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# The posterior auricular flap: anatomical studies

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Summary—The aim of this study was to investigate the blood supply of the auriculomastoid skin and to prove the reliability of the posterior auricular vessels for supply of a skin flap in this region. This was done by means of studies of arteriograms, cadaver dissections, India ink perfusion, lead oxide injection and contact radiographs. Information from operative dissections performed in the course of superficial parotidectomies and neck dissections was included, as was information from 11 clinical flap transfers. The conclusion was drawn that the auriculomastoid skin could safely be transferred on the posterior auricular vessels, either as an island flap or as a free flap.

Postauricular skin grafts and flaps have been known for a long time. The auriculomastoid skin has been used as a local flap (Steffanoff, 1948; Lewin, 1950; Tanzer, 1965; Renard, 1981) and transferred to a distance on a scalp pedicle (Washio, 1969; Galvao, 1981). Fujino *et al.* (1976) reported a free skin flap from the retroauricular region to resurface the nose, transferred by anastomosis of small vessels around its periphery. The auriculomastoid skin has been thought to be an unsuitable donor site for a free flap because of uncertainty about the position, size and presence of vessels. The aim of this study was to prove the reliability of the posterior auricular vessels for supply of an auriculomastoid skin flap.

## Basic research

Twenty carotid arteriograms, performed on patients with complete obstruction of the internal carotid artery, were studied. Small branches of the external carotid are clearly seen in such arteriograms, as the concentration of contrast is high and there is no confusion with the internal carotid system. The posterior auricular artery was present in all, in a fairly predictable position (Fig. 1), but in one case arising from the occipital artery.

Thirty-nine dissections of the posterior auricular vessels were performed, 26 in cadavers and 13 in clinical cases—6 superficial parotidectomies and 7 neck dissections. In addition, since completion of the basic research, 11 posterior auricular flaps have been performed. The anatomical information from these flap dissections is included in this study, making a total of 70 investigations.

India ink injection studies were carried out in five fresh cadavers within 8 hours of death. The external carotid artery was incised opposite the ostium of the posterior auricular artery, which was cannulated. On injection of the ink, the auriculomastoid skin and adjacent occipital and temporal scalp stained within a few seconds (Fig. 2A, C). Both lateral and cranial surfaces of the auricle stained simultaneously from the base towards the periphery (Fig. 2B). Two of these five cases were then dissected and revealed staining of the perichondrium of both surfaces, the tail of the parotid and the temporal fascia. Three to four vessels were seen to perforate the cartilage near its base.

Lead oxide injection was performed on eight fresh cadavers. This technique both facilitates dissection (Fig. 2D) and allows radiological studies to be carried out (Rees and Taylor 1986). After perfusion with warm saline, a mixture of lead oxide in gelatine at 50°C was injected. After one hour the posterior auricular artery was dissected. Digastric, parotid, sternomastoid and stylomastoid branches were noted before the artery entered the flap. A large flap was then raised, incorporating the entire auricular cartilage, the auriculomastoid skin and the adjacent temporal and occipital scalp. Contact radiographs were performed on all eight dissections, to visualise the branches of the posterior auricular artery and the different vascular patterns within the flap (Fig. 3). Auricular and occipital branches were seen in every case and, in 5 of the 8, the auricular branch continued upwards to anastomose with the temporal artery. In 11 cadavers, anatomical dissection was carried out to study the origin, course and distribution of the posterior auricular artery and vein (Fig 4), and the great auricular and lesser occipital nerves. The results of these dissections are described below. Finally, in two dissec-

