

# The LN Flap for Nasal Defect Reconstruction: An 84-case Experience with a Novel Technique

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**Background:** The nose is a common site for cutaneous malignancy and post-ablative reconstruction. To our knowledge, a myocutaneous island flap based on the levator labii superioris alaeque nasi (LLSAN) and nasalis muscles, with vascularity from the lateral nasal and angular arteries, has not been described for reconstruction of the lower lateral nose.

**Methods:** A retrospective chart review of patients who underwent LLSAN-nasalis island flap reconstruction between 2015 and 2019 was performed. The surgical technique involved marking of an inverted-V flap on the nasal sidewall. The skin lateral to the flap was then developed in the subcutaneous plane to expose the LLSAN muscle and divide its origin on the maxillary frontal process and its caudal insertions into the alar dermis. The medial incision was down to periosteum and perichondrium, and dissection beneath the flap separated it from the nasal support structure. The resultant flap had a great caudal mobility. The donor site was closed in a V-to-Y pattern.

**Results:** In total, 84 procedures were completed, mostly for alar defects (57.1%) between 100 and 400 mm<sup>2</sup> (71.4%). The average age of patients was 74.9 years. An estimated 27 patients were lost to follow-up. At mean follow-up of 24.3 weeks, there were no cases of flap necrosis, 1 case of hematoma (1.8%), 1 case of infection (1.8%), 3 cases of persistent trapdoor deformity (5.3%), and 3 cases of alar notching (5.3%), 1 of whom required revision surgery.

**Conclusion:** The LLSAN-nasalis myocutaneous island flap is a simple, reliable technique for resurfacing lateral lower nasal defects up to 2 × 2 cm. (*Plast Reconstr Surg Glob Open* 2021;9:e3526; doi: [10.1097/GOX.0000000000003526](https://doi.org/10.1097/GOX.0000000000003526); Published online 8 April 2021.)

## INTRODUCTION

The nose is a central and defining feature of the face and is of great aesthetic importance. Optimal reconstruction of nasal defects is thus critical, especially given that the nasal unit is affected by 33% of facial cutaneous malignancies.<sup>1</sup> Many options exist to reconstruct nasal defects, with Burget and Menick's subunit principle remaining

a central tenet.<sup>2</sup> Rohrich et al proposed refinements of these principles, stating that good contour is achievable even with scars within a nasal subunit; however, this relies in large part on adjunctive procedures such as primary dermabrasion, laser resurfacing, and primary defatting.<sup>3</sup> Few major flap innovations have been described for reconstruction of small defects of <50% of a subunit or under 2 cm in size, with nasolabial, bilobed, and Rybka nasalis<sup>4</sup> flaps remaining popular to this day. Unfortunately, these options do not respect subunit borders, and their scars can cause distortion of the nasal contour.

In 2002, Papadopoulos et al detailed their experience with a myocutaneous island flap with bilevel undermining based on the nasalis muscle for reconstruction of lateral nasal defects.<sup>5</sup> This technique allowed for a greater cephalocaudal flap mobility and coverage of more lateral defects than their previously described bi-pedicled island flap.<sup>6</sup>

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Over the past 5 years, the senior author has developed a similar technique by basing a myocutaneous island flap based on the nasalis and levator labii superioris alaeque nasi (LLSAN) muscles along with the lateral nasal artery. This “LN” flap provides an even greater mobility, with a robust blood supply making it resistant to potential complications, and provides coverage of small distal sidewall and alar defects with similar skin while pushing scars to the margins of the sidewall subunit and avoiding contour distortion even with defects at the alar free margin.

### REGIONAL ANATOMY

The LLSAN (Fig. 1) is a thin, band-like muscle originating from the maxillary frontal prominence and dividing into 2 slips, medial and lateral, which insert onto the lower lateral cartilage and the upper lip, respectively.<sup>7</sup> It is relatively superficial, lying deep to the orbicularis oculi but over the levator labii superioris.<sup>8</sup> Vascularization of this muscle is from branches of the lateral nasal artery (LNA), which lies in the alar crease, or the angular artery, depending on patient anatomy; vessels course along the muscle’s superficial aspect.<sup>9</sup>

