

# Our experience of scalp reconstruction in a tertiary care centre of Nepal

Bikesh Rajbhandari, Himalaya Niraula, Manish Devkota, Samit Sharma, Sangam Rayamajhi, Jayan Man Shrestha, Ishwar Lohani

## Abstract

### Introduction

Scalp defects are difficult to manage due to their inelastic nature, thus possess significant surgical and aesthetic concerns. The objective of the study was to analyse various scalp defects in terms of their clinical presentation, management and outcome in the context of Nepal.

### Methods

This was a retrospective review conducted by analysing clinical records of all the scalp reconstructions performed at Tribhuvan University Teaching Hospital (TUTH) from May 2018 to March 2021.

### Results

Among the 69 patients operated there were 37 females and 32 males. Most patients were in the age group of 0-10 years and 31-40 years with mean age of 30 years. Most common cause for defect was trauma (27 cases), followed by post oncologic resection (15), burn (11), raw area post craniotomy (7) and benign scalp lesions in 9 cases. Skin grafting was the most common procedure performed (16 cases), followed by transposition flap (15), primary closure (13), rotation flap (9) and free flap in 4 cases. Four patients had tissue expander placed over the scalp. Four patients had developed graft loss, two had infection post operatively requiring intervention, five had wound dehiscence and there was one free flap failure. There were two mortalities both due to pneumonia post operatively.

### Conclusion

Defect size, location, presence or absence of pericranium and quality of surrounding scalp tissue all influence the selection of reconstructive technique.

**Keywords:** Rotation flap; Scalp reconstruction; Skin grafting; Tissue expansion; Transposition flap.

### Author affiliations:

Department of Plastic Surgery and Burns, Maharajgunj Medical Campus, Institute of Medicine, TUTH

### Correspondence:

Dr. Bikesh Rajbhandari,  
Department of Plastic surgery and burns,  
Maharajgunj medical campus, TUTH,  
Kathmandu, Nepal.

Email- bikeshrb65@gmail.com

ORCID: <https://orcid.org/0000-0002-9667-3837>

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## Introduction

Scalp is a difficult site to repair as it possesses a unique anatomical and aesthetic feature. Most of the scalp skin is relatively inelastic, has a convex surface and repair of even small defect is relatively difficult.<sup>1</sup> A thorough understanding of scalp anatomy is paramount in deciding different reconstructive options. The scalp is composed of five layers and can be remembered via mnemonic @SCALP: Skin, subcutaneous Connective tissue, galea Aponeurotica, Loose areolar tissue and Pericranium. The first three layers are bound together forming a simple unit that slides along the loose areolar tissue over the pericranium. Scalp has a rich vascular supply, is able to withstand a great amount of tension and due to presence of hair is able to camouflage resulting scar and asymmetries.<sup>2</sup> Presence of robust choke vessel system allows relatively long local flap to survive without distal tip necrosis.<sup>3</sup>

Reconstruction of the Scalp can be simple or complex. Over the past few decades, an improved understanding of surgical anatomy, increased experience with tissue expansion and development of microsurgical technique have contributed greatly to the ability of surgeons to repair these defects.<sup>3</sup> Multiple reconstructive options are available as per reconstructive ladder, starting from healing by secondary intention, primary wound repair, skin grafts, local flaps with or without tissue expansion, regional flaps and micro vascular free flaps. Reconstruction is dictated primarily by the etiology, size, depth and location of the defect and is accomplished by simplest means possible following the reconstructive ladder. While considering the reconstructive options the plan must be tailored to the individual patient's needs and due attention must be given to the aesthetic features, like preservation of hairline, orientation of hair follicles and avoidance of alopecia.<sup>1</sup> Scalp defects may result from trauma, burn, infection, oncologic resection, radiation and congenital abnormalities. The objective of the study was to analyse various scalp defects in terms of their clinical presentation, management and outcomes in Nepalese context.

## Methods

This was a retrospective review conducted by analysing the clinical records of all the scalp reconstructions performed at Tribhuvan University Teaching Hospital (TUTH) from May 2018 to March 2021. Relevant data pertaining to the study were examined like patient demographics, past medical and surgical history, nature of the primary scalp or intracranial disease, size-location-nature of scalp defect, method of reconstruction, intra and post-operative complications and duration of hospital stay. The final choice of reconstructive method was determined based on wound related parameters like size, location and depth of the defect.

During the study period, a total of 69 cases of scalp reconstruction were undertaken under the department of Plastic Surgery and Burns, TUTH. The etiologies for the

scalp defect requiring reconstruction were burns (thermal, electric), road traffic accidents, malignancies, animal attack, machinery injuries, domestic accidents and various benign scalp lesions.

