ORIGINAL RESEARCH PAPER

Plastic Surgery

A SPECTRUM OF FOREHEAD AND TEMPLE RECONSTRUCTION WITH FREE MICROVASCULAR TISSUE TRANSFER IN A TERTIARY CENTRE.

KEY WORDS: Forehead reconstruction, free microvascular flaps, free ulnar artery forearm flaps.

Mainak Mallik* Mch Plastic Surgery, Senior Resident, Department of Plastic Surgery, Medical College, Kolkata, India. *Corresponding Author.

Santanu Suba Mch Plastic Surgery, Residential Medical Officer and Clinical Tutor, Department of Plastic Surgery, Medical College, Kolkata, India.

ABSTRACT

Introduction: Forehead and temple reconstruction poses a difficult challenge to the plastic surgeon owning to the aesthetical tantrums, non-hair bearing skin with hairline posteriorly into the scalp and the eyebrows and glabella in front. As per the nature and size of the defect a wide array of options ranging from skin grafting, tissue expansion, loco-regional flaps and microvascular free flaps are available and are customized in terms of the characteristics of the defect. Often higher microsurgical free tissue transfer is required in relatively smaller defects.

Aims and objectives: This retrospective descriptive non-randomized purposive study over six months at a Government Medical College aimed at executing different free microvascular flaps and to assess the technical details, operative outcome and short term follow up with the rationale behind choosing each specific reconstruction.

Methodology: Patients were selected based on the defects to be reconstructed, the pre operative work up and anesthesia check up were done, they were admitted and operated. Planning in reverse was done in every case, the source vessels and the perforators were identified and marked with hand held Doppler pre-operatively, the primary defect defined after excision and the flaps were harvested, inset given and donor sites managed accordingly. Post-operatively the flaps were monitored clinically, the complications and issues addressed, dressings changed on frequent intervals and results interpreted. After discharge, they were followed up at regular intervals.

Results: Out of 5 free flaps (2 radial artery forearm, 2 ulnar artery forearm and 1 latissimus dorsi myocutaneous flaps) in 5 patients, all flaps survived. Superficial temporal vessels end to end were used in all cases as recipient vessels for microvascular anastomosis. The mean size of the defects was 13 x 5.8 cm (mean surface area was 75.4 cm^2). The mean operative time was 5.5 hours. There were minor complications of partial necrosis of 1 latissimus dorsi muscle flap in 1 patient and donor site issue of hypertrophic unsightly scar in forearm in another patient. All other wounds and donor sites healed well. The mean post-operative hospital stay was 6 days.

Conclusion: In cases of defects in aesthetically important forehead and temporal regions with exposed calvarial bones not amenable for full thickness skin grafts or local flaps, free tissue transfer from non-hair bearing skin with good colour and texture should be considered as a primary option safely.

INTRODUCTION-

Forehead and temple reconstruction always poses a great challenge. The aesthetic tantrums, the visible scars, the contour, the complexion, the demarcation of the hair-bearing with the non-hair bearing landmarks like the anterior hair line in the scalp, the eyebrows, the side burns add to the difficulties and complexities. [1-5]

Any defect on the forehead and temple is categorized in terms of location, extent, size, depth from the reconstructive point of view and the region of the subunits from the aesthetic point of view. This is important as the placement of the incisions resulting in the final scars are planned and determined along the junctions of the aesthetic subunits. The type of pathology like tumor extirpation or trauma is important as it involves the depth and extent of the true defect. The motor and sensory nerve supply also plays a vital role in reconstruction. As per the defects, a wide array of reconstruction is considered starting from full thickness skin graft, loco regional flaps and under some circumstances free tissue transfer when the defect extent is large, involving full thickness tissue loss with exposed calvarium of frontal and temporal bones devoid of periosteum. [1-8]

