

# A Graded Approach to Repairing the Stenotic Nasal Vestibule

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**Objective:** To describe a graded approach to repairing vestibular stenosis that involves restoring structural support to the ala.

**Methods:** Retrospective review of 5 nostrils in 4 patients who presented to the senior author with vestibular stenosis. The cause was burn injury in 3 patients and congenital in 1 patient. The cornerstone is a batten graft to restore strength to the ala. A short-term thermoplastic stent helps the nostril assume its natural shape. When an obstructing cicatrix is present, it is excised in a second stage followed by full-thickness skin grafting. The patients were evaluated up to 16 months postoperatively. Vestibular patency was documented using high-resolution photographs, and medical records were reviewed for complications.

**Results:** Two patients had their nostrils repaired in a single stage and the others required 2 stages. In all patients, significant improvement in nostril diameter was maintained. The patients were satisfied with the functional and aesthetic results. Stenting averaged 13 days after surgery and was well tolerated. No wound complications occurred.

**Conclusions:** In patients with vestibular stenosis, we use a graded approach that addresses the inherent weakness of the nasal ala to achieve long-term vestibular patency. This technique restores form and function to the stenotic vestibule while avoiding long-term stenting.

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**N**ASAL VESTIBULAR STENOSIS is a relatively uncommon deformity with significant aesthetic and functional effects on the patient.<sup>1</sup> Trauma, infection, iatrogenic insults, and congenital lesions have all been described in the literature<sup>2-5</sup> as causes of vestibular stenosis. Traumatic injury to the ala or vestibular lining is typically secondary to burns or complex lacerations.<sup>2,4,5</sup> Infections that involve the anterior nasal mucosa, including syphilis, tuberculosis, smallpox, chickenpox, systemic lupus erythematosus, rhinoscleroma, and leprosy can lead to scarring within the vestibule and contracture of the ala.<sup>2-5</sup> Iatrogenic trauma to the nostril resulting in narrowing of the nasal aperture can include prolonged nasal packing, chemical cauterization, and poorly executed surgical maneuvers that sacrifice the lining membrane of the vestibule.<sup>2,3</sup> Congenital vestibular stenosis is less common and is typically seen in conjunction with a cleft lip or nose deformity.<sup>4,6</sup>

Stenosis of the nasal vestibule can be a vexing deformity for the facial reconstructive surgeon to successfully repair. Like other hollow orifices in the human body (eg, lacrimal ducts, urethra, and ear canals), once

injured, the vestibule has a tendency to rescar and contract despite seemingly well-designed surgical maneuvers to excise the offending cicatrix and create a new vestibular lining.<sup>7</sup> From a pathophysiologic standpoint, stenosis of the anterior nares can be caused by direct injury to the delicate lobule-ala-columella complex, loss of healthy vestibular lining, or both.<sup>8,9</sup> Direct injury to the ala, such as chemical burns, leads to tissue loss and scar contracture, which effectively sucks in and flattens the ala.<sup>10</sup> Partial or circumferential scarring within the vestibule contributes additional contractive forces that tend to obliterate the cephalic and lateral portions of the vestibule and distort the flaccid alar wing.<sup>9</sup> The medial aspect of the vestibule tends to be less affected by these distorting forces given the inherent support mechanism of the juxtaposed medial crura and caudal septum.<sup>9</sup> In addition to tissue loss and scar contracture, the constant negative pressure generated by inspiratory forces on the nostril further adds to the tendency for the injured vestibule to contract.<sup>11</sup>

The same factors that initiate and perpetuate vestibular stenosis also serve to frustrate surgical attempts to correct the defor-

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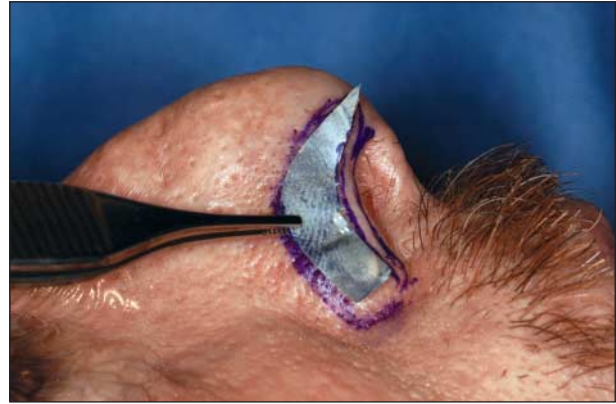