The nasalis muscle also originates from the maxilla and divides into transverse and alar parts. The transverse part overlies the junction of the lower and upper lateral cartilages as it ascends medially toward the nasal dorsum.<sup>7</sup> The LLSAN provides some muscle fibers to this transverse part but otherwise courses over the nasalis muscle. Vascularization to the nasalis is similarly provided by

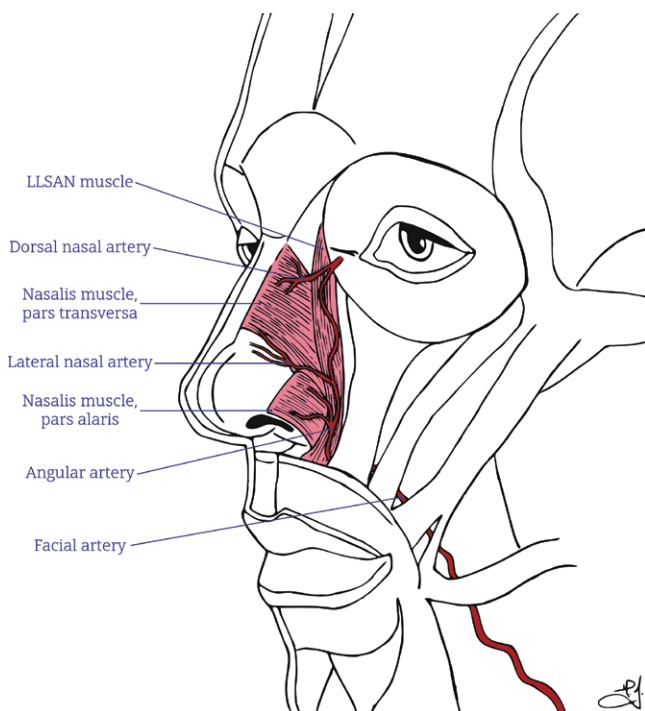
branches of the LNA and angular artery, as well as the inferior alar artery, a tributary of the superior labial artery.<sup>9,10</sup>

### METHODS

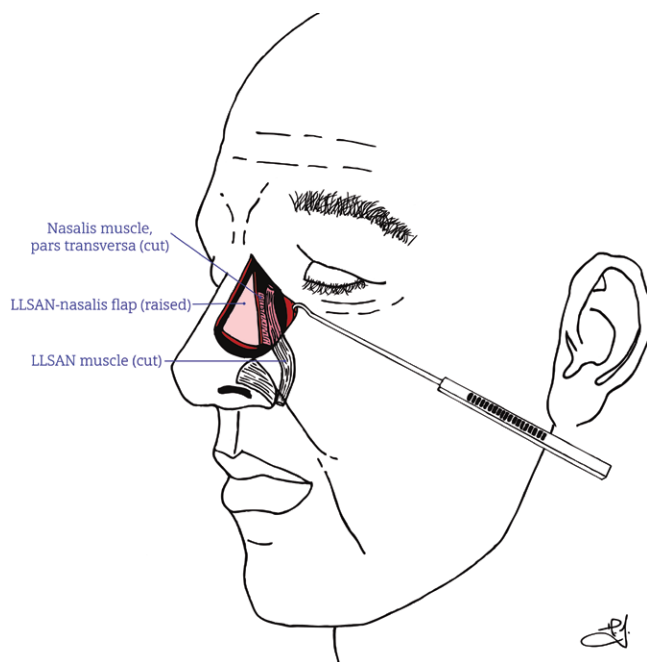
All procedures were performed by the senior author (GES) between April 2015 and November 2019 at our institution. The LN myocutaneous island flap was used for resurfacing defects of the caudal nasal sidewall, nasal tip, and ala after excision of cutaneous malignancies in 84 patients. Patient charts were retrospectively reviewed for demographic characteristics, along with information on tumor type, location, and deficit size. Digital photographs were taken both at presentation and at follow-up visits with consent for use in research. Our study protocol was written in ethical accordance with the 1975 Declaration of Helsinki and approval was obtained from the hospital research ethics board.

