Technical Advances in the Correction of Septal Perforation Associated With Closed Rhinoplasty

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Objective: To demonstrate technical advances for closing septal perforations that allow the perforation repair to be performed with primary or revisional closed rhinoplasty during the same operation.

Methods: We used this technique with closed rhinoseptoplasty in 258 cases of perforations in which the perforation ranged from 1.0 to 3.5 cm in diameter. We repaired the perforation using bilateral intranasal submucoperichondrial and submucoperiosteal advancement flaps with a sandwich graft interposition between. We prepared the sandwich graft using the auricular or septal cartilage and 2 layers of deep temporoparietal fascia.

Results: In every case, the septal perforation was corrected along with the closed rhinoseptoplasty and, because this is a conservative approach, the vascularization of the columella and anterior septum was preserved, with an excellent view of all the structures involved.

Conclusions: Perforation repair represents a challenge to most surgeons owing to the low rates of successful correction with some techniques. Some of these techniques not only fail to rectify nasal aesthetics and the perforation during the same surgery but also cause undesired aesthetic alterations due to the retraction and rotation of tissues to close the perforation. We have performed this repair since 1989, allowing for closure of the perforation in 257 of 258 patients.

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PERFORATION REPAIR REPRESENTS A CHALLENGE TO MOST RHINOLOGISTS Owing to the modest rates of successful correction provided by some of the traditional techniques.1-7 Some of these techniques not only fail to rectify nasal aesthetics and perforation during the same surgery but may even cause undesired aesthetic alterations due to the retraction and rotation of tissues to close the perforation.

Because the main cause of septal perforation is surgical trauma,8-17 many of the patients who seek the correction of septal perforation have already undergone nasal surgery, and in many cases there is a septal deviation or other aesthetic alteration that requires rhinoplasty. All of these alterations can be corrected as part of a single operation by way of this technique, which provides functional and aesthetic improvement for patients who need to have small aesthetic details fixed, as well as those who require major rhinoplasty involving the tip, dorsum, and nasal alae. In cases of large perforations, even when the patient does not have an aesthetic concern, this technique for closing septal perforations should be performed with rhinoplasty to avoid potential aesthetic alterations due to the retraction and rotation of tissues.

ETIOLOGICAL FACTORS

Septal perforation can result from a variety of causes, the most common of which is trauma from a septoplasty. A common error in nasal septal surgery is inadvertent dissection in a supraperichondrial submucosal plane. This leads to resection of the perichondrium or the periosteum with the cartilage and bone, leaving only mucosal flaps opposing each other. Kim et al18 believe that mucosa-only flaps, lacking the additional strength and support of the perichondrial layer, predispose the patient to immediate or delayed septal perforation. Intranasal splints also are associated with considerable morbidity, with significantly greater postoperative pain and a higher incidence of septal perforation and nasal vestibulitis.19

SYMPTOMS OF PERFORATION

Nasal septal perforations seem to be related to lower humidity in the anterior nasal airways during inspiration. Reduced humidity may contribute to crusting as a
Main symptom. 20 Other symptoms include a nasal-whistling breathing pattern, nasal obstruction, and epistaxis. The incidence of these symptoms depends on the location and size of the perforation. 21-24

Nasal septal perforations may cause functional and cosmetic problems. The cosmetic problems associated with septal perforations are caused by the loss of structural support of the nasal septum, leading to external deformities, the most common of which are saddle-nose deformity and columellar retraction. 10

However, not all septal perforations require surgical closure. A hole in the posterior bone part of the septum can remain untreated because it does not cause any inconvenience.

