Reconstruction of Nasal Defects 1.5 cm or Smaller
Charles R. Woodard, MD; Stephen S. Park, MD

Objectives: To review the repair of smaller nasal defects (≤1.5 cm) and their associated complications, elaborating on nasal obstruction and techniques to avoid it, and to determine outcomes with functional cartilage grafting.

Methods: The medical records of patients requiring nasal reconstruction for Mohs defects 1.5 cm or smaller were reviewed. Variables analyzed included defect location, defect size, use of cartilage, flap design, smoking status, and postoperative complications (nasal obstruction and flap/graft necrosis).

Results: A total of 208 patients with 213 nasal defects 1.5 cm or smaller were identified. The most common location was the alar subunit, followed by the tip, dorsum, and sidewall. Ninety-eight of the defects (46.0%) used cartilage grafts for reconstruction. Seventy-three of 84 alar defects (86.9%) were reconstructed with cartilage as a composite or batten graft. The sidewall and dorsum were the least likely to require cartilage grafting: 1 of 15 (6.7%) and 0 of 21, respectively. Ten patients (4.8%) had a postoperative complication: 6 of 19 smokers (31.6%) and 4 of 189 nonsmokers (2.1%). Overall, nasal obstruction was an infrequent complication (1.4%).

Conclusions: Regardless of defect size, defect location, and flap design, smokers were at higher risk for postoperative complications. Subtle modifications in the classic flap design and liberal use of cartilage grafting reduce the risk of postoperative nasal obstruction.

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The incidence of nonmelanoma skin cancer in the United States is estimated to be greater than 1 million cases per year. Of these, 75% occur in the sun-exposed head and neck, with approximately 30% (approximately 225,000 cases) occurring on the nose. Basal cell carcinoma is, by far, the most common pathologic subtype, accounting for 75% to 86% of head and neck nonmelanoma skin cancers.

Mohs surgery remains the criterion standard for tumor extirpation of the face, particularly of the nose, because it leads to minimal disruption of surrounding normal tissue. Reconstructive algorithms for nasal reconstruction exist in the medical literature, but they include defects of all sizes. Although reconstruction of large nasal defects may require the use of complex techniques, the algorithm is simple owing to the limited number of flap options. For smaller defects, patient expectations are often higher, necessitating selection of the ideal flap, graft, or both for reconstruction.

A scarcity of data exists for complications and outcomes in patients who have undergone nasal reconstruction. In particular, postoperative nasal obstruction is rarely reported. To address these issues, we examined complications and outcomes in patients who underwent flap or graft reconstruction of nasal defects 1.5 cm or smaller.

METHODS

A retrospective medical record review was performed of patients with nasal Mohs defects 1.5 cm or smaller between January 1, 2000, and December 31, 2009. The inclusion criteria were nasal defects 1.5 cm or smaller necessitating secondary reconstruction and complete medical records. Patients were excluded if preoperative, operative, or postoperative documentation was incomplete.

Variables analyzed included location of subunit defect, size and depth of defect, use of cartilage grafting, location of flap design, status of smoking, flap necrosis, and presence of nasal obstruction. Status of smoking was defined as continued tobacco use throughout the perioperative period. The complications evaluated were flap or graft necrosis and postoperative nasal obstruction. Necrosis was deemed present even in patients with partial epidermolysis. Nasal obstruction was specifically asked about in the postoperative visit, and its presence or absence was documented in the
medical record. Any mention of obstruction, even partial, was recorded as present.

Identification of complications and outcomes data from previous studies was performed using PubMed and the search terms Mohs nasal reconstruction complications and Mohs nasal reconstruction outcomes. Only studies reported in or translated to English were included.

To determine the strength of association of complications with smoking status, 2×2-tables were constructed, and χ² analysis was performed. A Fisher exact test was used to evaluate the significance of cartilage use based on flap location. VassarStats (http://faculty.vassar.edu/lowry/VassarStats.html) was used for statistical calculation.

RESULTS

A total of 208 patients with 213 defects met the inclusion criteria and had surgical dates between January 1, 2000, and December 31, 2009. There were 149 women (71.6%) and 59 men (28.4%). The mean patient age was 59 years (age range, 24-92 years). Nineteen patients (9.1%) were smokers.

Defects were categorized according to subunit location. The subunits included the ala (n=84, 39.4%), tip (n=60, 28.2%), dorsum (n=21, 9.9%), sidewall (n=15, 7.0%), and combinations of 2 subunits (n=33, 15.5%). Flap/graft design by location was documented. Reconstruction methods included full-thickness skin graft, advancement flaps with or without full-thickness skin graft, composite graft, bilobed flap, and melolabial flap (Table 1). Figures 1, 2, 3, 4, and 5 highlight examples of the surgical plan and execution for reconstruction of these defects. Figure 6 demonstrates placement of cartilage in a non-anatomical position to support the nasal valve before completing the reconstruction.