**Figure 1.** Cadaver dissection showing a sagittally degloved nose. Note the lack of cartilaginous support at the caudal aspect of the ala overlying the vestibule.

mity. A photograph of the ala in a cadaver dissection demonstrates that the lower lateral cartilage does not support the entire ala (**Figure 1**). The most caudal and lateral portion of the ala, which overlies the vestibule, is instead supported by easily injured fibrofatty or fibromuscular tissue. Once injured, the lack of cartilage prevents the ala from withstanding the irresistible forces of postoperative scar contracture. Furthermore, when trying to rearrange and/or excise the intravestibular cicatrix, the dictum “scar begets scar” holds true. Complicated intravestibular repairs often lead to a vicious cycle of new scar formation and recurrent stenosis of the nostril.<sup>4,12</sup>

Many different strategies have been described in the literature to address stenosis of the nasal vestibule. The common theme in each approach is the need to excise the obstructing cicatrix, replace the scar tissue with a new, healthy lining, and stent the nostril postoperatively to prevent restenosis. The use of cartilage grafts has been advocated by several authors as a means to combat restenosis. Egan and Kim<sup>11</sup> describe using a composite conchal graft to stent the region of the nasal sill, and Karen et al<sup>6</sup> advocate the use of an auricular composite graft to replace the intravestibular scar and to stiffen the repair. These approaches address isolated stenosis within the vestibule owing to scar tissue, but they do not correct for alar collapse. Copcu<sup>13</sup> reports using a gingivobuccal mucosal flap in conjunction with a cartilage graft to strengthen the weakened ala, but he does not provide details on the exact placement of the graft or explain how he obtains a natural internal nostril contour. Blandini et al<sup>12</sup> describe the theoretical use of cartilage grafts in conjunction with other techniques for relining the injured vestibule, but they did not use cartilage grafts in their series.

We reviewed the literature extensively using the keywords *nostril stenosis* and *nasal vestibular stenosis*. To our knowledge, no reports in the literature have described a technique for reestablishing the inherent structural support of the ala in patients with vestibular stenosis while allowing for a *graded surgical approach* via an optional second stage for excision of scar and creation of a neovestibular lining with a full-thickness skin graft. Furthermore, the technique described in this article makes progress in the use of postoperative stenting methods. Although other techniques have almost uniformly required months of postoperative stenting to prevent sur-



**Figure 2.** Foil template of contralateral ala. A foil template of the unaffected ala is designed preoperatively, which will be used to carve a batten graft.

gical failure, the senior author (S.R.M.) uses a custom-fashioned, limited-duration, thermoplastic stent that spares the patient the discomfort and cosmetic drawbacks of prolonged stent use. The custom-molded stent also contributes to establishing a more natural nostril contour. We share the senior author’s experience in using a graded approach for repairing congenital and acquired stenosis of the nasal vestibule.

## METHODS

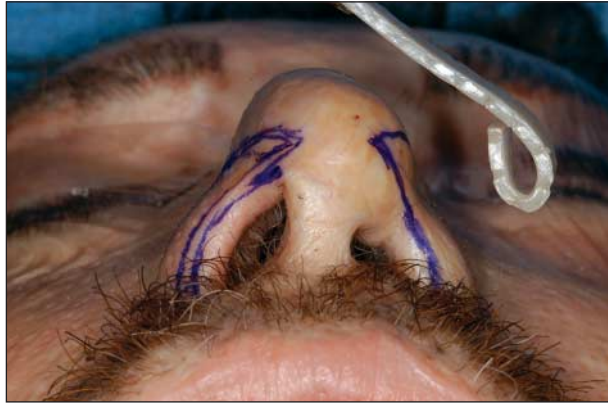
All patients were evaluated by the senior author and diagnosed as having stenosis of the nasal vestibule based on physical examination findings. Routine digital photographs were taken before and after surgery. A graded approach was used to repair the deformity based on the following algorithm. In patients whose anterior nasal stenosis was secondary to direct injury to the ala with resultant alar in-drawing and contracture, a single-stage operation was performed for placement of an alar batten graft and fitting of a short-term thermoplastic stent. In patients with a significant intravestibular cicatrix, a second-stage operation was performed to excise the offending scar and create a neovestibular lining with a full-thickness skin graft, again followed by short-term stent placement.