Because of the disturbance generated in the nasal cavity by a nasal septal perforation, the inspiratory airflow changes from the normal laminar type into turbulence. This turbulent airflow brings about an increased desiccating effect of inspired air, especially in the anterior part of the nasal cavity. If posteriorly located, nasal septal perforations produce little turbulence and are often asymptomatic. 9 Etiological factors of perforation are very important in determining the approach and the type of treatment. When dealing with a perforation, a detailed analysis of the case is essential to determine possible etiological factors. There should be research into previous nasal surgeries (rhinoseptoplasties and septoplasties), nasal traumas, symptoms or history of collagen diseases, granulomatosis illnesses, use of nasal medications, and inhalation of chemical or toxic substances. The predetermining cause of the perforation should not remain after the perforation correction surgery. Most of the patients who seek an otolaryngologist for correction of septal perforation report having undergone 1 or multiple nasal surgeries involving the nasal septum, which places surgical trauma among the most common causes of septal perforation. Additional examinations, including biopsies of tissue from the edge of the perforation, should be performed when needed to clarify the cause of the septal perforation. 25,26

METHODS

The technique for septal perforation repair described herein was used between 1989 and 2005 in 258 patients with perforations of 1.0 to 3.5 cm in diameter. Most of the disorders had a postsurgical cause (86.0%), and the others (14.0%) were found to be of unknown origin, even after detailed etiological investigation (Table 1). The technique was not used in patients with perforations resulting from cocaine use. The patient's chemical addiction must be resolved before any surgical management of the structural defect.

An essential aspect is that any of the factors that could compromise the nasoseptal microcirculation cannot be present in the postoperative period. Also, an incomplete preoperative evaluation or an inadequate postoperative orientation for the patient can compromise the success of the surgery.

ANATOMICLAL CONSIDERATIONS

Knowledge of the network of main arteries that vascularize the septum is very important if one is to preserve its branches when making incisions in the mucoperichondrium and the mucoperiosteum. The vascularization of the nasal septum is supplied by the branches of the anterior and posterior ethmoid arteries, the sphenopalatine arteries, and the anastomoses with branches of the palatine and labial arteries (Figure 1).

Vascularization of the nasal fossa lateral wall flows in a direction parallel to the inferior turbinate. Therefore, in cases of larger perforations, when it is necessary to make incisions to

Table 1. Characteristics of 258 Patients Undergoing Septal Perforation Closure

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, y</td>
<td></td>
</tr>
<tr>
<td>&lt; 30</td>
<td>192 (74.4)</td>
</tr>
<tr>
<td>30-40</td>
<td>51 (19.8)</td>
</tr>
<tr>
<td>40-50</td>
<td>9 (3.5)</td>
</tr>
<tr>
<td>50-60</td>
<td>6 (2.3)</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>133 (51.6)</td>
</tr>
<tr>
<td>Male</td>
<td>125 (48.4)</td>
</tr>
<tr>
<td>Location of perforation</td>
<td></td>
</tr>
<tr>
<td>Anterior</td>
<td>167 (64.7)</td>
</tr>
<tr>
<td>Medium portion</td>
<td>76 (29.5)</td>
</tr>
<tr>
<td>Posterior border of quadrangular cartilage</td>
<td>15 (5.8)</td>
</tr>
<tr>
<td>Perforation size, cm</td>
<td></td>
</tr>
<tr>
<td>1.0-1.5</td>
<td>74 (28.7)</td>
</tr>
<tr>
<td>&gt; 1.5-2.5</td>
<td>131 (50.8)</td>
</tr>
<tr>
<td>&gt; 2.5-3.5</td>
<td>53 (20.5)</td>
</tr>
<tr>
<td>Etiology</td>
<td></td>
</tr>
<tr>
<td>Septal surgery</td>
<td>121 (46.9)</td>
</tr>
<tr>
<td>Rhinoseptal surgery</td>
<td>101 (39.1)</td>
</tr>
<tr>
<td>Unknown</td>
<td>36 (14.0)</td>
</tr>
<tr>
<td>Symptoms</td>
<td></td>
</tr>
<tr>
<td>Nasal obstruction</td>
<td>215 (83.3)</td>
</tr>
<tr>
<td>Crusting</td>
<td>168 (65.1)</td>
</tr>
<tr>
<td>Bleeding</td>
<td>146 (56.6)</td>
</tr>
<tr>
<td>Headache</td>
<td>42 (16.3)</td>
</tr>
<tr>
<td>Whistling</td>
<td>32 (12.4)</td>
</tr>
<tr>
<td>Rhinorrhea</td>
<td>20 (7.8)</td>
</tr>
<tr>
<td>Local pain</td>
<td>12 (4.7)</td>
</tr>
<tr>
<td>None</td>
<td>20 (7.8)</td>
</tr>
<tr>
<td>Saddle nose deformity</td>
<td>35 (13.6)</td>
</tr>
</tbody>
</table>

a Some patients had more than 1 symptom.
loosen and advance the edges of the mucoperichondrium, these incisions should be made immediately below the inferior turbinal bone and parallel to it so that there is no damage to the arterial branches (Figure 2).

