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CASE SERIES

Selection of Superficial Temporal Artery Flaps for Eyebrow Reconstruction: Two Illustrative Cases

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Background: Eyebrow reconstruction remains challenging because an optimal outcome depends on restoring both stable soft-tissue coverage and natural hair-bearing characteristics. Several options are available, including hair transplantation, hair-bearing grafts, local flaps, and hair-bearing fascio-cutaneous flaps based on the superficial temporal artery (STA). Recipient-site and defect characteristics, together with patient factors, guide whether an STA-based flap is indicated. Once an STA flap has been chosen, however, the decision between a pedicled and a free transfer is determined primarily by donor-site availability, namely the condition of the ipsilateral temporal region and its vessels. Explicit decision-making criteria for this two-step reasoning are not well defined.

Cases Presentation: We present two cases that illustrate flap selection rather than a comparison of techniques. In the first case, a pedicled STA flap was used to reconstruct a partial eyebrow defect when the ipsilateral temporal region was intact. In the second case, previously reported elsewhere, a contralateral free STA flap was used for total eyebrow reconstruction because the ipsilateral temporal region had been compromised by prior surgery.

Results: Both flaps survived completely without major complications. At long-term follow-up, both reconstructions showed restoration of the eyebrow contour with acceptable symmetry, hair direction, and density relative to the contralateral side, and high patient satisfaction.

Conclusion: STA fascio-cutaneous flaps are a reliable option for eyebrow reconstruction. When an STA-based flap is indicated, the choice between a pedicled and a free transfer is governed mainly by donor-site availability: a pedicled flap when the ipsilateral temporal region is preserved, and a free flap when it is unavailable. These cautious, case-based observations are intended to illustrate clinical reasoning rather than to establish the superiority of one technique.

Keywords: eyebrow reconstruction, superficial temporal artery flap, free flap, pedicled flap, flap selection, microsurgery

Introduction

The eyebrow plays an important role in both facial aesthetics and emotional expression, in addition to protecting the ocular surface. Eyebrow reconstruction is therefore a challenging procedure in plastic surgery because it requires restoration of soft-tissue coverage, hair density, hair direction, and symmetry.[1]

Several techniques have been described for eyebrow reconstruction, including hair transplantation, hair-bearing skin or composite grafts, local flaps, pedicled flaps, and free flaps. Hair transplantation can reproduce the low density and fine orientation of eyebrow hair and is not limited by the size of the defect; however, it depends on an adequately vascularized, non-scarred recipient bed and is generally performed in stages.[2] Hair-bearing skin or composite grafts provide hair-bearing tissue without microsurgery but, being non-vascularized, are less reliable in poorly vascularized beds. Local flaps, including the contralateral eyebrow flap, give an excellent colour and hair match but are limited by defect size and may distort adjacent tissue.[3] In larger defects, or in scarred or poorly vascularized tissue where the options above are less reliable, hair-bearing fascio-cutaneous flaps based on the superficial temporal artery (STA) provide a robust reconstructive option.[4]

Selection therefore follows two steps. The recipient-site and defect characteristics, together with patient factors, first determine whether an STA-based flap is indicated. Once an STA flap has been chosen, the choice between a pedicled and

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a free transfer depends primarily on donor-site availability rather than on the size or characteristics of the defect. Clear indications for this reasoning remain limited. This report presents two clinical cases to illustrate a practical approach to flap selection.

Case Reports

Case 1: Pedicled STA Flap Reconstruction

A 32-year-old man presented with a post-traumatic scar involving approximately 50% of the left eyebrow of two years' duration. The reconstructive goal was to restore a natural-appearing eyebrow with appropriate symmetry, hair direction, and position relative to the contralateral side. The ipsilateral temporal region and the course of the STA were intact, so a pedicled STA island flap was selected (Figure 1). The preoperative appearance is shown in Figure 2a.

Preoperative Doppler ultrasonography was used to map the course of the left superficial temporal artery and to confirm the frontal branch. A 3×2 cm hair-bearing flap was designed over the frontal branch of the STA, within the frontotemporal scalp, with the long axis and hair direction oriented to match the contralateral eyebrow.