Table 1. Flap/Graft Design by Subunit Location

<table>
<thead>
<tr>
<th>Location</th>
<th>Defects, No.</th>
<th>Advancement Flaps and FTSG</th>
<th>Composite Graft</th>
<th>Bilobed Flap</th>
<th>Melolabial Flap</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ala</td>
<td>1</td>
<td>3</td>
<td>43</td>
<td>27</td>
<td>10</td>
</tr>
<tr>
<td>Tip</td>
<td>26</td>
<td>0</td>
<td>1</td>
<td>33</td>
<td>0</td>
</tr>
<tr>
<td>Dorsum</td>
<td>21</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Sidewall</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>Combination</td>
<td>7</td>
<td>1</td>
<td>6</td>
<td>17</td>
<td>2</td>
</tr>
</tbody>
</table>

Abbreviation: FTSG, full-thickness skin graft.

Figure 1. Left ala defect with helical root composite reconstruction. A, A 0.8 × 1.4-cm defect of the left ala. B, Note depth of defect and continuity of alar rim. C, Proposed helical root donor site. D, Composite graft inset. E and F, Six-month postoperative result.
Cartilage grafting was noted for each subunit. A significant number of alar (\(P<.001\) and combination (\(P=.009\)) reconstructions used cartilage grafting for nasal valve support (Table 2). In all combination reconstructions with the ala as one of the involved subunits, cartilage was used. A notable number of tip,
dorsum, and sidewall defects did not involve cartilage grafting.

Complications were recorded in 10 patients (4.8%). Six of 19 smokers (31.6%) and 4 of 189 nonsmokers (2.2%) had a complication (Table 3). All the complications in smokers involved some degree of flap or graft necrosis (1 melolabial flap, 2 full-thickness skin grafts, and 3 composite grafts). The 4 complications in nonsmokers included 3 cases of nasal obstruction (1 each of the melolabial flap, advancement flap, and composite graft) and 1 case of flap necrosis (composite graft). Smoking was significantly associated with a postoperative complication (P < .001).

**COMMENT**

Selection of the appropriate reconstructive technique is critical to an optimal outcome. The goal is a well-balanced functional and aesthetic result that is pleasing to the surgeon and the patient. This is achieved through a comprehensive and systematic analysis of the defect with 4 issues in mind:

1. **Immobile surrounding landmarks:** Which surrounding landmarks must not be subject to tension or distortion by the flap or graft? For upper-third defects, recruitment from the cheek may lead to lower eyelid malpositioning. As defects involving the lower two-thirds of the nose heal, the patient may experience alar retraction or twisting of the tip.

2. **Vectors of tension:** Where exactly is tension created during transposition of flaps and normal wound healing? Although the superior vector leading to alar retraction and tip twisting is well recognized, a perpendicular vector exists as well. This important third dimension of tension tends to push flaps medially or intranasally, narrowing the nasal valve. Consequently, it is essential to evaluate for preexisting nasal obstruction and to determine whether the flap or graft selected will further complicate this issue. The same consideration must be given to patients with normal valve function when reconstruction occurs along the alar and sidewall subunits. It is our experience that most obstruction arises in the intervalve area between the alar lobule (external valve) and the upper lateral cartilage (internal valve). This also corresponds to the lateral aspect of the lateral crus, which is often recurved and poorly supported by the lateral fibroareolar tissue extending to the bony pyriform aperture.

3. **Area of recruitment:** What region offers maximal laxity with the opportunity for tissue recruitment? This is largely dictated by surrounding immobile structures. An essential concept is that extensibility does not always correspond to optimal aesthetics. Advancement of the cheek onto the nose is an example of poor aesthetics despite an extensible, adjacent region.

4. **Aesthetic lines:** How are the facial lines and the borders of subunits oriented? Recall, relaxed skin tension lines arise from intrinsic vectors of tension in the dermis and do not always correspond with lines of minimal tension (facial creases). One important example on the nose is in the supratip region. Scars in this region should be designed along these preexisting facial creases. Modification of a defect based on the subunit principle outlined by Burget and Menick is limited by defect size and subunit involvement. Subunits with less than 50% involvement and dorsal defects are often not completely excised. Almost every defect, on the other hand, is modified in some manner to make it more inconspicuous. Straight lines and crisp corners along the edge of the defect lead to aesthetically pleasing scars.