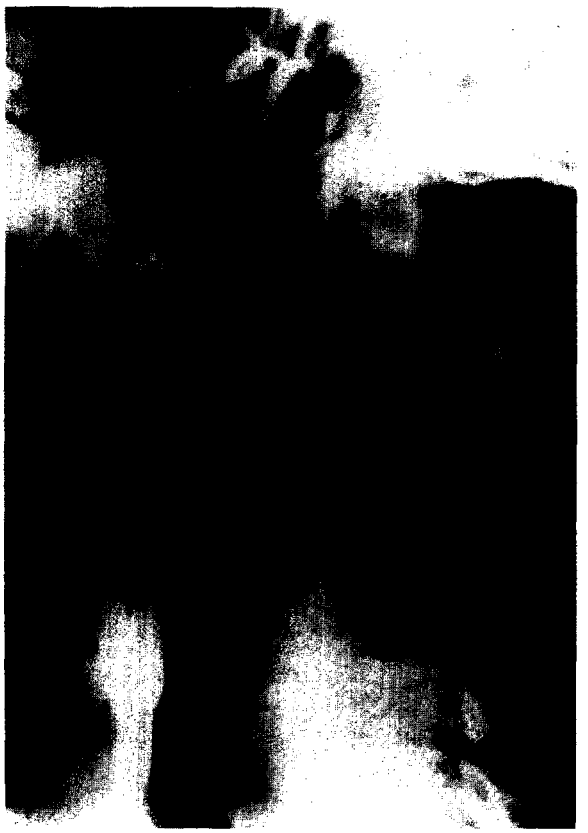

Fig. 1

Figure 1—A carotid arteriogram of a patient with complete occlusion of the internal carotid artery. The posterior auricular artery may be clearly seen, just above the occipital artery.

tions retrograde venograms were done. These confirmed the presence of communications with the temporal and occipital systems, and of two valves at the lower end of the external jugular vein.

## Arc of rotation

In five dissections, after a flap had been developed, the external carotid artery was dissected to its origin and the external jugular vein dissected low in the neck, to allow assessment of its maximum possible arc of rotation as an island pedicle flap. It appeared that defects over the malar, the upper lip as far as the alar base and as far forward as the point of the chin should lie within its reach (Fig. 5). Clearly, most defects within the oral cavity lie within these limits and this has been borne out by subsequent clinical experience.

## Applied anatomy of the posterior auricular artery

The posterior auricular artery arises from the posterior aspect of the external carotid, immediately above the digastric and stylohyoid muscles, which are intimately related. It runs along their superior border and then ascends between the deep surface of the parotid gland and the styloid process, to reach the groove between the cartilage of the external auditory canal and the mastoid process. It gives small branches to the stylohyoid, digastric and sternomastoid muscles, and particularly to the tail of the parotid gland. A constant stylomastoid branch anchors the main vessel towards the stylomastoid foramen. Here the posterior auricular artery is in close proximity to the facial nerve, a few millimetres away. Division of the stylomastoid branch is the key point in the dissection, which results in lengthening of the arterial pedicle by allowing it to take a less tortuous course. It is also a point where the posterior auricular artery could be damaged. The stylomastoid artery enters the foramen and travels alongside the facial nerve, to supply the tympanic cavity, the mastoid antrum, the mastoid air cells and the semi-circular canals (Williams and Warwick, 1980).

In the groove, the posterior auricular artery lies very deep on the periosteum of the mastoid process and the perichondrium of the cartilage of the external auditory canal. Just above the groove it gives an occipital branch which passes laterally across the front of the mastoid process, then turns backwards over the sternomastoid insertion to supply the scalp behind the ear and the occipital belly of the occipito-frontalis muscle. It anastomoses with the occipital artery. This occipital branch can sometimes be palpated as it crosses the mastoid process above the sternomastoid insertion.

The posterior auricular artery continues as the auricular branch which ascends deep to the auricularis posterior muscle, and ramifies on the cranial surface of the auricle; some of the branches pierce the cartilage and others curve round to supply its lateral surface. In this study, 5 of 8 cadavers had an auricular branch which continued upwards in the temporal area. Throughout its course it lies very deep in the sulcus, first on the mastoid bone and then on the temporal fascia.

## Variations

In two dissections the posterior auricular artery arose from the occipital artery. In one clinical case

