

# Alternative 1-Step Nasal Reconstruction Technique

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**Objective:** To describe a 1-step nasal reconstruction technique for use in lieu of a paramedian forehead flap that is usually raised at the location of the supratrochlear artery.

**Methods:** Using angiography in 10 fresh cadavers, we confirmed the arterial anatomy of the nasal and forehead regions to refine the paramedian forehead flap. Based on the anatomical data, we performed nasal reconstruction in 6 patients who had a full-thickness defect of the nasal ala or who needed alar base reconstruction with an island paramedian forehead flap based on the angular artery.

**Results:** From the anatomical study, we confirmed a rich network among the supratrochlear, dorsonasal, and an-

gular arteries around the medial canthus. In the clinical cases, the subcutaneous pedicle was tunneled beneath the skin, without conspicuous bulkiness. For all patients, the operation was completed in 1 stage, and the flaps healed without evidence of necrosis.

**Conclusions:** By moving the pedicle downward, a full-thickness nasal defect can be reconstructed in 1 stage that includes the alar lining or alar base with the paramedian forehead flap. This avoids restriction of the rotation arc, particularly when the alar lining or alar base is also needed for reconstruction.

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**F**OLLOWING INTRODUCTION OF the Indian method,<sup>1</sup> the median or paramedian forehead flap has been a workhorse for nasal reconstruction because the skin texture of the forehead and nose is similar. The paramedian forehead flap is usually raised according to the location of the supratrochlear artery. However, when the alar lining or alar base requires reconstruction with the paramedian forehead flap, the supratrochlear artery sometimes disrupts the rotation arc. To refine the paramedian forehead flap, arterial anatomical studies<sup>2-6</sup> of the forehead and nose have been performed.

In the present study, using angiography in 10 fresh cadavers, we confirmed the arterial anatomy of the nasal and forehead regions to refine the paramedian forehead flap. Based on the anatomical data, we hypothesized that the paramedian forehead flap could be raised at the location of the angular artery with a subcutaneous pedicle.

We designed an island paramedian forehead flap based on the angular artery in which the supratrochlear artery was ligated at the base. We used this method for facial reconstruction in 6 patients who required reconstruction of the nasal base or alar lining.

## METHODS

### ANATOMICAL STUDY

Ten fresh cadavers were systemically injected with a lead oxide–gelatin mixture as previously described.<sup>7</sup> The soft tissues were then elevated on the periosteum, and a radiograph was obtained to confirm the arterial anatomy of the mid to upper face.

### PATIENTS

Six patients underwent nasal reconstruction using the island paramedian forehead flap based on the angular artery. These patients had defects due to basal cell carcinoma (n=5) and scar contracture (n=1). The patients ranged in age from 54 to 73 years and comprised 4 women and 2 men. None were heavy smokers or had other risk factors for impaired wound healing. Because of defects after resection of the tumor, a local flap on the cheek was also performed in 4 patients. Patient characteristics are listed in the **Table**.

### SURGICAL PROCEDURE

Before the operation, the angular and supratrochlear arteries were identified by Doppler ultrasonography. Using general anesthesia, the paramedian forehead flap was designed according to the shape and span of the tissue

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**Table. Characteristics of the Patients and Angular Artery–Based Island Paramedian Forehead Flap Results**

Case No./ Sex/Age, y	Lesion Location	Indication	Skin Defect, cm	Flap Size, cm <sup>a</sup>	Additional Flap	Cosmetic Outcome
1/M/73	Left ala, alar base	BCC	2.5×2.0	1.5×9.0	Cheek V-Y	Excellent
2/F/73	Right ala	BCC	1.0×3.0	1.5×9.0	None	Excellent
3/M/68	Left ala, cheek	BCC	6.0×6.0	3.0×9.0	Cheek Limberg	Good
4/F/56	Left ala, alar base	BCC	3.0×2.0	1.5×8.0	Cheek Limberg	Fair
5/F/54	Right ala	Scar contracture	1.5×4.0	1.5×8.0	Nasolabial V-Y	Excellent
6/F/62	Left cheek	BCC	6.0×4.0	3.0×8.0	None	Excellent

Abbreviation: BCC, basal cell carcinoma.