### SINGLE-STAGE REPAIR

For patients with alar collapse without an obstructive cicatricial component contributing to their vestibular stenosis, the repair is performed in a single stage. First, a foil template of the contralateral (unaffected) ala is meticulously designed (**Figure 2**), and a thermoplastic stent is fashioned with the goal of achieving slight overcorrection, again using the contralateral nostril as a model (**Figure 3**). Then a generous conchal cartilage graft is harvested, typically through a postauricular incision (**Figure 4**).

Second, attention is directed to the nose. A rim incision is made along the stenotic nostril with a No. 11 blade scalpel, and a tight subcutaneous pocket is created with a 6900 Beaver blade (Beaver Surgical Instrument Company, Waltham, Massachusetts). A teardrop-shaped cartilage graft is carved (using the foil template designed at the beginning of the procedure) and inserted into the subcutaneous pocket (**Figure 5**). The rim incision is then closed.

Finally, the limited-duration thermoplastic stent is inserted in the vestibule and secured in place with 4-0 nylon suture over polytetrafluoroethylene (PTFE) tie-over pledget bol-



**Figure 3.** Molding of thermoplastic stent. A custom vestibular stent is molded with the goal of achieving slight overcorrection.

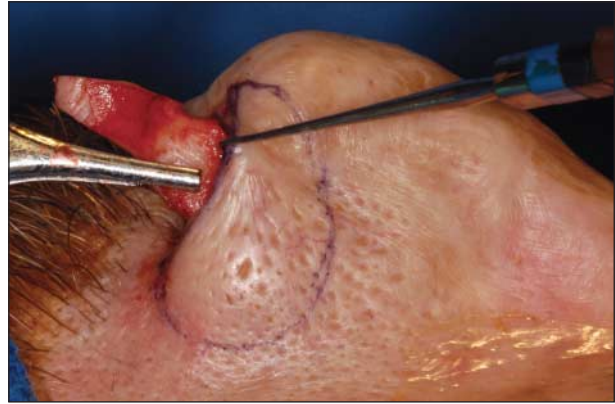


**Figure 4.** Auricular cartilage graft. A generous-sized piece of conchal cartilage is harvested.

stents to distribute the tension of the suture and protect the nasal skin (**Figure 6**). The senior author has found the use of PTFE pledgets extremely useful in nasal reconstruction because they allow a protective interface between the suture (which is helping to secure the intravestibular stent) and the skin. Without the use of the PTFE pledgets, the suture can have a cheese wire effect on the skin, resulting in a superficial laceration. The thermoplastic stent is left in for approximately 2 weeks.

### TWO-STAGE REPAIR

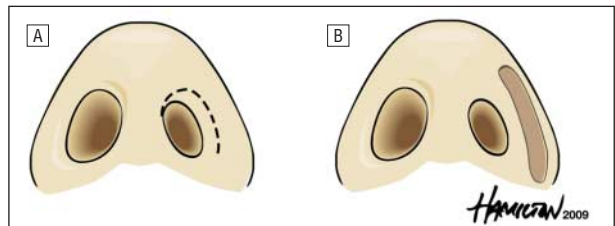
In patients whose vestibular stenosis is caused by alar collapse and intravestibular scarring, a 2-stage approach is used for re-



**Figure 5.** Insertion of cartilage graft. After the rim incision is made, the cartilage graft is placed in a tight subcutaneous pocket within the ala.

