Versatility of Posterior Auricular Flap in Partial Ear Reconstruction

Foot

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Background: The posterior auricular flap alone has always been popular because of its prompt availability, its rich vascularity, and the ease of closing the donor-site defect primarily.
Methods: Fifty-seven patients with partial ear defects covered with posterior auricular flaps during the period between 2002 and 2007 were reviewed. In the authors' series, posterior auricular flaps were harvested based on a simple random vascularization and tailored to reach almost any defect of the ear by a simplified and standardized approach.
Results: The authors propose a simple nomenclature after grouping the flaps according to skin paddle type, pedicle type, pedicle base, flap transfer method, and flap movement; they present a standardized algorithm with which to choose the flap design for a given defect from this group.
Conclusions: The authors contribute three new flap designs to enhance the versatility of the posterior auricular flap. These are the superiorly and inferiorly based twisted island flaps and the posterior auricular propeller flap. (*Plast. Reconstr. Surg.* 126: 1, 2010.)

Reconstruction of most partial ear defects can be achieved with the posterior auricular flap alone.[1] However, different locations of the defect require different designs of the posterior auricular flap. Various designs have been reported for selected sites in the ear, each one with individual limitations.[2–9] The aim of this article is to group these different flaps to solve the dilemma of the right indication. We also present a simple and standardized algorithm with which to choose the flap design for a given auricular defect.

APPLIED ANATOMY

The medial or posterior surface of the ear is hidden except in prominent ears. Thus, this surface along with the retroauricular area has always been a popular donor site both for full-thickness skin grafts and for posterior auricular flaps.[10,11]

The blood supply to the skin of the posterior auricular area is unusually rich. This is derived from an arterial arcade situated in the auriculocephalic groove between the auricular cartilage and the skull deep to the auricularis posterior muscle. This arterial arcade is formed by the auricular branch of the posterior auricular artery and posterior branch of the superficial temporal artery. Three arteries arising from this arcade supply the medial or posterior surface of the ear. These were described as upper, middle, and lower divisions of the posterior auricular artery by Park et al.[10]

The retroauricular skin over the mastoid is also supplied by a number of unnamed branches of this auriculocephalic arterial arcade. These branches fan out in either direction from this deep arcade, surfacing farther away from the auriculocephalic groove. As a result, the skin overlying the auriculocephalic groove is peculiarly characterized by dense superficial and deep dermal plexuses receiving blood from all directions. Thus, the vascular anatomy of the auriculocephalic groove resembles that of the nasolabial fold. This explains the basis of raising unusually long and thin random flaps in both of these locations. Venous drainage follows the superficial and deep dermal plexus. The posterior auricular area drains into the posterior au-

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Table 1. Classification of Posterior Auricular Flaps

Skin Paddle Type	Pedicle Type	Pedicle Base	Method of Transfer	Movement
Island	Deepithelialized skin pedicle	Superior	Folded pedicle Twisted pedicle	Through the cartilage
		Inferior	Folded pedicle Twisted pedicle	
	Subcutaneous pedicle	Central	Revolving door	
		Eccentric	Propeller	Around the cartilage
Peninsular	Skin pedicle	Superior Inferior	Transposition	

Table 2. Distribution of Ear Defects

Anatomical Region	No. of Defects (%)
Anterior surface	40 (70.2)
Helical rim	9 (15.8)
Ear lobule	4 (7)
Posterior surface	4 (7)
Total	57 (100)

ricular vein and then into the external jugular vein.

NOMENCLATURE

Terminology in this area is always a source of controversy. The controversy mainly is related to the commonly used terms: postauricular, retroauricular, and posterior auricular. This is mainly because the territories of above terms are ill defined. Tanzer categorically criticized using the term "postauricular" instead of "retroauricular" in his discussion article in 1981.[12] In our article, we use the term "posterior auricular," indicating the auriculomastoid area that includes the posterior (medial) surface of the ear, the auriculocephalic groove, and the mastoid (retroauricular) area.