<sup>a</sup>Maximum width by length.

needed. Dissection was begun at the distal end of the flap. The flap was raised from the peripheral area, including the galea over the periosteum, and thinning was performed. Around the subcutaneous pedicled area, the skin overlaying the subcutaneous pedicle was dissected subcutaneously, including the corrugator supercilii muscle. After elevating the flap, the excess galea and forehead muscle in the peripheral area were removed if needed. Because the supratrochlear artery runs just beneath the dermis approximately 1.0 cm above the eyebrow, care was taken not to disturb this artery when making the subcutaneous pedicle. To prevent disturbing the supratrochlear artery, the flap was elevated to the brow, and the excess skin covering the pedicle was then excised.

After reaching the eyebrow, the dissection was deepened to include the corrugator supercilii muscle. The supratrochlear artery was transected intraorbitally for several millimeters to keep the arterial network intact, and the pedicle was dissected caudally. The dissection was halted when the flap reached the defect without tension. The skin portion of the flap was moved through the skin tunnel. Depending on the size of the skin defect (left by the removal of the flap), another local flap was added if needed. All areas were sutured primarily.

## RESULTS

From the anatomical study in 10 cadavers, we confirmed that the angular artery has a rich network with the supratrochlear artery around the medial canthus, where the angular artery also gives rise to a rich network that leads to the dorsonasal artery (**Figure 1**). From these anatomical findings, it was postulated that a paramedian forehead flap could be raised by ligating and separating the supratrochlear artery where it anastomoses with the angular artery (**Figure 2**). We designed an island paramedian forehead flap based on the angular artery in 6 patients. The pedicles were moved from the medial canthus to a point approximately 1.5 cm downward from the medial canthus. The pedicle was situated ipsilateral or contralateral to the defect according to the shape of the defect. In all patients, the flap healed well without necrosis. Additional results are given in the Table.

## REPORT OF CASES

### CASE 1

A 73-year-old man was seen with a basal cell carcinoma extending from the left alar base to the nasal rim. The

