Full-Thickness Skin Graft Overlying a Separately Harvested Auricular Cartilage Graft for Nasal Alar Reconstruction

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Objective: To evaluate the aesthetic and functional outcomes of a full-thickness skin graft and a separately harvested auricular cartilage graft for nasal alar defects created by Mohs micrographic surgery.

Design: Twenty patients with deep Mohs micrographic surgery defects of the nasal ala who underwent reconstruction with a full-thickness skin graft and an auricular cartilage graft were prospectively studied at a single tertiary care institution between 2010 and 2011 in a non-randomized, nonblinded study. An ordinal 5-point Likert scale evaluation of overall outcomes was performed by 4 independent surgeon raters.

Results: The mean outcome for use of the full-thickness skin and auricular cartilage graft construct was a score of 2.3 on a scale of 1 through 5, with 1 being excellent and 5 being poor. The mean duration of follow-up was 6 months, with a range of 5 weeks to 23 months. There were no clinically meaningful losses of constructs in the patients studied.

Conclusion: A full-thickness skin graft and a separately harvested auricular cartilage graft are valuable and reliable tools for reconstructing deep nasal alar defects that require support to prevent alar retraction or collapse, particularly when a single-stage procedure is preferred or necessary because of medical comorbidities.

Nasal alar reconstruction presents an aesthetic and functional challenge. The ala is a critical nasal subunit that requires careful attention during repair to prevent alar retraction or collapse that may adversely affect reconstructive outcomes. It is a 3-dimensional structure that is highly contoured, with a long, free margin that is susceptible to the forces of wound contraction. Although the lateral aspect of the nasal ala does not contain cartilage, its soft-tissue structure frequently requires the placement of cartilage for deep defects. Nasal airflow is dependent on the support of the external nasal valve, of which the ala is the primary determinant. In addition to being crucial to the overall aesthetics of the nose, a properly functioning nasal ala and external nasal valve profoundly affect patient satisfaction and comfort. If cutaneous defects of the ala are of a depth where retraction or collapse is probable, a cartilage graft is recommended to augment reconstruction in order to resist contraction, to improve contouring, to enhance volume, and to stabilize the external nasal valve.

Cartilage augmentation of large-volume nasal alar defects was classically thought to require an overlying vascular soft-tissue repair, such as with an interpolated cheek or paramedian forehead flap. However, a staged reconstructive procedure may be undesirable either because of patient preference or for medical reasons. Single-stage reconstructions of deep alar defects have been reported using free cartilage or cartilage with a separate overlying skin graft. These techniques have maintained graft viability, suggesting that a single-stage procedure may be a reproducible and acceptable reconstructive option.

Herein, we provide a technical description of a single-stage reconstructive procedure using full-thickness skin grafts overlying a separately harvested auricular cartilage graft for repair of deep, mucosal-sparing nasal alar defects in a large patient cohort. Also, we discuss the outcomes in the largest series (to our knowledge) using this technique.
The study was approved by the institutional review board (HUM00048076) of the University of Michigan, Ann Arbor. Written informed consent was obtained from the study participants whose photographs were used. The study included 20 consecutive cases in which a full-thickness skin graft and a separately harvested auricular cartilage graft were used for the reconstruction of deep nasal alar defects ranging in size from 0.8 to 5.9 cm². The patient characteristics are summarized in the Table. The patients were selected to receive an auricular cartilage graft and a full-thickness skin graft if the operating surgeon thought that there would be a risk of either alar collapse or alar retraction if cartilage support was not used. Before this technique, it was our standard practice to cover cartilage grafts with vascularized tissue such as an interpolated cheek or forehead flap. While there was no formal exclusion criteria for the study, the patients were generally not offered this technique if the defect involved the most caudal margin of the ala (“free edge”), if, in the surgeons opinion, an interpolated flap would give significantly better tissue coverage (e.g., for a large surface defect), or if the patient desired the best cosmetic result regardless of the need for multiple procedures (i.e., an aesthetically demanding patient).

The technique uses auricular cartilage that is harvested through a postauricular incision. The contralateral ear provides better contour, although consideration should also be taken to avoid harvesting from a specific ear if the patient reports consistently sleeping on that side. The concha cymba are harvested with a posterior incision, preserving the antihelical fold. The cartilage is carved and refined into the appropriate shape. Scoring to increase its convexity may be performed but is often unnecessary. The graft typically measures 3.0 x 1.5 cm. Careful lateral undermining in the fibrous tissue abutting the alar facial sulcus and medial undermining underlying the soft facet (similar to the placement of an alar batten) produce an envelope to accept the cartilage graft, with an attempt to situate the cartilage graft caudally along the alar margin (Figure 1). The cartilage graft is then sutured using a 5-0 polydioxanone horizontal mattress suture technique. After the cartilage is secured in place, a full-thickness skin graft fashioned from a template of the defect is procured. We typically use the supraclavicular region, although the graft can be harvested from any of the traditional donor sites in the head and neck. An attempt is made to maximize full-thickness skin graft contact with the surrounding vascularized tissue. Horizontal mattress sutures of 5-0 or 6-0 fast gut as a bolster through both the cartilage graft and the skin graft, or, alternatively, sutures of 5-0 or 6-0 fast gut are tied over a bolster to secure the construct in place in order to facilitate imbibition and inosculation of the grafts.