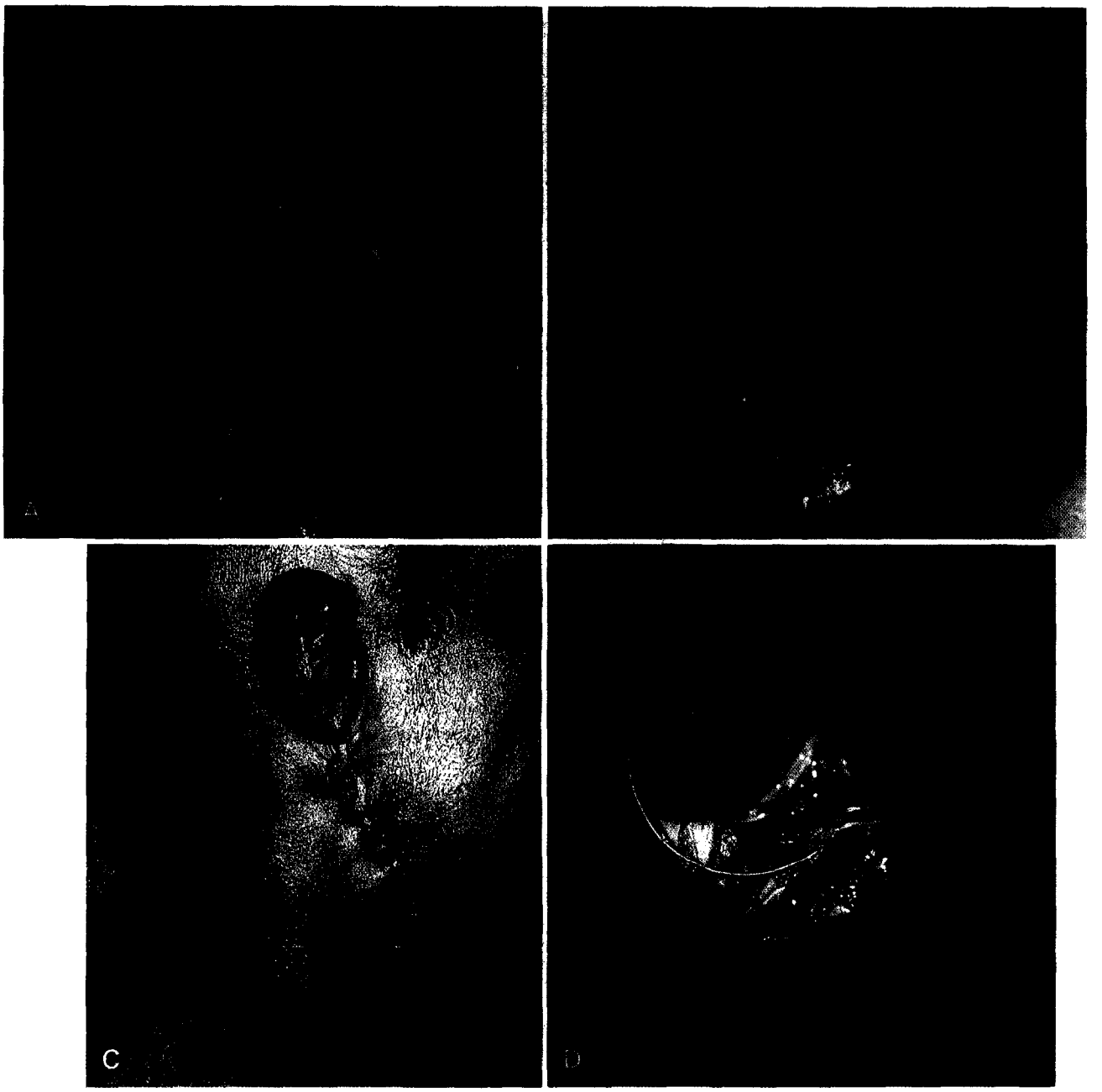


**Fig. 2**

Figure 2—(A) India ink staining of the auriculomastoid skin after injection into the posterior auricular artery. (B) The lateral surface of the auricle is also stained via the perforating branches. The helical rim is the last area to stain. (C) Ink staining may be seen to extend well within the hairline in both occipital and temporal directions. (D) The posterior auricular artery has been cannulated and injected with lead oxide/gelatin mixture. The vessel may be seen ascending towards the groove.