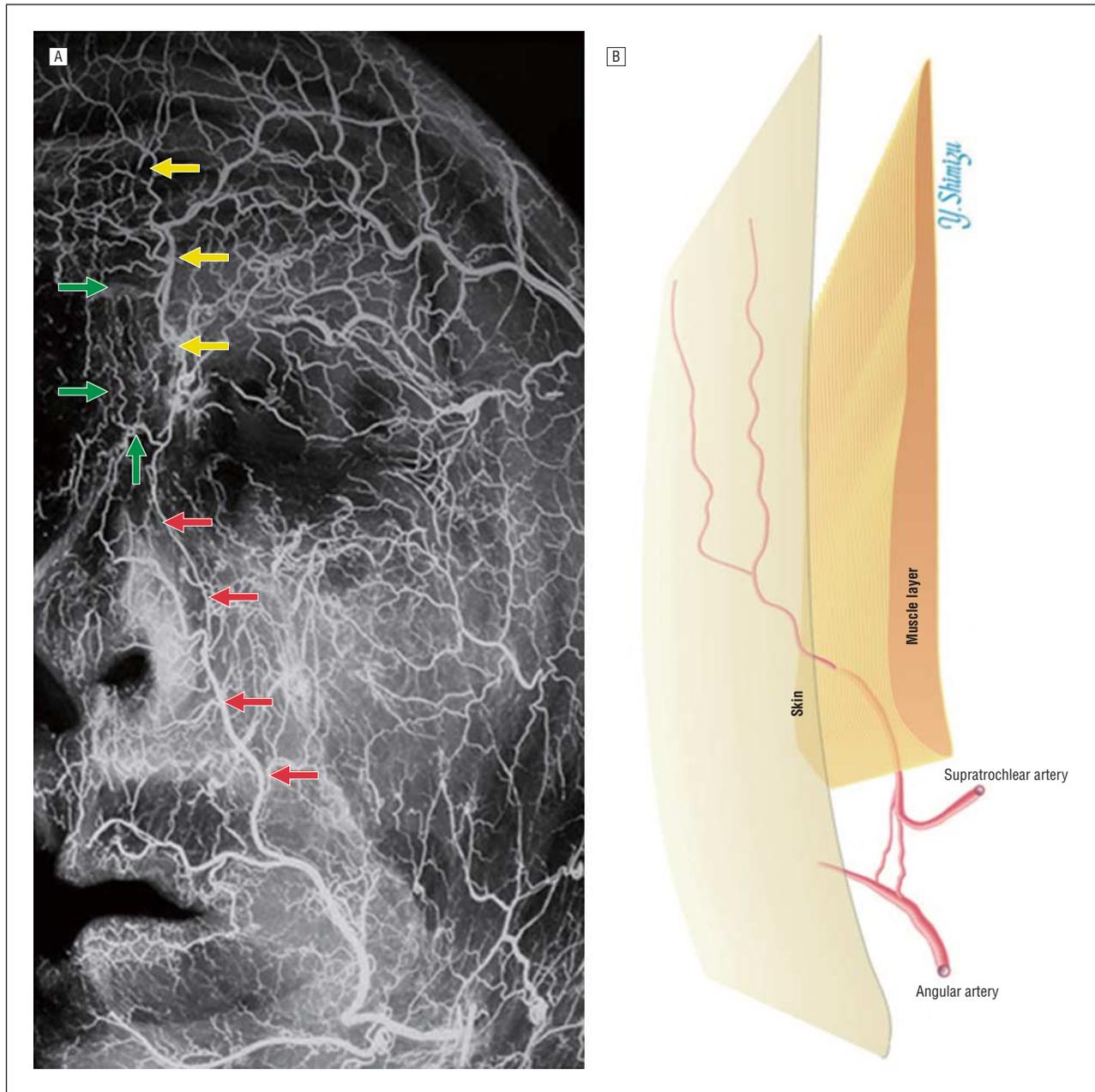
tumor was removed along with 5 mm of surrounding skin, resulting in the loss of one-third of the alar and half of the upper lip. For reconstruction, an angular artery–pedicled island paramedian forehead flap, 1.5×9.0 cm with a 1.0×4.0-cm skin portion, was designed. The flap was elevated and made into an island by removing the surrounding skin. The tip of the flap was thinned and used as the alar lining and alar base. The upper lip was reconstructed with an advancement V-Y flap from the left cheek. The donor sites of each flap were sutured. The flap healed well, and the alar contour was well preserved at 9 months after the operation (**Figure 3**).

### CASE 2

A 73-year-old woman had a basal cell carcinoma on her right alar and had undergone resection at an outside institution 1 year previously. Her right ala was tight, and she wanted to restore the natural contour. By comparing the left ala, reconstruction of two-thirds of the total nasal rim was necessary. An angular artery–pedicled island paramedian forehead flap, 1.5×9.0 cm with an attached 1.5×5.0-cm skin portion, was designed. The supratrochlear artery was ligated and separated at the base, and the flap was transposed to the right alar. The donor site was sutured. The tip of the flap was thinned and used for the alar lining, and the length of the flap was sufficient to cover the entire area. The flap healed well without necrosis. Six months after the operation, the contour of the ala was satisfactory, although the volume of the cheek was somewhat bulky because of the pedicle (**Figure 4**).

### CASE 3

A 68-year-old man had a basal cell carcinoma on his left cheek, and wide resection had resulted in a 6.0×6.0-cm skin defect. An angular artery–pedicled island paramedian forehead flap with a 6.0×4.0-cm skin portion was designed, which covered the skin defect of the cheek. The tip of the flap was thinned and used for the alar lining. The lower one-third of the skin defect was covered with a rhomboid flap designed on the left cheek. The flap healed well without necrosis. Twelve months after the operation, the contour was satisfactory (**Figure 5**).