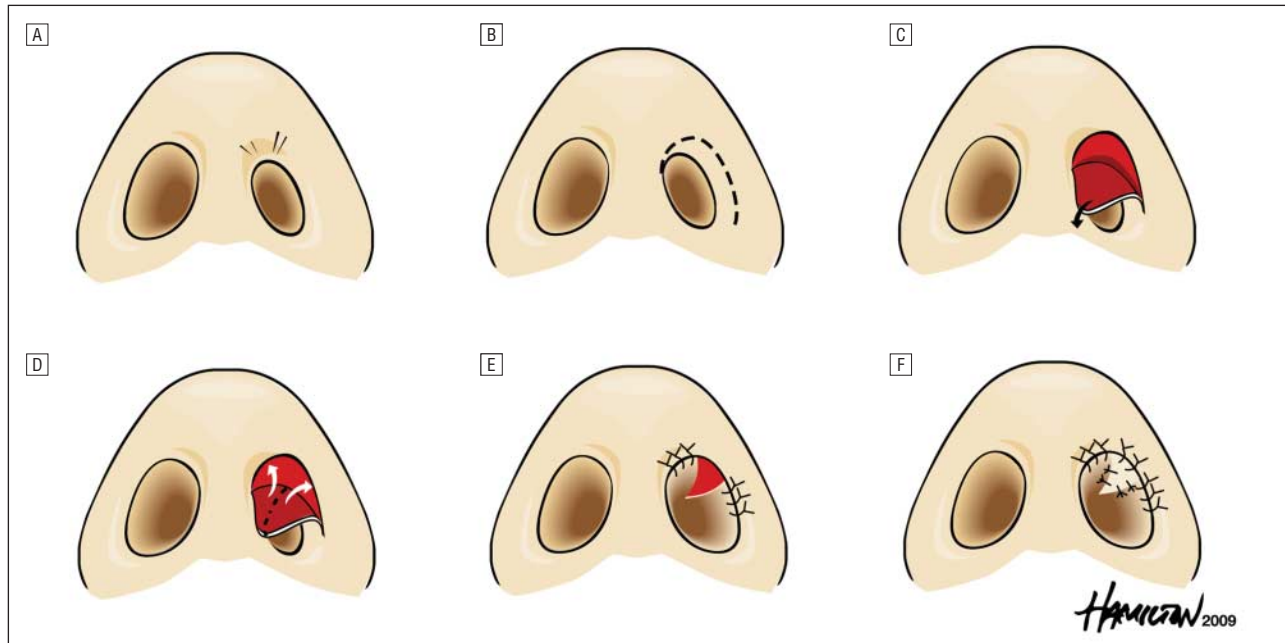


**Figure 6.** Vestibular stents in situ. The stents are secured within the vestibule using polytetrafluoroethylene tie-over pledget bolsters to distribute the tension of the suture on the skin of the ala.



**Figure 7.** Important technical details for 2-stage repair. A, Rim incision placed at future edge of vestibular opening. B, Batten graft placed in close proximity to external nasal skin.

pair. The first stage proceeds in a similar fashion to the technique described for the single-stage vestibular stenosis repair with attention to 2 important technical details. First, the rim incision must be placed exactly at the future edge of the vestibular opening (**Figure 7A**). The second technical detail concerns the creation of the tight subcutaneous pocket that will receive the auricular cartilage graft: the pocket is created with a thin layer of overlying skin so that the alar batten graft will be in very close proximity to the external nasal skin (**Figure 7B**). This is an important technical detail because in stage 2, much of the tissue between the internal nasal lining and the cartilage graft will be excised. If the graft is not placed in close approximation to the external nasal skin, a portion of it could be unintentionally excised (along with obstructing scar tissue) in the second stage, compromising the structural integrity of the reconstruction. After the batten graft has been inserted and rim



**Figure 8.** Diagram of second-stage operative technique. A, Markedly stenotic left nostril. B, Dashed line represents planned incision along nostril rim. C, Vestibular skin reflected down and scar debulked. D, Skin flap bisected. E, Two resulting flaps sewn back in place. F, Triangular defect after scar excision reconstructed with full-thickness skin graft.



**Figure 9.** Scar excision. When a second-stage surgery is necessary for scar excision, a thin flap of vestibular skin is raised and obstructing scar tissue is sharply resected.



**Figure 10.** Intravestibular full-thickness skin graft. The vestibular skin defect created after scar excision is replaced with a full-thickness skin graft.

incision closed, a thermoplastic stent is sewn into the vestibule, as previously described.