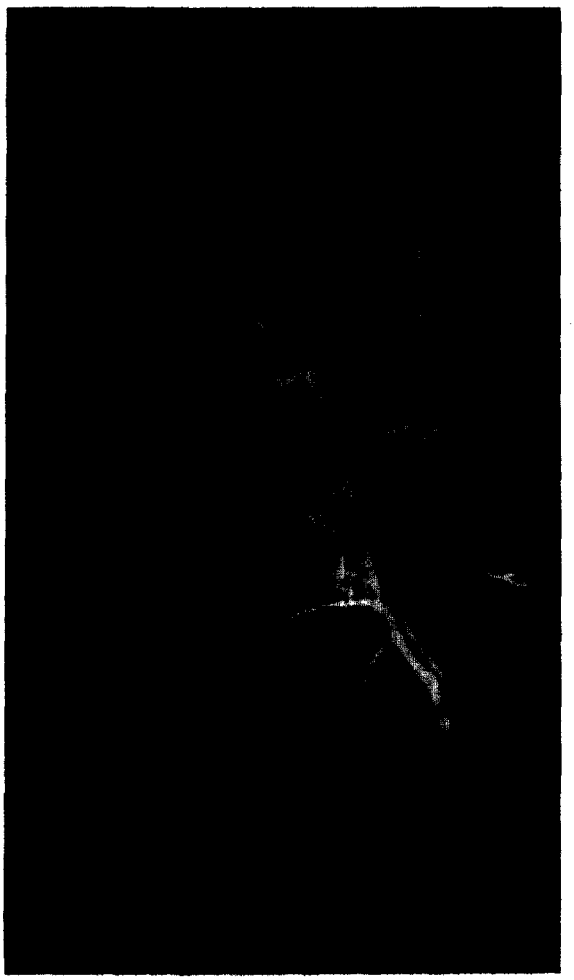

**Fig. 3**

Figure 3—Contact arteriogram of a posterior auricular flap after lead oxide injection.

encountered since these dissections were completed, the stylomastoid branch was the main termination of the posterior auricular artery, with only a tiny auricular branch present. In these circumstances, clearly a flap could not be transferred. This is the only significant arterial anomaly encountered and represents an incidence of approximately 1.4% of the cases studied.

## Venous drainage

The venous drainage of the auriculomastoid area is more variable. The area drains into the posterior auricular vein, which begins in the posterior part of the scalp as a network which communicates with the tributaries of the occipital and superficial temporal veins and receives tributaries from the cranial surface of the auricle. It descends behind the auricle and joins the posterior division of the retromandibular vein in or just below the parotid gland to form the external jugular vein (Fig. 6). It also receives the stylomastoid vein. The external jugular vein descends vertically, deep to platysma, across the sternomastoid muscle on which it lies in front of and parallel to the great auricular nerve. It pierces the fascia at the posterior border of the sternomastoid 2 cm above the clavicle, then receives the transverse cervical, suprascapular, anterior jugular and other veins and finally pierces the omohyoid fascia, to end in the subclavian vein. It usually has two valves, one at its termination and a second 4 cm higher.

## Variations

The termination of the posterior auricular vein was the main variation in our 50 dissections (Fig. 7). In 37 studies (74%) it joined the external jugular in the upper one-third of the neck. In two dissections a posterior jugular vein was present. In two clinical cases the external jugular vein was absent, and the posterior auricular vein joined the internal jugular. In these cases there was a large communication with the superficial temporal vein at the upper border of the flap.

## Pedicle length

In nine dissections, the length of the posterior auricular artery was measured from its origin from the external carotid artery to the point where it entered the groove between the cartilage of the external meatus and the mastoid. This varied from 3 to 7 cm, with a mean of 4.2 cm.

In six dissections in which the posterior auricular vein joined the external jugular vein in its upper or middle third, the length of the vein was measured. This varied from 5 to 8 cm, with a mean of 5.7 cm.

However, both of these lengths can be greatly extended; the artery by dissection of the external carotid artery, down as far as the bifurcation, if necessary, and the vein by dissection of the external jugular vein as far down the neck as necessary. It should be possible to provide a pedicle of adequate length for any purpose to which this flap might be put, with very large vessels for easy anastomosis.

