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ORIGINAL ARTICLE

Reconstruction Techniques Following Resection of Auricular Skin Cancers - A Comparative Analysis

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ABSTRACT

Background: *Ear skin cancers present specific reconstructive challenges due to the ear's three-dimensional nature and functional requirements. The reconstructive technique significantly affects both oncologic and cosmetic outcomes. The objective of this study is to compare various reconstructive techniques following excision of skin cancer from the ear in terms of complications, function, and recurrence rate.* ***Methods & Materials:*** *This is a retrospective study of 80 patients who underwent surgical excision of histopathologically confirmed auricular skin malignancies and reconstruction. Patients were categorized based on the reconstructive techniques: primary closure, skin graft, local flap, regional flap, and composite graft. Complications at follow-up, oncological outcome, functional/cosmetic result by surgeon's assessment, and patient satisfaction by visual analogue scale were endpoints measured. Data were analyzed in SPSS (version 26) using descriptive statistics, chi-square tests for associations, and Kaplan–Meier with log-rank tests for recurrence-free survival across reconstruction techniques.* ***Results:*** *The most common malignancy was basal cell carcinoma (50%), followed by squamous cell carcinoma (40%) and melanoma (10%). Local flaps were employed most commonly (30%), and skin grafts and primary closure were used equally (25% each). Primary closure resulted in the fewest complications (10%) and the most cosmetic satisfaction (90%), and skin grafts resulted in more complications (40%) and poorer cosmetic outcomes (60%). Kaplan-Meier analysis identified substantially improved recurrence-free survival with primary closure and local flaps compared to graft-based methods ($p < 0.001$).* ***Conclusion:*** *Local flaps and primary closure are associated with improved aesthetic and oncologic outcomes and fewer complications compared with graft-based reconstruction techniques for auricular skin cancer defects.*

Keywords: *Auricular reconstruction, Skin cancer, Local flaps, Recurrence-free survival*

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INTRODUCTION

Auricular skin cancers are a significant category of cutaneous malignancies, accounting for approximately 8–10% of all head and neck skin cancers [1]. The outer ear is an abnormally exposed area since it is continuously exposed to ultraviolet (UV) radiation, which is the key factor in the pathogenesis of most auricular malignancies. In addition, the complex three-dimensional auricular structure and limited tissue mobility create special difficulties for oncological resection as well as subsequent reconstruction [2]. Compared to other facial regions, auricular defects are prominent due to its focal location, and suboptimal reconstruction can not only lead to a compromise of function but also have critical aesthetic and psychosocial consequences. For the majority of patients, the ear is the center of facial harmony, and postoperative deformities may result in anxiety, social isolation, and reduced quality of life [3]. Most common auricular malignancies include basal cell carcinoma, squamous cell carcinoma, and melanoma, and basal cell carcinoma is the most common [4]. These tumors are most commonly found in sun-exposed regions such as the helix, antihelix, and scaphoid fossa where the skin is extremely thin and supported by minimal subcutaneous tissue [5]. Total oncological excision with histologically evident margins continues to be the standard of successful treatment. Yet, this usually leads to extensive tissue loss that requires prompt reconstructive treatment in order to re-establish function as well as form. Over the decades, many reconstructive techniques have been proposed to close auricular defects, ranging from the most uncomplicated of primary closure to intricate composite grafts and microvascular free tissue transfer [6]. The choice of technique would then depend on numerous variables like defect size,

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depth, anatomical subunit involved, patient age, comorbidities, and the surgeon's level of experience [7]. Primary closure, though limited to small defects, is preferred because of its technical ease and improved color match [8]. In large or irregular defects, local flaps such as advancement, rotation, or transposition flaps are utilized extensively, offering superior tissue similarity in terms of color, thickness, and contour [9]. Local flaps, like postauricular and temporoparietal fascia flaps, provide more versatility but may result in donor site morbidity and longer operation time [10]. Split-thickness and full-thickness skin grafts remain useful for covering extensive surface areas, albeit their cosmetic results marred by imprecise matching of texture or coloration [11].