Patients presenting with burns were initially resuscitated and taken for surgery, once stabilized. Patients presenting with trauma were evaluated at Emergency Room (ER) for other associated injuries and those with other associated injuries were treated by respective departments and were transferred to department of plastic surgery for scalp reconstruction. Some of the cases requiring multidisciplinary intervention were managed under the same operative window.

## Results

A total of 69 patients were operated, among them 37 were females and 32 were males (**Figure 1**). Most of the patients were in the age group of 0-10 and 31-40 years, with mean age of 30 years (**Figure 2**). The size of the defect ranged from 1cm<sup>2</sup> with exposed implant to the involvement of entire scalp.

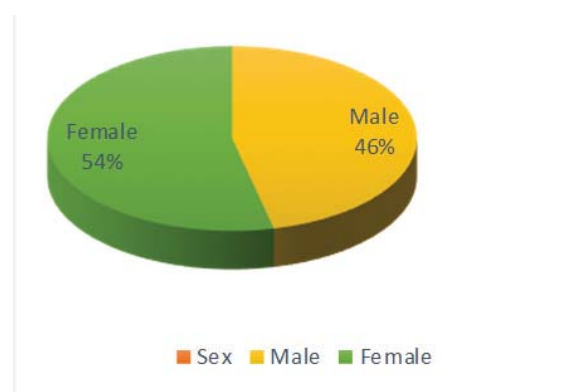


Figure 1. Sex distribution

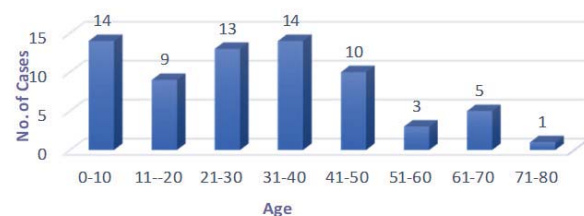


Figure 2. Age distribution

The most common cause of defect was trauma with 27 cases, followed by malignancy requiring oncologic resection in 15 cases (**Table 1**). Of the trauma cases, 12 were road traffic accidents, three were fall from height, seven had their hair caught in machine leading to avulsion injury and there were five cases of animal attack with four cases of bear maul and one case of dog bite (**Table 2**). There were seven cases requiring reconstruction post craniotomy. There were 11 cases requiring reconstruction

**Table 1. Primary condition of the scalp requiring reconstruction**

Primary condition of scalp	No. of cases
Trauma	27
Malignancy	15
Burn	11
Raw area post craniotomy	7
Cutis vertices gyrata	2
Nevus sebaceous	2
Scalp hemangioma	2
Dermoid cyst	1
Nevus verrucous	1
Coup de sabre	1

post burn. The most common site of involvement was frontal/ frontoparietal region (27%), followed by temporal/ temporoparietal region (25%), occipital region (21%), parietal region (13%), vertex (10%) and the least involved was the entire scalp accounting to 3% of total cases (Table 3).

Skin grafting was the most common procedure performed in a total of 16 cases, followed by transposition flap in 15 cases, primary closure in 13 cases, rotation flap in 9 cases and free flap in 4 of the cases. Four patients had tissue expander placed over the scalp (Table 4). Among the free flaps there was one case of anterolateral thigh flap, one case of chimeric latissimus dorsi and serratus anterior flap, one case of radial artery fasciocutaneous flap and one case of latissimus dorsi flap.

**Table 2. Different causes of trauma presenting to our institute**

Trauma	No. of cases
Road traffic accidents	12
Hair caught in machine	7
Animal attack	5
Fall from height	3

Two patients had intraoperative complications. One had moderate to severe blood loss requiring intraoperative blood transfusion and the other had hypotension requiring halting of the procedure. There were four cases of graft loss requiring re-graft, five cases of wound dehiscence/ flap tip necrosis of local flap requiring debridement and secondary closure or additional local flap to close the defect. Two patients developed wound infection after local flap, requiring intervention. There was one free flap loss, a case of radial artery fasciocutaneous flap done after wide local excision of Marjolin ulcer (Table 5).

All those cases, who underwent split thickness skin grafting (STSG) had alopecia over the grafted site. In cases of Marjolin ulcer, majority had burn during their infancy with mean duration between burn and development of lesion being 37 years. During the study duration, there were two mortalities. First was the case of raw area over the scalp

**Table 3. Distribution of site of reconstruction**

Site of Injury	No. of cases
Frontal / Frontoparietal region	27%
Temporal / Temporoparietal region	25%
Occipital region	21%
Parietal region	13%
Vertex	10%
Complete scalp	3%

post craniotomy, who had undergone transposition flap+ STSG. Patient developed ventilator associated pneumonia during post-operative period and the second was the case of latissimus dorsi free flap post wide local excision for SCC of scalp and the cause of mortality here was also pneumonia. The shortest hospital stay was of two days following excision of dermoid cyst and primary closure and the longest hospital stay was of 71 days following latissimus dorsi free flap for bear maul ( due to multiple reconstructions).