The forehead, temple and scalp are divided into several aesthetic subunits for reconstructive purposes based on the anatomical locations and the watershed lines. They are the midline forehead (representing a strip between the medial edges of the eyebrows and extends from the nasion to the hairline), the median forehead unit (located lateral to the midline and extends to the midpupillary line), the lateral forehead unit (extending from the midpupillary line to the superior temporal line), the temple unit (including the region from the superior temporal line to the temporal hairline and extends inferiorly to a line connecting the lateral canthus with the superior helical root) and the eyebrows. [8]

Free microvascular tissue transfer has been used for forehead regions with defects larger than 50 cm^2 with exposed calvarial bone. [3,5] Commonly used free flaps are the radial forearm, anterolateral thigh, rectus abdominis, latissimus dorsi myocutaneous, scapular, omentum. [5,6,8,9] The superficial temporal vessels are the commonly used recipient vessels for anastomosis. Other options are using the facial vessels and external jugular vein as interposition grafts if the vascular pedicle falls short, or the facial and occipital vessels in rare instances. [2,7] The disadvantages of free tissue transfer in the forehead area include contour and colour mismatch. [2] Ideal free flaps used for this purpose should have adequate size, superior texture, large and long pedicle with consistent anatomy, can be easily and safely dissected with the feasibility of a two team approach causing acceptable and minimal donor site morbidity. [7] Often free microvascular tissue transfer is considered as the first line reconstructive option "violating" the reconstructive ladder especially in cases of bony defects even if the size of the defects is smaller, as the region heals primarily, survives more rapidly with lowered instances of meningitis and abscess compared with the pedicled options (the reconstructive elevator approach). [4,6] As per one study there is an algorithmic approach of forehead reconstruction considering the depth of the defects (with bony loss and exposed dura/meninges for which bone grafts or vascularised bone transfer or use of bone cement has been recommended) and the area of soft tissue loss, considering the hairline, mastoid and angular regions (preferred free flaps in such scenarios being latissimus dorsi, anterolateral thigh or rectus muscle or myocutaneous flaps) and finally the forehead proper for which a thin fasciocutaneous free flap (like the radial forearm, parascapular and thin anterolateral thigh flaps) in cases where the defect is not amenable for primary closures, immediate and delayed reconstructions with muscle free flap and STSG and pre-expanded or pre-fabricated ones

respectively (like latissimus dorsi, rectus abdominis, parascapular free flaps). [10] In non- hair bearing regions requiring reconstruction (like the forehead and temple in our study) the more ideal flap should have a less or non-hair bearing area like the medial aspect of the forearm specially in males in which the vascular supply to the overlying skin comes from the ulnar artery which has been the basis of ulnar artery forearm flaps used in head and neck reconstructions as per literature with the advantages of a more pliable skin with less visible donor area skin graft and superior cosmesis. [11]

METHODOLOGY-

This is a retrospective, descriptive, purposive, institutional study conducted at the Department of Plastic and Reconstructive Surgery, Medical College and Hospital, Kolkata, India over 6 months (January 2018 to June 2018). No randomization of the study patients was done. Patients were included between age group of 20 to 70 years based on traumatic and oncologic defects on forehead and temples involving full thickness soft tissue losses on the described region with bare bone devoid of periosteum. Informed consents were taken after explaining procedure details to patients and their attendants. Planning in reverse was done pre-operatively based on the apparent defects and the donor areas marked with defect templates after ascertaining the vascular supply by clinically palpating the arteries and dopplering them with 8 MHz hand held pencil Doppler. The defects were excised in the regions of forehead and temple depending on the pathology, margins confirmed to be negative by frozen section biopsies in cutaneous malignancy cases and haemostasis achieved. The true defect templates were made and the flap measurements in the donor areas were modified. The flaps were harvested, pedicles dissected to a considerable length. The recipient vessels in all the cases were superficial temporal artery and single vena comitantes, which were prepared often by using a separate pre-tragal incision, the distal ends of vessels ligated and prepared for end to end anastomosis under microscope with 10-0 monofilament interrupted sutures. The flaps were detached and transferred to the defect sites and inset in a single layer given with 3-0 monofilament, the pedicle ensured of having no tension or kinking and microvascular anastomosis done in standard fashion to 1 artery and 1 vein. The skin overlying the superficial temporal vessels was loosely sutured over a corrugated drain which was removed after 48 hours. There was no special dressing for the flap area. The donor sites (in radial forearm and ulnar forearm flaps) were split skin grafted and the free latissimus dorsi myocutaneous flap donor area primarily closed over a suction drain. Flap monitoring was done every hourly for the first 48 hours and thereafter every 6 hourly till the patients were discharged, with suture removal at 7^{th} to 10^{th} post operative day and subsequent OPD follow up every 2 weeks for the next 3 months.

