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Microvascular Reconstruction of Extensive Scalp Defects

Dr Pradeep Goil, Dr PreetiYadav, Dr Pranay Ahari
Sawai Maan Singh Medical College And Hospital, Jaipur, Rajasthan,India

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ABSTRACT
Introduction: Extensive scalp defects are frequently seen by reconstructive surgeons. Simple reconstructive methods such as skin grafts, locoregional flaps or tissue expanders are often not feasible in such defects. Large defects can be challenging to repair as it is hair bearing aesthetically sensitive area and scalp has comparatively less mobile tissue. Here microsugical reconstruction provides distinct advantage over other methods.
Objective: To study the different options available for microvascular reconstruction of extensive scalp defects.
Material and method: A total number of 82 cases of large scalp defects with surface area more than 50cm^2 were reconstructed with myriad of free flaps over a period 11 years between august 2010 to august 2021.
Result : out of 82 cases, 44 cases reconstructed with lattismusdorsi (LD)flap, 10 cases with LD+Serratus anterior(SA) flap, 3 cases with LD+SA+parascapular flap,16 cases with anterolateral thigh (ALT) flap , 1 case with LD+radial artery forearm flap(RAFF), 3 cases with omental flap and 3 cases with RAFF,2 cases with ALT+tensor fascia lata(TFL). Free flaps proved to be extremely reliable, only 5 case showed partial changes in flap (3 LD and 2 ALT) which were managed conservatively and 1 case of LD flap had complete necrosis which was later reconstructed by ALT flap and 1 case of ALT had necrosis which was later skin grafted.
Conclusion: free tissue transfer for scalp defects provides a reliable, durable, and cosmetically adequate reconstructive option. The LD is the most commonly used flap, although the ALT and other flaps have also been an important aspect of reconstruction. In scalp defect, the surgeon should consider all the parameters not only the defect size, recipient vessels, pedicle length and anatomiccomponents but also the patient's condition, age, sex and goals while selecting the best available option.
Key words: scalp, reconstruction, microvascular, LD, ALT

I. INTRODUCTION

The scalp covers the calvarium and is therefore critical not only for normal cosmesis but also for protecting the intracranial structures.Scalp defects can occur secondary to traumatic injuries, burns (mostly electrical),infectionsand oncological resections.[1]Scalp reconstruction remains a challenging task despite advances in reconstructive options elsewhere. Reconstructive surgeons must consider the unique tissue characteristics of the scalp including the tissue's inelasticity and adherence to the underlying galeaaponeurosis. It is also thin, convex and hair-bearing.[2]

The scalp can be subdivided into anterior/frontal, parietal, occipital and vertex regions. Size is described in centimeters square and can be considered small(2 cm^2), medium(2-50 cm^2) and large (>50cm^2) .Reconstruction of the scalp follows the reconstructive ladder of any other plastic surgical procedure butsimple reconstructive methods such as skin grafts,local flap, locoregional flap or expanders are often not feasible in large defects. Large defects can be challenging to repair as it is hair bearing aesthetically sensitive area and scalp has comparatively less mobile tissue. Here microvascular free tissue transfer is a mainstay in scalp reconstruction The advent of free tissue transfer to the field of head and neck reconstructive surgery has greatly expanded the repertoire of techniques available for treating defects of the scalp and has been shown to be well tolerated and reliable with acceptable cosmetic and functional results.[3,4]

The purpose of this study was to evaluate different available options for microvascular reconstruction of extensive scalp defects and there surgical and aesthetic outcome at our academic center.

II. MATERIAL AND METHODS

Patient data:Our study is a retrospective review of large scalp defect reconstructions performed by the department of Plastic Surgery SawaiMaan Singh Medical College And Hospital, Jaipur,Rajasthan,India over a period of eleven years from august 2010 to august 2021. We reviewed 82 cases performed with large scalp defects. 48 patients were men and 34 were women; the age of the patients ranged from 12 to 68 years.(Table 1)

International Journal Dental and Medical Sciences Research
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Fifteen patients were diagnosed with scalp tumor, 6 patients presented with infection, 21 patients had history of burn and majority (40) patients had scalp trauma. (Table 2) Area of the defect was located in the frontal region (17cases), the frontoparietal region (16cases), the lateral occipital region (05 cases), the parietal to occipital region (11 cases), and the temporal region (18 cases),total scalp avulsion(15cases).(Table 3)