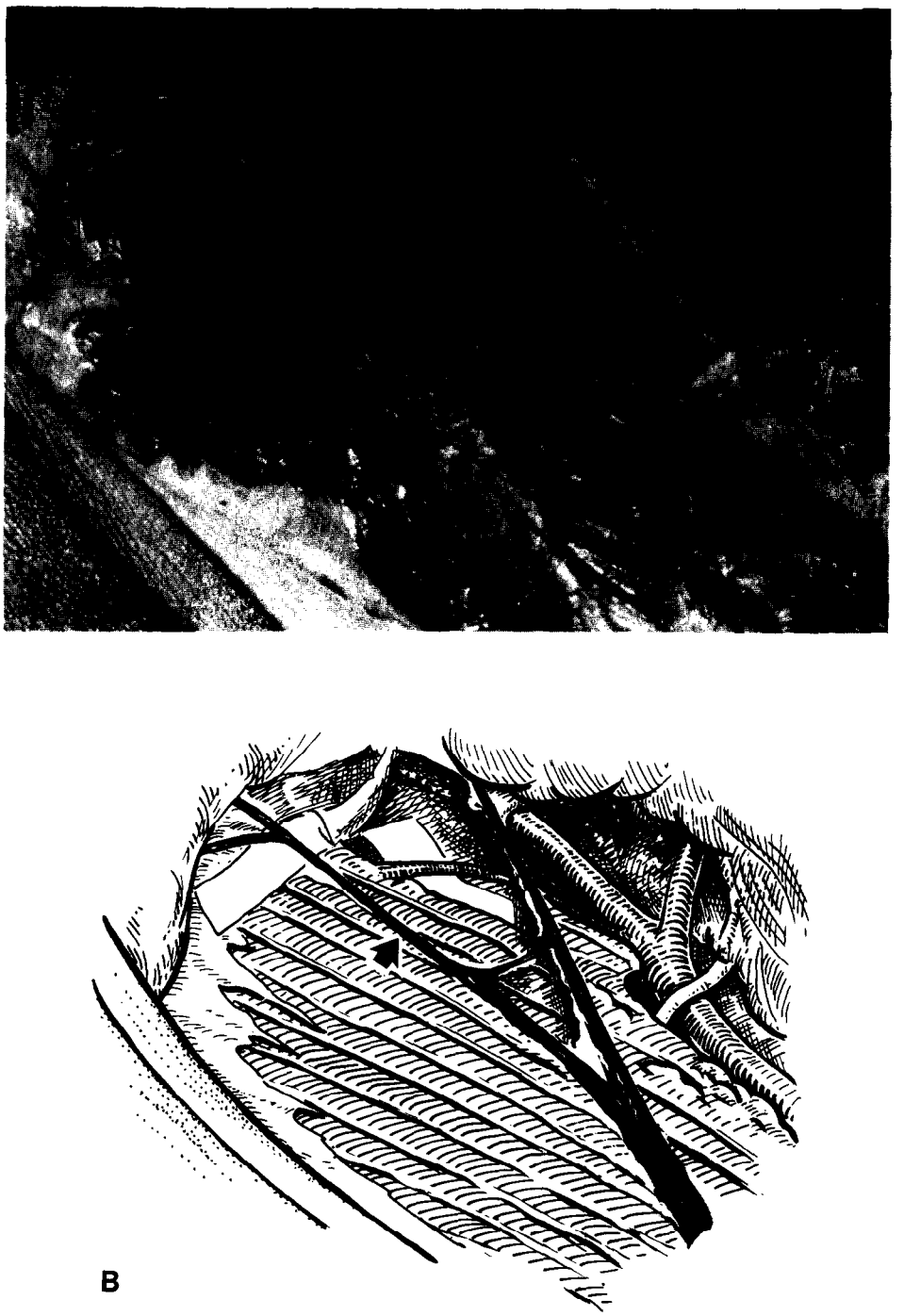


Fig. 4

Figure 4—(A) and (B) Cadaver dissection of the posterior auricular artery and vein. The arrow indicates the posterior auricular vein, the artery lies more deeply.