The procedure was performed under local anaesthesia with 2% lidocaine. After excision of the scar, the flap was elevated from the frontotemporal region on the frontal branch of the STA, preserving the hair follicles within the skin paddle. The pedicle was carefully dissected proximally to obtain sufficient length for tension-free transfer. A subcutaneous tunnel was created between the donor and recipient sites, and the flap was passed atraumatically through the tunnel into the eyebrow defect (Figure 2b).

The flap was inset with attention to hair orientation and with minimal tension on the pedicle. The donor site was closed in layers using Vicryl 3–0 and Nylon 4–0 sutures, and the recipient site was closed with Prolene 6–0 sutures. The postoperative course was uneventful, and complete flap survival was achieved.

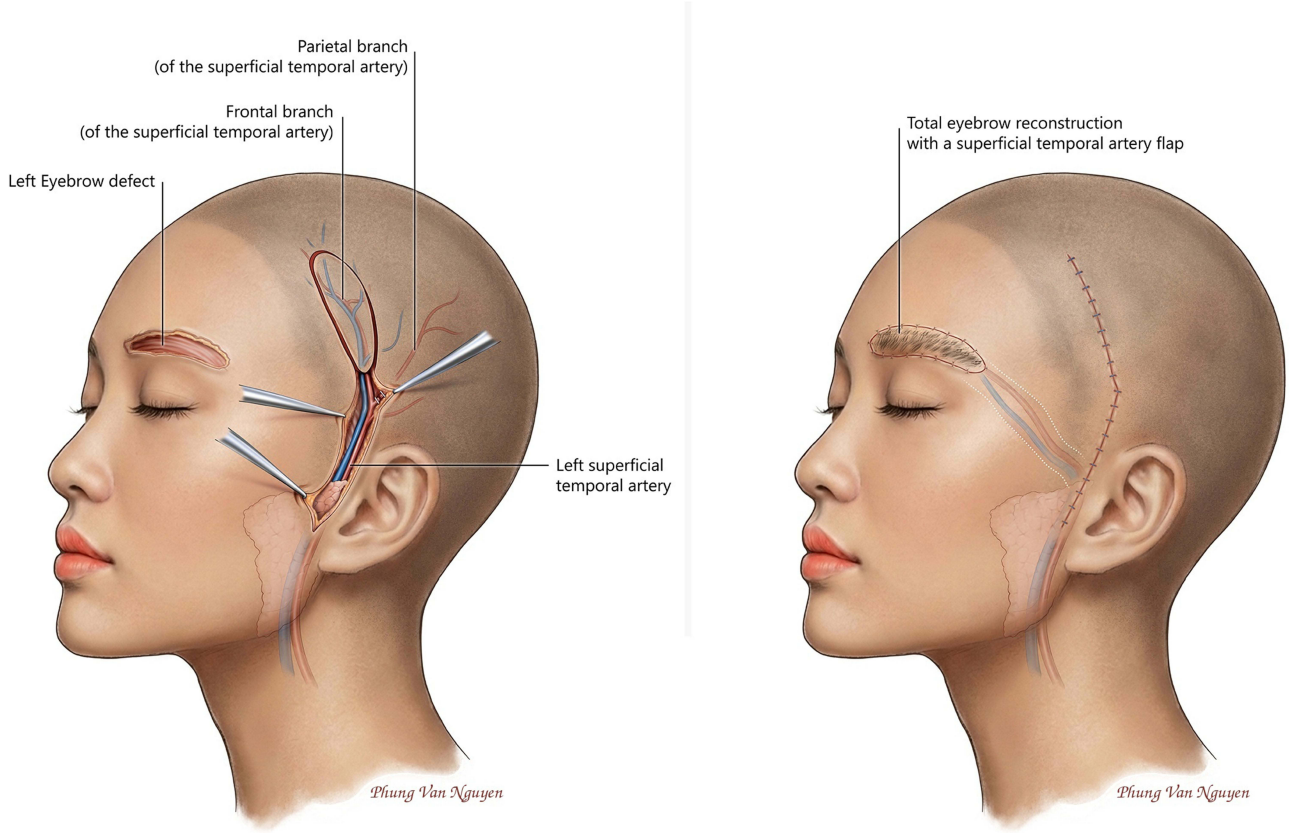

Figure 1 Schematic of pedicled superficial temporal artery (STA) flap reconstruction of a partial left eyebrow defect (Case 1), showing the frontal and parietal branches of the STA and the immediate postoperative appearance.