Table 1

Total	82
Male	48(58.5%)
Female	34(41.5%)
Age(yr)	12-68
Mean Age(yr)	44

Table 2

Scalp tumor	15(18.75%)
Infection	6(7.31%)
Burn	21(25.61%)
Scalp trauma	40(48.78%)

Table 3

Area	
Frontal	17(20.73%)
Frontoparietal	16(19.51%)
Lateral occipital	05(6.10%)
Parieto-occipital	11(13.41%)
Temporal	18(21.95%)
Total avulsion	15(18.29%)

Surgical Technique: All the patients received a routine preoperative examination. For the patients with scalp malignancies, tumor infiltration of the periosteum or skull was evaluated and excision of the skull bone was performed accordingly and for the cases due to infection, reconstruction was done when no sign of infection was there. Out of 82 cases, 44 cases reconstructed with lattismusdorsi (LD)flap, 10 cases with LD+Serratus anterior(SA) flap, 3 cases LD+SA+parascapular flap,16 cases with ALT flap , 1 case with LD+radial artery forearm flap(RAFF), 3 cases with omental flap and 3 cases with RAFF, 2 cases ALT+TFL flap.(Table 4) Facial artery and facial vein were anastomosed with the vessel pedicle of the flap passing through the subcutaneous tunnel in 48 cases and superficial temporal vessels were used as the recipient artery in 34 cases. Sizes of flap ranged from54cm^2 to 690cm^2. Follow-up period was 3 to 108months.

International Journal Dental and Medical Sciences Research
Volume 4, Issue 4, July-Aug 2022 pp 66-75 www.ijdmsrjournal.com ISSN: 2582-6018

Table 4

LD	44(53.65%)
LD+SA	10(12.20%)
LD+SA+parascapular	03(3.66%)
ALT	16(19.51%)
RAFF	03(3.66%)
LD+RAFF	01(1.22%)
Omental	03(3.66%)
ALT+TFL	02(2.44%)

CASE1- A 40 yrfemale patient came with history of scalp avulsion injury from fodder cutting machine. Here,LD flap was used and anastomosis was done with facial vessels and grafting was done over muscle. Post op results were satisfactory with 100% graft take.(figure 1)