In spite of this broad armamentarium of reconstructive techniques, few high-quality comparative studies exist to support evidence-based decision-making. Most of the literature consists of small case series or isolated reports of a single technique, making it difficult to develop clear guidelines. Surgeons are thus frequently forced to rely on personal experience rather than standard evidence when planning auricular reconstruction. To address this deficiency, the present study intends to make a comprehensive comparative review of the reconstruction techniques following resection of auricular skin cancer based on complications, functional outcome, aesthetic satisfaction, and oncologic safety.

METHODS AND MATERIALS

This was a retrospective comparative study conducted on patients who underwent surgical excision of auricular skin cancers followed by reconstruction at Rajshahi Medical College, Rajshahi, Bangladesh from January, 2024 to December, 2024. Patients with histologically confirmed auricular malignancies were included in the study. A total of 80 patients with histologically confirmed auricular malignancies were included, and both males and females across all age groups were eligible, provided that complete clinical, surgical, and follow-up records were available. Patients with recurrent auricular tumours at presentation, incomplete documentation, or a history of prior auricular reconstruction were excluded from the analysis. Clinical records were carefully reviewed to collect demographic data, tumour location, histopathological diagnosis, and details of the reconstruction techniques applied. Postoperative outcomes assessed included complications such as infection, flap or graft necrosis, hematoma, and wound dehiscence, while oncological outcomes were evaluated in terms of local recurrence and the need for revision surgery. Functional and cosmetic results were determined based on surgeon-assessed cosmetic outcomes and patient-reported satisfaction measured using a visual analogue scale (VAS). Ethical approval was obtained by institutional requirements, and the study was conducted in compliance with the principles of the Declaration of Helsinki. Informed written consent for surgical treatment for research and publication was obtained from all patients.

Statistical Analysis

Data were entered and analyzed using SPSS (version 26). Categorical variables were expressed as frequencies and percentages. Associations between tumor location and reconstruction techniques, as well as between reconstruction techniques and complications, were assessed using the chi-square test (χ^2 test). A p-value of <0.05 was considered statistically significant.Comparative functional and oncological outcomes across reconstruction methods were also analyzed with chi-square tests. Kaplan–Meier survival analysis was performed to assess recurrence-free survival, and differences across techniques were evaluated using the log-rank test. Survival curves were generated to visually compare long-term oncological outcomes between reconstruction techniques.

RESULTS

Table I reflects the baseline demographic and clinical characteristics of the 80 patients on whom analysis was performed. The distribution of age reveals a preponderance of middle-aged individuals, 50% belonging to the age group of 40-59 years, followed by 30% ≥60 years and 20% <40 years. Male dominance (60% to 40% female) is in keeping with epidemiological patterns for skin carcinomas. The site of the tumor was most commonly the helix (30%), then concha (25%) and antihelix (20%), while the least common was the tragus (10%). [Table I]

Table – I: Basic Characteristics of the Study Population (*n* = 80)

Variable	Category	Frequency (n)	Percentage (%)
Age Group	<40 years	16	20%
	40–59 years	40	50%
	≥60 years	24	30%
Sex	Male	48	60%
	Female	32	40%
Tumor Location	Helix	24	30%
	Antihelix	16	20%
	Lobule	12	15%
	Concha	20	25%
	Tragus	8	10%

Table II presents the histopathologic breakdown of the 80 auricular skin cancers in the cohort. Basal cell carcinoma was the most frequent malignancy and accounted for 50% (n=40) of cases, followed by squamous cell carcinoma in 40% (n=32) of cases, and melanoma accounting for 10% (n=8) of cases. The moderately high frequency of squamous cell carcinoma (40%) compared to other body regions may result from the visibility and susceptibility of the ear to chronic actinic injury. [Table II]