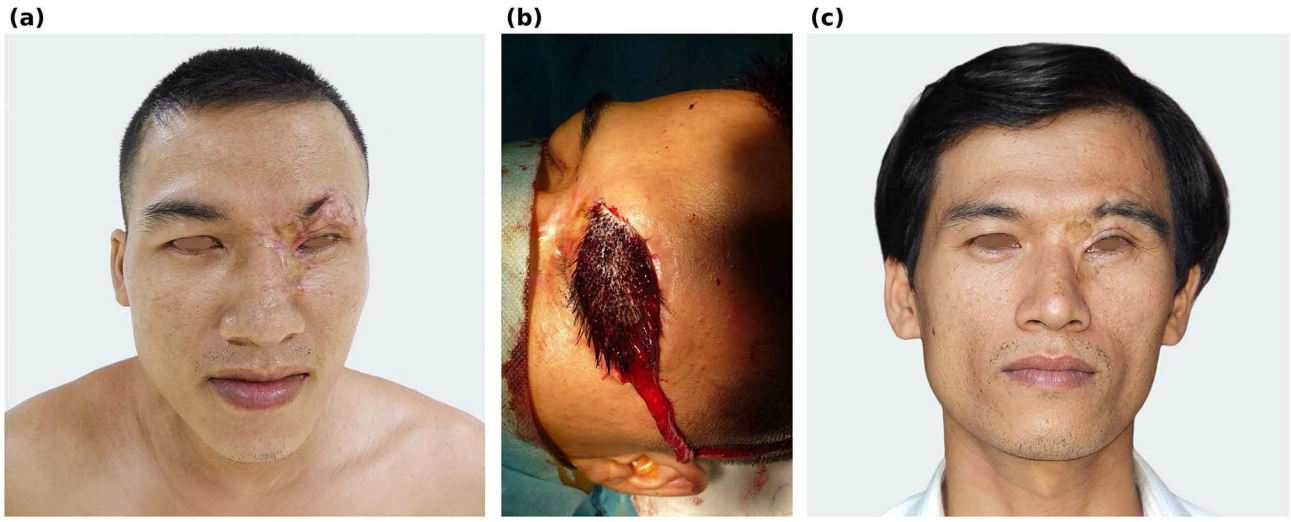

Figure 2 Case 1, pedicled STA flap reconstruction of the left eyebrow: (**a**) preoperative view; (**b**) intraoperative view showing the frontotemporal hair-bearing island flap elevated on the superficial temporal artery pedicle; (**c**) five-year postoperative view.

Aesthetic outcome. At five-year follow-up, the reconstructed eyebrow showed a stable, continuous contour that restored the eyebrow aesthetic subunit (Figure 2c). Hair growth was maintained, and the hair direction had been aligned to that of the contralateral brow at insetting. Position and overall symmetry relative to the contralateral eyebrow were acceptable As is typical of frontotemporal hair-bearing tissue, the transferred hair was slightly coarser and denser than native eyebrow hair, which required periodic trimming; this did not detract from the patient's high satisfaction with the result.

Case 2: Free STA Flap Reconstruction

This case has been reported in detail elsewhere;[5] the surgical technique is summarized here so that the present report is self-contained. An 18-year-old woman presented with complete loss of the left eyebrow following excision of a giant congenital melanocytic naevus that had involved nearly the entire left hemiface. The naevus had been excised previously and reconstructed with a supercharged superficial cervical artery perforator flap harvested from the scapular region; the flap's blood supply had been augmented by anastomosing the circumflex scapular artery to the ipsilateral (left) superficial temporal artery. Six months later, the patient requested eyebrow reconstruction. Because the ipsilateral temporal region and donor vessels had been used during the earlier reconstruction, a contralateral (right) free STA flap was selected for total eyebrow reconstruction (Figure 3). The preoperative appearance is shown in Figure 4a.

