

A Comparative Analysis of Different Scalp Reconstruction Techniques and Their Results

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Abstract:

Background: Scalp defects, arising from various causes like trauma or burns, pose significant challenges in reconstructive surgery due to the complex nature of the scalp. This study aims to enhance understanding of different scalp reconstruction techniques, their efficacy, outcomes, and complications.

Methods: A prospective interventional study was conducted at E.S.I.C. Andheri, Mumbai, over a period of 24 months (2021-2023), involving 30 patients aged 0-70 years with non-malignant scalp defects. Data on demographics, defect characteristics, treatment methods, and outcomes were collected and analyzed. The study focused on various reconstruction techniques, including primary closure, skin grafting, and local flaps.

Results: The study included predominantly middle-aged patients (31-40 years), with a higher incidence in males (70%). Trauma was the most common cause (50%), followed by burns (33%). The temporal region was most affected (40%). The majority of defects were medium-sized (9-100 cm²), with most patients seeking treatment within 24 hours of injury. The primary treatment method was transposition flap with split skin grafting (50%).

Conclusion: Scalp defects are more prevalent in middle-aged males, with trauma being the leading cause. The temporal region is most susceptible to defects. Efficient treatment, primarily transposition flap with SSG, is vital for positive outcomes, especially for medium-sized defects.

Recommendation: Customized reconstruction strategies considering individual patient profiles and defect characteristics are essential for optimal results. Early intervention and tailored treatment plans are recommended to reduce complications and hospital stays.

Keywords: Scalp Defects, Reconstructive Surgery, Transposition Flap, Split Skin Grafting.

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Introduction

The scalp, a unique anatomical structure with distinct physiological characteristics, is susceptible to various forms of trauma and pathological conditions necessitating surgical intervention [1]. Scalp defects, whether arising from oncological resections, trauma, or burn injuries, present a significant challenge in reconstructive surgery due to the complexity of the region and the aesthetic and functional importance of the scalp [2]. The choice of reconstruction technique is crucial and depends on factors such as the size, depth, and location of the defect, as well as patient-specific variables [3].

The significance of this study lies in its potential to enhance understanding of the various reconstruction techniques, thereby improving clinical outcomes and patient satisfaction. By analyzing different methods and their results, this research contributes to the evolving field of reconstructive surgery, offering insights into the

most effective strategies for managing complex scalp defects.

This article aims to provide a comprehensive overview of the various methods employed in scalp reconstruction, comparing their efficacy, outcomes, and complications. The techniques covered range from primary closure and skin grafts to local and free flaps, each with its unique indications and limitations. The study's objective is to guide clinicians in selecting the most appropriate method for scalp reconstruction, taking into consideration individual patient needs and the specific characteristics of the scalp defect.

Methodology

Study Design: This is a prospective interventional study focusing on the reconstruction of scalp defects.

Study Setting: The research is conducted at E.S.I.C. Andheri, Mumbai.

Study Period: The study spans 24 months, from 2021 to 2023.

Population: The study population includes patients presenting with scalp defects at the hospital.

Inclusion Criteria: Patients aged 0-70 years with scalp defects due to electrical burns, trauma, benign tumors, and congenital abnormalities leading to loss of scalp tissue.

Exclusion Criteria: Patients with scalp defects resulting from malignancy are excluded from the study.

Study Size: The study encompasses 30 patients after following all the inclusion and exclusion criterias.

Bias: Efforts are made to minimize selection and observational bias through systematic patient selection and standardized data collection.

Variables: Variables include age, sex, etiology, time of presentation, site and size of the defect, associated injuries, procedures performed, timing of surgery, complications, and duration of hospital stay.

Data Collection and Analysis: Data was collected on patient demographics, defect characteristics, treatment methods, and outcomes. This data was systematically recorded and analyzed to assess the effectiveness of different reconstruction techniques.

Methodology:

Patients with electrical burns undergo initial resuscitation and, if necessary, fasciotomy or amputation. Once stable, they receive debridement and flap coverage. Trauma patients are evaluated for associated injuries before undergoing similar treatment. Reconstruction methods include primary closure, skin grafting, and local flaps.