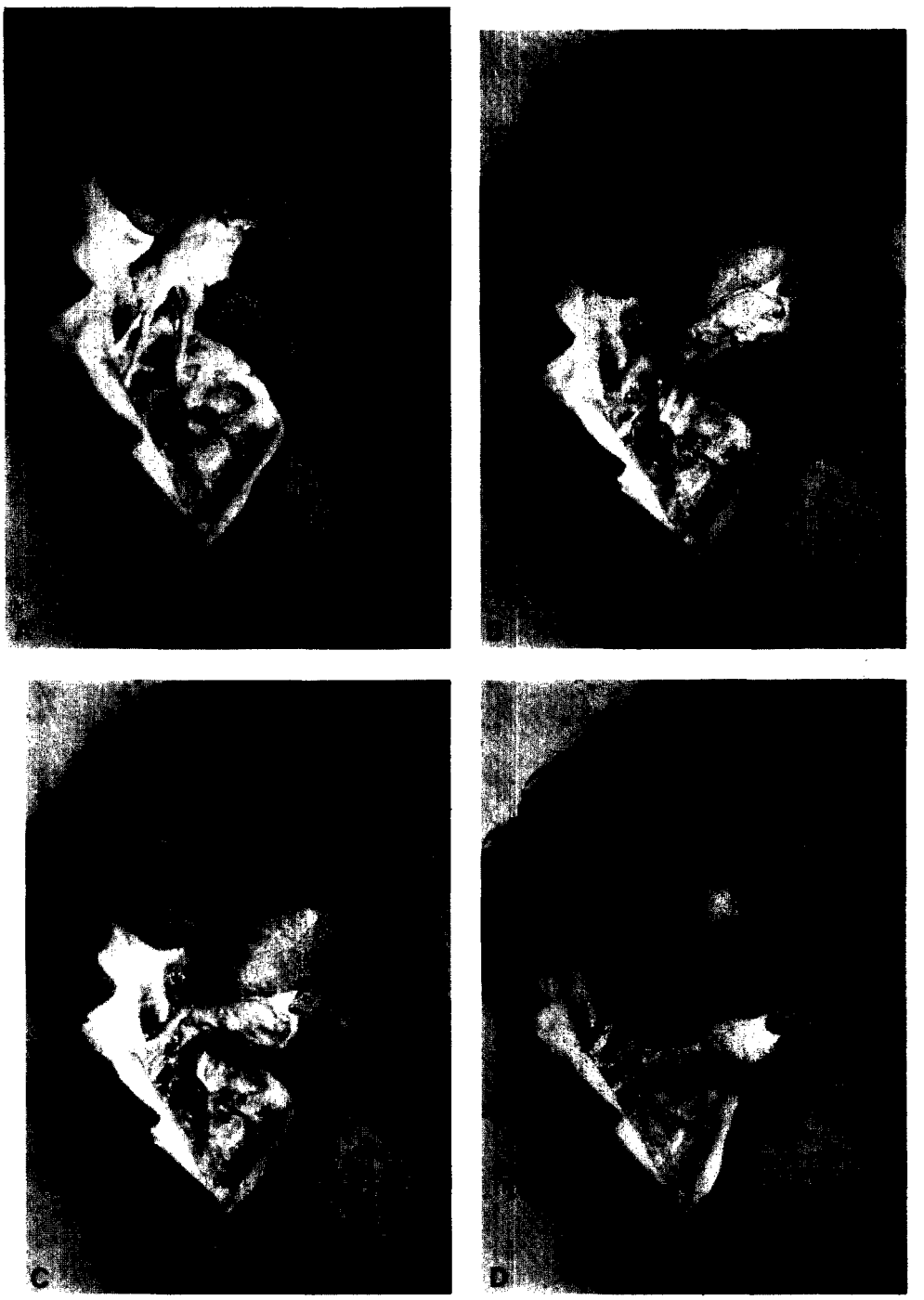


**Fig. 5**

Figure 5—The arc of rotation of the pedicled posterior auricular flap. (A) Malar. (B) Upper lip as far as the alar base. (C) Commisure. (D) Point of chin.

Fig. 6

Figure 6—The posterior auricular and retromandibular veins uniting to form the external jugular vein in the middle third of the neck. Cannulae are present in both vessels.

## Skin supply

The posterior auricular artery perfuses a constant area of skin which in the injection studies was represented by both non-hair-bearing and hair-bearing skin. The auriculomastoid skin and adjacent area of neck skin over the sternomastoid muscle, extending 2 to 3 cm behind and below the ear-lobe, is the non-hair-bearing area. Adjacent to this area a 2 to 3 cm strip of scalp extending towards the occipital and temporal area is also reliably perfused by the posterior auricular artery (Fig. 2). The greater part of the skin of the lateral surface of the auricle is also supplied by the posterior auricular artery via its perforating branches (Fig. 2B), raising the possibility of transferring a composite flap for alar reconstruction.

## Cartilage

The injection studies confirm that the posterior auricular artery supplies the perichondrium on both surfaces of the auricular cartilage. Three to four auricular branches pierce the cartilage at its base. Clearly a well vascularised cartilage graft can be incorporated in this flap.

## Temporal fascia

The India ink stained the temporal fascia to a variable distance above the supramastoid crest. This was confirmed by filling of small vessels in the fascia in the lead oxide injection studies.

## Nerves of the flap

The great auricular nerve and the lesser occipital nerve could be included in the flap. The great auricular nerve lies just deep to the platysma and superficial to the external jugular vein, lying on the sternomastoid muscle as it ascends towards the auricle. It gives mastoid, auricular and facial branches. The lesser occipital nerve ascends near the posterior border of the sternomastoid to supply the adjacent scalp.