Flap design. Doppler ultrasonography was used to map both the right and left superficial temporal arteries for the flap pedicle and the recipient vessels. The flap was designed over the frontal branch of the right STA, with its dimensions and hair direction matched to the contralateral eyebrow.

Flap harvest and pedicle dissection. The operation was performed under local anaesthesia with 2% lidocaine and 3.5× loupe magnification. A skin and subcutaneous flap was harvested from the right frontotemporal region based on the frontal branch of the STA, with the dissection preserving the underlying hair follicles. The lateral branches of the artery were ligated and divided, and the vascular pedicle was dissected to a length of approximately 10 cm before the flap was detached.

Recipient vessels and inset. The recipient site was prepared by exposing the left superficial temporal vessels, and the planned anastomosis site and the required pedicle length were confirmed. After transfer, the superficial temporal vessels of the flap were anastomosed end-to-end to the left superficial temporal vessels using 9–0 Prolene sutures. The flap margins were inset to the eyebrow defect with 6–0 Prolene sutures (Figure 4b). Haemostasis was confirmed, the donor and recipient sites were closed in layers, and a drain was placed at the reconstruction site. The total operative time was two hours.

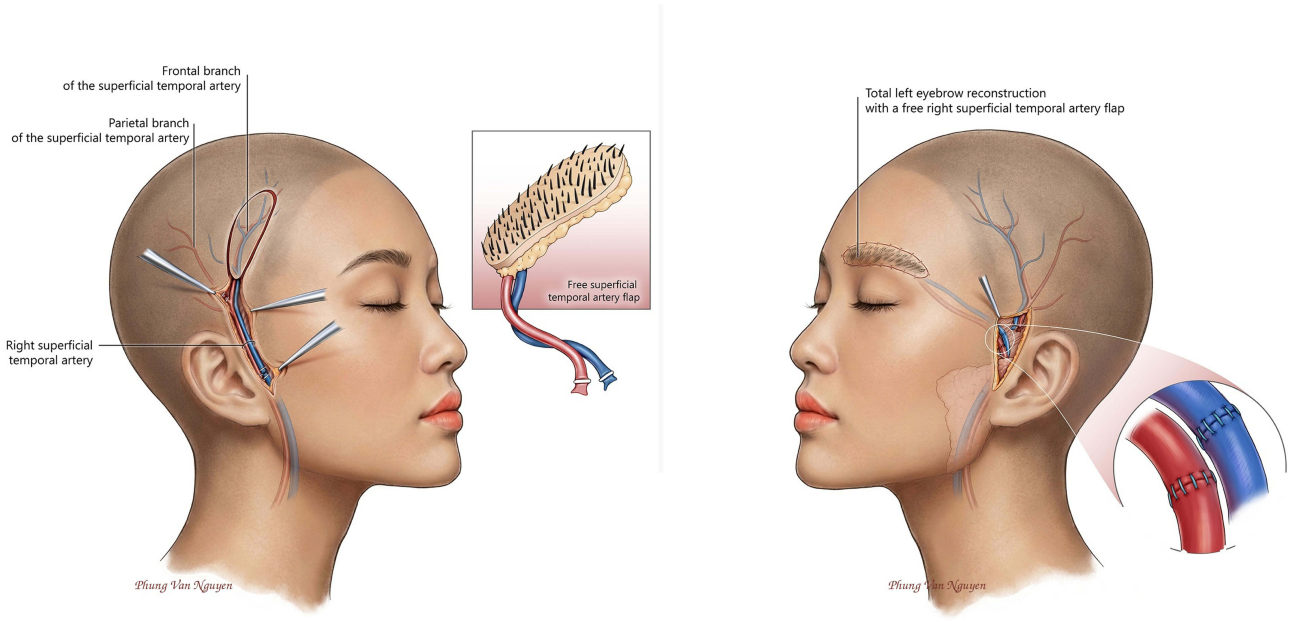

Figure 3 Schematic of total left eyebrow reconstruction with a free STA flap (Case 2), based on the right frontal branch with microvascular anastomosis to the left STA vessels.