### PROCEDURE

Procedures were performed in a minor operating theater after either Mohs’ micrographic surgery or local excision of the nasal lesion. (See Video [online], which displays an intraoperative video demonstrating the complete flap dissection in a 73-year-old man with a 21 × 11-mm defect of the ala involving the free margin. The large degree of craniocaudal movement possible is demonstrated, as well as the early postoperative result at 3 weeks.) Frozen section analysis of margins was used for most non-Mohs’ cases, but reconstruction after melanoma resection was delayed until receipt of final pathology results (3–5 days) with interim placement of a bacteriostatic, nondesiccating dressing. Procedure selection was based on the dimensions and location of the deficit as well as patient preference. A triangular flap was initially marked out to recruit skin from the upper nasal sidewall (Fig. 2). Height and width were determined by the pinch test and location of relaxed skin tension lines of the nasal wall subunit. Lidocaine 1% with epinephrine (1:200,000) was infiltrated in the manner of an infraorbital nerve block as well as around the lesion and along the planned skin incisions. The lateral marking was first incised, and dissection proceeded in the subcutaneous plane superficial to the nasalis so as to expose the superficial surface of the LLSAN muscle and release its caudal insertions at the alar dermis. The LLSAN origin was then divided from the maxillary frontal process to allow caudal movement of the flap. The medial marking was then incised down to the periosteum of the nasal bones or perichondrium of the upper lateral cartilages. The transverse nasalis was sectioned horizontally at the upper and lower borders of the flap and dissection over the perichondrium toward the lateral border of the flap was undertaken, freeing it from the structural components of the nose and leaving it pedicled on the LLSAN muscle and blood supply. The LN flap was then trimmed to the shape of the defect and inset after meticulous hemostasis was ensured. The distal-most end of the flap was inset into the distal-most segment of the defect. The donor site was closed in a V-to-Y pattern by recruiting laxity at the nasal radix with nonresorbable



**Fig. 1.** A pictorial depiction of the muscular and arterial anatomy relevant to the LLSAN-nasalis myocutaneous island flap demonstrates its vascular supply—the lateral nasal and angular arteries—as well as the LLSAN and transverse nasalis muscles on which it is based (LLSAN: levator labii superioris alaeque nasi).



**Fig. 2.** Pictorial depiction of the LLSAN-nasalis flap shows the triangular-shaped flap raised off the bony and cartilaginous structure of the nose. The LLSAN (levator labii superioris alaeque nasi) muscle is shown cut at both origin and insertion to permit greater craniocaudal movement.

sutures in an everting fashion. Steristrips were then placed as a dressing and standard postoperative care instructions were provided. Sutures were removed on postoperative day 5. Scar management counseling touched on scar massage and sunblock utilization, but no adjunctive therapies were routinely provided.

## RESULTS

Eighty-four patients in our series underwent nasal reconstruction with the LN flap. Patients' mean age was 74.9 years, 54.8% were women, and all were White (Table 1). Smoking status was available for only 32 of our 84 patients (38.1%). In total, 37.5% of patients with known smoking status were active smokers. An estimated 89.3% of excised cutaneous malignancies were basal cell carcinomas, 6.0% were squamous cell carcinomas, and 4.8% were melanomas. The mean defect size was 13.1 × 12.7 mm, with a mean defect surface area of 178 mm<sup>2</sup>.

Among all defects, most (71.4%) were between 1 × 1 and 2 × 2 cm in size (Table 2). Most defects were located on the ala (57.1%), followed by the nasal tip (14.3%) and the sidewall (13.1%). Combined alar-sidewall and alar-tip defects represented 7.1% and 8.3% of cases, respectively. An estimated 27 patients were lost to follow-up. Mean follow-up in the remaining patients was 24.3 weeks.

There were no occurrences of flap necrosis or flap loss. Trapdoor phenomenon was common in the early postoperative period, but persistent trapdoor (>3 months) was present in only 3 patients (Fig. 3). Of these, 1 case subsided by 8-month follow-up, whereas the other 2 remained by 18 weeks and 13 months postoperatively. One case of

**Table 1. Patient Demographic and Oncologic Data**

| Patient Characteristics         |       |          |
|---------------------------------|-------|----------|
| No.                             | 84    |          |
| Mean age, y (range)             | 74.9  | 52–95    |
| Woman, n (%)                    | 46    | 54.8     |
| White, n (%)                    | 84    | 100      |
| Smokers, n (%)                  | 12/32 | 37.5     |
| Tumor Characteristics           |       |          |
|                                 | n     | %        |
| Basal cell carcinoma            | 75    | 89.3     |
| Squamous cell carcinoma         | 5     | 6.0      |
| Melanoma                        | 4     | 4.8      |
| Defect Dimensions               |       |          |
|                                 | Mean  | Range    |
| Length (mm)                     | 13.1  | 6–32     |
| Breadth (mm)                    | 12.7  | 1–28     |
| Surface area (mm <sup>2</sup> ) | 178   | 12.0–704 |