In the second stage, after allowing 2 months for the cartilage graft to take and the rim incision to heal, the patient returns to the operating room to address the intravestibular scar tissue (**Figure 8A**). The location of the intended incision is marked and the site injected with local anesthetic; then a curvilinear incision is made along the stenotic segment from the alar base to the columella (**Figure 8B**). A thin segment of vestibular lining is raised and the thick, obstructing scar tissue between the vestibular skin flap and the previously placed batten graft is excised (**Figure 8C** and **Figure 9**). Usually the underside of the intact cartilage graft is visualized, reassuring the surgeon that all obstructing scar tissue has been removed. With the volume of scar tissue removed, there will be a relative paucity of internal lining. A down cut is made into the existing vestibular skin flaps, creating a missing segment of vestibular lining in a "V" shape (**Figure 8D**). A postauricular, full-thickness skin graft is harvested and sewn into the vestibule to establish a new, healthy vestibular lining (**Figure 8E** and **F** and

**Figure 10**). Then, as was done in the first surgical stage, a thermoplastic stent is placed into the vestibule and secured with 4-0 nylon over PTFE pledgets to protect the skin. The thermoplastic stent is, as before, left in place for approximately 2 weeks.

## RESULTS

A total of 5 stenotic nostrils were repaired in 4 patients using a graded approach. The cause was burn injury in 3 patients and congenital in 1 patient. Two patients had their nostrils repaired in 1 stage with a generous alar batten graft and custom-fit thermoplastic stent, whereas the other 2 patients required a second planned stage to excise scar tissue and create a neovestibular lining with a full-thickness skin graft. There was significant improvement in nostril aperture in all 4 patients, and none of the stenoses had recurred at follow-up (**Figure 11**). One patient was not included in calculations of follow-up be-



**Figure 11.** Patient with vestibular stenosis. A, Preoperative photograph demonstrates severe stenosis of the left nostril after industrial burn accident. B, Significant improvement in stenosis after single-stage surgical repair.

cause he left the country the month after surgery and has not returned, to our knowledge. In the other 3 patients, follow-up ranged from 4 to 16 months, with a mean of 11 months. Duration of stent use in the 2 patients with nostrils repaired in a single stage was 8 and 15 days, respectively (mean, 11.5 days). In the 2 patients who required nostril repair in 2 stages, 1 patient did not have a stent placed after the first stage because his vestibule was too stenotic to accommodate a prosthesis. The other patient wore a stent for 15 days after the first stage of repair. After the second stage in these 2 patients, the stents were worn for 11 and 16 days, respectively (mean, 13.5 days). The overall average duration of stent use after any surgical stage was 13 days. None of the patients experienced local wound complications from the limited-duration thermoplastic stents. No cellulitis, superficial lacerations, or skin breakdown was observed. The full-thickness skin grafts remained viable in all the patients who had creation of a neovestibular lining. No significant morbidities occurred at the conchal cartilage or full-thickness skin graft donor sites. All 4 patients stated that the stents were well tolerated and easily cared for.

#### COMMENT

Stenosis of the nasal vestibule can occur after direct trauma to the ala or injury to the lining vestibular membrane. Given that most of the ala is composed of fibrofatty or fibromuscular tissue, once injured, there is a tendency for the postinjury forces of healing and cicatrix formation to contract and flatten the ala. The resultant vestibular stenosis is frequently compounded by the formation of scar tissue within the vestibule itself.

Many authors have described their techniques for repairing stenosis of the anterior nares. Despite well-conceived plans for removing obstructing scar tissue and recreating a healthy vestibular lining, attempts to maintain correction are frequently met with relapses of stenosis even when long-term stenting is used.

The simplest technique for reconstruction of the vestibule is to excise the stenotic tissue from within the vestibule and replace the lining with a split-thickness skin graft.<sup>4,5,9</sup> The skin graft can be wrapped around a molded

stent, which must be left in place for up to 6 months to prevent relapse. Although this approach addresses removal of cicatrices and restoration of a healthy lining, it ignores the need to restore intrinsic support to the collapsed ala. Furthermore, as Bajaj and Bailey<sup>4</sup> state, "The crux of the problem is the use of a prosthesis."<sup>4</sup> Nasal stents are uncomfortable and unsightly and, when used long-term, require frequent cleaning. The stents can also break or must be exchanged intermittently for larger stents.<sup>8</sup> These factors make compliance an issue for patients faced with wearing a stent for prolonged periods. Mandatory long-term stenting has further drawbacks, including the possibility of skin abrasion, pressure ulceration, and rhinitis.