RESULTS-

Table- 1 – showing the details of the patients, pathology, free flap used and complications.

S.No.	Age (years)	Gender	Pathology and defect	Free flap used	Complications
1	25	Male	Post traumatic scar measuring 12 X 5 cm and tear drop shaped right face involving the zygomatic subunit with exposed body of the zygoma extending superiorly up to the forehead area lateral subunit and temporal hairline and medially up to the lateral orbital wall causing a cicatrical ectropion of the right lower eyelid.	Ulnar artery forearm	Hypertrophic scar on forearm donor site after 3 months which needed pressure garment therapy.
2	67	Female	Basal cell carcinoma left forehead involving the median and lateral subunits measuring 10 x 5 cm oval shaped defect with exposed frontal and temporal bone after excision.	Radial artery forearm	Nil.
3	69	Male	Vascular malformation involving whole forehead and anterior scalp measuring 25 x 5 cm forehead unit and 25 x 3 cm of anterior scalp with exposed frontal and parietal bones after excision.	Latissimus dorsi myocutaneous-skin for forehead and only muscle with split skin graft for scalp	20% muscle part of flap posteriorly in the scalp area necrosed with STSG loss over it which required re-grafting after appearance of granulation tissue.
4	45	Female	Basal cell carcinoma involving right forehead meadian and lateral subunits measuring 12 x 5 cm oval shaped defect with exposed frontal and temporal bone after excision.	Radial artery forearm	Nil.
5	51	Male	Basal cell carcinoma involving whole of median subunits of both the sides of forehead with 6 x 6 cm oval shaped true defect with exposed frontal bone after excision.	Ulnar artery forearm	Nil.

In the 6 months of study period we operated on 5 patients with various pathologies on forehead and temple area which resulted in large defects with exposed calvarium not suitable for skin grafting or any other loco-regional flap. 2 radial artery forearm free flaps (40%), 2 ulnar artery forearm free flaps (40%) and 1 latissimus dorsi myocutaneous free flap (20%) for composite forehead, temple and scalp defects were undertaken.

The choice of the flaps were governed by donor areas, non hair bearing skin, expendability and acceptance of the donor site issues, calibre and length of the pedicles to reach the recipient superficial temporal vessels (pre-tragal in all cases) for microvascular anastomosis and the composite nature of the tissue incorporated (only skin or skin with muscles) The average operating time was 5.5 hours, the average length of post-op hospital stay was 6 days, with mean follow up of 2 weeks at OPD for the first 6 months. Sutures on forehead were removed after a mean period of 8 days. Corrugated drains at pre-tragal area of anastomosis were removed after 48 hours in all cases. Hourly monitoring of the flap was done for the first 48 post operative hours and then 6 hourly till discharge. Monitoring was done by flap inspection in terms of colour, temperature, turgor, capillary refill and not by scratching owning to the cosmetic prejudice. The mean age of the patients was 51.4 years with male female ratio of 1.5:1. 80% of the defects were from oncological resection (Basal cell carcinoma in 60% of total cases). The average size of the defects was 13 x 5.8 cm. Co-morbidities of Diabetes (in 60% cases), systemic hypertension (in 40% cases), and coronary heart disease (in 20% cases) were present in 60% of the total cases. The average length of pedicle was 9 cm and the

average calibre of the flap artery 1.5 mm and that of vena commitantes was 1.8 mm. There was 40% minor complications in all the cases, 20% relating to flap in terms of partial necrosis over muscle with skin graft loss in early post operative period requiring re-grafting after granulation tissue while 20% relating to donor site hypertrophic scarring on 3 months follow up post operatively. There was no incidence of haematoma, wound dehiscence, seroma and infection. All flaps survived (except partial necrosis in 1 case).