Table – II: Histopathological Distribution of Auricular Skin Cancers (*n* = 80)

Histopathology	Frequency (n)	Percentage (%)
Basal Cell Carcinoma	40	50%
Squamous Cell Carcinoma	32	40%
Melanoma	8	10%

Table III demonstrates the application of reconstruction techniques used following excision of auricular skin cancer. Local flaps constituted the most frequent technique (30%,

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n=24), followed by primary closure and skin grafting, each accounting for 25% (n=20) of patients. Regional flaps were employed for 15% (n=12) of the patients, and composite grafts were the least common at 5% (n=4). Equal application of primary closure and skin grafts (25% each) reflects that size and location of the defect are important factors in determining the technique of choice, with primary closure in the minor defects and skin grafting in the major defects where local tissue becomes thin. [Table III].

Table – III: Reconstruction Techniques Used Following Resection (*n* = 80)

Reconstruction Technique	Frequency (n)	Percentage (%)
Primary Closure	20	25%
Skin Graft	20	25%
Local Flap	24	30%
Regional Flap	12	15%
Composite Graft	4	5%

Table IV shows significant correlations between tumor location and choice of reconstruction technique (p = 0.03). The helix, being the most frequent location, had preferential utilization of local flaps (15% of total cases), reflecting local tissue availability for reconstruction and the challenging curvature for which tissue of similar nature was required. The antihelix showed a trend in favor of local flaps (12.5% of the total). The tragus too favored skin grafts (5% of the total cases), possibly due to the fact that it is small and there isn't much tissue to spare around it. The area of the concha saw more diverse reconstructive techniques, where local flaps (15%) and regional flaps (3.8%) were commonly utilized, possibly due to the fact that it is deeper and requires differently to be repaired. [Table IV]

Table – IV: Association Between Tumor Location and Reconstruction Technique (*n* = 80)

Tumor Location	Primary Closure n (%)	Skin Graft n (%)	Local Flap n (%)	Regional Flap n (%)	Composite Graft n (%)	χ^2, df, P- value
Helix	4 (5%)	2 (2.5%)	12 (15%)	2 (2.5%)	0 (0%)	$\chi^2 = 16.28$, df = 8, p = 0.03
Antihelix	2 (2.5%)	2 (2.5%)	10 (12.5%)	2 (2.5%)	0 (0%)	
Lobule	1 (1.2%)	2 (2.5%)	8 (10%)	1 (1.2%)	0 (0%)	
Concha	2 (2.5%)	2 (2.5%)	12 (15%)	3 (3.8%)	1 (1.2%)	
Tragus	0 (0%)	4 (5%)	1 (1.2%)	0 (0%)	0 (0%)	
Total	9 (11.2%)	12 (15%)	43 (53.7%)	8 (10%)	1 (1.2%)	

Table V provides a lucid comparison of postoperative outcomes between different reconstruction techniques, indicating statistically significant differences (p = 0.014). Primary closure was best in terms of complication with 90% of the patients having no complications and with only a 10% overall complication rate with the majority being minor infection (5%) and hematoma (5%). Local flaps had the second-best outcome with 75% complication-free outcomes and 25% overall rate of complications. Put this in perspective with skin grafts having the highest rate of complications at 40%, which appeared with infections (15%), graft necrosis (10%), hematoma (10%), and wound dehiscence (5%). Regional flaps recorded a 33.3% rate of complications, while composite grafts registered a 50% rate of complications with the minimal number of cases. [Table V].