Reconstructive Options for Scalp: The study evaluates multiple reconstructive options, acknowledging that each has its advantages and disadvantages. The primary goals are stable coverage and good contour. Options range from secondary intention healing for small defects to more complex procedures for larger defects.

Closure by Secondary Intention: For small defects, secondary intention healing is considered, especially on the forehead, where it is deemed preferable to skin grafting. This method requires daily moist dressing changes until the wound heals.

Statistical Analysis: Statistical methods are used to analyze data for trends and significant differences in outcomes among the various reconstruction methods.

Ethical Considerations: The study received ethical clearance from the Institutional Ethics Committee. Informed and written consent was obtained from all patients. The study adheres to ethical standards concerning patient confidentiality and the right to withdraw from the study without consequences.

Results

The study involved 30 patients treated for scalp defects. The age distribution of the patients indicates a higher prevalence in the younger to middle-aged groups, with the majority falling within the 31–40-year age range, accounting for 33% (10 patients). This is closely followed by the 21–30-year age group, which includes 30% (9 patients) of the cases. The study also includes patients aged 41-50 years (13%, 4 patients), 51-60 years (10%, 3 patients), and younger age groups of 0-10 and 11-20 years, each constituting 7% of the cases (2 patients in each group).

Table 1: Clinical Feature of the participants

Demographic or Clinical Feature	Percentage/Number of Patients
Age Groups	
31-40 years	33% (10)
21-30 years	30% (9)
41-50 years	13% (4)
51-60 years	10% (3)
0-10 and 11-20 years	7% (2)
Gender	
Male	70% (21)
Female	30% (9)
Causes of Scalp Defects	
Trauma	50% (15)
Burns	33% (10)
Post-infectious conditions	10% (3)
Excision of cystic lesions	7% (2)
Location of Scalp Defects	
Temporal region	40% (12)
Parietal region	13% (4)

Temporoparietal region	10% (3)
Temporofrontal region	13% (4)
Frontal and Occipital regions	10% each (3)
Size of Scalp Defects	
9-100 cm ²	60% (18)
Less than 9 cm ²	10% (3)
More than 100 cm ²	30% (9)
Timing of Presentation Post-Injury	
Within 24 hours	60% (18)
Within 1 week	13% (4)
After 3 months	13% (4)
Treatment Methods	
Transposition flap with SSG	50% (15)
Rotation flap	13% (4)
SSG alone	27% (8)
Primary closure	13% (4)

Gender-wise, the study shows a higher incidence of scalp defects in males, comprising 70% (21 patients) of the cases, while females account for 30% (9 patients). This gender distribution aligns with the global trends observed in similar clinical settings.

Regarding the causes leading to scalp defects, trauma emerges as the most common etiology, affecting half of the patients (50%, 15 patients). Burns are the second most common cause, seen in 33% (10 patients) of the cases. Other less frequent causes include post-infectious conditions (10%, 3 patients) and excision of cystic lesions (7%, 2 patients).

The study further categorizes the scalp defects based on their anatomical location. The temporal region is the most commonly affected area, with 40% (12 patients) of the cases. Other locations include the parietal region (13%, 4 patients), temporoparietal region (10%, 3 patients), temporofrontal region (13%, 4 patients), and the frontal and occipital regions, each accounting for 10% of the cases (3 patients in each).

In terms of defect size, a majority of the patients (60%, 18 patients) presented with defects ranging between 9 to 100 cm². Smaller defects of less than 9 cm² were seen in 10% (3 patients) of the cases, while larger defects exceeding 100 cm² were observed in 30% (9 patients) of the patients.

The timing of the presentation post-injury varied, with the majority (60%, 18 patients) seeking medical attention within 24 hours. A smaller fraction presented within a week (13%, 4 patients), and an equal number (13%, 4 patients) reported after 3 months of the injury.

Treatment modalities employed in this study were diverse, tailored to the specific needs of each case. The most commonly used technique was the transposition flap with split skin grafting (SSG), utilized in 50% (15 patients) of the cases. Other

methods included rotation flaps (13%, 4 patients), SSG alone (27%, 8 patients), and primary closure (13%, 4 patients).

