PEDICLED SCALP ISLAND FLAP FOR SUCCESSFUL ONE STAGE AESTHETIC EYEBROW RECONSTRUCTION

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ABSTRACT

The use of scalp flap based on frontal branch of superficial temporal artery is one of the famous known methods of eyebrow reconstruction. But to achieve aesthetic eyebrow appearance it is important not only to have viable scalp flap but also normal width, length together with and more importantly the direction of the hairs and lastly the density of hairs. This study included 18 patients, six patients were males and 12 were females with age ranging from 13 to 50 years. The treated patients had unilateral partial or complete brow loss. Management was done for all patients by following some technical considerations to have aesthetic eyebrow shape during using the scalp island flap based on one of the branches of superficial temporal artery. All cases were done as one stage operation with satisfactory appearance and survival rate (100%). There was minimal swelling due to the subcutaneous pedicle in the temporal region which needed between 2-3 weeks to subside in all cases. One case of the post-burn alopecia of eyebrows suffered partial flap congestion, which improved by conservative measures. The results were satisfactory as regard the eyebrow measurement (width and length), hair direction, but the hair density was higher than the normal density which was clearly noted in partial cases or unilateral reconstruction. And the hair growth also was noted to be faster than normal (they needed frequent shortening). Scalp island superficial temporal artery flap is an excellent solution for aesthetic eyebrow reconstruction. Perfect match with the undamaged eyebrow in partial loss or unilateral cases can be achieved by following some pre-operative and intra-operative important technical considerations.

Key words: eyebrow reconstruction- scalp pedicled superficial temporal artery flap. Abbreviations: TPF = Temporo-Parietal Fascia, STA= Superficial Temporal Artery, SC= Sub-Cutaneous

INTRODUCTION

The eyebrow is an important subunit of facial aesthetics and expression. Partial or total absence of the eyebrow is an aesthetically unacceptable and disturbing condition. Surgical defects of the eyebrow region routinely present a cosmetic challenge, and aesthetic eyebrow reconstruction is a very challenging problem for the reconstructive surgeon(1).

Understanding the unique anatomy and function of the eyebrow, including its movement in facial expression, is useful in achieving good aesthetic and reconstructive outcome while maintaining normal eyebrow function(2).

Most common causes of eyebrow loss include post-traumatic total or partial losses, post-burn losses, losses after chemical peel, defects resulting after lesion excision and congenital absence of eye brows(3).

Different methods of reconstruction include: superficial temporal artery scalp pedicled flaps (4), partial eyebrow reconstruction using subcutaneous pedicle flap from the ipsilateral eyebrow (5), eyebrow transplantation using follicular-unit hair grafting technique (6), free composite scalp strip grafting (3), and successful transfer of "free" microvascular superficial temporal artery flap for eyebrow reconstruction with no obvious venous drainage and use of leeches for reducing venous congestion(7).

From the mentioned methods, there are several options available for reconstruction of the eyebrow. Each method has advantages and disadvantages. The selection must be individualized, depending on the extent and
location of the eyebrow defect in relation to other structures, taking into consideration gender and age of patients. Each of the five closure options aid to maintain the function and aesthetic appearance of the eyebrow\(^{(2)}\).

The superficial temporal artery (STA); subcutaneous pedicled; scalp island flap yields excellent functional and cosmetic results when medium or larger defects were confronted in the eyebrow region\(^{(8)}\).

There have been several reports about the use of STA scalp island flap for eyebrow reconstruction, but there were some complications raised for criticism; including flap loss, mal-alignment or mal-direction of hair \(^{(9)}\). The technique may be associated with substantial morbidity (donor site scar, linear alopecia or swelling), a false dense eyebrow appearance and lastly rapid rate of hair growth in the reconstructed eyebrow \(^{(6)}\).

**Objective:**
To achieve aesthetic eyebrow as regards perfect match with the undamaged eyebrow in partial loss cases, proper hair direction, proper hair density, no or minimal obvious swellings at the recipient site or due to SC pedicle, and proper positioning of the reconstructed part.

**PATIENTS & METHODS**

Eighteen patients were included in this study, during the period from February 2002 to September 2004 in the department of surgery, plastic and burn surgery units, Cairo University. Six patients were males and 12 were females with age ranging from 13 to 50 years (mean = 21.9 ± 8.439907).