Over the past 50 years, numerous designs of the posterior auricular flap have been reported with various terminologies. In this article, we propose a simplified nomenclature (Table 1) after grouping flaps according to skin paddle type, pedicle type, pedicle base, flap transfer method, and flap movement. T1

PATIENTS AND METHODS

Fifty-seven patients with partial ear defects covered with posterior auricular flaps during the period between 2002 and 2007 were reviewed. This series included 40 defects over the anterior

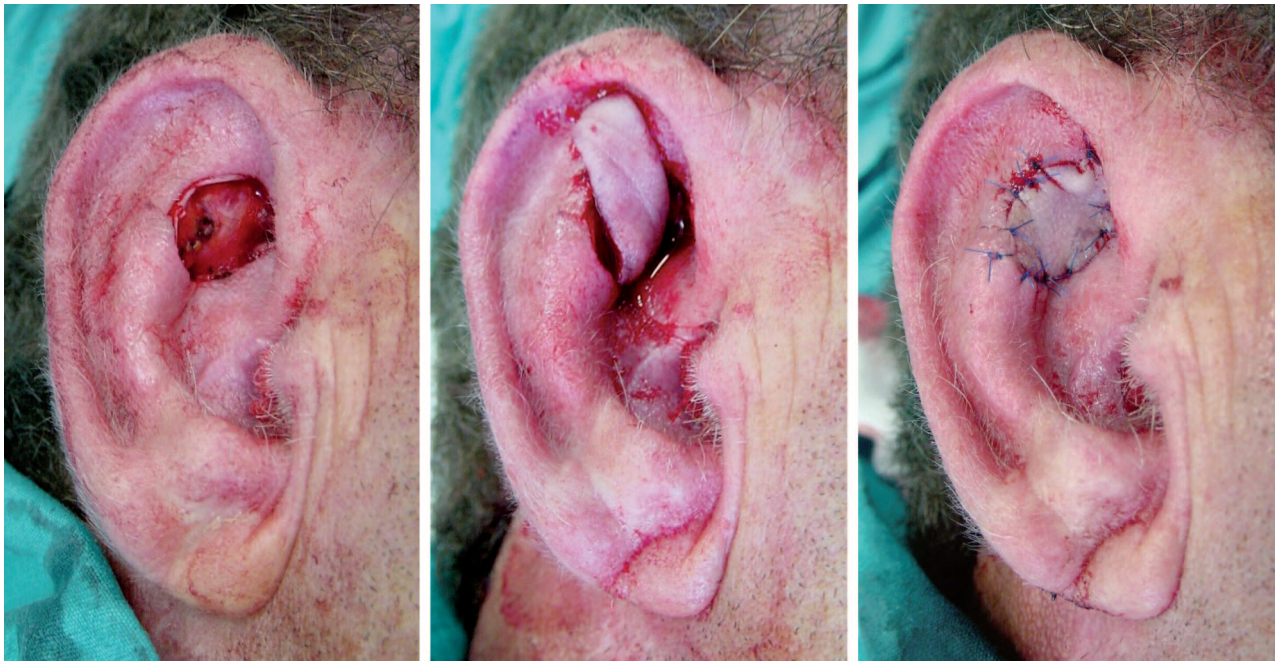

Fig. 1. Superiorly based folded deepithelialized skin pedicle posterior auricular flap. (*Left*) Right ear: defect of the inferior crus after excision of basal cell carcinoma. (*Center*) Flap transfer by upward pedicle folding. (*Right*) Flap tailoring and insetting.