**Table 2. Surgical Findings and Postoperative Events**

| Defect Size (mm <sup>2</sup> ) | n    | %    |
|--------------------------------|------|------|
| ≤100                           | 19   | 22.6 |
| 101–400                        | 60   | 71.4 |
| 400–900                        | 5    | 6.0  |
| Location of Defect             |      |      |
|                                | n    | %    |
| Ala                            | 48   | 57.1 |
| Sidewall                       | 11   | 13.1 |
| Tip                            | 12   | 14.3 |
| Ala and sidewall               | 6    | 7.1  |
| Ala and tip                    | 7    | 8.3  |
| Follow-up                      |      |      |
|                                | n    | %    |
| Lost to follow-up              | 27   | 32.1 |
| Mean follow-up (wk)            | 24.3 |      |
| Aesthetic Outcome (n = 57)     |      |      |
|                                | n    | %    |
| Good contour                   | 54   | 94.7 |
| Complications (n = 57)         |      |      |
|                                | n    | %    |
| Alar notching                  | 3    | 5.3  |
| Trapdoor                       | 3    | 5.3  |
| Hematoma                       | 1    | 1.8  |
| Revision surgery               | 1    | 1.8  |
| Infection                      | 1    | 1.8  |

hematoma was managed expectantly, with no adverse aesthetic consequences at 23-weeks follow-up. One case of infection responded to oral antibiotics and resulted in an acceptable appearance. Alar notching was noted in 3 patients, of whom 2 declined revision surgery. The third represented the only case of revision surgery—a cartilaginous graft was placed for correction of the deformity.

## DISCUSSION

Reconstruction of the lower lateral segment of the nose with myocutaneous flaps has a long history, with Rybka first describing his 10-year experience with a sliding flap based on the alar nasalis muscle in 1983,<sup>4</sup> Staahl adopting this technique in 1986,<sup>11</sup> and Wee et al presenting their refinements to this technique in 1990.<sup>12</sup> Sakai et al described in 1986 a flap based laterally on the transverse nasalis muscle to help in closure of the donor site defect resulting from raising a nasolabial flap.<sup>13</sup> Other authors have over the years published their experiences with V-Y advancement flaps,



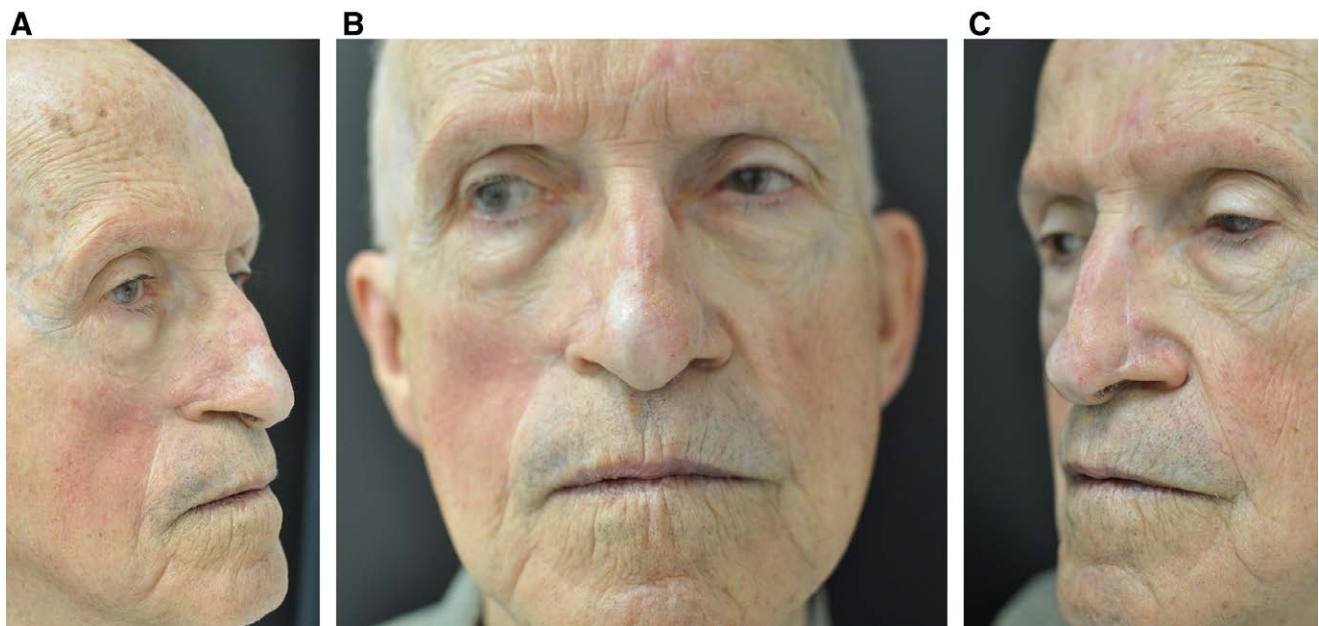
**Fig. 3.** Photographs of a 53-year-old male patient at 13-month postoperative follow-up after LN flap reconstruction of a right medial ala and lateral tip defect. Persistent trapdoor deformity is seen, especially at the caudal margin of the flap (A, B, C), as well as some wrinkling of the scar near the radix at the junction of the Y closure (A, B).