## Conclusions

As a result of these investigations, it appeared that the auriculomastoid skin and adjacent scalp, if necessary incorporating cartilage and temporal fascia, could be transferred on the posterior auricular vessels, either as an island flap or as a free flap. Dissection of the external carotid artery and external jugular vein allows a considerable arc of rotation as an island pedicle flap, or alternatively should provide a free flap with a long pedicle and large vessels for reliable anastomosis. Sensory nerves could possibly be retained to provide a neurovascular flap. The area of non-hair-bearing skin available will depend on the size of the ear and the position of the hairline. As we shall show in a subsequent paper, the flap has proved reliable in the reconstruction of a variety of defects.

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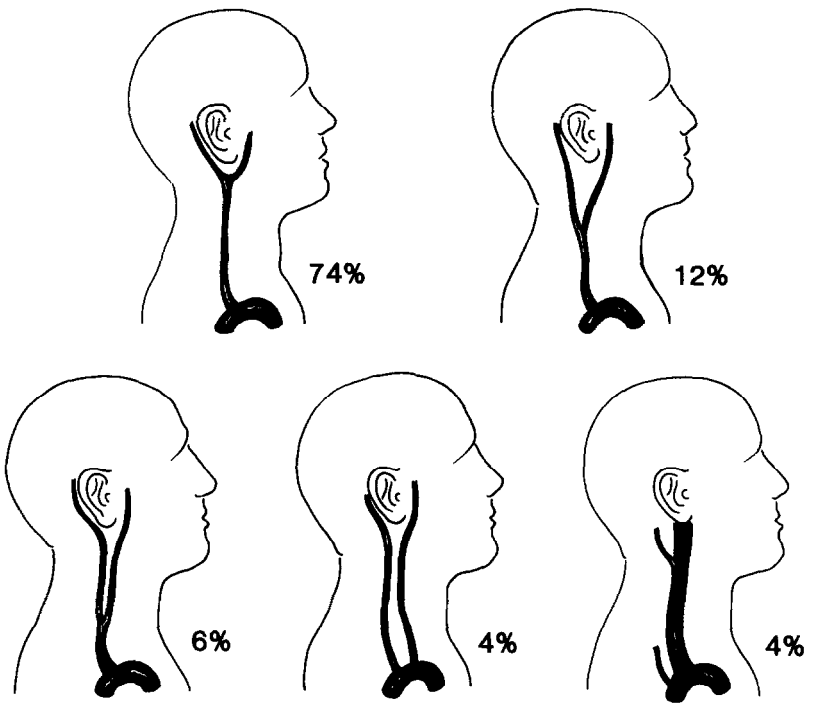


**Fig. 7**

Figure 7—The variations in termination of the posterior auricular vein. Upper third, 74% (above left). Middle third, 12% (above right). Lower third and posterior jugular vein, 6% and 4% respectively (below, left and centre). Absent external jugular; posterior auricular vein draining into internal jugular, 4% (below right).

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## References

**Fujino, T., Harashina, T. and Nakajima, T.** (1976). Free skin flap from the retroauricular region to the nose. *Plastic and Reconstructive Surgery*, **57**, 338.

**Galvao, M. S. L.** (1981). A postauricular flap based on the contralateral superficial temporal vessels. *Plastic and Reconstructive Surgery*, **68**, 891.

**Lewin, M. L.** (1950). Formation of the helix with a postauricular flap. *Plastic and Reconstructive Surgery*, **5**, 432.

**Rees, M. J. W. and Taylor, G. I.** (1986). A simplified lead oxide cadaver injection technique. *Plastic and Reconstructive Surgery*, **77**, 141.

**Renard A.** (1981). Postauricular flap based on a dermal pedicle for ear reconstruction. *Plastic and Reconstructive Surgery*, **68**, 159.

**Steffanoff, D. N.** (1948). Auriculomastoid tube pedicle for otoplasty. *Plastic and Reconstructive Surgery*, **3**, 352.

**Tanzer, R. C.** (1965). The reconstruction of acquired defects of the ear. *Plastic and Reconstructive Surgery*, **35**, 355.

**Washio, H.** (1969). Retroauricular temporal flap. *Plastic and Reconstructive Surgery*, **43**, 162.

**Williams, P. L. and Warwick, R.** (1980). *Gray's Anatomy*. 36th Ed. Edinburgh, London, Melbourne and New York: Churchill Livingstone.

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