**PREOPERATIVE PREPARATION**

Every patient who will undergo nasal surgery in which there is any possibility of aesthetic alteration should be photographed from the front, oblique right, and oblique left and in profile as a part of basic documentation. Besides being part of preoperative documentation from a legal point of view, the photographs also serve as references for postoperative evaluation. Preoperative and postoperative care is very important to the success of the surgery. The computerized study of the patient’s face is a tool that can help the surgeon to better understand the patient’s wishes; however, the patient should be warned that this does not guarantee such a result. The surgeon must be well aware that revisional surgery is highly difficult because the anatomical features have been altered. The presence of fibrosis hampers the dissection of tissues, demanding advanced technique and expertise from the surgeon to handle the variations that are common in this type of surgery. Suitable surgical instruments will reduce the time spent on the surgery, and they should be delicate enough so as not to cause laceration of the tissues during movements, which can damage vascularization and delay the healing process. The immediate postoperative follow-up, which requires several visits to the surgeon, helps to promote early detection and prevention of any impediments to the healing process, such as infections. Follow-up care should also include warning the patient about medications that could have negative vasoconstrictive effects. Long-term follow-up provides a more accurate evaluation of the technique’s effectiveness and of the changes that occur in the nasal dynamics after the healing process, which takes about 2 years. Any infection should be treated before the surgery.

**PREOPERATIVE EVALUATION OF THE PERFORATION**

The evaluation of the septal perforation itself is very important. The size, location, coloring, and edges of the perforation should be assessed. Whether there is septal cartilage between the mucoperichondrium or whether the mucoperichondrium is stuck directly can be discovered by touching the edges of the septal perforation with a probe. This finding will determine the need to harvest ear cartilage grafts. Submucoperichondrial detachment without inserted cartilage is normally more difficult to detach and increases the time it takes to complete the surgery. Pale coloring of the mucosa suggests weak vascularization. The external evaluation of the nose should focus on the support of the nose tip by applying gentle pressure on the tip with a finger (Figure 3).

**SURGICAL TECHNIQUE**

A solution of ropivacaine with epinephrine (7 mg/mL) in a 1:100,000 concentration is used as a local anesthetic, even in patients under general anesthesia. The infiltration of the temporal region of the scalp is followed by infiltration of the nose in accordance with the specific surgical plans. This procedure reduces transoperative bleeding.

To begin, the graft of temporal deep fascia that will be placed in the perforation is removed. The size of the fascia to be removed should be proportional to the size of the perforation, aiming for a bit more than twice the size of the perforation. The graft is laid on a metal plate to dry (Figure 4).

The perforation is approached by way of a hemitransfixion incision at a joint angle with the intercartilaginous incisions made on both nasal fossae (Figure 5A). After the 2 hemitransfixion incisions are connected, proceed with the submucoperichondrial detachment (Figure 5B and C).