Table – V: Comparison of Outcomes across Different Reconstruction Techniques (*n* = 80)

Reconstruction Technique	No Complication n (%)	Any Complication n (%)	Infection n (%)	Flap Necrosis n (%)	Hematoma n (%)	Wound Dehiscence n (%)	χ^2, df, P-value
Primary Closure (n=20)	18 (90.0)	2 (10.0)	1 (5.0)	0 (0.0)	1 (5.0)	0 (0.0)	$\chi^2 = 12.47$, df = 4, p = 0.014
Skin Graft (n=20)	12 (60.0)	8 (40.0)	3 (15.0)	2 (10.0)	2 (10.0)	1 (5.0)	
Local Flap (n=24)	18 (75.0)	6 (25.0)	2 (8.3)	2 (8.3)	1 (4.2)	1 (4.2)	
Regional Flap (n=12)	8 (66.7)	4 (33.3)	2 (16.7)	1 (8.3)	1 (8.3)	0 (0.0)	
Composite Graft (n=4)	2 (50.0)	2 (50.0)	1 (25.0)	1 (25.0)	0 (0.0)	0 (0.0)	
Total	58 (72.5)	22 (27.5)	9 (11.2)	6 (7.5)	5 (6.2)	2 (2.5)	

Table VI contrasts oncological and functional outcomes among reconstruction techniques, with significant differences in cosmetic outcomes (p = 0.009). Best results were seen in primary closure with 90% satisfactory cosmetic outcomes and 85% satisfaction of the patient (VAS ≥7), and with the lowest incidence of local recurrence (5%). Local flaps performed equally to 83.3% good cosmetic outcomes, 79.2% patient satisfaction, and an 8.3% rate of local recurrence. Skin grafts provided poorer outcomes with 60% good cosmetic outcome, 55% patient satisfaction, and a 15% rate of local recurrence. Regional flaps produced average outcomes (75% good cosmetic outcomes, 66.7% satisfaction), while composite grafts provided the poorest outcomes in all areas. [Table VI].

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Table – VI: Comparative Oncological and Functional Outcomes Across Reconstruction Techniques (*n* = 80)

Reconstruction Technique	Local Recurrence n (%)	Revision Surgery n (%)	Good Cosmetic Outcome n (%)	Patient Satisfaction (VAS ≥7) n (%)	χ^2, df, P- P-value
Primary Closure (n=20)	1 (5.0)	1 (5.0)	18 (90.0)	17 (85.0)	χ^2 = 14.82, df = 4, p = 0.009 (for cosmetic outcomes)
Skin Graft (n=20)	3 (15.0)	4 (20.0)	12 (60.0)	11 (55.0)	
Local Flap (n=24)	2 (8.3)	2 (8.3)	20 (83.3)	19 (79.2)	
Regional Flap (n=12)	1 (8.3)	1 (8.3)	9 (75.0)	8 (66.7)	
Composite Graft (n=4)	1 (25.0)	1 (25.0)	2 (50.0)	2 (50.0)	
Total	8 (10.0)	9 (11.2)	61 (76.2)	57 (71.2)	