Four surgeon raters (D.A.Z., J.C.K., S.R.B., and J.S.M.) used a standardized ordinal Likert scale to independently analyze postoperative photographs. A result was rated as 1, excellent (when a review of the photographs showed no asymmetry and no evidence of reconstruction); 2, very good (when there was slight visibility of scar, though not distracting to the patient’s appearance); 3, good (when minimal asymmetry or minimal visibility of scar was observed but was not distracting to the patient’s appearance); 4, fair (when moderate asymmetry or scar that was somewhat distracting to the patient’s appearance was observed); and 5, poor (when the photographic results showed obvious asymmetry or scar that dominated the patient’s appearance). An intrarater reliability analysis was performed using the κ statistic.

Nasal alar reconstruction using full-thickness skin grafts overlying a separately harvested auricular cartilage graft was performed in 20 patients (mean age, 69 years; age range, 47-90 years). Fourteen patients (70%) were male, and 6 (30%) were female. In all cases, the involved neoplasm was basal cell carcinoma. Six patients had diabetes, 1 of whom was insulin dependent. Eleven patients had hypertension. No patients were active smokers, although 9 (45%) had a smoking history.

Photographs used for surgeon rating were taken at postoperative visits at a mean follow-up of 6 months (range, 5 weeks–23 months). Defect size repaired with the full-thickness skin grafts overlying a separately harvested auricular cartilage graft had a mean area of 2.0 cm² (range, 0.8-5.9 cm²). The mean Likert rating for our series was 2.3, with the most common rating being 2, or very good, in 26 of 80 photographs (33%). A rating of 1 (excellent) was given in 21 photographs (26%); a rating of 3 (good) was given in 24 photographs (30%); and a rating of 4 (fair) was given in 9 photographs (11%). A rating of 5 (poor) was not given

### METHODS

Table. Demographic Characteristics of 20 Study Participants and Defect Dimensions

<table>
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<tr>
<th>Variable</th>
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<tr>
<td>Female</td>
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<td>Type of malignant neoplasm</td>
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<tr>
<td>Comorbidities</td>
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<td>HTN</td>
<td></td>
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<td>Smoking historya</td>
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</table>

Abbreviations: BCC, basal cell carcinoma; HTN, hypertension; IDDM, insulin-dependent diabetes; NIDDM, non–insulin-dependent diabetes.

No patients were active smokers.

![Figure 1. Full-thickness skin graft and separately harvested auricular cartilage graft technique for mucosal-sparing nasal alar defects. A, Nasal alar Mohs defect. B, Outlined area of lateral undermining. C, Typical auricular cartilage graft dimensions and positioning with overlying full-thickness skin graft placement.](image-url)
The best combined rating was 4, which translated to an agreement of an excellent outcome among all 4 surgeons. This optimum outcome was seen in 3 different patients (15%). Two additional patients had only 1 slightly dissenting rating of 2 (overall combined rating, 5). The interrater reliability for the raters was measured with a weighted k of 0.36 to 0.67 (significant at $\alpha = .05$).

**Figure 2.** Surgeon Likert rating value frequency (1, excellent; 2, very good; 3, good; 4, fair; and 5, poor).

(Figure 2). Nasal skin is one of the most common locations for malignant neoplasms, with approximately 85% being basal cell carcinoma, 14% squamous cell carcinoma, and 1% melanoma. Twenty-one percent of nasal skin cancers occur on the nasal ala. Common techniques for nasal alar defect repair include healing by secondary intention, primary repair, and skin grafts for small, superficial defects and cartilage with interpolated cheek or forehead flaps for deeper, larger defects. Regardless of the choice of reconstruction, adherence to the subunit concepts described by Burget and Menick will optimize the aesthetic outcome. In many cases of nasal alar reconstruction, a cartilage framework, such as auricular cartilage, is necessary to maintain alar contour, to resist contraction forces, and to provide a stable external nasal valve.

