Anterior Ethmoidal Artery Septal Flap for the Management of Septal Perforation

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Objectives: To achieve long-term closure of nasal septal perforations and to describe our surgical technique for repairing septal defects.

Methods: We describe 11 patients who underwent endoscopic repair of anterior septal perforations with a unilateral septal flap pedicled by the anterior ethmoidal artery. The patients were followed up for a period of 12 to 132 months (median follow-up, 51 months).

Results: There were no complications after surgery. All cases of septal perforation remained closed for the duration of follow-up.

Conclusion: Closure of a perforated nasal septum through an endonasal technique can be achieved with a unilateral mucosal flap based on the anterior ethmoidal artery.

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Nasal Septal Perforations (NSPs) can be divided into anterior and posterior types mostly based on whether they cause symptoms, as there are no guidelines regarding the division of the septum into these 2 regions. Nevertheless, the more posteriorly positioned NSPs tend to be asymptomatic or minimally symptomatic and are often a coincidental finding years after nasal surgery. The more anteriorly placed NSPs cause a well-known series of symptoms, such as a whistling sound on inspiration owing to the edge-tone effect of air hitting the margin of the perforation; a sense of nasal obstruction, which is an adverse effect of nonlaminar flow; crusting due to inadequate mucociliary clearance from the anterior septum; and bleeding, which can lead to recurrent small bouts of minor epistaxis.1,2 The size and pathogenesis of the NSPs have a significant impact on the symptoms and surgical management. Factors that can lead to failure of the repair technique include ongoing exposure of the septum to the cause of the NSP as well as its size. In general, larger defects require a bigger graft and flap to sustain them. As there is a limited amount of mucosa available for providing vascular supply to the graft, the process of maintaining a viable graft becomes more complex and fragile with larger grafts.

Although the incidence of NSP is difficult to ascertain in the general population around the globe, 0.9% has been reported in the United States.3 Similarly, the pathogenesis of NSP varies widely according to the region; however, as septoplasty and rhinoplasty have become widespread, surgical trauma has become a leading cause of NSP in many countries. While the other causes of NSP are listed in the Table, the use of cocaine and heroin in powder form has been increasing over the past few decades and represents a particularly challenging set of problems because of the extensive areas of necrosis caused by the drugs as well as the inability of most patients to discontinue the use of these drugs for sustained periods.

METHODS

Eleven symptomatic adult patients (4 women and 7 men) with NSPs were treated with endoscopic surgery. The patients were between 31 and 57 years of age (mean age, 41.6 years). Examination of each patient included a 3-pass technique using a 30° rigid nasendoscope. Countess of Chester Hospital, Chester, United Kingdom (Mr Khodaei).
mographic scanning of their paranasal sinuses, which helped identify anatomical variants such as a concha bullosa that could be later used as an interpositional graft of bone and periosteum for closure of the NSP.

All perforations were located anteriorly. The mean size of the septal perforation was 15 mm (range, 10-25 mm). The patients were followed up for a period of 12 to 132 months (median follow-up, 51 months). Before surgery, each patient’s symptoms were documented and tabulated.

<table>
<thead>
<tr>
<th>Symptom</th>
<th>No. of Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nasal obstruction</td>
<td>9</td>
</tr>
<tr>
<td>Rhinorrhea</td>
<td>3</td>
</tr>
<tr>
<td>Epistaxis</td>
<td>5</td>
</tr>
<tr>
<td>Crusting</td>
<td>8</td>
</tr>
<tr>
<td>Whistling</td>
<td>4</td>
</tr>
</tbody>
</table>

The causative factors of the NSPs were septoplasty (6 cases), nasal cauterization (3 cases), and idiopathic (2 cases).

Ten patients underwent general anesthesia with controlled hypotension, and 1 patient chose a local anesthetic. After topical vasoconstriction, a 4-mm, 0° rigid nasendoscope was used to visualize both sides of the nose. The septum and the floor of the nose were injected with lignocaine, 1%, and adrenaline, 1:100,000. Curettage of the anterior edge of the septum achieves a “freshening of the edge” effect and promotes a minor amount of bleeding to assist the integration of the flap after suturing.

The posterior aspect of the perforation marks the beginning of the superiority based flap, which contains both mucoperichondrium and mucoperiosteum. Using a Beaver knife, the surgeon fashions the posterior border of the flap vertically along the septum, 0.5 to 1.0 cm posterior to the septal projection of the axilla of the middle turbinate (Figure 1). This incision is continued along the nasal floor, following the posterior border of the hard palate, reaching the lateral wall of the posterior portion of the inferior meatus. Then, the incision turns parallel to the septum, following the lateral border of the inferior meatus, until it reaches the anterior portion. At this point, the incision becomes perpendicular to the septum, reaching the inferior border of the perforation. The extension to the inferior meatus creates a larger mucosal flap, allowing advancement of the flap without tension. Because extensive flap elevation is essential to maximize the mobility and blood supply of the flap, a superiorly based rotation advancement flap, supplied by the anterior ethmoidal artery, was developed. The surgeon does not make a flap to cover the perforation on the contralateral side (Figure 2).

The prepared mucosal flap is advanced carefully to cover the perforation, and the posterior portion of the septum and the nasal floor are left uncovered. The flap is then sutured to the mucosa around the perimeter of the perforation, with minimal or no tension on the vascular pedicle.