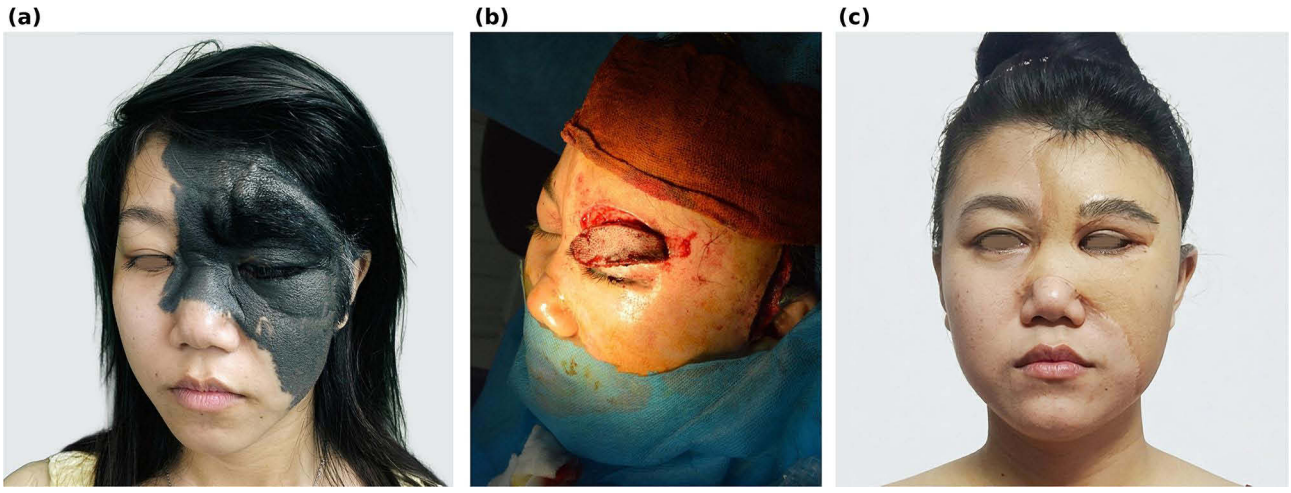

Figure 4 Case 2, free STA flap reconstruction of the left eyebrow: (**a**) preoperative view; (**b**) intraoperative view showing the free flap inset at the left eyebrow; (**c**) five-year postoperative view.

Postoperative course. Recovery was uneventful. The drain was removed 16 hours postoperatively, and the patient was discharged. Complete flap survival with hair growth was observed.

Aesthetic outcome. At more than five years' follow-up, the reconstructed eyebrow remained stable, with preserved contour, maintained hair growth, and acceptable symmetry and hair direction relative to the contralateral side, restoring the eyebrow aesthetic subunit (Figure 4c). The patient reported high satisfaction.

Discussion

Both cases achieved complete flap survival and satisfactory long-term aesthetic outcomes, supporting the reliability of STA fascio-cutaneous flaps for eyebrow reconstruction. Rather than comparing techniques, the two cases illustrate the clinical reasoning that underlies flap selection.

Selection algorithm. We find it useful to separate the decision into two steps.[6,7] First, the recipient-site and defect characteristics and the patient's preferences determine whether an STA-based vascularized flap is indicated at all. In a well-vascularized, non-scarred bed, hair transplantation or a hair-bearing graft may be appropriate, whereas a scarred or poorly vascularized bed favours a vascularized hair-bearing flap. Second, once an STA flap has been chosen, the choice between a pedicled and a free transfer is governed principally by donor-site availability: a pedicled island flap is used when the ipsilateral temporal region and the STA are intact, as in Case 1, and a free flap from the contralateral STA is used when the ipsilateral donor site has been compromised by previous surgery or trauma, as in Case 2. The size or location of the defect does not, by itself, dictate the choice between pedicled and free transfer.