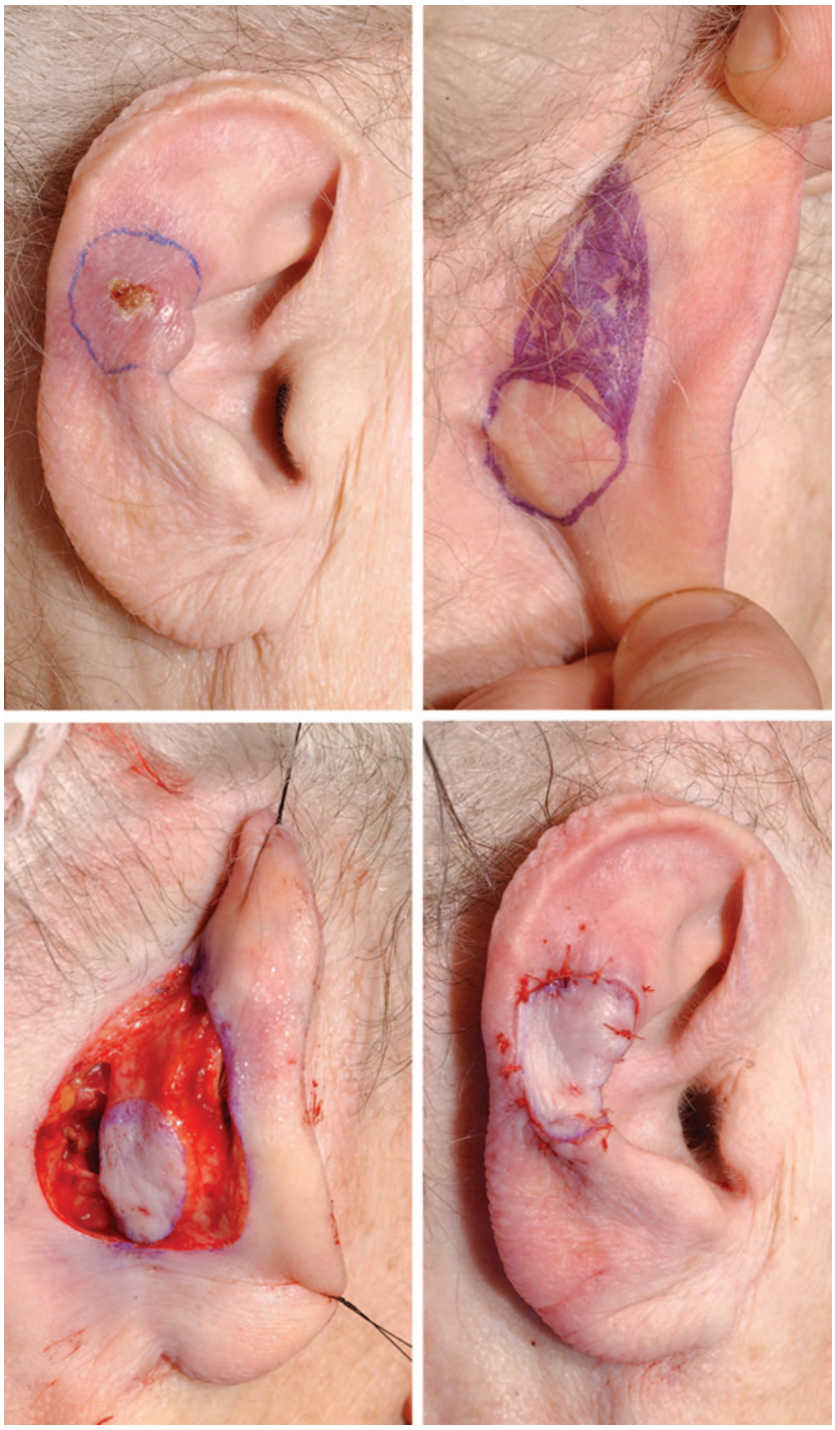

Fig. 2. Superiorly based twisted deepithelialized skin pedicle posterior auricular flap. (*Above*, *left*) Right ear: skin lesion at the antihelix and planned margin of excision. (*Above*, *right*) Flap design with superior pedicle and area to be deepithelialized. (*Below*, *left*) Skin paddle and deepithelialized skin pedicle. (*Below*, *right*) Flap transfer by pedicle twist and skin island insetting.

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surface, nine helical rim defects, four ear lobule defects, and four posterior defects (Table 2). These defects were secondary to elective excision of skin lesions. The lesions were excised according to oncologic principles. All the flaps used in this series were harvested along the auriculocephalic groove. Flap planning started with marking the skin paddle by transferring the measured template of the defect to the posterior auricular area, centering the flap and the flap pedicle on the auriculocephalic groove. The remaining markings and steps of the procedure were quite different for individual flaps. Procedures were performed under local anesthesia by infiltration of mepivacaine chlorohydrate with adrenaline 1:100,000.