Analysis of previous nasal reconstruction studies revealed 257 articles indexed in PubMed. Of these, 57 reported complications or outcomes data. Only 1 article described the incidence of postoperative nasal obstruction. The reported rate of obstruction was 21.1% in at-risk patients, which were those defects located in the alar/ sidewall region. Contributors to obstruction were identified as healing by second intention, bulky flaps, inadequate cartilaginous support, inappropriate flap choice, mucosal scarring, and sacrifice of nasalis and levator labii superioris alaeque nasi muscle fibers. No cartilage grafting was used. Conversely, the overall rate of nasal obstruction was 1.4%. When evaluating at-risk patients (ala, sidewall, or both locations) in the present study, the ob-
struction rate was 3.0%. We attribute this significant difference to the liberal use of cartilage grafting. Nonanatomically positioned batten grafts and composite helical root grafts were the most common cartilage grafts used in reconstruction. For patients with internal valve collapse (preexisting or predicted), spreader grafts or nasal flaring sutures were used. Smoking is a well-identified risk factor for suboptimal outcome and is described in other cutaneous reconstruction studies. The present study supports these previous findings. Smoking was significantly associated with flap/graft necrosis. Although our definition of necrosis is all encompassing (from partial epidermolysis to full-thickness flap/graft loss), it is clear that smoking increases the risk of a suboptimal surgical result. Necrosis was observed almost exclusively in 6 smokers, with only 1 of the 189 nonsmokers developing this complication.

Use of adjunct rhinoplasty maneuvers in patients who require local flap reconstruction may improve the aesthetic outcome. However, improvement in aesthetics should not come at the sacrifice of decreased function. The subsuperficial muscular aponeurotic system dissection affords excellent access to the cartilaginous framework of the lower two-thirds of the nose. For wider noses, narrowing the tip may also minimize the defect and relieve tension on the closure. Common maneuvers include cephalic trims and tip sutures. This is best seen in dorsal and tip defects where advancement flaps with or without full-thickness skin grafting are used. Care must be taken not to overadvance the flaps, leading to alar retraction or nasal obstruction. It has been our practice to advance these flaps to a point of minimal tension and distortion, followed by a full-

Table 2. Cartilage Grafting by Subunit Location

<table>
<thead>
<tr>
<th>Location</th>
<th>Defects, No. (%)</th>
<th>Cartilage</th>
<th>No Cartilage</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ala</td>
<td>73 (86.9)</td>
<td>11 (13.1)</td>
<td></td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Tip</td>
<td>3 (5.0)</td>
<td>57 (95.0)</td>
<td></td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Dorsum</td>
<td>0</td>
<td>21 (100)</td>
<td></td>
<td>&lt;.001</td>
</tr>
<tr>
<td>sidewall</td>
<td>1 (6.7)</td>
<td>14 (93.3)</td>
<td></td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Combination</td>
<td>21 (63.6)</td>
<td>12 (36.4)</td>
<td></td>
<td>.009</td>
</tr>
</tbody>
</table>
thickness skin graft. As the closure ensues, one checks the overall aesthetics, and once maximal acceptable tip narrowing is achieved, the remaining defect is resurfaced with a skin graft from the adjacent standing cutaneous deformity.

In conclusion, ultimately, the reconstructive plan offered to the patient is dictated by the surgeon’s preference, comfort, and ability. A careful preoperative assessment, identification of the appropriate flap or graft, and execution of surgical technique are essential to achieve an optimal outcome. To accomplish this goal consistently, we propose the following: (1) a systematic defect analysis addressing immobile surrounding landmarks, vectors of tension, area of recruitment, and pre-existing lines and resultant scars (ie, aesthetic lines); (2) liberal use of nonanatomical cartilage grafting in regions that are predisposed to nasal obstruction (ala and sidewall); (3) counseling about the risk of a suboptimal outcome in patients who smoke; and (4) use of adjunct rhinoplasty maneuvers to achieve a balance between function and aesthetics.

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Correspondence: Stephen S. Park, MD, Department of Otolaryngology—Head and Neck Surgery, University of Virginia Health Systems, PO Box 800713, Charlottesville, VA 22908 (ssp8a@virginia.edu).

Author Contributions: Both authors had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.
Study concept and design: Woodard and Park.
Acquisition of data: Woodard.
Analysis and interpretation of data: Woodard and Park.
Drafting of the manuscript: Woodard and Park.
Critical revision of the manuscript for important intellectual content: Woodard and Park.
Statistical analysis: Woodard.
Administrative, technical, and material support: Woodard.
Study supervision: Park.

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REFERENCES


Table 3. Complications by Smoking Status

<table>
<thead>
<tr>
<th>Status</th>
<th>Obstruction</th>
<th>Necrosis</th>
<th>No Complication</th>
<th>Complications, %</th>
<th>P Value</th>
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</thead>
<tbody>
<tr>
<td>Smoker</td>
<td>0</td>
<td>6</td>
<td>13</td>
<td>31.6</td>
<td>&lt;.001</td>
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<tr>
<td>Nonsmoker</td>
<td>3</td>
<td>1</td>
<td>189</td>
<td>2.1</td>
<td>&lt;.001</td>
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</tbody>
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