The treated patients had unilateral partial or complete brow loss. There were 8 cases after facial trauma, 7 cases post deep burn of the face and 3 cases of eyebrow lesions which were pigmented naevi (benign mole) of the eye brow (2 cases) and ulcerated nodule which was proved to be basal cell carcinoma ulcer (one case).

All the patients were assessed for the feasibility of the superficial temporal artery scalp flap as regards the presence of arterial pulsations (manual and Doppler assessment). The course of the frontal or parietal branches was marked to centralize the scalp island, taking enough subcutaneous pedicle around the vessels. The hair bearing scalp unit was chosen, taking into consideration the direction of hair which always needed shortening of the scalp hairs to confirm the hair direction.

**Technique:**
Flap design started by marking the site of the branch of STA till the selected scalp island. The scalp hair at incision line was shaved, and then the incision line was infiltrated with saline adrenaline 1/200,000 solution. After 10 minutes dissection of the pedicle started first with elevation of the scalp at incision site one fat cell deep to the pulp of hair follicles exposing the intact temporo-parietal fascia (=TPF) showing underneath the vascular pedicle till the scalp island. Then, cutting the edges of the island and then the TPF around the vessels till the main trunk of STA was done.

Afterwards the subcutaneous tunnel was created till the eye brow defect after excision of a lesion or scar tissue. The flap was sutured in place taking care not to twist the thin pedicle during passage through the subcutaneous tunnel. A fine suction drain was passed around the pedicle to come out through the posterior scalp. The final adjustment of the shape and position of the brow compared to the normal side is mandatory during suturing and wound closure with 7/0 prolene stitches.

**Some technical considerations that were followed in all cases include:-**
- Measuring of the accurate length & width of the deficient part of the brow.
- Estimation of the length of the needed pedicle to reach without tension. (always 1 cm. more)
- Assessment of the STA and its frontal branches. (Palpation, Doppler probe, or during dissection) to determine exactly the least possible thickness of the S.C. pedicle (but should include an artery branch and a vein) which was in all cases between 1 to 2 cm in width and as thin as TPF.
- Be sure of the adequacy of the tunnel to transmit the pedicle without twist, tightness or crumbling.
- Choice of the hair direction of the scalp island (shorten to be sure).
- Extensive thinning and adjustment (all thinning steps were done at the level of the scalp island and the TPF not to be touched), to match the position and thickness of the same brow in partial losses, or the contra-lateral brow in total losses.

Postoperative care was directed towards the wound, systemic antibiotic therapy was prescribed and antibiotic skin ointment was applied every 6 hours. The drain was removed after 48 hours. All stitches were removed by the 6th day.

Follow up was done daily for the first week then weekly for the first month then after 3, 6, 9 and 12 months. The data obtained in the follow up period was observational regarding; aesthetic appearance of the eyebrow (position, hair direction, thickness and length), temporal swelling, linear alopecia at scar site.

RESULTS

The 18 patients included in this study were treated by subcutaneous pedicled island scalp flap based on frontal branch of the STA. 11 cases based on the centro-frontal branch and 7 cases on postero-frontal branch of STA. All cases were done as one stage operation taking into consideration the technical refinements steps mentioned before, with satisfactory appearance and survival rate (100%).

There was minimal swelling due to the subcutaneous pedicle in the temporal region which needed between 2-3 weeks to subside in all cases. One case of the post-burn alopecia of eyebrows suffered partial flap congestion, which improved by conservative measures (few stitch removal + local heparin at congested edge for the first 48 hours post-operatively). (Table 2)

The results were satisfactory (figures 1, 2 and 3) as regards the eyebrow measurement (width and length), hair direction, but the hair density was higher than the normal density which was clearly noted in partial cases or unilateral reconstruction.

The hair growth also was noted to be faster than normal (they needed frequent shortening).

Table (1): Causes and number of cases of eyebrow losses

<table>
<thead>
<tr>
<th>Cause of eyebrow loss</th>
<th>Number of cases</th>
</tr>
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<tbody>
<tr>
<td>Post traumatic</td>
<td>8</td>
</tr>
<tr>
<td>Post burn</td>
<td>7</td>
</tr>
<tr>
<td>After lesion excision</td>
<td>3</td>
</tr>
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Table (2): Complication rate following STA scalp island flap for eyebrow reconstruction.