Deepithelialized Skin Pedicle Posterior Auricular Flap

Marking involved an ellipse drawn with the main axis along the auriculocephalic groove. The ellipse included the skin paddle and the pedicle area. The pedicle of the flap could be superiorly or inferiorly based according to the position of the defect. The pedicle area was deepithelialized and the skin edges on both sides of the pedicle were freed laterally to enhance its mobility. An adequate window in the auricular cartilage was made to transfer the flap to the defect anteriorly. The flap and its pedicle were gently passed through the cartilage window. Transfer was either by folding or twisting the pedicle on its longitudinal axis to bring the skin paddle into position without any tension or distortion. The skin paddle was then tailored to match the exact shape of the defect. This involved trimming the distal tip of the ellipse and the edges of the flap as necessary (Figs. 1 through 3).

Subcutaneous Pedicle Islanded Posterior Auricular Flap

The revolving door flap was performed as originally described by Masson[13] and used for defects of the concha, of the scapha up to the fossa triangularis, or of the external ear canal.[4,14] The skin paddle was centered on the auriculocephalic groove. The skin island was planned half on the mastoid and half on the medial auricular surface. The flap size was large enough to allow its edges to comfortably reach and inset into the defect. The skin was incised and lifted up all round the flap, leaving the subcutaneous pedicle intact at the auriculocephalic groove level. Revolving door flaps were transferred to the defect on the anterior surface of the ear through the cartilage window by a forward tilt of

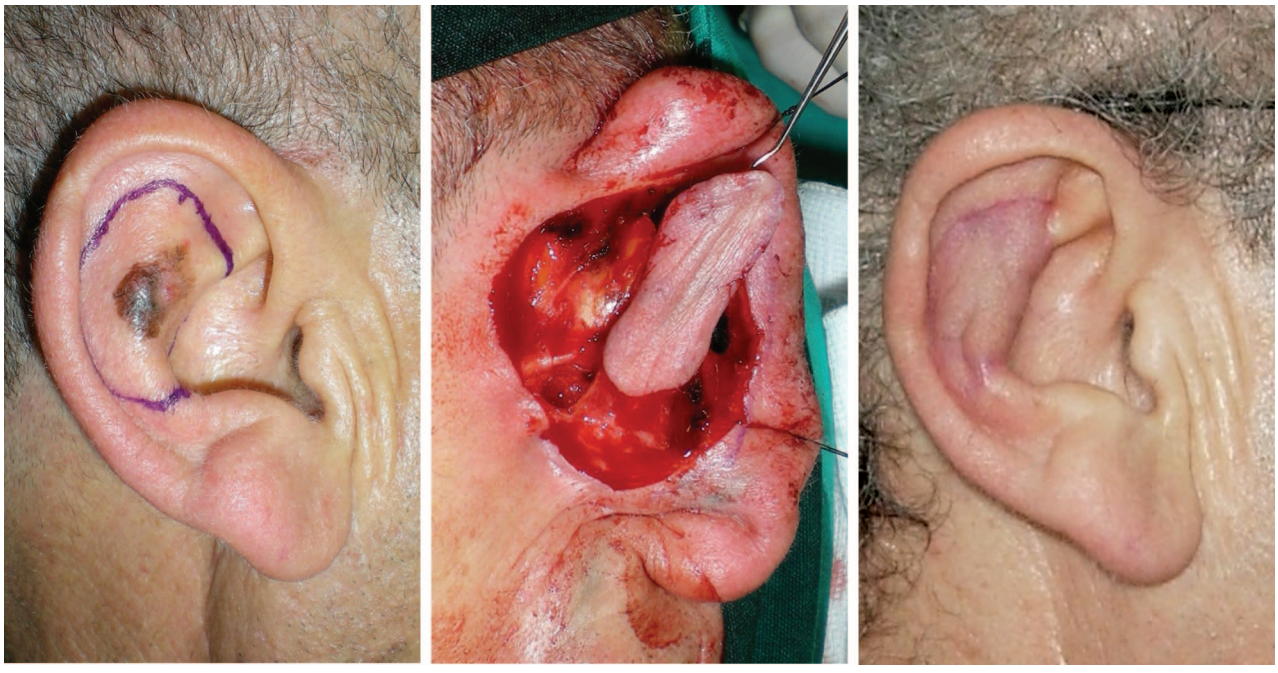

Fig. 3. Inferiorly based twisted deepithelialized skin pedicle posterior auricular flap. (*Left*) Right ear: cutaneous melanoma of the antihelix with 1-cm margins of excision. (*Center*) Deepithelialization of the skin pedicle and skin paddle (3.4 × 2.7 cm). (*Right*) Satisfactory result at 6-month follow-up, after flap transfer to the anterior auricular surface through a cartilage window.