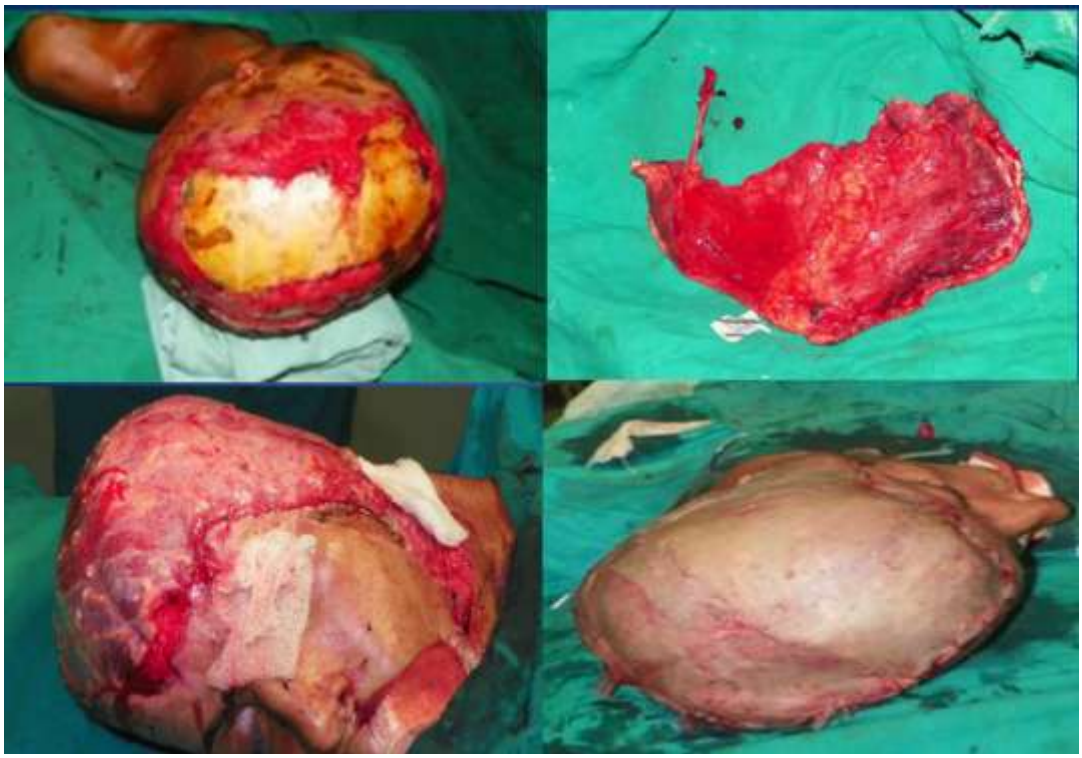

Figure 1-LD flap

CASE2- A 47 yr old female patient came with history of scalp avulsion injury from fodder\cutting machine. The patient had fractured right forearm bones and mild pleural effusion on right side. After management of associated trauma, patient was planned for reconstruction of scalp defect and chimeric flap including LD +Serratusanterior+parascapular was raised based on subscapular vessels and anastomosis was done to facial vessels using vein graft as the flow in superficial temporal vessels was low. Flap healed well in postop period.(figure 2)

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Figure 2-LD+SA+parascapular flap

CASE3- A 40 year old patient came with history of post burn squamous cell carcinoma with involvement of cranium, after removing the cranium reconstruction with ALT flap was done ,simultaneously dura was reconstructed with vascularized TFL based on transverse branch of lateral circumflex scapular vessels and anastomosis with superficial temporal vessel was done. In post op period flap settled well. Later radiotherapy was also given to the patient.(figure 3)

International Journal Dental and Medical Sciences Research
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Figure 3-ALT+TFL flap

Figure 4-post op at 15 days

CASE5- A 50 yr old female came with bare skull after scalp avulsion injury. After proper debridement reconstruction was done using omental free flap with STSG. There were no major complications in the post operative period apart from post operativeileus.Flap was well settled in post op period.(figure 5,6,7)

International Journal Dental and Medical Sciences Research
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Figure 5-showing scalp avulsion.

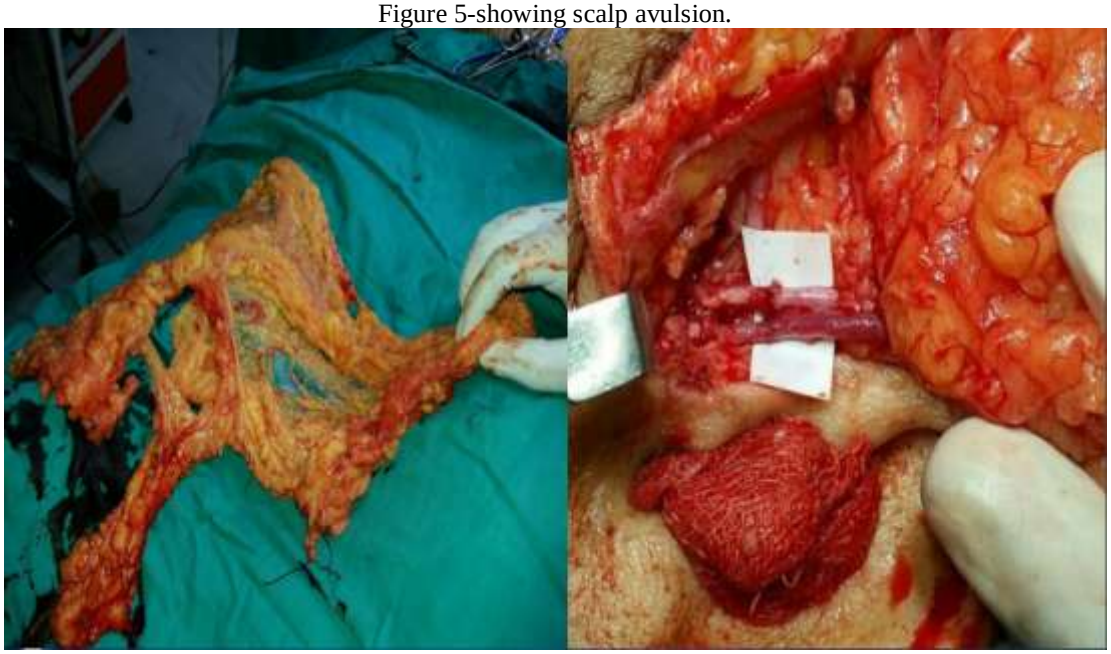

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Figure 6-showing omental flap