<table>
<thead>
<tr>
<th>Complications</th>
<th>Number of cases</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear alopecia (donor site)</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>Temporary congestion of flap (partial)</td>
<td>1</td>
<td>6%</td>
</tr>
<tr>
<td>Temporal swelling</td>
<td>none</td>
<td>-</td>
</tr>
<tr>
<td>Flap loss</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>Patient dissatisfaction</td>
<td>none</td>
<td>-</td>
</tr>
<tr>
<td>Improper brow position</td>
<td>none</td>
<td>-</td>
</tr>
<tr>
<td>Mal-direction of hair</td>
<td>1</td>
<td>6%</td>
</tr>
<tr>
<td>Hair over density</td>
<td>15</td>
<td>90%</td>
</tr>
<tr>
<td>Rapid brow hair growth (need frequent shortening)</td>
<td>18</td>
<td>100%</td>
</tr>
</tbody>
</table>

Fig (1):
A- Preoperative view of post traumatic partial eye brow loss in 15 years old female.
B- Intra operative view showing the scalp island elevated on a branch of STA.
C- 1&2 Post operative front & lateral views early post operative with good aesthetic result.
Fig. (2):

A-1 & 2 Preoperative (front & oblique) views of post burn partial eye brow loss in 30 years old female with marked ectropion of the right lower eyelid.

B- Intra operative view showing the scalp island elevated on a branch of STA (note the very thin pedicle = only 1 cm wide).

C- Refinement after flap insetting and during flap thinning

D- Immediate post operative view with perfect aesthetic result.+ full thickness grafting of lower eyelid in the same operation.

E- 1&2 = late postoperative, 14 months after surgery.
DISCUSSION

Reconstruction of eyebrow defects is a challenge, as eyebrow positioning provides an important role in communication, cosmesis, and signaling age, gender, and emotional status. Special consideration must be paid in order to maintain eyebrow symmetry and to avoid distortion of the hairline\(^2\).

Fig. (3):
A- Preoperative (lateral & front) views of benign mole of outer half of eye brow in 23 old female.
B-Intra operative view showing the scalp island and the post excision defect with the flap tunneled.
C- Immediate post operative view showing the result.
D- (1 & 2) Post operative photos (lateral and front view) 3 months later.
An improved understanding of the vascular supply of the layers of the temporal fossa has increased the potentiality of reconstructive techniques involving this area to demonstrate various combinations of the temporoparietal fascial pedicle with other tissues in the reconstruction of the ear, eyebrows, eyelids, malar, cheek and parotid areas(10).

A scalp island flap based on any branch of the superficial temporal artery could allow aesthetic one stage eyebrow reconstruction for total or partial eyebrow loss, whatever its aetiology. This method can be used not only in male patients but also in female or pediatric patients(11).

There have been several reports of the use of a TPF and STA scalp island flap for eyebrow reconstruction, but there were some complications raised for criticism; loss of a significant portion of the flaps (30.8 %) and mal-alignment or mal-direction of hair (23.1 %)(9).

Secondly, the technique may be associated with substantial morbidity (donor site scar, linear alopecia or swelling). Thirdly a false, overly dense eyebrow appearance and lastly rapid rate of hair growth (needs frequent shortening) were noticed (6).

In this study with some technical considerations it was possible to decrease the complication rate; there was not even a single case of flap failure (0%). About mal-direction of eyebrow hairs we succeeded to overcome this problem during flap marking by shortening of the scalp hair to observe accurately the direction of the hair to plan the island axis. (Only in one case we noticed part of the flap had maldirected hair and this was due to some difficulties during flap insetting and tunneling) (less than 6%).

With the recent techniques of hair removal, decreasing hair density and rate of growth could be achieved using IPL or laser epilation.

CONCLUSION

Scalp island superficial temporal artery flap is an excellent solution for aesthetic eye brow reconstruction. Perfect match with the undamaged eyebrow in partial loss or unilateral cases can be achieved by following some pre-operative and intra-operative important technical considerations.

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