The next step up the reconstructive ladder is intra-vestibular Z- or W-plasty. Stallings and Sessions<sup>14</sup> describe the triplanar W-plasty, which involves excision of scar tissue from within the nostril and creation of multiple flaps, which are then interdigitated to provide epithelial coverage. The use of acrylic stents for 5 months postoperatively is advocated after W-plasty to prevent restenosis. Naasan and Page<sup>15</sup> describe the double-cross plasty, which involves making precise superficial and deep cuts in the scar tissue in the shape of a cross, excising the intervening scar tissue, and interdigitating the resultant flaps, leading to a continuous W-plasty encircling the nostril. They believe that, when done correctly, their technique does not require a stent to maintain patency. The clear drawback of these techniques is that the scar within the vestibule is rearranged but not eradicated, and Z- or W-plasty cannot increase the amount of vestibular lining.<sup>4</sup> If the small, stiff flaps do not survive, raw areas are created, which can ultimately lead to new scar formation and surgical failure.<sup>4,12</sup> These techniques focus on improving the vestibular aperture but do nothing to provide long-term autologous rigid support to the ala.

Numerous flaps that use local tissue to reconstruct the injured nostril have been advocated. Most local flaps described for repair of vestibular stenosis are based on Poulailon's perialar transposition flap and Jalaquier's double quadrilateral flap, described in 1884 and 1902, respectively.<sup>2</sup> The perialar flap is an inferiorly based flap transposed into the floor of the nostril, replacing the vestibular lining while simultaneously lateralizing the contracted alar base. The double quadrilateral flap consists of 2 flaps. Flap A is raised from nasolabial tissue below the nostril continuous with the ala and is turned in to form the new lining of the ala. Flap B is an inferiorly based nasolabial flap transposed into the defect created by flap A. Mavili and Akyürek<sup>1</sup> describe an upper lip flap followed by use of a nostril retainer for 2 months. Blandini et al<sup>12</sup> use a piercing mucosal flap from the labial vestibule followed by 2 weeks of stenting at night. Aydogdu et al<sup>3</sup> use an alar transposition flap to recreate a vestibular lining followed by 1 month of around-the-clock stenting and 2 months of stenting at night. Although these local flaps can provide healthy, vascularized tissue to replace vestibular scar tissue, they have the potential to be too bulky to replace the delicate vestibular lining.<sup>12</sup> Local flaps alone cannot restore strength to a collapsed ala and counteract postoperative scar contracture. Furthermore, almost all local flaps result in additional facial scars.

A few authors<sup>6,11-13</sup> have advocated composite or cartilage-alone grafts in the context of repairing stenosis of the nasal vestibule. Blandini et al<sup>12</sup> describe the theoretical advantage of placing a small cartilage graft under the vestibular labial mucosal flap, stating that a cartilage graft may eliminate the need for a stent. Copcu<sup>13</sup> advocates a gingivobuccal mucosal flap and uses a cartilage graft between the outer nasal skin and the inner mucosal flap for structural support. However, he does not provide specific details regarding the size or placement of the graft. Kim<sup>16</sup> describes using a composite auricular cartilage graft in a patient with scarring of the nasal sill and columella. A vertical incision is made in the scar tissue, and narrow tunnels are made medially and laterally. The graft is inserted into the defect with its flanges in the narrow tunnels. The composite graft replaces a portion of the excised cicatrix and provides structural support to resist the forces of scarification and compress excess scar tissue. A rubber stent is used at night for 7 months. Kim's technique appears limited to repairing stenosis involving the nasal sill, and it does not eliminate the need for long-term stenting. Karen et al<sup>6</sup> describe an auricular composite graft using a full-thickness wedge of auricle from helix to antihelix to repair stenosis of the vestibule. Most patients in their series were treated for stenosis of the nasal floor. The obvious drawbacks of their technique are a visible scar, potential notching of the helix, and the risk of contributing to further stenosis by transfer of 2 avascular elements (skin and cartilage) simultaneously into an already scarred wound bed.