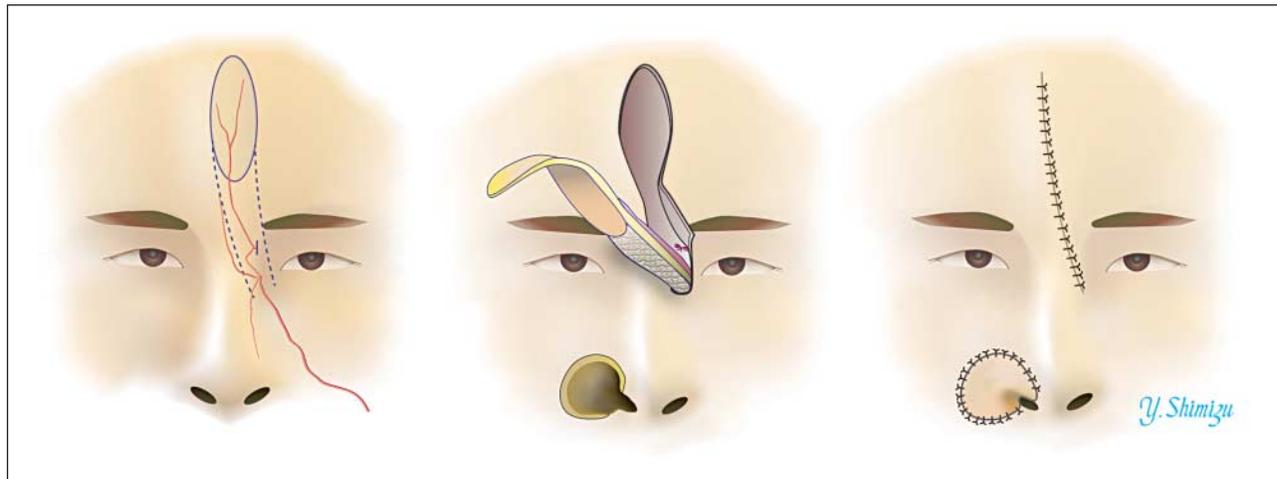
**Figure 1.** The arterial anatomy of the face is shown on the left. The soft tissues were raised on the periosteum. The supratrochlear artery (yellow arrows) and angular artery (red arrows) are connected to each other, and the dorsonasal artery (green arrows) also connects to the angular artery. A schematic view of the arteries is shown on the right.

### COMMENT

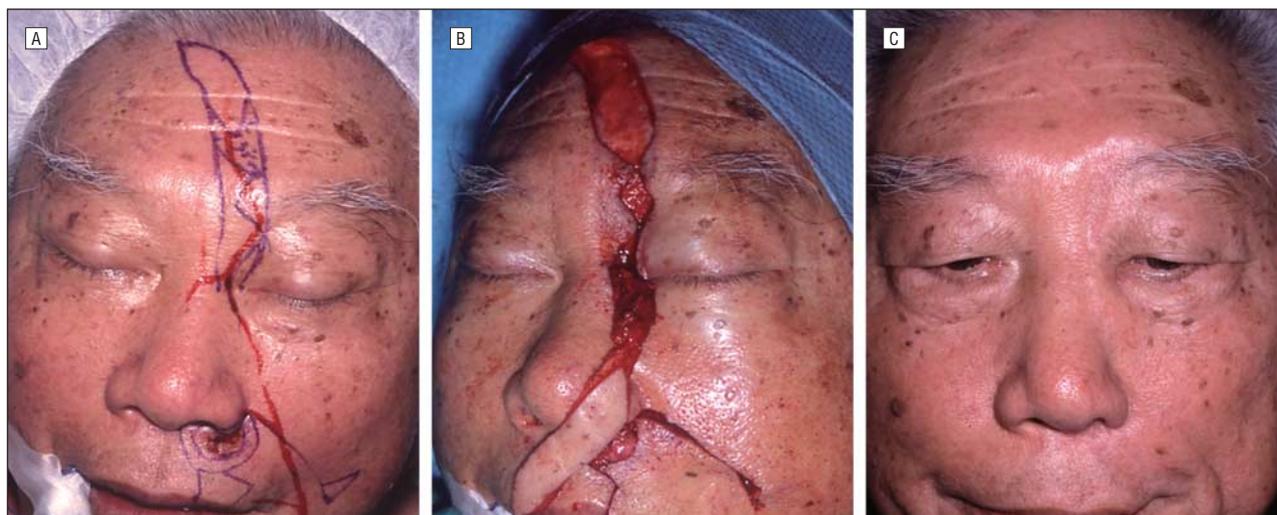
For 1-stage nasal reconstruction, an interpolated melolabial flap is frequently used. Although a melolabial flap is an easy and excellent method of nasal reconstruction, the outcome may not be satisfactory because the original texture of the nose resembles more that of the forehead region than the cheek region. Therefore, we present herein an alternative method for 1-stage nasal reconstruction.