In this study, the surgeon ratings of full-thickness skin grafts overlying a separately harvested auricular cartilage graft resulted in a mean score of 2.3, approaching a Likert rating of very good. **Figure 3** is an example of a good to very good outcome (mean score, 2.5), and **Figure 4** is an example of a good to fair result (mean score, 3.5). Figure 4 is also included to illustrate an acceptable outcome in a patient with a larger defect (5.9 cm$^2$). Several patients had remarkable aesthetic results despite large nasal alar defects. The worst rating given in our series, fair (score, 4), was given in only 3 patients (11%); there were no poor ratings (score, 5). Previous reports raised concerns of graft necrosis and poor aesthetic outcome, which were not seen in our series. Our interrater reliability analysis using our ordinal Likert scale indicated fair to good agreement above chance.

When patients present with a large-volume mucosal-sparing nasal alar defect such as that seen in Figure 4, it is generally our practice to recommend an interpolated forehead flap (or interpolated cheek flap if an alar defect is primarily involved) with auricular cartilage. However, a staged reconstruction may be undesirable for patients who are unwilling or unable to undergo multiple operations. Other surgical options that meet the reconstructive goals of deep alar defects but are single stage would be highly desirable in this patient population. Our results indicate that a separately harvested full-thickness skin graft and an auricular cartilage graft can be combined in a single-stage operation to meet the reconstructive goals of deep alar defects while maintaining an acceptable aesthetic and functional result. Attempts to maximize skin graft contact with surrounding vascular tissue are recommended, although we ob-

**Figure 3.** Full-thickness skin graft overlying a separately harvested auricular cartilage graft used to reconstruct a right lateral nasal alar defect. A, Pre-Mohs resection. B, Post-Mohs resection prereconstruction. C-E, Twenty-two months after reconstruction: lateral view (C), oblique view (D), and frontal view (E) (mean rating, 2.5).

**Figure 4.** Full-thickness skin graft overlying a separately harvested auricular cartilage graft used to reconstruct a large, rim-sparing, nasal alar defect. A, Post-Mohs resection prereconstruction. B-E, Six months after reconstruction: frontal view (B), lateral view (C), oblique view (D), and basal view (E) (mean rating, 3.5).
served skin graft also take over bare cartilage. Our results demonstrate the maintenance of excellent alar contour, external nasal valve support, and volume replacement. Alar notching and significant alar retraction, highly undesirable outcomes, were not observed in our series.

Recognized omissions include data from the patient’s perspective. Future assessment and evaluation of our series and prospective patients could include this perspective. Our mean follow-up was 6 months, well beyond the recently reported 12-week window of short-term psychosocial dysfunction associated with nasal reconstruction. Surgeon bias is recognized as a potential confounder. This series of patients did not include any active smokers, although they were not intentionally omitted. While it can be postulated that active smoking status may result in partial or complete loss of a graft or lesser aesthetic outcomes, this information is unknown. Another unanswered question concerns whether free cartilage would remain viable in a through-and-through defect using a septal mucoperichondrial or bipedicle vestibular skin advancement flap.

Although the full-thickness skin graft overlying a separately harvested auricular cartilage graft construct cannot completely replace the aesthetic and functional long-term results of cartilage underlying a vascularized interpolated cheek or forehead reconstruction, it does lend a valuable adjunctive reconstructive tool in certain instances. For mucosal-sparing nasal alar defects requiring structural and volume support of cartilage, a full-thickness skin graft overlying a separately harvested auricular cartilage graft should be given strong consideration when medical comorbidities and patient preference outweigh aesthetic demands (Figure 5). In conclusion, our findings indicate that a full-thickness skin graft overlying a separately harvested auricular cartilage graft construct is a viable and valuable option in mucosal-sparing nasal alar defect reconstruction when a single-stage procedure is preferred for personal or medical reasons.

Accepted for Publication: July 30, 2012.
Published Online: December 3, 2012. doi:10.1001/2013.jamafacial.25

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Author Contributions: Dr Moyer had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. Study concept and design: Moyer. Acquisition of data: Zopf, Iams, Kim, Baker, and Moyer. Analysis and interpretation of data: Zopf and Moyer. Drafting of the manuscript: Zopf, Iams, and Moyer. Critical revision of the manuscript for important intellectual content: Zopf, Kim, Baker, and Moyer. Statistical analysis: Zopf. Administrative, technical, and material support: Iams, Baker, and Moyer. Study supervision: Kim, Baker, and Moyer.

Conflict of Interest Disclosures: None reported.

Previous Presentations: This study was presented in part at the American Academy of Facial Plastic and Reconstructive Surgery Annual Fall Meeting; September 9, 2011; San Francisco, California.

Additional Contributions: Andrew Joseph, MD, MPH, provided assistance with statistical analysis.

REFERENCES