Patna Journal of Medicine
An official journal of ***Indian Medical Association, Bihar State Branch***

ORIGINAL ARTICLE

Scalp Wound: Clinical Experience on Various Modalities of Reconstruction

Sreepriya PP, Anupama Kumari, Varun H Kashyap, Ansarul Haq, Veena K. Singh

Department of Burns & Plastic Surgery, AIIMS, Patna, Bihar, India

Abstract

Introduction: Scalp defect reconstruction becomes imperative in cases of acute trauma, tumour removal, radiation-induced necrosis, and for enhancing cosmetically undesirable scars or alopecia. Surgeons should carefully select the most suitable reconstructive procedure for individual patients, considering variables such as defect dimensions, depth, location, proximity to the hairline, and the potential risk of alopecia. We aim to compare and analyze cases conducted within a single centre over the last 1-year.

Method: A retrospective study was done from 1st January 2023 to 31st December 2023. We included all the patients who underwent scalp reconstruction for various aetiologies and excluded patients with minimal skin defect who underwent primary closure.

*Result:*Post-traumatic was the most common etiology. The method of reconstruction has been affected significantly by the depth of defect ($p< 0.05$). Major complications were flap necrosis and skin necrosis.

Conclusion: A myriad of factors influences the selection of scalp reconstruction methods.Achieving successful scalp reconstruction demands meticulous preoperative strategizing and meticulous execution during surgery.

Keywords: Scalp wound, Scalp reconstruction
Patna Journal of Medicine. 98(2): 2024

INTRODUCTION

Scalp is a protective shield for the cranial bones, shielding the brain from external elements,[1] and is a significant aesthetic feature due to its hair-bearing nature.

Scalp defect reconstruction becomes imperative in cases of acute trauma, tumour removal, radiation-induced necrosis, and for enhancing cosmetically undesirable scars or alopecia.

Embarking on a journey through time, the evolution of scalp reconstruction unveils a captivating narrative, In1696, French surgeon Augustin Belloste advocated for the fenestration of the exposed cranium to facilitate granulation tissue formation and later epithelialization[2] and this practice persisted till Netolitzky (1871) introduced the technique of using skin grafts following the development of granulation tissue.[3] Shortly thereafter, multiple authors demonstrated reconstruction using local flaps. Kazanjian illustrated that galeal scoring facilitated additional advancement of local flaps.[4] Orticochea introduced three flaps technique for large scalp defects in 1971.[5] Manders et al. (1984) documented the reconstruction of approximately fifty percent of the scalp using hair-bearing tissue through tissue expansion.[6]

In 1976, Miller *et al*. replanted a completely avulsed scalp, resulting in normal hair growth and frontalis function.[7] Historically, the first described scalp reconstruction with a free flap was by McLean and Buncke who used a free omental flap.[8]

Surgeons should carefully contemplate strategies for scalp reconstruction to ensure minimal disruption to the natural hairline and, ideally, to mitigate the occurrence of scars, alopecia, or deformities.[9] Surgeons should carefully select the most suitable reconstructive procedure for individual patients, considering variables such as defect dimensions, depth, location, proximity to the hairline, and the potential risk of alopecia.

We aimedto compare and analyse scalp reconstruction cases conducted within a single center over the last 1 year.

Corresponding email: *sreepriyapp94@gmail.com*

METHODOLOGY

A retrospective study was done from 1st January 2023 to 31st December 2023. We included all the patients who underwent scalp reconstruction for various aetiologies and excluded patients with minimal skin defects who underwent primary closure. Demographic data and details of examination and follow-up were collected from records. The consent to use the details and photographs was obtained from patients and the study was approved by the institutional ethical committee.

We gathered data on defect etiology, location, size, depth, reconstructive techniques used, postoperative complications, and the need for revision surgery. Defect locations were categorized into three groups: frontoparietal/vertex, temporal/temporoparietal, and occipital areas. Defect sizes were classified as small (<10 cm^2), medium (10–50 cm^2), or large (>50 cm^2). The depth of defects was categorized as either soft-tissue defects without cranial bone exposure or defects involving exposure of cranial bone or dura mater. Reconstructive techniqueswere categorized into primary closure, skin graft, local flap, pedicled regional flap, and free flap.[1]

Major complications encompass flap necrosis, thrombosis, and skin graft necrosis, all necessitating revision surgery under general anesthesia. In contrast, minor complications involved issues such as flap congestion, partial loss of the skin graft, infection, hematoma, and wound dehiscence, which were successfully managed with conservative treatment measures.

RESULTS

16 patients were included in the study.Table 1 shows the etiology of the scalp reconstructions. Post traumatic was the most common etiology (5 cases), after that postoperative soft-tissue defect (4 cases), postinfectious soft-tissue defect (4 cases) and post-malignant tumour resection(3 cases).