Various and detailed anatomical studies<sup>2-6</sup> describing the refinement of the paramedian forehead flap have been published. Although the main pedicle of the paramedian forehead flap is the supratrochlear artery, studies<sup>4,5</sup>

have indicated that the paramedian forehead flap can be raised based on the angular artery. Using angiography in fresh cadavers, we observed findings similar to those reported, demonstrating that the supratrochlear, dorsonasal, and angular arteries participate in a rich network around the medial canthus. There is variation in the branching pattern of the angular artery. Kleintjes<sup>4</sup> reported the results of a study using 30 cadavers and found in 60 hemiforeheads that 96% of angular arteries have communicating branches with the dorsonasal artery and 67% with the supratrochlear artery. Besides the direct connection of these arteries as examined by latex injection,



**Figure 2.** A schematic view of the paramedian forehead flap based on the angular artery is shown. The supratrochlear artery is dissected.



**Figure 3.** Case 1. A 73-year-old man had a basal cell carcinoma of the upper lip that extended to the nasal rim. A, An angular artery–pedicled island paramedian forehead flap (1.5 × 9.0 cm) was designed. The results are shown following the flap elevation (B) and at 9 months after the operation (C).

there seems to be a rich network among the supratrochlear, dorsonasal, and angular arteries.<sup>4,6,8</sup> Therefore, as long as the supratrochlear artery and peripheral angular artery are included in the pedicle, an angular artery–based paramedian forehead flap can be raised safely. Even if direct communication between the supratrochlear artery and angular artery does not exist, the subcutaneous arterial network around the medial canthus is rich. Therefore, by keeping the tissue between the subcutaneous pedicle and periosteum intact, a rich blood supply can reach the flap. We maintain at least 1.0-cm width intact to accomplish this.

Kelly et al<sup>5</sup> reported findings of a cadaver injection study and a clinically representative case demonstrating supratrochlear and facial artery networks. Our anatomical investigations indicated the possibility of raising the island paramedian forehead flap based on the angular artery. However, no detailed clinical applications had been reported to date. In our patients, we transected the supratrochlear artery deep into the orbit to keep the bifurcation of the artery intact, which may increase the blood supply to the flap. We are uncertain as to the necessity

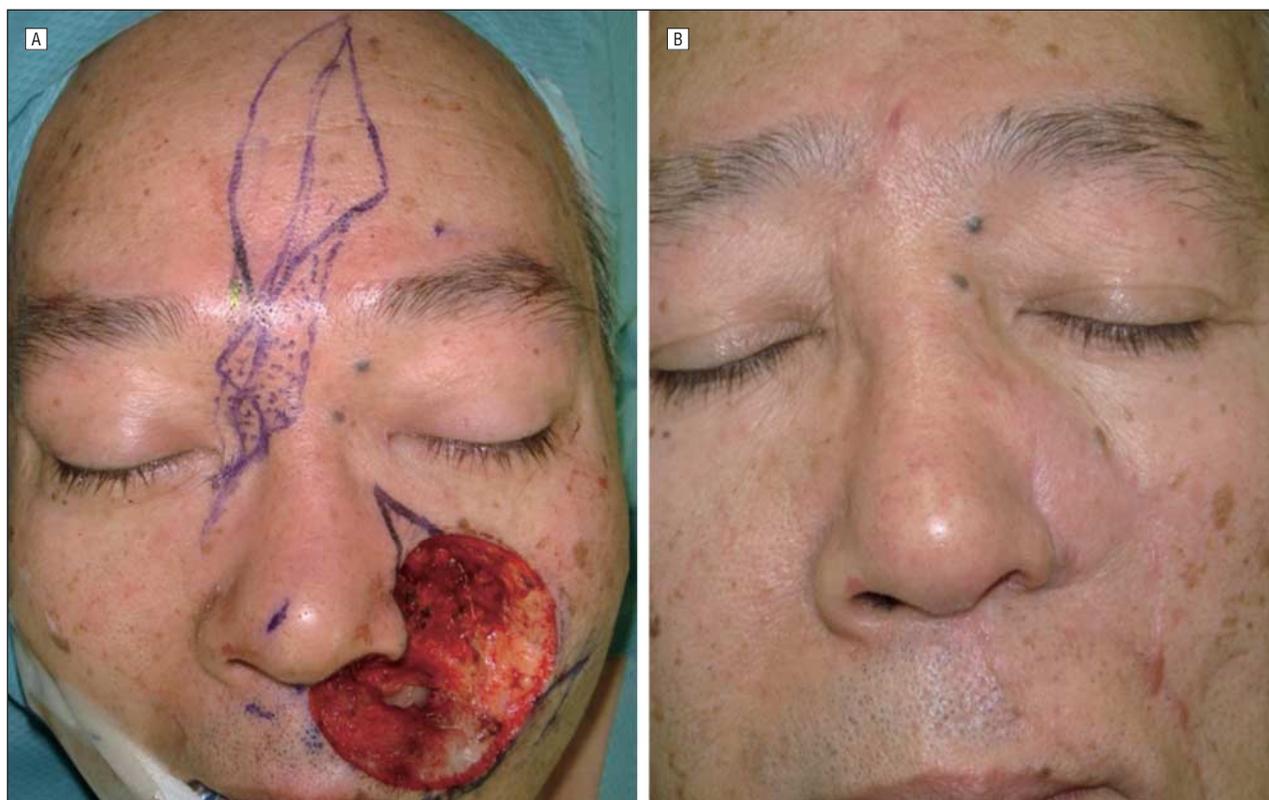
of this step, but our anatomical study showed that the main anastomosis of the supratrochlear artery and the angular artery sometimes occurs in the orbital area.