The submucoperichondrial detachment demands patience and skill from the surgeon. Many of the patients have undergone nasal surgery previously and have fibrosis, which makes dissection difficult. Also, there may be no cartilage between the 2 mucoperichondria, which may be stuck to each other. In such circumstances, the detachment must be performed even more delicately and finer instruments must be used to avoid lacerating the mucosa; preservation of the integrity of the mucoperichondrium is a crucial factor for the success of this procedure. The detachment extension should be proportional to the size of the perforation so as to allow the advancement of the edges of the perforation. In larger perforations, this detachment may be extended superiorly to the superior lateral cartilage and inferiorly to the lower part of the nasal cavity as far as the implantation of the lower turbinate by making low tunnels. Use of finely pointed scissors facilitates the separation of the 2 mucoperichondria at the edge of the perforation and prevents lacerations that could enlarge the perforation instead of closing it. Once the mucoperichondrium around the perforation has been detached, the edges should be reset by means of microincisions no larger than 1 mm, made in a radial pattern. The objective is to avoid a ring removal of the fibrous edge of the perforation, which could increase the size of the perforation, because this tissue is generally quite brittle and easily lacerated. At this point, assess whether the edges of the perforation can be advanced without tension. If tension remains after extensive superior and inferior detachment, additional incisions parallel to the lower turbinate will relieve the tension. The
The correct orientation of these incisions is crucial to avoid damage to the vascularization of the nasal septum. Given that vascularization of the septum occurs in posteroanterior and superoinferior directions by way of the ethmoid and sphenopalatine arteries, an incision parallel to the implantation of the inferior turbinate will preserve septal vascularization, which is important for integrating the graft. The edges of the perforation on each side are closed individually with 4/0 chromic surgical gut sutures. This step might be challenging for the surgeon if the instruments are not fine enough to enable suturing in small cavities. For this purpose, a combination needle and small scissors holder in the same instrument will facilitate the suturing and allow the surgeon to focus on the field of surgery without the need to change instruments to cut the suture.

A sandwich graft is prepared using cartilage wrapped with the deep temporal fascia on both sides and is placed where the perforation was (Figure 5D). The cartilage that will serve as the graft can be taken from the septum itself or, in patients who have undergone a previous septoplasty and have little septal cartilage left, ear cartilage can be used. Patients with a very high dorsum and a broad perforation may frequently require reduction of the nasal dorsum to close the perforation. Because the incisions made to approach the perforation are the same as in rhinoplasty, septal deviation can also be corrected, the dorsum can be reached, and, if combined with bilateral alar marginal incisions, the nasal tip can be reached. Thus, previous evaluation of the nasal cartilaginous structure and the need for grafts are important in the surgical planning (Figure 6). After the rhinoplasty is performed, the incisions are closed with 4/0 chromic surgical gut sutures. The septum should not be transfixed with stitches in an attempt to avoid hematoma because this could compromise vascularization and hinder graft integration. In some cases, mainly in those involving larger perforations, the nasal cavity is smaller and an inferior turbinate surgery also should be performed. In cases of nasal fracture with narrowing of the dorsum, partial turbinectomy of the middle turbinate is recommended for proper nasal functioning. The nasal tamponing is performed with hydrophilic gauze impregnated with neomycin sulfate. The gauze should remain in place for 48 hours and should not be compressive.

**POSTOPERATIVE CARE**

After removal of the nasal tamponing, the patient should return periodically to the surgeon’s office. It is recommended that the patient avoid fans that blow air directly into the facial area and environments with heaters or fireplaces because the warm, dry air could dry the nasal mucosa.

Drops of physiological solution should be applied to avoid the formation of nasal crusts. Vasoconstrictive nose drops are absolutely prohibited, as well as any substance that would act as a vasoconstrictor on the nasal mucosa or would lead to mucosa atrophy, such as topical corticosteroids. Systemic decongestants and medication containing caffeine are also not to be taken for at least 3 weeks. Likewise, smoking is unconditionally prohibited, and the patient cannot be exposed to smoke-filled environments.

**COMPLICATIONS**

The surgical complications after conventional correction of a perforation normally involve reopening. When performed with strict observation of all details, however, the present technique has one...
of the lowest relapse rates, especially if the patient carefully follows the postoperative care instructions. The temporary reduction of the nasal cavity diameter tends to resolve spontaneously after the immediate postoperative period. Nasal bleeding is infrequent and is usually the result of turbinectomies that are performed in addition to this technique.