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the skin paddle on the auriculocephalic axis (Figs. 4 and 5). F4-5

Propeller flaps were used in our series for defects located at the helical root. Compared with the revolving door flap, the subcutaneous pedicle of the propeller flap was eccentrically located at the proximal end of the skin paddle and the skin paddle itself was an ellipse; the flap was transferred to the defect by up to 120 degrees of rotation on the subcutaneous pedicle (Fig. 6). F6

Fig. 4. Subcutaneous pedicle posterior auricular revolving door flap. (*Left*) Basal cell carcinoma of the left tragus and excision margins. (*Center*) Posterior auricular revolving door flap design. (*Right*) Satisfactory result at 2-month follow-up, after flap transfer to the anterior auricular surface.

Fig. 5. Subcutaneous pedicle posterior auricular revolving door flap. (*Left*) Left ear: basal cell carcinoma of the inferior crus and excision margins. (*Right*) Aesthetic result at 3-month follow-up after subcutaneous pedicle flap transfer.

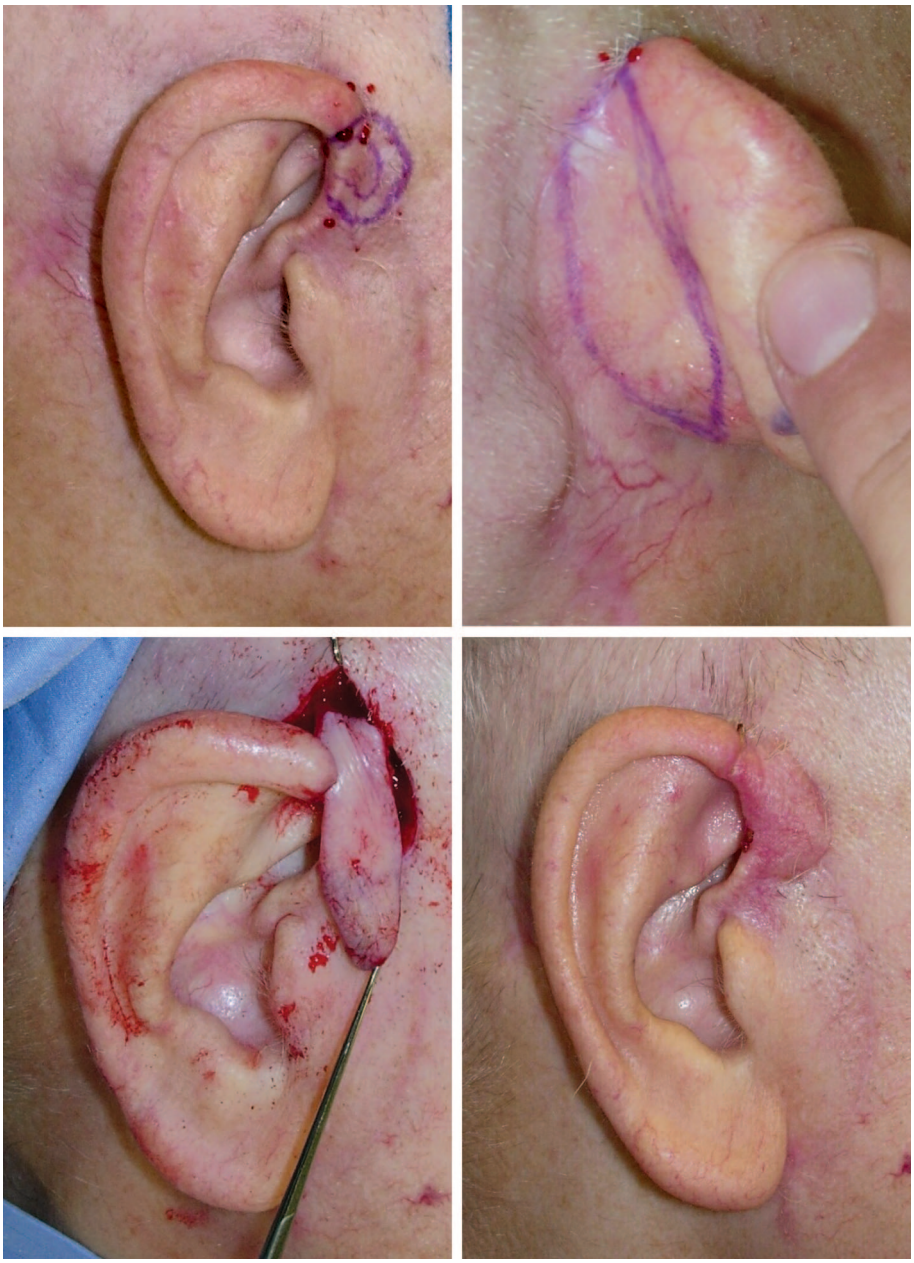


Fig. 6. Subcutaneous pedicle posterior auricular propeller flap. (*Above*, *left*) Right ear: basal cell carcinoma of the helical root and excision margins. (*Above*, *right*) Posterior auricular flap design. (*Below*, *left*) Flap transfer to the anterior auricular surface. (*Below*, *right*) Satisfactory outcome at 4-month follow-up.

Transposition Posterior Auricular Flap

Transposition flaps were marked at the auriculocephalic groove as standard skin pedicle flaps either superiorly or inferiorly based. The distal half of the flap was raised relatively thinner than the proximal part of the flap (pedicle). No particular attention was paid to include branches or perforators of the posterior auricular artery into the pedicle base. The flap was transferred to the defect as a standard transposition flap. The donor-site defect was closed directly. Transposition flaps were designed as bilobed flaps when defects were particularly large.

RESULTS