some relying on random pattern vascularization<sup>14</sup> and others raised as myocutaneous flaps based on the alar nasalis once more.<sup>15</sup> Subsequently, Papadopoulos et al introduced their myocutaneous island flap based on the nasalis muscle. Their initial description involved a bi-pedicled flap with subperichondrial dissection.<sup>6</sup> They subsequently modified the flap to be unipedicled, which allowed for a better reconstruction of lateral nasal defects. The modified uni-pedicled flap was more mobile and avoided cephalic retraction of the nasal tip that was seen with the bipedicled flap version.<sup>5</sup> Recently, Moore et al presented a cadaveric study describing the harvest of a modification of the nasolabial flap, incorporating the LLSAN muscle with skin directly overlying it and a pedicle located in the sublevator space deep to the muscle.<sup>16</sup>

Besides the aforementioned axial flaps, the random bilobed flap has been a popular reconstructive option to resurface nasal defects for its ease of design and use. However, the bilobed flap is known to have significant complications such as alar retraction, trapdoor deformity, tip deviation, and scars that transgress subunit borders and deform natural nasal anatomy. Random nasolabial flaps are also commonly used for alar reconstruction but also tend to deform natural subunit anatomy of the nasal sidewall and alar creases (Fig. 4). Random flaps taken from outside the boundaries of the aesthetic subunits must, by definition, violate the borders, and thus create unnatural-appearing reconstructions.

The chief characteristics sought in an axial myocutaneous flap for reconstructive surgery are recruitment of like-for-like tissue, robust vascularity, and great mobility, which allows preservation of the natural aesthetic subunits of the nose. The LN myocutaneous island flap described here can be designed to recruit the skin of the nasal sidewall—thinner skin cephalad and thicker, sebaceous skin caudally—which allows for similar texture and thickness at the defect site. The incisions are kept in the cheek/nasal sidewall junction and are easily camouflaged.

The vascularity of the flap is robust, incorporating perforators from the nasalis into the overlying skin as well as branches into the LLSAN muscle. In our experience, this has resulted in limited cases of dehiscence and the absence of partial or total flap necrosis. This axially based island flap is highly mobile owing to the complete disinsertion of the LLSAN. Maintaining the subcutaneous lateral attachments of the LLSAN allows for up to 2 cm of cephalocaudal movement while maintaining adequate venous drainage. (See Video [online], which displays an intraoperative video demonstrating the complete flap dissection in a 73-year-old man with a 21 × 11-mm defect of the ala involving the free margin. The large degree of craniocaudal movement possible is demonstrated, as well as the early postoperative result at 3 weeks.) Flap dimensions were up to 700 mm<sup>2</sup>; therefore, the LLSAN-nasalis flap can reliably fill 2 × 2-cm defects without adding tension to the nasal framework. As such, the



**Fig. 4.** Photographs of an 81-year-old male patient showing left LLSAN-nasalis flap for reconstruction of a distal sidewall and tip defect 2 years and 4 months postoperatively. Fine-line scars with no distortion of the nasal architecture are seen (B, C). Of note, the patient was also postoperative 1 year and 3 months from a right nasolabial flap (A, B), with resulting loss of definition of the alar-sidewall junction.