Figure 7-post op at 3months

CASE6- A 50 year old patient came with mucormycosis infection post covid, debridement of dead skin and cranium was done and under amphotericin cover reconstruction done with ALT flap , anastomosis to superficial temporal vessel done with good post op results.(figure 8)

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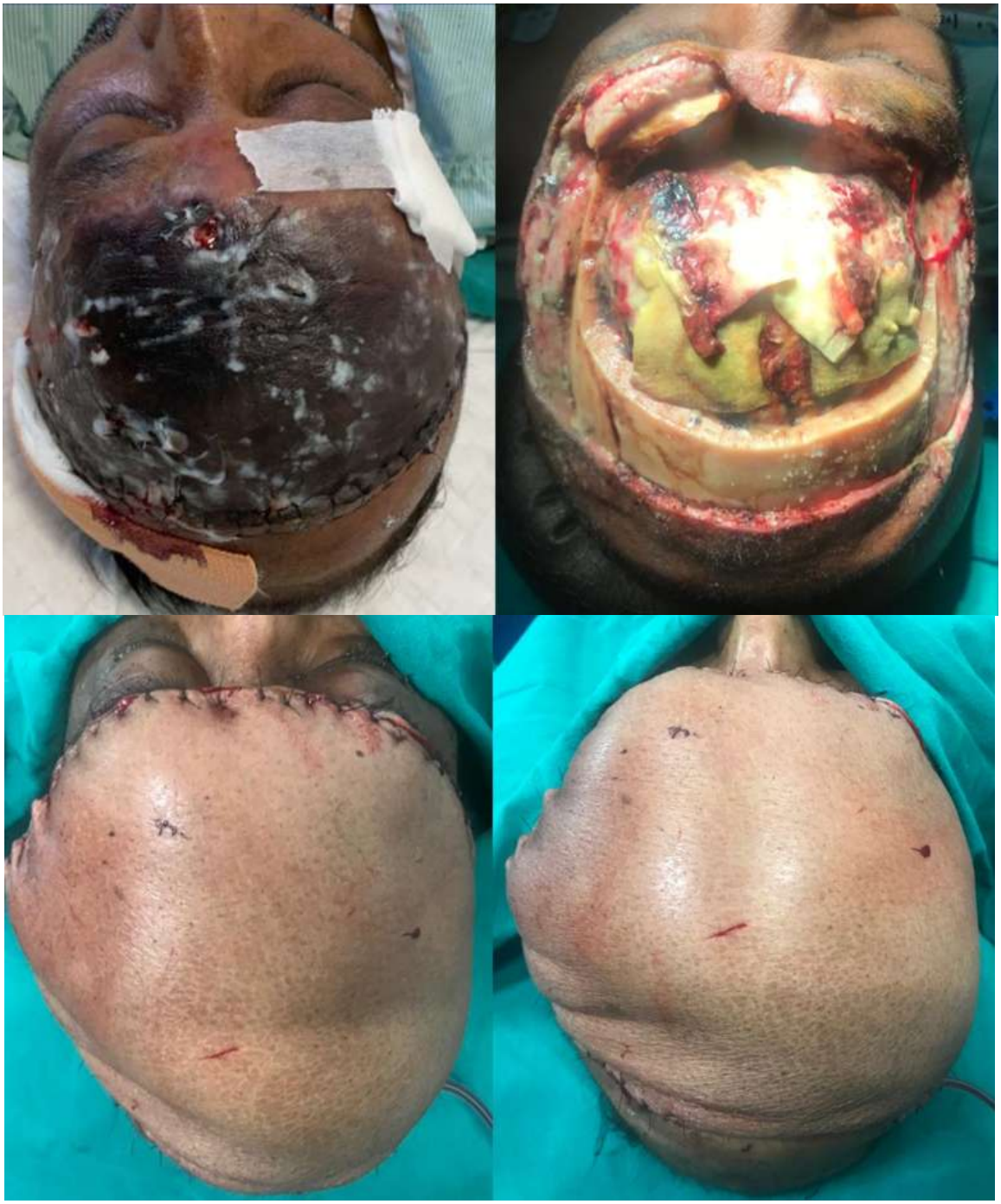

Figure 8-showing post mucor defect reconstructed with ALT flap.