**Table 4. Distribution of different methods employed for reconstruction**

Method of reconstruction	No. of cases
Primary closure	13
Skin grafting	16
Transposition flap	15
Rotation flap	9
Tissue expander	4
Temporalis muscle flap	1
Flap re-elevation and re-positioning (Crane principle)	1
Free flap	4
Secondary suturing	1

**Table 5. Complication of scalp reconstruction**

Complications	No. of cases
Graft loss	4
Infection	2
Wound dehiscence	5
Free flap loss	1
Intraoperative Hypotension	1
Intraoperative blood loss	1

## Discussion

A sound understanding of the anatomy of the scalp is paramount for planning scalp reconstruction. One feature of scalp is the limited elasticity as compared to other tissues, primarily due to underlying galea and pericranium. This basically limits options for primary closure except in relatively small defects. Extensive undermining and creation of large rotation flaps are often required even for

relatively small defects.<sup>4</sup> As scalp also carries an aesthetic importance, the surgeon must also consider the hairline and avoidance of alopecia rather than just closure of the defect.

There are multiple methods employed for surgical treatment of scalp defects and it is useful to approach the defect using the basic concept of reconstructive ladder from simple skin closure to skin graft, local flap, regional flap and ultimately to free flap. Further, patient may present with CSF leak, exposure of the allograft material or non-vascularized bone grafts or hardware, making the process of wound closure even more demanding and tedious.<sup>4</sup> The arteries of the scalp originate from periphery and ascend toward the vertex, thus scalp flaps have their bases peripherally.<sup>1</sup>

A primary closure is the first surgical options for smaller defect. Usually only the defects with less than 3cm in diameter or < 5cm<sup>2</sup> area are amenable to primary closure.<sup>5</sup> Attempt at closure of larger wound would create undue tension often resulting in wound breakdown. In our study most of the wounds post trauma with diameter less than 3cm or area less than 5cm<sup>2</sup> were closed primarily. However in chronic wound, especially after craniotomy with exposed bone or implant, flap cover was attempted even for smaller wounds.

Split thickness skin graft is an option when the wound bed is well vascularized. An intact pericranium or presence of healthy granulation tissue is required for adequate graft take. Graft over the bone devoid of pericranium has low probability of survival. However, the survival could be improved by burring the outer table to expose the vascularized diploic space, where graft could be placed.<sup>3</sup>

In our study the most common method for reconstruction was split thickness skin graft. The most common indication was raw area post trauma. Others being post excision of benign scalp lesions and burns. There were seven cases of hair being caught in the machine causing scalp avulsion. In one case, we attempted to graft the skin, harvested from the avulsed scalp. All patients presented late, so revascularization couldn't be attempted. These are fairly rare but serious injury, resulting in defects of hair bearing skin. They are potentially life threatening, owing to the fact that scalp is highly vascular and might lead to massive blood loss. One of our patients had severe intra-operative blood loss requiring intraoperative blood transfusion. These patients are also more prone to develop cervical spine, brain and brachial plexus injuries due to sudden traction force. One of our patients had simultaneous brachial plexus injuries, which required exploration and nerve transfer. One of the complications of STSG is alopecia, creating an unaesthetic appearance.

For the moderate sized defect local flaps may be planned and is advantageous as it transfers hair bearing area to the defect and minimizes alopecia and it provides like-with-like tissue creating a more favourable appearance. Local flap is the most feasible method for reconstructing scalp defect for

size <150cm<sup>2</sup> with fewer complication rate.<sup>6</sup> The designs of local flaps should incorporate at least one major scalp vessels. The axial component of blood supply ranges from 2-7 cm from the vessel origin and beyond which the supply is of random pattern.<sup>7</sup> Thus the designs of flaps should be limited to defects near the axial vessels to increase the flap reliability. In our study, there were a total of 25 local flaps, with nine rotation flaps, 15 transposition flaps and one temporalis muscle flap. We had one case of coup de sabre involving forehead and frontal region, which was excised and managed via Z-plasty. The flaps were designed large enough to cover the defect. The secondary defect was closed primarily in rotation flap, however in case of transposition flaps, the secondary defect was skin grafted. The dog ear that formed during the transposition flap was not corrected in fear of compromising the vascularity.