**Fig. 5.** Photographs of a 65-year-old female patient during surgery demonstrating the oncologic defect, located at the left medial ala and distal sidewall. A, Before reconstruction. B, After reconstruction with an LLSAN-nasalis flap. Postoperative photographs at 1 month (C, D) showing a good early result, with slight pincushioning of the flap and a degree of alar asymmetry.

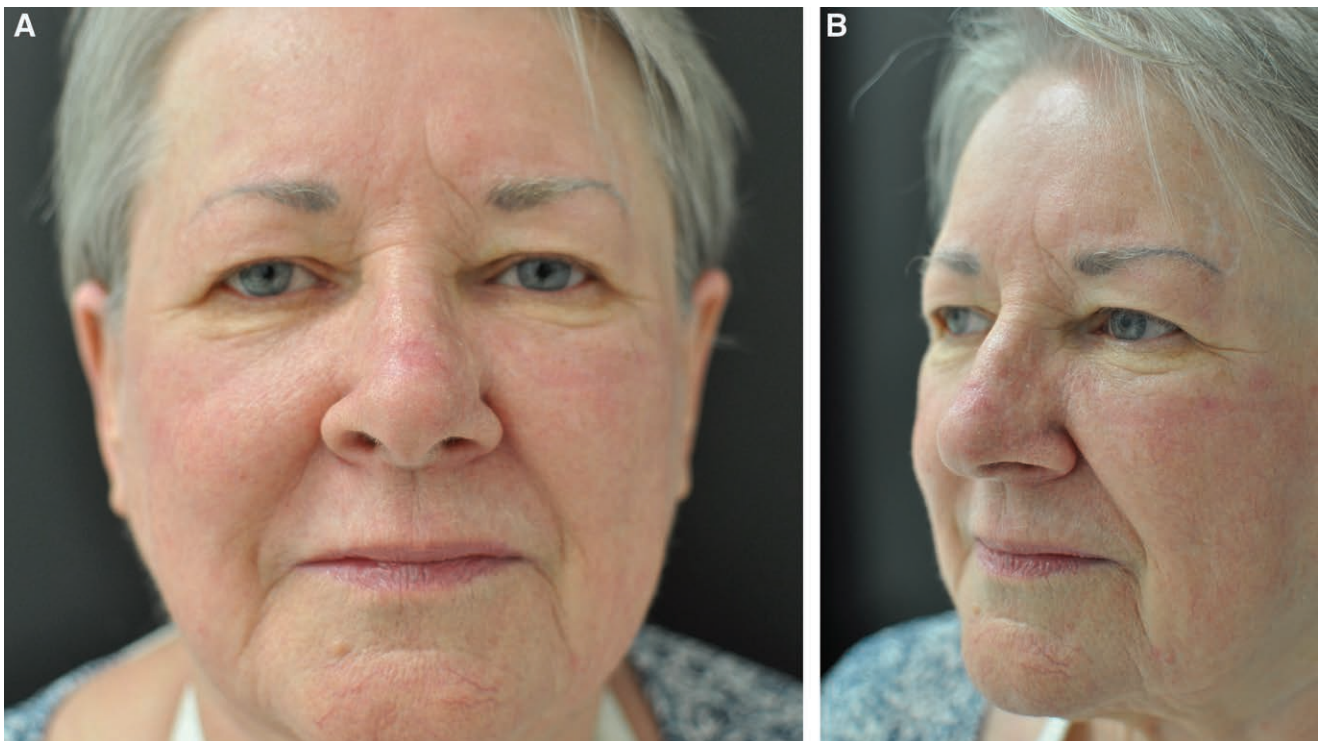
flap is useful in the reconstruction of defects of the caudal nasal sidewall and of the ala. When used to resurface lateral nasal tip defects the scars may cross subunit borders, but it remains an option in certain patients. The LN flap is best suited for defects that are wider than they are tall, as this allows for increased height of the V-shaped flap and distribution of tension along a greater distance during V-Y closure.