Histologic evaluation showed 53 skin malignancies and four cases of chondrodermatitis nodularis helicis. Fifty-two skin malignancies were

completely excised in this series (98 percent), with adequate margins. One patient, with incomplete margins, presented an early recurrence of his infiltrating basal cell carcinoma, which was reexcised. None of the four cases of chondrodermatitis nodularis helicis recurred in our series at a mean follow-up of 18 months.

Reconstruction was performed in 27 cases with deepithelialized skin pedicle posterior auricular flaps either superiorly or inferiorly based. Nineteen patients underwent reconstruction with subcutaneous pedicle posterior auricular flaps. Of them, 16 were revolving door flaps and three were propeller flaps; the remaining 11 cases were posterior auricular transposition flaps, either simple or bilobed (Table 3). The donor site was closed primarily in all cases. T3

Fifty-four flaps survived completely (95 percent). Two transposition flaps suffered tip necrosis; this was in part attributed to sharp bending of the flap tip over the auricular cartilage helical rim. In another case, a pressure necrotic area occurred in the center of the flap, which healed conservatively; this was probably provoked by the sharp edge of the cartilage. Among the flaps that survived completely, eight suffered from temporary venous congestion, which settled over a 2- to 4-day period (Table 4). T4

Aesthetic outcome was considered satisfactory in 53 patients (93 percent). Four aesthetic unsatisfactory results are worth mentioning: two cases were related to loss of antihelical definition consequent to partial cartilage removal. In these cases, no further corrective procedure was performed. In the other two cases, the unsatisfactory result was related to the flap reconstruction: in one case, tethering of a revolving door flap used to cover a large scaphoid fossa and inferior crus anterior defect; in the last case, a superiorly based transposition flap, complicated with tip necrosis and treated conservatively, resulted in a notch-like appearance of the helical rim. These latter two patients refused further correction.