One young female patient had a moderate sized raw area over the left frontal and forehead region with exposed bone, which was covered via transposition flap. This led to transfer of hair bearing tissue to forehead. Thus in second setting the transposed flap was re-elevated and transferred back to the original donor site leaving behind a thin vascularised tissue over the bone, which was subsequently skin grafted. This was based on the concept of crane principle. This is a technique that temporarily transfers a scalp flap to the defect and the flap is again returned to its original location later, leaving behind a layer of soft tissue that is used to nourish the skin graft.<sup>8</sup>

Tissue expansion is an important tool for providing donor skin with a match in terms of skin colour, texture and hair bearing characteristics.<sup>9</sup> Scalp defects involving upto 50% of total area can be reconstructed with expanded scalp tissue.<sup>9</sup> An inflatable sac is implanted subcutaneously and is periodically inflated by injecting normal saline via a port. The overlying skin is expanded under the mechanical stretch, providing a supply of tissue similar in colour, texture to that of defect area. Once inflated to desired size, the expander is removed, and advancement or rotation of flap is planned appropriately for defect closure. Tissue expansion requires a healthy, well vascularised expandable tissue, free of infection along with patient compliance for prolonged reconstruction procedure and stable calvarial coverage during the expansion process. A total of four patients underwent tissue expansion placement, all for post burn alopecia coverage. One patient required re-positioning of expander. After the adequate expansion, expanders were removed and flaps transposed or advanced to cover the area of alopecia with acceptable result. Tissue expander is a reliable and safe option for reconstructing post burn alopecia with a good outcome.

Free tissue transfer can be a good option for moderate to large sized defects. However, its selection depends on multiple factors such as size of the defect, vascular pedicle length, size and thickness of the flap, donor site morbidity and surgeons' preference. With free flap we do not get a hair bearing tissue but a good quality tissue in pliability

and quantity. Numerous free flaps have been described for scalp reconstruction. The free latissimus dorsi (LD) muscle flap is one of the most preferred option for repairing large defects. The muscle is thin, broad, well vascularised, with adequate pedicle size and length and further atrophy of the muscle in due time maintains the contour, close to that of native scalp. They are usually harvested without a skin paddle and covered by skin graft. If a large amount of tissue is needed a chimeric flap including serratus anterior muscle and latissimus dorsi muscle can be harvested based on subscapular vessels.

Other free flaps that can be used are rectus abdominis myofascial or myocutaneous flap, radial artery fasciocutaneous flap, anterolateral thigh flap (ALT), and omental flap. Anterolateral thigh flap has been gaining popularity lately. The superficial temporal vessels are frequently used as the recipient vessels. Occasionally the occipital and even neck vessels can also be used as a recipient with or without vein graft. Selection of reliable flaps with straightforward harvest, large calibre vessels and long pedicle length, helps for successful transfer and also minimize the rate of complications. One chimeric LD and serratus anterior free flap was done for a case of raw area over the scalp caused by bear maul. One radial forearm fasciocutaneous flap was attempted for Marjolin ulcer after wide local excision, along with duroplasty. Unfortunately the flap failed and had to undergo debridement. The wound was later covered by a transposition flap. One young female presented with non-healing ulcer in old scalp burn wound infested with maggots. The wound was debrided, with removal of all the maggots. There was breach of the calvarium and the maggots had even invaded the brain parenchyma, which was meticulously removed by neurosurgical team. The final wound was covered by anterolateral thigh flap. The post-operative course was uneventful. One latissimus dorsi free flap was done for a

raw area post wide local excision done for SCC of the scalp. However, patient developed pneumonia postoperatively and died. The flap was viable up till the time of death.

In the context of third world countries like ours, most of the scalp cases are due to trauma and road traffic accidents. Other notable mode of injury is machinery accidents. Females are more prone, for their hair can get caught in the machine leading to avulsion injury. Appropriate education regarding occupational safety and personal protection around machine could protect most of these cases.

In regard to malignant lesions of the scalp, most of these patients present late due to lack of education, negligence or lack of easy accessibility to nearest health services. By the time they present, its already late requiring massive undertaking. Also most of these patients are lost to follow up. So unlike our western counterpart, we deal with more compromised patient on the backdrop of poor socioeconomic condition. Hence, in our setting, our scalp reconstruction protocol has to be tailored accounting these factors too.

## Conclusion

The defect size, location, presence or absence of pericranium and quality of surrounding scalp tissue all affect the selection of the reconstructive technique ranging from simplistic approach to the higher reconstructive options mainly free tissue transfer. Further lesser financial stability, negligence, delayed presentation and higher chances of loss to follow up are added factors that need to be addressed in reconstructive plan unlike our western counterpart. Thus by using different options from our varied armamentarium we can cover almost all of the scalp defects that we encounter.

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