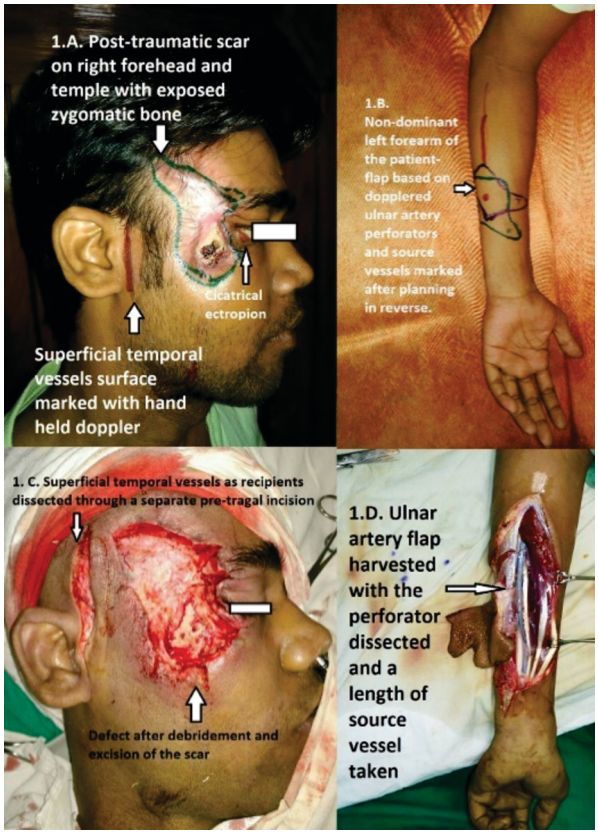

Fig. 1 A- showing a post traumatic defect on rt. temple and exposed zygomatic bone with rt. lower eyelid cicatrical ectropion extending upto the lateral forehead subunit; B- Planning in reverse on the ulnar forearm; C- defect after excision and separate pre-tragal incision for preparing the superficial temporal vessels for anastomosis; D- the free ulnar artery flap in non hair-bearing aspect of the non-dominant ulnar forearm harvested and the pedicle dissected.

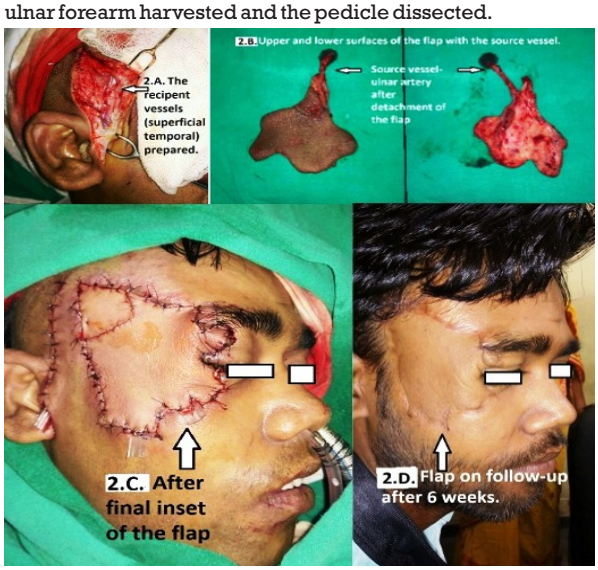

Fig. 2 A- showing the superficial temporal vessels prepared; B- the flap with both its dorsal and ventral surfaces after detachment; C- flap after final inset, anastomosis of the ulnar vessels to the superficial temporal vessels and wound closure; D- follow up after 6 weeks.