Table 1: Etiology of scalp reconstruction (n=16)

Etiology	Cases (%)
Tumour resection	18.8
Soft-tissue defect	
Posttraumatic	31.3
Post surgery	25
Postinfectious	25

Defect classification and reconstructive proceduresare described in Table 2. The reconstruction of scalp defects was conducted in the frontoparietal/vertex in 6 cases and temporoparietal area in 8 cases, and in the occipital area in 2cases. The scalp defects were performed in 16 cases of small size,12.5%, medium size was 62.5%, and 4 cases (25%) of large size. In terms of the depth of scalp defects, there were 7 soft-tissue defects without cranial bone exposure and 9 soft-tissue defects with cranial bone or dura mater exposure.

Table 2. Defect classification and reconstructive procedures (n=16).

Variable	No. of cases (%)
Location	
Frontoparietal/vertex	37.5
Temporal/temporoparietal	50
Occipital	12.5
Size	
Small (<10 cm^2)	12.5
Medium (10–50 cm^2)	62.5
Large (>50 cm^2)	25
Depth	
Cranial bone exposure (–)	43.8
Cranial bone or dura mater exposure (+)	58.3
Reconstructive procedures	
Skin graft	37.5
Local flap only	25
Local flap + skin graft	25
Regional flap only	0
Regional flap + skin graft	6.3
Free flap	6.3

Figure 1: The post-traumatic scalp avulsion wound coverage with SSG.

Figure 2: Post-traumatic scalp avulsion wound coverage with rotational flap done in a 12-year-old female child.

Table 3: Defect classification and reconstructive procedures (n=16).

	Reconstructive procedures				
Variable	**Skin graft**	**Local flap**	**Regional flap**	**Free flap**	**p-value**
Size					
Small (<10 cm^2)	0	2	0	0	0.082
Medium (10–50 cm^2)	3	2	5	1	
Large (>50 cm^2)	3	0	0	0	
Depth					
Cranial bone exposure (–)	6	1	0	0	0.012
Cranial bone or dura mater exposure (+)	0	3	5	1	

The choice of method has been affected by the defect depth ($p< 0.05$), which was significant.

Figure 3: Case of a post-infectious wound with exposed dura placed titanium mesh and transposition flap were performed to cover the scalp defect and the donor site was covered with STSG.

Figure 4: The reconstruction of post-traumatic scalp wound with a latissimus dorsi muscle free flap.

Table 4. Complications of scalp reconstruction.

Complications	**No. of cases**
Major complications	
Flap necrosis	12.5
Skin necrosis	12.5
Minor complications	
Flap congestion	6.3
Hematoma	6.3
Skin necrosis	0
Dehiscence	12.5
Infection	0

There were 4 major complications andminor complications each (Table 4). There were 2cases of flap necrosis andno cases of skin necrosis within the major complications group. Figure 5A shows patient underwent pedicled trapezius flap cover for temper-occipital wound in which distal end of the flap got necrosed and needed debridement and secondary suturing, figure 5B shows post-traumatic scalp avulsion wound covered with skin graft showing graft loss, which got secondarily healed with regular dressing.

Following the patient's split-thickness skin graft (SSG), alopecia became evident (figure 6). As a secondary procedure, w-plasty and z-plasty techniques are viable options to alleviate the visibility of aprolonged alopecic scar. Additionally, microfollicular hair grafting stands as a popular approach to addressing this concern.

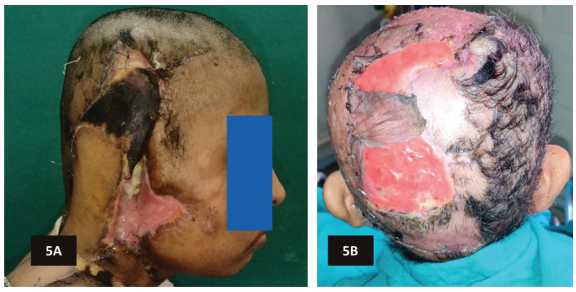

Figure 5: Flap necrosis and graft loss.

Figure 6: Post-SSG alopecia.

DISCUSSION

The scalp and forehead have similar layered anatomy. Throughout history, addressing extensive and intricate scalp defects has typically entailed navigating through multiple stages of the reconstructive

process.[13] From historical management techniques involving trephination of the outer table of the skull for scalp avulsion injuries to modern advancements in microsurgery enabling free tissue transfer, the evolution of scalp reconstruction techniques has mirrored the progress in plastic surgery.

Rotation-advancement flaps, utilizing the scalp mobility from the parietal regions, stand as the cornerstone of reconstructive techniques.

Ensuring the appropriate planning of these flaps involves several key considerations: maintaining the natural hairline, redirecting hair follicles into desired patterns, integrating major vascular pedicles, and achieving closure without tension.

Several approaches are available for the surgical management of scalp defects, and a range of surgical algorithms have been suggested for this purpose.[10] Skin grafts are generally not the first choice for scalp reconstruction, as they can lead to less favourable cosmetic outcomes, such as alopecia, color mismatch, and height differences. Nevertheless, in select cases, they can be considered a suitable option if a well-vascularized tissue bed is available.[11] Local flaps appear to be the most feasible method for reconstructing scalp defects less than 150 cm^2 with a low complication rate (3.4%).[1] it also minimizes alopecia by covering defects using hair-bearing tissue and it provides "*like with like*" tissue.