Frontal branch versus parietal branch. The STA divides above the zygomatic arch into a frontal and a parietal branch, and the branch selected influences both the donor scar and the character of the transferred hair. A flap based on the frontal branch is harvested from the frontotemporal scalp, where the hair is relatively fine and its direction approximates that of the eyebrow, which makes this territory aesthetically favourable for brow reconstruction; the donor scar lies within the temporal hairline. A flap based on the parietal branch draws on a larger parietal territory but carries coarser, denser hair with a less brow-like orientation, and the donor scar lies more posteriorly. In both of the present cases the frontal branch was used, consistent with the aim of matching eyebrow hair characteristics.

Venous drainage in free STA flaps. Venous insufficiency is frequently cited as a limitation of free STA transfer. The superficial temporal vein does not always run with the artery, may be of small or variable calibre, and can lie at a distance from it, so a reliable venous outflow must be identified and preserved during flap design and confirmed at anastomosis. In the present free flap, the superficial temporal vessels of the flap were anastomosed to the left superficial temporal vessels, providing a venous outlet within the operative field; nonetheless, attention to venous drainage remains essential to avoid congestion and flap loss.

Recipient-vessel selection in Case 2. The ipsilateral (left) superficial temporal artery had already been used to supercharge the earlier scapular flap, which confirmed its patency and adequacy as a recipient vessel. Re-using these vessels for the free STA anastomosis was therefore logical: they were of suitable calibre, accessible within the operative field, and of proven reliability, and they provided both arterial inflow and venous outflow close to the eyebrow defect.

Why a free STA flap rather than hair transplantation in Case 2. Although the previous scapular flap provided a vascularized bed that could in principle have accepted follicular grafts, a free STA flap was preferred for several reasons supported by this patient's circumstances. It restored the entire hair-bearing eyebrow in a single stage with immediate, durable coverage, whereas follicular transplantation over a transferred flap is typically staged and yields variable graft survival in previously operated tissue. The STA flap also transferred a continuous segment of hair-bearing skin of appropriate thickness and texture, and the patient preferred a single definitive procedure. These considerations are specific to this case and are not presented as a general rule.

Limitations of STA flaps. STA-based flaps have recognized drawbacks. The reliable flap island is narrow because only the scalp directly overlying the vessel is dependably perfused, which constrains the width of tissue that can be transferred. Donor-site scar alopecia is an inherent cost of harvesting hair-bearing scalp. Because scalp hair is coarser and denser than eyebrow hair and lies in a different direction, mismatch of hair density and orientation is a genuine problem and may require subsequent trimming or refinement. Free transfer additionally demands microsurgical expertise and longer operative time and carries the vascular risks of anastomosis, including the venous concerns noted above.

Alternatives and their trade-offs. Local flaps, particularly the contralateral eyebrow flap, remain a strong option for partial defects because of their excellent colour and hair match, but they are limited by defect size and may distort the donor brow. Hair transplantation offers the best control of hair density and orientation and is not limited by defect size, but it requires an adequately vascularized, non-scarred bed and is generally staged, which limits its reliability in scarred or grafted tissue. Hair-bearing grafts avoid microsurgery but, being non-vascularized, give less predictable take. Against this background, vascularized STA flaps are most valuable in scarred or poorly vascularized defects where graft- or transplant-based methods are less dependable.

Taken together, these two cases highlight the value of a structured, stepwise approach to flap selection in eyebrow reconstruction, in which recipient-site and patient factors establish the indication for an STA-based flap and donor-site availability then determines whether a pedicled or a free transfer is used.

Conclusion

STA fascio-cutaneous flaps are a reliable option for eyebrow reconstruction. When an STA-based flap is indicated, the choice between a pedicled and a free transfer is determined principally by donor-site availability: a pedicled flap is appropriate when the ipsilateral temporal region remains intact, and a free flap from the contralateral STA is appropriate when the ipsilateral donor site is unavailable. These observations are case-based and are intended to illustrate clinical reasoning in flap selection rather than to demonstrate the superiority of one technique over another.

Ethical Approval

Institutional ethical approval was not required for this case report.

Patient Consent

Written informed consent was obtained from both patients for publication of clinical information and images.

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Disclosure

The author declares no conflicts of interest.

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