RESULTS

Our patients were followed up for at least 1 year and, of the 258 patients who underwent surgery using this technique in combination with rhinoseptoplasty, only 3 experienced perforation reopening. Two of these patients had second perforations that were much smaller than the original ones; the patients underwent subsequent reoperation with the same technique, and the perforations remained closed at the last follow-up visit. In only 1 case did the perforation return with a size similar to the original (2.5 cm in diameter), 2 months after the surgery. Considering that 260 surgeries were performed in 258 patients, we can conclude that, of the 258 cases submitted to this procedure, 257 underwent successful correction of their septal perforation. Two patients with anterior septal perforations of 2.0 and 2.5 cm presented with mild stenosis of the nasal valve bilaterally that was surgically corrected at least 1 year after the first surgery. During the first 2 postoperative months, 37.9% of the patients complained of nasal obstruction, which improved spontaneously after the end of that period. The symptoms related to the septal perforation were totally reversed in 256 cases. One case showed some residual nasal dryness that did not resolve. The patient with the perforation reopening had the same symptoms as before the surgery (epistaxis and crusting). Cosmetically, 255 patients were very satisfied with their aesthetic improvement. Two patients complained of dorsal irregularity and required a minor revision 1 year later. One patient with a 2.5-cm anterior septal perforation noted a retracted columella postoperatively, which was corrected 1 year later with a small procedure.

COMMENT

The major goal in septal perforation surgery is not only to repair the perforation but also to restore normal form and function to the nose.\(^\text{10}\)

Nasal septal perforations disturb the intranasal temperature and humidity profile. After surgical closure, the nasal function of heating and humidification is improved. Surgical closure may reduce the crusting, bleeding, and dryness frequently experienced by patients with septal perforation. Although surgical closure of septal perforations is considered one of most difficult procedures in nasal surgery, it can restore adequate air conditioning in the nasal airways and reduce subjective complaints.\(^\text{17}\)

Historically, a multitude of local flaps and various approaches have been described in attempts to close septal perforations (Table 2). Two obstacles to good surgical results are locating and using adequate healthy tissue and obtaining adequate surgical exposure. Repair can be performed through a variety of approaches, including the endonasal,\(^\text{31}\) external rhinoplasty,\(^\text{3,32}\) and midface degloving techniques.\(^\text{7}\) Endonasal techniques, although effective, are considered by some\(^\text{1}\) to be technically more difficult. External rhinoplasty approaches afford excellent visualization of the septal perforation in all directions. However, this approach requires the use of a columellar incision, which may be undesirable. Sublabial and midface degloving techniques are effective though more extensive procedures. Hier et al\(^\text{33}\) found that use of a sinonasal endoscope provides excellent direct visualization, but they recognized that other techniques may be needed for large perforations.
Many different techniques have been described for septal perforation closure, including mucosal flaps,15 advancement and suture of the perforation’s borders,25 inferior turbinate flaps,26 grafts of temporal fascia,27,28 conchal cartilage with perichondrium and mastoid periosteum,29 and tragal cartilage with perichondrium and temporal fascia3 (Table 2). However, the rate of reperforations is unacceptably high for many of these techniques.10,11 Fairbanks and Fairbanks10 emphasized an endonasal approach with bipedicled flaps and interposition of autologous grafts from temporalis fascia or cranium; they reported successful closure in 32 of 35 cases (91%). Goodman and Strelzow1 stressed the importance of avoiding septal hematoma or fixating the graft because such stitches may impair the vascularization of the graft. The autologous temporal fascia is highly resistant to reperforation and easily epithelialized.11

We believe that this technique rebuilds layers of the septum as they were originally. In addition, the access incisions allow correction of various nasal aesthetic problems and correction of deviated septum in a single operation with the highest rates of successful perforation closure, as long as the technical and anatomical considerations mentioned herein are followed. Another relevant factor for the success of this technique is the non-use of transfixing stitches in the septum for the purpose of avoiding septal hematoma or fixating the graft because such stitches may impair the vascularization of the nasal mucosa and thus the graft integration.

The same technique can be used for perforation recurrence. Before indicating a new surgery, however, one must consider whether a minimum of 6 months has elapsed since the last nasal surgery, whether there were potential failures in the performance of this technique in the first surgery, whether the postoperative care instructions were followed, and what factors, if any, predisposed to septal perforation in the postoperative period.