From our clinical cases, it was found that the pedicle could be moved at least 1.5 cm downward from the medial canthus by dissecting the supratrochlear artery. Following this step, reconstruction of the alar lining or alar base was possible.

We also created the island paramedian forehead flap in our patients. The island paramedian forehead flap was reported in 1963 by Converse and Wood-Smith.<sup>9</sup> Our approach to constructing the flap island was based on our detailed arterial anatomical study of the supratrochlear artery, which runs just beneath the dermis in the upper frontal region and traverses beneath the corrugator supercilii muscle. Therefore, if the supratrochlear artery is not disrupted in the distal part of the flap, the paramedian forehead flap can safely be subcutaneously pedicled. Our clinical cases showed that, even if it is necessary to construct an island paramedian forehead flap, the angular artery–pedicled paramedian forehead flap can be raised safely. Although the volume becomes slightly bulky where



**Figure 4.** Case 2. A 73-year-old woman had a basal cell carcinoma on her right ala, and the lesion had been resected and primarily sutured at another hospital. A, Reconstruction of two-thirds of the total nasal rim was necessary. B, An angular artery–pedicled island paramedian forehead flap (1.5 × 9.0 cm) was designed. The supratrochlear artery was ligated and separated at the base. C, At 6 months after the operation, the contour of the alar is fine, although the volume of the cheek is somewhat bulky because of the pedicle.



**Figure 5.** Case 3. A 68-year-old man had a basal cell carcinoma on his left cheek. A 6.0 × 6.0-cm skin defect was covered with a right angular artery–pedicled island paramedian forehead flap. A, The lower one-third of the skin defect was covered with a rhomboid flap designed on the left cheek. B, At 12 months after the operation, the contour was fine.

the subcutaneously pedicled area runs beneath tunneled skin, the bulkiness becomes negligible several months after the operation. When the pedicle is designed on the contralateral side, the dog-ear around the pedicle becomes flattened and more natural.

As for the alar lining, various methods of reconstruction have been reported. These include a septal mucosal flap,<sup>10</sup> nasolabial turnover flap,<sup>11</sup> musculomucosal flap,<sup>7</sup>

and free grafting of the hard palate<sup>12</sup> or ear.<sup>13</sup> Using the paramedian forehead flap as a lining has merit in that the arteries nourishing the forehead run just beneath the dermis in the peripheral area of the flap; therefore, thinning can be performed safely. Especially for patients in whom the whole alar needs to be reconstructed, a thinned flap for the alar lining makes an ideal base for the rim reconstruction.

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