Taking into account the view that "one size fits all" rarely works in nasal reconstruction, we favor a graded approach for repair of vestibular stenosis. In patients whose nostril stenosis is due to a scarred, contracted ala without an internal obstructive component, the defect can be repaired with a single-stage operation. The centerpiece of our reconstructive technique is a generous alar batten graft, which we prefer to place into the substance of the fleshy ala in a tight subcutaneous pocket in close proximity to the external nasal skin. Augmenting the structural support of the flaccid ala counteracts the persistent forces of healing and cicatrix formation and eliminates the need for prolonged stenting to prevent relapse. A thermoplastic stent is fashioned and suture secured into the vestibule in the immediate postoperative period to act as a scaffold for healing and to aid in achieving a natural shape to the reconstructed nostrils. In patients with a significant obstructing, intravestibular scar, a planned second-stage operation can be performed to excise the scar tissue and to create a neovestibular lining with a full-thickness skin graft. This approach for relining the vestibule transfers thin, healthy tissue to the nostril without the need for complex local flaps or unreliable W- or Z-plasty. Because an alar batten graft has previously been placed, there is no need for prolonged postoperative stenting to maintain nostril patency.

With a mean long-term follow-up of 11 months, we recognize some may argue that we have not followed up our patients long enough to determine whether restenosis will occur. However, we believe that if the reconstructed nostril has not demonstrated alar col-

lapse or neocicatrix formation by 11 months, the likelihood of reconstructive failure occurring after that point is low.

A vast array of nostril stents and retainers have been described in the literature. Some authors<sup>7,17,18</sup> have advocated using custom-molded stents to maintain the corrected contour of the nostril after surgery. Although these stents may function well, most reconstructive surgeons do not have the requisite materials readily accessible to make such a device. Other stent materials mentioned in the literature include acrylic resin,<sup>5,14</sup> silicone,<sup>3,12</sup> nasopharyngeal airway tubes,<sup>11</sup> and rubber.<sup>16</sup> Although these materials may be easier to procure, the inherent flaw in choosing these types of stents is that they all tend to be round. Clearly, if 1 of the goals in repairing vestibular stenosis is to restore the natural contour of the nostril, a round stent will not achieve this end point. Even digital dilation has been promoted as an effective means to prevent postoperative restenosis, but this method has obvious hygienic drawbacks.<sup>15</sup> We choose to fashion a stent from thermoplastic material for 3 main reasons: the material is readily accessible in any operating room where rhinoplasty is performed, the stent can be custom molded using the contralateral nostril as a template to reestablish the natural shape of the reconstructed nostril, and it is well tolerated by the patient. Two other groups of coauthors<sup>18,19</sup> also describe using thermoplastic material for fabricating vestibular stents. However, 1 group<sup>19</sup> states that the stent should be molded around a cylindrical object instead of tailoring the stent to the nostril's native contour, whereas the other group<sup>18</sup> creates a custom acrylic vestibular device 1 week after surgery using a hydrophilic vinyl polysiloxane impression material. One of the drawbacks of the latter method is the discomfort associated with packing the patient's nose posterior to the valve in the first postoperative visit to fashion a custom cast of the vestibule.

## CONCLUSIONS

Stenosis of the nasal vestibule is a challenging deformity to repair because of frequent relapses and difficulty in reestablishing a natural contour in the reconstructed nostril. We use a graded approach to repair stenosis of the anterior nares, which relies on a sturdy alar batten graft to restore intrinsic support to the collapsed ala. In patients with obstructing scar tissue within the vestibule, a second planned surgical stage is used to excise the cicatrix and create a neovestibular lining with a full-thickness skin graft. After each surgical stage, a thermoplastic stent is suture secured within the vestibule to combat stubborn healing forces, which can lead to contracture and restenosis. The stent has an added advantage of being custom molded and readily available in the operating room. In our series, 5 stenotic nostrils were repaired in 4 patients. Satisfactory improvement of nostril aperture was achieved and maintained in all 5 nostrils. Postoperative stenting averaged less than 2 weeks and was well tolerated by all 4 patients with no wound complications.

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