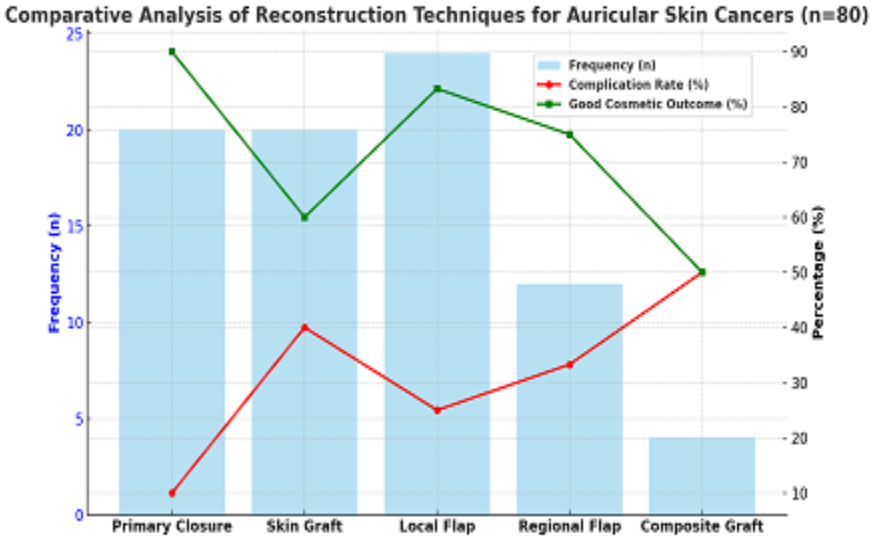

Figure 1 shows the comparative analysis of Reconstructive Techniques for Auricular Skin Cancers. The graph shows that local flaps were the most frequently used, offering a good balance of low complications (25%) and high cosmetic outcomes (83.3%). Primary closure had the best overall results with the lowest complication rate (10%) and highest cosmetic satisfaction (90%). In contrast, skin grafts and composite grafts showed higher complication rates (40–50%) and poorer cosmetic outcomes (50–60%), while regional flaps performed moderately. Overall, primary closure and local flaps emerged as the most favourable reconstruction techniques.

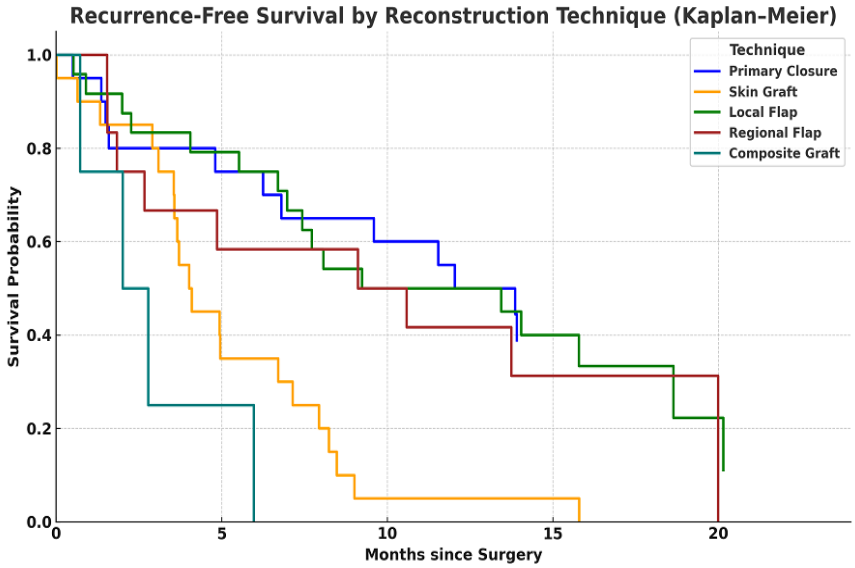

Figure 2 Shows Kaplan-Meier Recurrence-Free Survival Curves by Reconstruction Technique Following Auricular Skin Cancer Resection. The Kaplan–Meier survival curves demonstrate clear differences in recurrence-free survival across reconstruction techniques over a 24-month follow-up. Primary closure achieved the most favourable outcomes, maintaining the highest survival probability with minimal recurrence. Local flaps also performed strongly, showing sustained recurrence-free survival comparable to primary closure and confirming their reliability for covering auricular

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defects. Regional flaps provided moderate outcomes, with a gradual decline in survival over time. In contrast, skin grafts and composite grafts demonstrated the poorest recurrence-free survival, with earlier and more frequent recurrences observed during follow-up. The overall log-rank test confirmed a statistically significant difference among techniques (χ^2 = 25.8, df = 4, $p < 0.001$), highlighting that primary closure and local flaps are superior options in terms of oncological safety, while graft-based methods are associated with worse long-term outcomes.