In our study, we found that as the size of the defect increases, the likelihood of opting for a skin graft as the preferred method for donor site closure also rises. However, this approach often leads to unavoidable alopecia. On the other hand, utilizing a free flap offers a more aesthetically pleasing outcome, as it provides adequate volume to address the scalp deformity, which aligns with findings from previous studies.[12]However, our study revealed that only one free flap procedure was conducted, and regrettably, it did not achieve satisfactory cosmetic results.

When a patient's overall health condition does not allow for reconstruction surgery under general anaesthesia, conservative methods such as secondary intention healing or vacuum-assisted closure should be considered. This study does not mention it, but we have managed a small number of patients through a process involving debridement followed by 1-2 sessions of negative pressure wound therapy. After granulation, split-thickness skin grafting was performed, yielding favourable outcomes (Figure 7).

There are some limitations in this study. The data was evaluated retrospectively and the operations were not performed by only one surgeon, so the choice of reconstruction method was affected somewhat by the surgeon's preference. We didn't consider patients with cardiovascular disease, diabetes mellitus, or other comorbidities as well as socioeconomic status that can influence the outcome of our study. We had a small sample size.

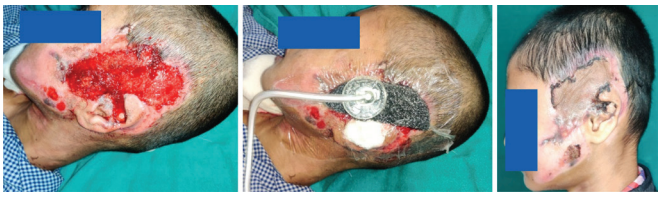

Figure 7: Post-traumatic wound over the auriculotemporal region, treated with negative pressure wound therapy and given SSG later.

CONCLUSION

A myriad of factors influences the selection of scalp reconstruction methods achieving successful scalp reconstruction demands meticulous preoperative strategizing and meticulous execution during surgery. A thorough understanding of the anatomy of scalp, biomechanics and physiology of skin and hair, and the diverse array of local tissue rearrangement techniques contributes to achieving superior aesthetic outcomes.

Consent

Informed consent was obtained from the patients for this study and accompanying images.

Conflicts of Interest

None.

REFERENCE

1. Desai SC, Sand JP, Sharon JD, Branham G, Nussenbaum B. Scalp reconstruction: an algorithmic approach and systematic review. JAMA Facial PlastSurg2015;17:56-66.
2. Strayer LM. Augustin belloste and the treatment for avulsion of the scalp: The odd history of an operation in head surgery. N Engl J Med [Internet]. 1939;220(22):901–5. Available from: http://dx.doi.org/10.1056/nejm193906012202201
3. Klasen HJ. Skin grafting by the reverdin method and subsequent developments. In: History of Free Skin Grafting. Berlin, Heidelberg: Springer Berlin Heidelberg; 1981. p. 9–46
4. Vh K. Repair of partial losses of the scalp. PlastReconstrSurg [Internet]. 1946;12(5):325–34. Available from: http://dx.doi.org/10.1097/00006534-195311000-00003
5. Orticochea, M. New three-flap reconstruction technique. Br. J. Plast. Surg. 24: 184, 1971
6. Manders EK, Graham WP 3rd, Schenden MJ, Davis TS. Skin expansion to eliminate large scalp defects. Ann PlastSurg [Internet]. 1984;12(4):305–12. Available from: http://dx.doi.org/10.1097/00000637-198404000-00001
7. Miller GD, Anstee EJ, Snell JA. Successful replantation of an avulsed scalp by microvascular anastomoses. PlastReconstrSurg [Internet]. 1976;58(2):133–6. Available from: http://dx.doi.org/10.1097/00006534-197608000-00001
8. Sierakowski K, Solanki NS, Riddell P. Total scalp excision and reconstruction using a free omental flap. Eplasty. 2015;15:ic58.
9. Leedy JE, Janis JE, Rohrich RJ. Reconstruction of acquired scalp defects: an algorithmic approach. PlastReconstrSurg [Internet]. 2005;116(4):54e–72e. Available from: http://dx.doi.org/10.1097/01.prs.0000179188.25019.6c
10. Temple CLF, Ross DC. Scalp and forehead reconstruction. Clin PlastSurg [Internet]. 2005;32(3):377–90, vi–vii. Available from: http://dx.doi.org/10.1016/j.cps.2005.02.002
11. Mehrara BJ, Disa JJ, Pusic A. Scalp reconstruction. J Surg Oncol [Internet]. 2006;94(6):504–8. Available from: http://dx.doi.org/10.1002/jso.20487
12. Serletti JM, Higgins JP, Moran S, Orlando GS. Factors affecting outcome in free-tissue transfer in the elderly. PlastReconstrSurg [Internet]. 2000;106(1):66–70. Available from: http://dx.doi.org/10.1097/00006534-200007000-00012
13. Yeong EK, Huang HF, Chen YB, et al. The use of artificial dermis for reconstruction of full thickness scalp burn involving the calvaria. Burns 2006;32:375Y379