Discussion

The comprehensive analysis of 30 patients treated for scalp defects revealed significant insights. The majority of patients were in the younger to middle-aged groups, with the highest incidence in the 31–40-year age bracket (33%). The study predominantly involved male patients, accounting for 70% of the cases. Trauma was identified as the leading cause of scalp defects, affecting 50% of the patients, followed by burns (33%). The temporal region was the most commonly affected area (40%). In terms of defect size, most patients (60%) presented with medium-sized defects (9-100 cm²). The majority sought treatment swiftly, with 60% presenting within 24 hours of injury. Regarding treatment methods, transposition flap with split skin grafting was the most employed technique, used in 50% of the cases.

The data indicates a higher prevalence of scalp defects in younger to middle-aged individuals, particularly among males, which might reflect occupational or lifestyle risks associated with this demographic. The predominance of trauma as a cause suggests a potential focus for preventive strategies, such as safety education and protective measures in high-risk activities. The temporal region's vulnerability could be attributed to its exposure and position, making it more prone to injury. The size of the defects predominantly being medium-range implies that most patients experience significant, yet not excessively large, scalp injuries, which could influence the choice of reconstruction technique.

The swift presentation of most patients' post-injury is encouraging, as timely medical intervention is crucial for optimal outcomes in scalp reconstruction. The frequent use of transposition

flaps with SSG underscores the technique's effectiveness in treating medium-sized defects, balancing the need for adequate coverage with aesthetic considerations.

The studies [4] and [5] identified the 21 to 40 year age group as the most affected by scalp defects, which aligns with our observation that this age range encompasses the majority of patients. This consistency across studies suggests that scalp defects are most prevalent in this age demographic globally. Similarly, study [6] highlighted a substantial presence of scalp defects in the 11-20 and 31-40 year age groups, further emphasizing their prevalence among younger individuals.

In line with the findings, a male predominance in scalp defect cases has been consistently reported. Specifically, studies [4] and [5] noted a higher occurrence in males, correlating with the observed male to female ratio of 2.33:1. This pattern of male dominance in scalp defect cases is further supported by research from studies [6, 7, 8], confirming a worldwide trend of higher incidence in males.

Trauma, including road traffic accidents and electric burns, emerged as the leading cause of scalp defects in the study, a conclusion that mirrors the findings of studies [9] and [10]. This commonality underscores the critical need for implementing safety measures and preventive strategies, particularly in activities and occupations that are high-risk for such injuries.

Regarding the anatomical location of the injuries, the study found that the temporal region was most frequently involved in scalp defects, a finding that is consistent with the results of studies [9] and [11]. This suggests a general susceptibility of the temporal region to injury-induced scalp defects.

In terms of treatment approaches, the study primarily employed transposition flap with split skin grafting, a method also favored in the studies [6, 7, 8, 11]. This preference indicates a shared clinical perspective on the effectiveness and adaptability of this technique in scalp defect reconstruction.

Conclusion

In the study, scalp defects were most common in the 31-40 year age group and more prevalent in males. The primary causes were trauma and burns, with the left side and temporal region being most affected. Treatment usually involved transposition flap and split skin grafting (SSG), especially for wounds smaller than 3 cm due to limited scalp elasticity. Flap cover, applied within 24 hours post-debridement in uncomplicated cases, helped reduce hospital stays. Complications like flap tip necrosis required minor surgical adjustments. Successful reconstruction relies on customizing each

procedure, taking into account the patient's specific needs and the surgeon's expertise in scalp anatomy and surgical techniques.

Limitations: The limitations of this study include a small sample population who were included in this study. The findings of this study cannot be generalized for a larger sample population. Furthermore, the lack of comparison group also poses a limitation for this study's findings.

Recommendation: Customized reconstruction strategies considering individual patient profiles and defect characteristics are essential for optimal results. Early intervention and tailored treatment plans are recommended to reduce complications and hospital stays.

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List of abbreviations:

SSG: Split Skin Grafting

RTA: Road Traffic Accident

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