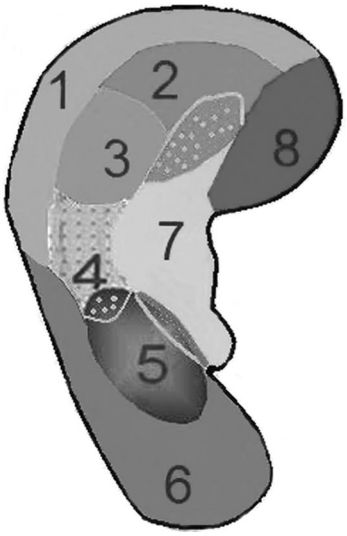
A reconstructive algorithm for anterior ear defects followed the review of the clinical series. Different posterior auricular flaps were assigned to eight anatomical regions (Fig. 7). F7

Table 3. Results of Different Flap Types Used in the Series

Flap Type	No.
Superiorly based folded deepithelialized skin pedicle	7
Superiorly based twisted deepithelialized skin pedicle	6
Inferiorly based folded deepithelialized skin pedicle	8
Inferiorly based twisted deepithelialized skin pedicle	6
Revolving door flap	16
Propeller flap	3
Superiorly based transposition flap	6 (2 bilobed)
Inferiorly based transposition flap	5

Table 4. Outcome of Posterior Auricular Flaps

Outcome	No. of Patients (%)
Uneventful healing	54 (95)
Tip necrosis	2 (3.5)
Central necrosis	1 (1.5)
Total	57 (100)



	Region	Flap
1	Anterior upper half of helix	Superiorly based transposition flap
2	Scapha	Superiorly based folded de-epithelialized skin pedicle or Revolving door flap
3	Upper antihelix	Inferiorly based twisted de-epithelialized skin pedicle
4	Middle antihelix	Superiorly based twisted de-epithelialized skin pedicle
5	Lower antihelix, antitragus	Inferiorly based folded de-epithelialized skin pedicle
6	Lobule and lower helix	Inferiorly based transposition flap
7	Concha	Revolving door flap
8	Helical root	Propeller flap

Fig. 7. Flap algorithm: auricular regions and corresponding flaps.

DISCUSSION

Reconstruction of partial defects of the ear, without reducing the size and without altering the natural shape, is a challenge. Alternatives to flap reconstruction are spontaneous healing, skin grafts, and wedge excisions that reduce the auricular height.

Although the preauricular flap was introduced very early in Sushrutha's description of cheek flap for lobule reconstruction, the use of the area behind the ear as a donor site is relatively recent. Brown and Cannon in 1946[15] first used this postauricular or auriculomastoid area as a donor site for free skin and composite grafts. This was quickly followed by a series of reports[16,17] of harvesting postauricular flaps for staged partial and total reconstruction of the ear. Owens[18] introduced in 1959 the concept of transposing the postauricular flap to the other side of the ear through a window in the cartilage with a buried deepithelialized pedicle.

The posterior auricular area has become a favored donor site for full-thickness skin grafts, local flaps, regional flaps, and free flaps in facial reconstruction. The popularity of this area as a donor site is mainly attributed to its low morbidity, hidden scars, allowance for direct donor-site closure, good skin match to the ear and other facial areas, and its rich vascularization.[19] Although the posterior auricular flap was drawn in many different ways, none of them was able to cover all defects in different sites on the surface of the auricle. Good planning of these flaps and the knowledge of advantages and limitations of each one of these designs are fundamental for achieving satisfactory aesthetic outcomes.

Some authors have considered the posterior auricular flap as an axial flap based on one of the major divisions of the posterior auricular artery.[10] In our series, posterior auricular flaps were harvested on a random pattern and tailored to reach almost any site of the ear.

CONCLUSIONS

The posterior auricular flap is the most versatile option for partial ear defect reconstruction. The key to achieving good aesthetic results is to choose the appropriate design. Our algorithm, together with the proposed techniques, provide a simple approach for reconstructing any given partial ear defect.

CODING PERSPECTIVE

This information prepared by Dr. Raymond Janevicius is intended to provide coding guidance.