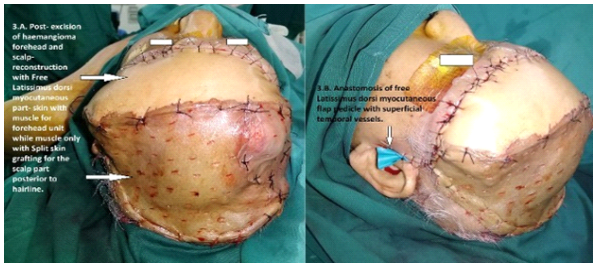

Fig 3 A and B showing a forehead and scalp defect following excision of haemangioma resurfaced with Latissimus dorsi myocutaneous free flap with skin paddle used for forehead unit and muscle with split skin graft for the scalp to maintain the anatomical landmarks.

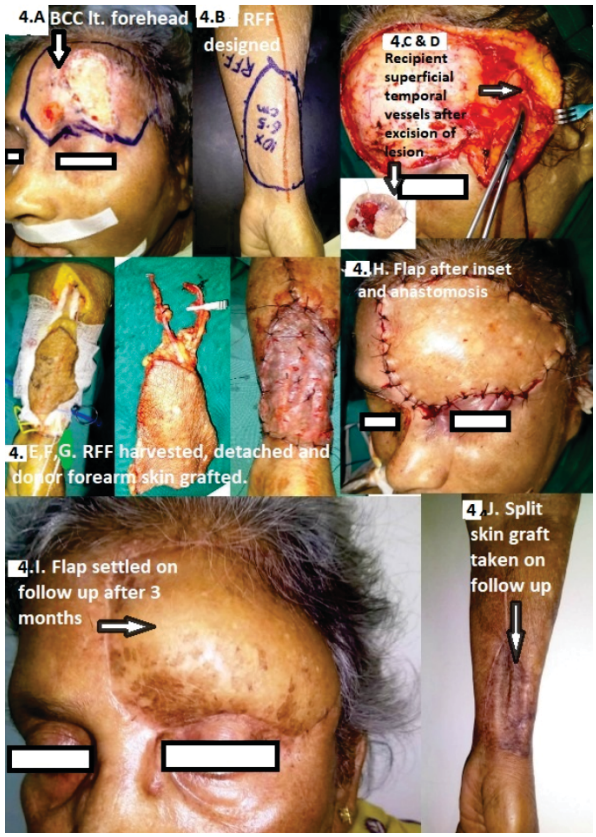

Fig. 4 A- showing Basal cell carcinoma lt. forehead and temple; B- planning in reverse and free radial forearm flap designed on non-dominant left forearm; C and D- defect after excision with the superficial temporal vessels prepared and the specimen in inset; E, F and G- the flap harvested, detached and the donor site split skin grafted; H- The flap after final inset and anastomosis with closure; I- follow up at 3 months with the flap completely settled; J- donor site skin graft take on follow up.

DISCUSSION-

In this retrospective non-randomized descriptive study over 6 months in a tertiary care hospital, the mean age of the patients was 51.4 years with male female ratio being 1.5:1 as compared to another similar study where the mean age was 67 years with 2.6:1 male female ratio. [9] Co-morbidities (diabetes, hypertension, coronary heart disease etc.) were present in 60% of the patients in our study. Mean operative time was 5.5 hours and the average length of post-op hospital

