Reconstruction of nasal defects can be a difficult task if large amounts of nasal mucosa are missing. We have found the inferior turbinate mucosal flap to be a reliable and effective flap in a series of 16 patients undergoing nasal reconstruction or repair of septal perforations. Most of these patients had insufficient mucosa to use traditional flaps harvested from the nasal floor or the lateral nasal wall. Eight patients underwent reconstruction of septal perforations, 9 patients underwent nasal reconstruction of large nasal defects after tumor extirpation, and 1 patient underwent closure of a palatal fistula. Six of the septal perforations were closed completely and 3 were reduced in size by 50%. All 11 turbinate flaps used for nasal reconstruction (2 patients had bilateral flaps) survived. Two flaps underwent mild superficial epidermolysis without flap necrosis or exposure of overlying cartilage grafts. The turbinate flap is based anteriorly and provides large amounts of well-vascularized mucosa. The turbinate is rotated anteriorly and bivalved and the conchal bone is removed to increase the dimensions of the flap. The flap is sometimes staged to allow transfer of mucosa to distant sites, such as the septum, the nasal ala, and the nasal wall. An anatomical dissection of 10 turbinate flaps on 5 fresh cadaver specimens demonstrated an average flap size of 4.97 cm². The average length of the flap was 2.83 cm, which is sufficient length to reach the nasal dorsum. A description of the surgical technique and the vascular supply of this flap will be discussed.

Reconstruction of full-thickness nasal defects, with aesthetically pleasing and structurally stable results, remains a challenging problem in reconstructive nasal surgery. The importance of providing a 3-layered repair of vascularized mucosa, vascularized skin, and an intermediate layer of structural bone or cartilage grafts is well known. The paramedian forehead flap can provide large amounts of vascularized external cutaneous tissue. However, obtaining sufficient amounts of vascularized inner lining is often the most difficult aspect of the 3-layered nasal reconstruction.

Many authors have described various techniques for providing nasal lining. Burget and Menick¹ and Millard² describe septal mucosal rotation/transposition flaps or septal chondromucosal pivotal flaps. With these methods, a septal perforation is sometimes an accepted outcome of the repair. Park et al³ reported the use of epithelial turn-in flaps for nasal lining. These flaps are constructed from the skin surrounding the defect. In many of these cases, this skin would be discarded to undertake a reconstruction of the entire aesthetic subunit. While these are all valuable techniques, situations arise when these traditional methods of providing nasal lining are either not possible (eg, the septum is missing) or the amount of tissue is inadequate for the given defect. We report the use of an anteriorly based inferior turbinate mucosal flap for repairing nasal lining defects and as an adjunct technique for repairing septal perforations. We describe the technical aspects of harvesting the turbinate flap and include a series of flap measurements based on cadaver dissection.

This article is also available on our Web site: www.ama-assn.org/facial.
MATERIALS AND METHODS

We performed a retrospective chart review of 18 patients who underwent nasal reconstruction or septal perforation repair, using the inferior turbinate mucosal flap between August 1986 and February 1998. Flap survival, cartilage and bone graft coverage, septal perforation closure, and nasal airway patency were assessed.

In addition, anatomical dissection of 10 turbinate flaps was performed on 5 fresh cadaver specimens to determine the average amount of tissue available for reconstruction purposes.

TECHNIQUE

The patient is surgically prepared and draped in the standard manner and 1% lidocaine with 1/100 000 epinephrine is infiltrated into the inferior turbinate, nasal floor, and inferior meatus. After vasoconstriction occurs, the inferior turbinate is gently medialized to open the inferior meatus. A Cottle elevator is placed in the inferior meatus and pushed superiorly to “postage stamp” perforate the bony attachment of the inferior turbinate to the lateral nasal wall (Figure 1). This process is started approximately 1 cm posterior to the anterior end of the turbinate and is carried completely through the posterior attachment of the turbinate. Care should be taken to maintain the elevator in a vertical plane against the lateral nasal wall. This will maximize the amount of tissue obtained yet will prevent damage to the middle meatal structures. With the turbinate pedicled anteriorly, the posterior aspect of the mobilized structure is gently and progressively rotated through the nostril or the defect using Takahashi forceps. Once the turbinate is delivered anteriorly, the mucosa is dissected from the underlying concha bone and unfurled. The concha bone is removed and discarded or used for grafting. The flap is next rotated into the defect, where it is meticulously sutured to the mucosa of the defect.

The nose is lightly packed for 4 to 5 days with a soft sponge pack to prevent the drying effects of nasal airflow. Once this packing is removed, the patient is instructed to use a petroleum jelly–moistened cotton plug in the nostril for an additional 2 weeks to prevent desiccation while the flap develops collateral circulation. The cotton plug is changed by the patient 2 to 3 times a day.

Figure 1. Turbinate flap is released from posterior to anterior with a periosteal elevator. The anterior pedicle is left intact. The posterior turbinate is grasped with a Takahashi forceps and delivered through the defect or nostril (A). The conchal bone is removed as the turbinate is bivalved open (B and E). The flap is sutured into position and the nose is packed with a light sponge pack (F).

RESULTS

The cadaver study demonstrated an average flap surface area of 4.97 cm² (range, 3.1-8.0 cm²). The average length of the flap was 2.8 cm (range, 1.7-4.0 cm) and the average width was 1.7 cm (range, 1.5-2.0 cm).

The clinical cases were divided into 2 groups. Group 1 consisted of 8 patients who underwent nasal recon-
struction using an inferior turbinate flap for internal lining. In each case, structural support was obtained using autologous cartilage or cranial bone grafts and the skin defect was reconstructed using a paramedian forehead flap with a single exception.