15576	Formation of direct or tubed pedicle, with or without transfer; eyelids, nose, ears, lips, or intraoral
13151-59	Complex repair
1164X-51	Ear malignancy resection

- The posterior auricular flap is a nonadjacent, random-pattern flap. Code 15576 describes the formation and straightforward transfer of a nonadjacent flap.
- Unusual maneuvers, such as de-epithelialization, creation of an island, excision of cartilage for transfer, and transaural transfer, are separately reportable. Since these maneuvers are a "further reconstructive effort," the complex repair code, 13151, is reported.
- Some payers may incorrectly overbundle the complex repair into the flap code; use modifier -59 to indicate that this is a separate procedure not considered part of the flap code, 15576.
- Code 15576 does ***not*** include tumor resection, which is separately reportable with code 1164X, selected by the size of the resection.
- The posterior auricular flap is not an adjacent tissue transfer, so code 14060 is not appropriate here.
- Until 2010, this "island flap" would be reported with code 15740, which took into account the elevation and transfer of the flap and creation of an island of skin by de-epithelialization. As of 2010, code 15740 can only be used for an axial pattern island flap, so it is not appropriate for the random-pattern posterior auricular flap.

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REFERENCES

1. Yotsuyanagi T, Watanabe Y, Yamashita K, Urushidate S, Yokoi K, Sawada Y. Retroauricular flap: Its clinical application and safety. *Br J Plast Surg.* 2001;54:12–19.
2. Elsahy NI. Ear reconstruction with a flap from medial surface of the auricle. *Ann Plast Surg.* 1985;14:169–179.

3. Renard A. Postauricular flap based on a dermal pedicle for ear reconstruction. *Plast Reconstr Surg.* 1981;68:159–164.
4. Jackson IT, Milligan L, Agrawal K. The versatile revolving door flap in the reconstruction of ear defects. *Eur J Plast Surg.* 1994;17:131–133.
5. Dean Ferrer A, Alamillos Granados FJ, Vélez García-Nieto A, Fernández Sanromán J. Reconstruction of the scaphoid fossa of the ear after tumour resection with a retroauricular flap. *Br J Plast Surg.* 1994;47:285–287.
6. Talmi YP, Horowitz Z, Bedrin L, Kronenberg J. Auricular reconstruction with a postauricular myocutaneous island flap: Flip flop flap. *Plast Reconstr Surg.* 1996;98:1191–1199.
7. Yotsuyanagi T, Nihei Y, Sawada Y. Reconstruction of the defects involving the upper one-third of the auricle. *Plast Reconstr Surg.* 1998;102:988–992.
8. Lynch J, Mahajan AL, Regan P. The trap door flap for reconstructing defects of the concha. *Br J Plast Surg.* 2003;56:709–711.
9. Reddy LV, Zide MF. Reconstruction of skin cancer defects of the auricle. *J Oral Maxillofac Surg.* 2004;62:1457–1471.
10. Park C, Shin KS, Kang HS, Lee YH, Lew JD. A new arterial flap from the postauricular surface: Its anatomic basis and clinical application. *Plast Reconstr Surg.* 1988;82:498–504.
11. Kolhe PS, Leonard AG. The postauricular flap: Anatomical studies. *Br J Plast Surg.* 1987;40:562–569.
12. Tanzer RC. Postauricular flap based on a dermal pedicle for ear reconstruction (Discussion). *Plast Reconstr Surg.* 1981;68:165.
13. Masson JK. A simple island flap for reconstruction of concha helix defects. *Br J Plast Surg.* 1972;25:399–403.
14. Papadopoulos ON, Karypidis DK, Chrisostomidis CI, Konofaos PP, Frangoulis MB. One-stage reconstruction of the antihelix and concha using postauricular island flap. *Clin Exp Dermatol.* 2008;33:647–650.
15. Brown JB, Cannon B. Composite free grafts of two surfaces of skin and cartilage from the ear. *Ann Surg.* 1946;124:1101–1107.
16. Lewin ML. Formation of helix with postauricular flap (1946). *Plast Reconstr Surg.* 1950;5:432–440.
17. Crikelair GF. A method of partial ear reconstruction for avulsion of the upper portion of the ear. *Plast Reconstr Surg.* 1956;17:438–443.
18. Owens N. An effective method for closing the external auditory canal. *Plast Reconstr Surg Transplant Bull.* 1959;23:381–387.
19. Cordova A, D'Arpa S, Pirrello R, Giambona C, Moschella F. Retroauricular skin: A flaps bank for ear reconstruction. *J Plast Reconstr Aesthet Surg.* 2008;61(Suppl 1):S44–S51.

AUTHOR QUERIES

AUTHOR PLEASE ANSWER ALL QUERIES **1**

AQ1: AUTHOR—chlorohydrate correct?