stay was 6 days. Defects following oncological resection were 80% while 100% in other studies. [9,11] The mean size of the defect was 13 x 5.8 cm (mean surface area was 75.4 cm^2 with the maximum of 200 cm^2 and a minimum of 36 cm^2). As per other studies the mean defect size was 135 cm^2. [9] This is in context with studies which have recommended free tissue transfer for exposed calvarial defects on forehead areas with a defect area greater than 50 cm^2. [3,5] The average length of pedicle was 9 cm and the average calibre of the flap artery 1.5 mm and that of vena commitantes was 1.8 mm. Post operatively the flaps were all monitored clinically by hourly assessing the colour, temperature, turgor, capillary refill and often with hand held Doppler but no flaps were scratched to see bleeding as it would have damaged the dermis resulting in scar marks in the aesthetically sensitive region of the face. Other studies also recommended this type of post operative flap monitoring. [7] There was no re-exploration of anastomosis because of compromised vascular supply or congestion in the flaps in our study while other studies reported a 5.88% rate of re-exploration of the flaps. [4] The complications related to flap (necrosis and dehiscence) was 20% and those related to the donor site (graft loss/ hypertrophic scar/ unsightly appearance) was 20% from our study compared to other studies where 33% and 29% in radial forearm free flaps and 45% in Latissimus dorsi free flaps (higher incidences of complications were noted in Latissimus dorsi free flaps as compared with radial forearm free flaps). [9,11] In 2 male patients (40% of the total study patients) in our study (with more hair on the radial aspects of forearm) we chose the ulnar artery forearm free flaps with relatively less or no-hair bearing supple and pliable skin to reconstruct the forehead and temple where both the flaps were viable with superior colour and texture match to the adjacent skin.

CONCLUSION-

In cases of defects in aesthetically important forehead and temporal regions, with exposed calvarial bones not amenable for full thickness skin grafts or local flaps, free tissue transfer from non-hair bearing skin with good colour and texture should be considered as a primary option safely.

REFERENCES-

1. Bradford, Benjamin D. et al; Reconstruction of the Forehead and Scalp, Facial Plastic Surgery Clinics, February 2019, Volume 27, Issue 1, 85 - 94, DOI: https://doi.org/10.1016/j.fsc.2018.08.009
2. Mo yinfolu Sokoya, Jared Inman, Yadranko Ducic; Scalp and Forehead Reconstruction, Seminars in plastic surgery, May 2018: 32(2): 90-94, DOI https://doi.org/ 10.1055/s-0038-1642638. ISSN 1535-2188.
3. Angelos, Patrick C. et al; Options for the Management of Forehead and Scalp Defects, Facial Plastic Surgery Clinics, August 2009, Volume 17, Issue 3, 379 – 393, DOI: https://doi.org/10.1016/j.fsc.2009.05.001
4. Nigel J. P. Beasley, Ralph W. Gilbert, Patrick J. Gullane, Dale H. Brown, Jonathan C. Irish, and Peter C. Neligan. Archives of Facial Plastic Surgery. Jan 2004.16-20.http://doi.org/10.1001/archfaci.6.1.16
5. Angelos, Patrick C. et al.; Options for the Management of Forehead and Scalp Defects: Facial Plastic Surgery Clinics, Volume 17, Issue 3, 379 – 393 doi:10.1016/j.fsc.2009.05.001
6. Temple, Claire L.F. et al; Scalp and Forehead Reconstruction, Clinics in Plastic Surgery, July 2005, Volume 32, Issue 3, 377 – 390, DOI: https://doi.org/ 10.1016/j.cps.2005.02.002
7. Barbara S. Lutz; Scalp and Forehead Reconstruction, Semin Plast Surg. 2010 May;24(2):171–180. doi: 10.1055/s-0030-1255334
8. Hicks, David L. et al.; Soft Tissue Reconstruction of the Forehead and Temple:Facial Plastic Surgery Clinics, Volume 13, Issue 2, 243 – 251 DOI: https://doi.org/10.1016/j.fsc.2004.11.002
9. Sweeny, Larissa et al. "Reconstruction of scalp defects with the radial forearm free flap." Head & neck oncology vol. 4 21. 14 May. 2012, doi:10.1186/1758-3284-4-21
10. van Driel AA et al; Aesthetic and oncologic outcome after microsurgical reconstruction of complex scalp and forehead defects after malignant tumor resection: an algorithm for treatment : Plast Reconstr Surg. 2010 Aug;126(2):460-70. doi: 10.1097/PRS.0b013e3181de2260.
11. Mark K. Wax, Eben L. Rosenthal, Catherine P. Winslow, Daphne A. Bascom, Peter E. Andersen; The Ulnar Fasciocutaneous Free Flap in Head and Neck Reconstruction, The Laryngoscope, December 2002, DOI: 10.1097/ 00005537-200212000-00005