III. RESULTS

Free flaps proved to be extremely reliable, Only 5 cases showed partial changes in flap (3 LD and 2 ALT) which were managed conservatively and 1 case of LD flap had complete necrosis which was later reconstructed by ALT flap and 1 case of ALT had necrosis which was later skin grafted. All patients ultimately achieved full defect coverage. In 08 patients re-exploration was done.Wound dehiscence was found in 5cases, which was healed after resuturing in 3 cases and keeping on dressings in 2 patients which was later grafted .No secondary infection occurred. Donor sites of 51 patients were primarily closed while 31 patients received split-thickness skin grafting.

IV. DISCUSSION

Scalp reconstruction for large defect is an ardous problem to deal with. Primary closure, local flap transposition or regional flaps are insufficient for reconstruction of large defects. Many factors of each patient should be taken into consideration.[5] For example; the condition of the adjacent scalp of the defect, concomitant scalp and calvarial defects, scalp defects with previous foreign material implantation, the possibility of subsequent radiotherapy, and the general condition of the patient are all closely related to the reconstructive choice.

LD flap can be used in extensive scalp defects even in total scalp avulsion. The latissimusdorsi can be harvested with and without a skin paddle. The muscle flap is typically covered with skin graft. Skin paddle elevated with muscle is usually small in size and used mainly for flap monitoring. We almost always close the donor site without using graft to reduce donor site morbidity.[6]

When LD flap cannot completely cover the scalp defect mostly in cases of near total scalp avulsion we can also include serratus anterior muscle based on serratus branch of thoracodorsal vessels. Mostly, this is able to cover complete scalp and in some cases we also included parascapular flap based on descending branch of circumflex scapular vessel. Both circumflex scapular and thoracodorsal are branch of subscapular artery. Hence, this chimeric flap can be raised on single pedicle. .

The radial forearm free flap is an underutilized option for reconstruction of complex scalp defects. Even a moderate size flap can be raised specially in patients who are healthy and good arm circumference. Advantages of the radial forearm free flap include the ability to harvest without having to reposition the patient and shorter operative times.[7]

Omental flap is also one of many options in the basket of free flaps.The average omental length is 24 to 25 cm, with an average width of 33 to 35 cm. The omentum is one of the largest autologous composite tissues available for transplantation (i.e. 792-875 cm^2). As a result of its excellent microcirculation and phagocytic activity, the omentum is particularly suited to reconstruction of an unsuitable and compromised recipient site.Positive attributes of the omental flap include its vascularity, long pedicle length and malleability, which allow the tissue to fold and conform to a three dimensional wound. Another advantage of omental flap is that there is no need to change position of the patient. The necessity of laparotomy and post-operative ileus is the obvious disadvantage, and previous abdominal surgery may preclude use of omentum.[8]

ALT flap is one of the robust flap available to cover large scalp defect. The anterolateral thigh flap allows various options for reconstruction. Its vascularized fascial component enables simultaneous dural reconstruction without additional donor-site morbidity. We can also raise TFL based on transverse branch of lateral circumflex femoral vessel.The ALT flap provides a large skin area. Also no change in position required and two team approach can be followed. It may be pleasing when a large defect reconstruction is the primary issue; however, donor-site morbidity increases with increased dimensions of the flap, eliminating the option of primary closure.[9]

V. CONCLUSION

The scalp represents a unique tissue for which there is no completely adequate substitute, still the ability to reconstruct scalp defects via free tissue transfer is possible. A variety of free flaps are available for this task, most prominently the latissimusdorsi and the ALT flap. In very large defects, the latissimusdorsi and a parascapular flap can be elevated on their common vascular tree and used as a chimeric flap. Although the reconstruction itself as well as the perioperative management can be challenging, the overall outcomes with regards to the reconstruction is good.

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