial flap elevation. By adding the endoscope (4-mm/30-degree) to the open approach, you achieve superior posterior visualization and lighting, which are useful tools for stubborn areas around the turbinates and maxillary crest posteriorly. Disadvantages of the open approach include disruption of tip-supporting mechanisms and postoperative supratip edema. The endoscope requires a camera, video monitor, and extra equipment. However, it can be used as an excellent teaching and intranasal documentation tool. Midfacial degloving procedures have
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For defects less than 1 cm in diameter, we prefer the endonasal approach with endoscopic assistance (4-mm/30-degree). Create a bilateral bipedicled mucosal flap with interpositional scaffolding of crushed septal cartilage or postauricular muscle complex connective tissue. Freshen the edges of the perforation conservatively until you attain healthy mucoperichondrium. Make a slightly longer hemitransfixion incision and create bilateral mucoperichondrial flaps encircling the perforation, extending from the nasal floor to the nasal dorsum. On one side, make a crescentic relaxing incision dorsally with a downward curve posterior, promoting advancement toward the nasal floor. Then suture the lower margin of the perforation to the advancing margin of the flap, closing one side of the nasal septal perforation. On the contralateral side, make a relaxing incision along the nasal floor and advance a mucoperichondrial flap superiorly for closure. Interpose a crushed cartilage or connective tissue graft between the 2 flaps and secure it with horizontal mattress absorbable sutures and tissue glue (Vitagel, Orthovita Malvern, PA). The addition of tissue glue helps to secure the scaffold and eliminate dead space. Then close the hemitransfixion incision, inspect the repair, and examine it with the endoscope. There are many other techniques for closure of smaller perforations, including inferior turbinate flaps, tragal cartilage grafts, and free turbinate grafts.

Defects ranging from 1 to 4 cm

These defects are best treated with an external rhinoplasty approach and endoscopic assistance, allowing creation of bilateral mucoperichondrial advancement flaps, and using a connective tissue interpositional scaffolding (Figure 2). Our preferred scaffolding materials are crushed cartilage and postauricular connective tissue.

Using the external approach, connect a transcolumellar incision with bilateral marginal incisions, and elevate the skin-soft nasal tissue envelope. Separate the medial crura and raise bilateral mucoperichondrial flaps encircling the perforation. Bilaterally, extend incisions inferiorly from the anterior margins of the perforation along the nasal vestibule to the head of the inferior turbinate. Proceed with elevation along the anterior and inferior portion of the nasal floor and under the inferior turbinate. Elevate posteriorly based, unipedicle bilateral mucoperichondrial flaps to close the nasal septal mucosal defect.

The endoscope can be helpful with dissection in tight or scarred areas. If needed, to help promote tension-free closure, advance the mucoperichondrium inferiorly under the upper lateral cartilage as a bipedicled flap. Exercise great caution with this maneuver and use only one flap to prevent bilateral exposure of dorsal septal cartilage.
Then position suitably sized connective tissue scaffold- ing between the bilateral mucoperichondrial advancement flaps to effect perforation closure (Figure 3). Use horizontal, absorbable mattress sutures and tissue glue to secure the interposed connective tissue scaffold- ing. Secure silicone splints (0.25-mm–thick) on both sides of the perforation and remove 3 to 4 weeks after surgery. Because silicone splints are transparent, the repair can be visualized postoperatively in the office, and the splints left in place until complete healing and closure have taken place. The splint protects the flap site from drying and allows for safe postoperative suctioning. By keeping this area moist, healing is accelerated. The bare areas on the floor of the nose and inferior turbinate will remucosalize over a 2-month period. Place epinephrine-soaked Gelfoam (Pharmacia/Pfizer, Kalamazoo, MI) under the inferior turbinate to help prevent epistaxis. Light nasal packing may also be used. There is little risk of vestibular stenosis with this technique.

Defects 4 cm or greater

Three procedures have been described that reliably close nasal septal perforations of 4 cm or greater. In the first procedure, Tardy describes a sublabial flap for closure of mid to large perforations used as a single-layered closure, brought through the superior gingivalbuccal sulcus and left tethered to its pedicle. Tardy found this technique especially useful for anterior defects.

In 1994, Meyer published a modification of Tardy’s technique, successfully closing 13 of 16 perforations greater than 4 cm using a composite buccal graft in a 3-stage delay procedure. The first stage of the procedure involves designing a buccal flap based near the frenulum of the upper lip that is long enough to reach the perforation without tension. It is elevated and backed with a thinned conchal cartilage graft and then returned and sutured into place. The second stage is performed 2 to 3 weeks later when the flap is raised again and delivered into the nasal cavity through an incision in the superior gingivalbuccal sulcus and left tethered to its pedicle. Tardy found this technique especially useful for anterior defects.

In the second procedure, Romo et al have described increasing the area of nasal mucoperichondrium available for closure by inserting bilateral 1 × 3-cm tissue expanders onto the nasal floor in a subperiosteal pocket. Two weeks after original insertion, .5 to 1.0 mL aliquots of sterile saline are injected transorally into the peripheral fill port located on the anterior maxillary wall. This is repeated weekly until the desired amount of expansion (typically 4- to 7 mL) is achieved. The perforation is subsequently closed via a midfacial degloving approach designed to fully expose the nasal vault and septal perforation. The expanders are removed and the expanded posteriorly-based mucosal flaps are rotated to close the defect over a scaffold of human acellular dermal matrix. A full thickness skin graft is used to line the floor of the nose in an attempt to prevent vestibular stenosis. Romo reported an 82% closure rate with this technique for defects 2.0 to 4.5 cm.

The third procedure, first reported in 1998, is the use of free tissue to close large septal perforations. Temporoparietal fascia, radial forearm, and perforator flaps have been used to close large defects. Walton et al reported successful closure in 8 of 11 instances of large septal defects, with mean follow-up of 2.8 years with maintenance of the repair. Templates for reconstructing nasal lining were formatted from 3-dimensional models using high-resolution CT scanning. On completion of reconstruction, all patients demonstrated a patent nasal airway, improvement in nasal form and aesthetics, and satisfaction with results. Free-tissue transfer should now be considered as a viable option for closure of large nasal septal perforations.

Conclusion

Nasal septal perforations arise when pathological conditions cause bilateral adjoining disruption of the nasal septal mucoperichondrium and necrosis of the underlying quadrangular cartilage. Nonsurgical management requires detection of cause, treatment of causal systemic illnesses, and optimization of nasal mucosal health. Optimal surgical treatment of nasal septal perforations involves not only closure of the defect, but also reestablishment of normal nasal function. No single consistent technique exists for the closure of all perforations, but successful closure usually involves use of vascularized tissue flaps, interpositional connective tissue scaffolding, and tension-free closure. In our hands, this is best provided by mucoperichondrial advancement flaps and interpositional scaffolding of crushed cartilage grafts or postauricular connective tissue. Larger perforation may require special approaches.
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and different flaps, including free-tissue transfer for optimal repair and long-term closure.

References