Group 2 consisted of 7 patients who underwent nasal septal perforation repair with an inferior turbinate flap and 1 patient who underwent closure of palatal fistula. Patients in group 2 were operated on earlier in our series of turbinate flap patients.

All 9 patients in group 1 required structural grafting with free bone or cartilage and the turbinate flap technique was used to provide internal vascularized mucosal lining. Eight of the 9 patients in group 1 had full-thickness nasal defects of the ala, tip, or nasal wall. Two patients required bilateral turbinate flaps for a total of 11 turbinate flaps in this group. Two patients had full-thickness defects of the middle third of the nose with partial-thickness defects involving other subunits (Figure 2). Four patients had primary full-thickness defects isolated to the ala. Two patients had combined full-thickness defects of the ala and tip. One patient had a 1.5 × 1.5-cm internal nasal defect of the superior nasal vault and septum that required bone grafting for support and a turbinate flap for vascularized mucosa. This defect did not include skin but required extension of the turbinate flap to the level of the cribiform to cover nasal bone grafts.

The mean length of follow-up in this group is 17.6 months, with a range of 8 to 25.5 months. Two of the flaps in these 9 patients had superficial epidermolysis of the distal tip mucosa, but all flaps survived and complete coverage of the supporting structural grafts was achieved in all cases. Three patients in this group had postoperative nasal obstruction. One case was secondary to mild nasal stenosis caused by wound contracture around the margin of

Figure 2. Patient status post-Mohs micrographic excision of the basal cell carcinoma. The full-thickness defect involves the nasal tip, side wall, and dorsum, and extends onto the medial cheek. A sponge pack is seen within the nasal cavity (A and B). The turbinate flap is prepared and sutured into the defect (C). The turbinate flap is covered with a septal cartilage graft and a paramedian flap design (D, E, and F). Eight-month postoperative result with mild pincushioning of the distal flap (G-I). The patient’s airway is patent and the pedicle of the flap did not require release. Endoscopic view of the turbinate flap demonstrates an intact pedicle (J).
the nostril. This resolved with daily nasal dilation exercises using a nasal speculum. Two patients had nasal obstruction secondary to the bulk of the flap's pedicle, which resolved after transection of the pedicle.

The 8 patients in group 2 had nasal perforations ranging in size between 1 and 6.25 cm² with a mean size of 2.64 cm². All patients reported preoperative nasal obstruction and crusting. Repair was attempted using bilateral inferior turbinate flaps in 2 patients, an inferior turbinate flap and free turbinate mucosal graft in 2 patients, and unilateral inferior turbinate flaps in 4 patients. Complete perforation closure and immediate resolution of symptoms occurred in 3 patients with perforation sizes of 1.88, and 4 cm². Two of these 3 patients with complete closure required delayed release of the flap pedicle because of postoperative nasal obstruction. Release of the flaps resolved the nasal obstructive symptoms. Two patients with perforations of 2.25 and 1.5 cm² had near total closure but were left with asymptomatic pinpoint perforations. Two patients with perforation sizes of 1.88 and 1.25 cm² had residual perforations postoperatively that were reduced in size by 50% to 80%, which resulted in resolution of nasal crusting and the symptoms of obstruction. The last patient who underwent septal perforation surgery (perforation size, 6.25 cm²) had minimal reduction in perforation size and only partial improvement in nasal crusting and obstruction. The patient with a 1-cm palatal fistula underwent successful closure with a turbinate flap. No patient in either group has developed atrophic rhinitis or ozena secondary to the use of the turbinate flap.

**COMMENT**

The inferior turbinate flap has a dual blood supply as nicely outlined by Burnham in 1935 and Padgham and Vaughan-Jones in 1991. The main supply enters the turbinate from above, 1 to 1.5 cm from its posterior border, and is a descending branch of the sphenopalatine artery. The artery then passes forward, giving off a rich anastamotic network of vessels. As the vessel courses anteriorly, it increases in diameter, which suggests a significant anteriorly based component to its blood supply. This anterior blood supply originates from the angular artery and allows the current anteriorly pediced inferior turbinate flap design.

Providing a vascularized nasal lining for newly placed cartilage or bone grafts at the time of reconstruction is essential for a successful outcome. Clinically, the turbinate flap has exhibited a robust vascularity at the time of surgery. All patients undergoing nasal reconstruction in this series had complete coverage of structural grafts with the inferior turbinate flap, and no patients have experienced full-thickness flap necrosis or graft exposure. Use of the inferior turbinate flap instead of hinged chondromucosal septal flaps prevented the iatrogenic creation of septal perforations. Additionally, the size of the flap allows its use in a variety of intranasal locations, including the alar rim and vestibule, the middle third of the nose, and even the superior nasal vault. Pedicle placement in the nasal airway may result in temporary nasal obstruction, but this can be resolved with pedicle transection in a delayed manner.

The turbinate flap has been previously described for reconstruction of septal perforations by others. In our study, the turbinate flap has worked quite well for reconstruction of full-thickness nasal defects of the nasal ala or nasal wall; however, only 3 of 8 septal perforations achieved complete closure when this flap was used to treat septal perforations. For this reason, we do not advocate its use as the first-line treatment for septal perforations. However, the turbinate flap may have valuable application in patients with scarred and friable tissues that preclude the use of traditional mucoperichondrial-mucoperiosteal flaps harvested from the nasal floor and inferior meatus.

**CONCLUSIONS**

The anteriorly based inferior turbinate flap is a useful adjunct for nasal reconstruction, when traditional reconstructive techniques are not ideal. Creation of the turbinate flap is relatively simple and can be accomplished with consistent results. The turbinate provides ample vascularized tissue for reconstruction of nasal alar or middle-third nasal lining defects but should not be a first-line choice for nasal septal perforation repair.

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