LN flap indications include defects of the distal nasal sidewall as well as the ala. It can equally resurface lateral nasal tip defects, but aesthetic outcomes here are suboptimal. It is well suited to cover defects that are wider than they are tall, as these are difficult to cover with a nasolabial flap. Patients must have sufficient sidewall laxity for the LN flap to be sufficiently mobilized, and those who have contraindications to nasolabial or paramedian forehead flaps (ie, flaps already used or precarious medical condition precluding 2-stage surgery) can benefit from this technique.

The aesthetic results after LN flap reconstruction have been satisfactory in our hands. The trapdoor deformity is a difficult complication to avoid in flaps with a V-shaped or triangular geometry. This complication was highly prevalent, especially in the early (<3 months) postoperative period (Fig. 5). We did note 3 particularly persistent cases of this in our series. Although 1 had improved at 8-month follow-up, 2 cases were still present at 18 weeks and 13 months (Fig. 3) postoperatively; these patients declined further intervention and referrals for adjuvant therapies. The incidence and severity of trapdoor deformity can be minimized by careful flap design avoiding round incisions, meticulous size, and thickness matching of the flap to the defect, preservation of maximal soft tissue around the pedicle to increase venous outflow,

and careful cutaneous closure to decrease scar contracture (Fig. 6). This said, some degree of pincushioning is to be expected (Fig. 5), and patient consent should be transparent regarding the importance of rigorous scar massage, corticosteroid injection, and possible secondary debulking. Primary dermabrasion or laserabrasion might play a role in centers that can offer these therapies. The scar placement of the LN flap contributes to minimizing its donor site deformity (Fig. 7). With adequate flap design, the scars are placed at the borders of the subunits of the dorsum and sidewall, and are effectively hidden by the shadows at the dorsal-sidewall junction and nasojugal fold. In cases of lateral tip reconstruction, the scars do cross subunit borders, however, and care should be taken to explore options such as dorsal advancement, paramedian forehead, and nasolabial flaps before settling for the LN.

The LN, like all axially perfused flaps, is not totally impervious to adverse outcomes. One hematoma and 1 infection did occur, but occurrence rates of 1.8% for both fall well within those reported in the literature.<sup>16</sup> Three cases of alar notching were noted, secondary to cicatricial contracture at the margins of the flap after reconstruction of alar defects. This is a complication of which to be wary after surgery of the ala and should be included in consent, as it can result in unsightly prominence of the affected nare. Although 2 patients declined correction of the deformity, the third represented our only case of revision surgery and a satisfactory result was achieved with a conchal cartilage graft. Outside these complications, disadvantages of the LN flap include its lack of adaptability for deficits outside the lateral nasal region, the theoretical possibility of upper lip asymmetry—although this was not



**Fig. 6.** Postoperative photographs of the same patient in Figure 5 at 3 years and 8 months, showing resolution of the pincushioning seen in the early postoperative period, with improvement of alar asymmetry. A, Frontal view. B, Three-quarter view.



**Fig. 7.** Postoperative photographs at 3 months follow-up showing a favorable result. Part of the surgical scar is well-hidden in the alar-sidewall junction, and the nose retains good contour, albeit with slight hollowing near the flap donor site. A, Frontal view. B, Three-quarter view. C, Profile view.

noted in our series—and a more extensive dissection up to the medial canthal region at the LLSAN origin.

Weaknesses of our study include the high rate of loss to follow-up and the mean follow-up time of only 24 weeks. In our practice, patients are free to have their sutures removed in an outside publicly funded nursing facility, which may explain the 32.1% of patients not seen at all postoperatively. Patients who did not return likely did not experience complications requiring intervention, but their aesthetic outcome is uncertain. As for the mean follow-up time, long-term evaluation was not always insisted upon if patients were without complications, had low aesthetic demands, and were elderly or comorbid. With a mean age of nearly 75 years, many of our patients fulfilled these criteria, but in a younger patient population, a more rigorous follow-up with a higher rate of adjuvant procedures might be expected.

### CONCLUSIONS

The LN myocutaneous island flap is a useful addition to the nasal reconstructive armamentarium. Its indications include deficits of the lower third of the nasal sidewall and ala. The flap can reliably resurface defects of up to 2 × 2 cm. The LN flap has a reliable vascular pedicle and good mobility and the incisions occur at natural aesthetic subunit junctions, making this flap a useful substitute for the more common random flaps used in nasal reconstruction.

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### PATIENT CONSENT

Patients provided written consent for the use of their images.

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