To an increasing degree, aesthetics and functionality are becoming inseparable, and the improvement of techniques that link these concepts are being used to resolve nasal problems in which previous techniques showed modest results and a great number of relapses. The closed rhinoplasty approach avoids scarring of the columella while preserving its vascularization. This approach ex-

<table>
<thead>
<tr>
<th>Source</th>
<th>No. of Patients</th>
<th>Closure Rate, No. (%)</th>
<th>Size, cm</th>
<th>Flap</th>
<th>Grafts</th>
<th>Approach</th>
<th>Follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fairbanks and Fairbanks, 1980</td>
<td>20</td>
<td>19/20 (95)</td>
<td>&lt; 3.0</td>
<td>Bipedicled</td>
<td>Temporalis fascial/mastoid</td>
<td>Intranasal</td>
<td>1-7 y</td>
</tr>
<tr>
<td>Kridel et al, 1986</td>
<td>22</td>
<td>17/22 (77)</td>
<td>&lt; 4.0</td>
<td>Bipedicled</td>
<td>Mastoid pericranium/ethmoid</td>
<td>External rhinoplasty</td>
<td>1-3 y</td>
</tr>
<tr>
<td>Romo et al, 1988</td>
<td>24</td>
<td>18/24 (75)</td>
<td>&gt; 3.0</td>
<td>Posterior unipedicled</td>
<td>Mastoid peristeum</td>
<td>Midfacial degloving</td>
<td>1-3 y</td>
</tr>
<tr>
<td>Olséen, 1988</td>
<td>39</td>
<td>7/11 (64)</td>
<td>&lt; 1.1</td>
<td>Gingivobuccal</td>
<td>Perichondrocutaneous</td>
<td>Ulotomy</td>
<td>8-9 y</td>
</tr>
<tr>
<td>Meyer, 1994</td>
<td>55</td>
<td>35/39 (90)</td>
<td>&lt; 4.0</td>
<td>Posterior gingsivobuccal</td>
<td>Fascia/cartilage</td>
<td>Intranasal/external</td>
<td>Not reported</td>
</tr>
<tr>
<td>Romo et al, 1999</td>
<td>36</td>
<td>13/14 (93)</td>
<td>0.5-2.0</td>
<td>Posterior</td>
<td>Alloderm</td>
<td>Extended external rhinoplasty</td>
<td>1 y</td>
</tr>
<tr>
<td>Hussain and Murthy, 1997</td>
<td>15</td>
<td>14/15 (93)</td>
<td>&lt; 3.0</td>
<td>mucosa</td>
<td>Tragal cartilage</td>
<td>Intranasal</td>
<td>6-24 mo</td>
</tr>
<tr>
<td>Foda, 1999</td>
<td>20</td>
<td>18/20 (90)</td>
<td>1.0-4.0</td>
<td>Posterior expanded mucosa</td>
<td>Alloderm</td>
<td>Closed rhinoplasty</td>
<td>10-36 mo</td>
</tr>
<tr>
<td>Present study</td>
<td>258</td>
<td>255/258 (99)</td>
<td>1.0-3.5</td>
<td>Intrasal mucosal advancement flap</td>
<td>Temporal fascia dermal allograft</td>
<td>Closed rhinoplasty</td>
<td>1-15 y</td>
</tr>
</tbody>
</table>

Dry temporal fascia such as that used for membrane grafting is apparently nonviable tissue consisting of collagen, mucopolysaccharides, and a middle fibrous layer of connective tissue rich in fibroblasts. It would appear that the tissue characteristics accounting for the high survival rate of dry fascia grafts in humans are nonviability, the absence of metabolic requirements or autolysis, and a high content of collagen and mucopolysaccharides.60

Table 2. Methods for and Rates of Closure of Nasal Septal Perforations
poses the surgical field to allow correction of a variety of anatomical problems that alter nasal aesthetics. The technique presented herein not only boosts the rates of successful closure but also affords fewer surgical interventions and reduces the postoperative recovery time.

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