### Table. Causes of Nasal Septal Perforations

<table>
<thead>
<tr>
<th>Iatrogenic Trauma</th>
<th>Physical Trauma</th>
<th>Autoimmune Disease</th>
<th>Inhalants</th>
<th>Malignancy</th>
<th>Infections</th>
</tr>
</thead>
<tbody>
<tr>
<td>Septoplasty</td>
<td>Nose picking</td>
<td>Wegener granulomatosis</td>
<td>Cocaine</td>
<td>Lymphoma</td>
<td>Untreated septal abscess</td>
</tr>
<tr>
<td>Rhinoplasty</td>
<td>Septal abscess</td>
<td>Nasal sarcoidosis</td>
<td>Heroin</td>
<td>Squamous cell carcinoma</td>
<td>Invasive fungi</td>
</tr>
<tr>
<td>Nasal intubation</td>
<td>Foreign body, eg, small battery</td>
<td>Churg-Strauss syndrome</td>
<td>Nasal sprays containing steroids or vasoconstrictors</td>
<td>Malignant melanoma</td>
<td>Syphilis</td>
</tr>
<tr>
<td>Nasogastric tube</td>
<td>Mucosal laceration</td>
<td>Systemic lupus erythematosus</td>
<td>Phosphorus</td>
<td></td>
<td>Tuberculosis</td>
</tr>
<tr>
<td>Nasal cauterization</td>
<td></td>
<td>Crohn disease</td>
<td>Mercury</td>
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</table>

Figure 1. Anterior ethmoidal artery septal flap. The first vertical incision is made at the level of the posterior border of the perforation. The second vertical incision is made 0.5 to 1 cm posteriorly to the septal projection of the axilla of the middle turbinate (A). Inferiorly, the incision is extended toward the floor of the nasal cavity, keeping the junction of the hard and soft palate as the posterior border of the incision (B). The septal branches of the anterior ethmoidal artery (C) are the main supply to this flap (D).

Figure 2. Anterior ethmoidal artery septal flap. This design allows the surgeon to fashion a flap of adequate size, pedicled on the septal branches of the anterior ethmoidal artery. Such a flap can be transferred anteriorly, as indicated by the arrows, to cover all the borders of the perforation, with minimal or no tension on the vascular pedicle.
Each patient came for review at 3 weeks, 3 and 6 months, and 1 year. The 3- and 14-week postoperative views of the nasal floor that had been left uncovered during surgery showed completely reepithelialization (Figure 5C and D). There were no postoperative complications. All cases of septal perforation remained closed for the duration of follow-up. The median follow-up period was 51 months.

Septal perforation closure poses a particularly challenging problem for the ear, nose, and throat surgeon: technically, it is time-consuming and fraught with difficulties. With a few exceptions, no surgeon has performed a large number of operations aimed at closing an NSP. This may explain the current plethora of surgical techniques available. A literature review in 2007 could not make any statistically significant conclusions about the relative rate of success for the various techniques used to close NSPs. The approach to closing a perforated septum depends on local surgical practice and expertise. Surgical options include approaching the perforation through an endonasal or external rhinoplasty incision or even a midface degloving approach⁵; the use of various graft materials, whether endogenous or synthetic; and the raising of various flaps either unilaterally or bilaterally. The current preference for autologous grafts results from the lack of rejection by host tissues, the relative ease of access, and the potential for a 2-surgeon team for simultaneous procedures. However, endogenous tissues such as temporalis fascia and tragal cartilage can be difficult to handle and to mold into shape.⁶-¹⁵ The external approach has been used for perforations up to 30 mm in diameter; how-
ever, it might also lead to further disability of an already precarious supported nose and may require grafting to reestablish the stability of the nose. Besides these more traditional approaches to septal perforation, larger tissue transfers such as the facial artery musculomucosal flap have also been tried, with good results. 16-20

The endonasal technique avoids these potential problems but may be more difficult for the junior surgeon to achieve. Various flaps, such as unilateral or bilateral bipedicled flaps, have been described for closure of septal perforations. Anatomical studies have reported the presence of 2 or 3 anterior ethmoidal artery septal branches. 21 These vessels are always easily recognizable in the cranial portion of the nasal septum area (Figure 6).

Based on these anatomical criteria, we have used the mucosal flap, which is characterized by a large and flexible pedicle, to bring a suitable blood supply to the flap. The technique we used for our patients raises a unilateral flap through an endonasal technique with endoscopic instruments and is therefore less invasive than other procedures. Furthermore, because no cartilage graft is harvested, it also abolishes donor site morbidity. These 2 factors may help reduce operating times. We recommend the use of Silastic sheets to avoid postoperative scarring.

Our series of 11 patients were followed up for a median of 51 months. A long follow-up period is necessary to completely evaluate the surgical procedure results. Clearly, while our technique requires a great deal of training and skill in endonasal endoscopic surgery and a lengthy follow-up period, early results seem very encouraging and have shown the added advantage of not requiring grafts from outside the nose without creating the potential for further nasal disability through an external approach. In conclusion, closure of an NSP through an endonasal technique can be achieved with a unilateral mucosal flap based on the anterior ethmoidal artery.

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Study supervision: Khodaei and Palma.

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REFERENCES