DISCUSSION

This study demonstrates the comparative series of 80 patients with significant differences in the various reconstruction modalities following auricular skin cancer removal. The findings indicate primary closure and local flaps are superior to grafting procedures regarding complications, cosmesis, and oncologic safety. The results have important implications for surgical planning and patient counseling in auricular reconstruction. The incidence of basal cell carcinoma (50%) and squamous cell carcinoma (40%) among our cohort aligns with Wunderlich et al. for cutaneous malignancies in sun-exposed areas [12]. The gender predominance and age distribution are predicted demographics for auricular skin cancers and serve to emphasize the importance of sun protection and regular dermatological check-ups in at-risk populations [13]. The preferential involvement of the helix and antihelix regions is consistent with prominent position and maximal sun exposure, as noted by Gibson et al. that the primary closure provided the lowest complication rate (10%) and highest patient satisfaction (85%) justifies its continued preference for appropriate defects [14]. The excellent outcome is likely the result of an absence of tension, optimal tissue matching, and preservation of normal anatomy [15]. Primary closure is limited, however, to small defects in which there is adequate tissue mobility without ear contour compromise or distortion [16]. The local flaps emerged as the most frequent technique (30%) and with good results of 83.3% good cosmetic results and low complication rates (25%). This is explained by the fact that they are ideal for the reconstruction of moderately sized defects with tissue whose characteristics are similar to the surrounding ear [17]. The improved blood supply of the local flaps compared to grafts results in healing with fewer complications [18]. Our results strengthen the continued emphasis on local flap reconstruction as a reliable option for auricular defects. The significantly higher complication rates observed with skin grafts (40%) and composite grafts (50%) highlight the intrinsic challenge in graft-based reconstruction of the auricular region. The complicated three-dimensional anatomy of the ear and the lack of recipient bed vascularity can be attributing factors for graft-related complications like necrosis and poor aesthetic outcomes [19]. In addition, color and texture mismatch intrinsic to grafting procedures typically results in poor cosmetic results, as in our 60% good cosmetic result rate for skin grafts [20]. The Kaplan-Meier survival analysis with primary closure and local flaps demonstrating improved recurrence-free survival ($p < 0.001$) is a result of particular importance. This suggests that beyond the cosmetic factor, these procedures can have better oncological results. Improved surveillance and better healing of well-vascularized local tissue may result in earlier detection of recurrences and better long-term oncological control [21]. The higher rates of recurrence observed with graft-based operations need to be considered in surgical planning and may necessitate more intensive follow-up protocols.

Regional flaps, while showing intermediate outcomes in our series, still remain valuable for larger defects when local tissue is insufficient. The donor site morbidity and increased operative complexity, however, must be weighed against perceived benefits [22]. Planning should consider patient factors such as age, comorbidities, and aesthetic expectations, along with defect characteristics. The significant association between tumor location and reconstruction modality selection in our series ($p = 0.03$) demonstrates the influence of anatomic considerations on surgical planning. Preferential use of local flaps for helix and antihelix defects, and skin grafting for tragal defects, aligns with the differing local tissue availability and reconstructive requirements of these auricular subunits. This confirms a site-specific approach to reconstruction modality selection over a one size fits all philosophy.

Limitations of the Study:

Small series sizes within some of the reconstruction groups, particularly composite grafts, limit statistical power for detecting differences. The single-institution nature of the study has the potential to restrict generalizability across different surgical practices and patient groups.

CONCLUSION

Primary closure and local flaps are the optimal reconstruction procedures for auricular skin cancer defects, offering superior oncologic control, reduced complication rates, and greater aesthetic outcomes compared to grafting-based reconstructive procedures. Reconstruction choice must be individualized based on defect size, location, and anatomic landmarks as well as the patient's unique circumstances. These findings support ongoing use of tissue-sparing techniques whenever feasible, emphasizing the importance of careful patient selection and planning in achieving optimal outcomes.

RECOMMENDATION

Multicenter studies with more patients and standardized outcome measures in the future studies are needed to validate these findings. Investigation into novel reconstruction techniques, including tissue engineering and regenerative techniques, is warranted. Development of valid scoring systems for measuring outcomes of auricular reconstruction would permit more objective comparison of techniques and institutions.

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