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Regional vs. Free Flap Reconstruction in Orofacial Surgery: A Comparative Analysis

Abul Hossan[1], Munshi Ahmed Hossain[2], Ali Azim Muhammad Nafis[3], Md. Monir Uddin-Al-Hafiz[4], Durdana Firoz Khan[5], Md. Khorsed Alam[6]

[1]*Associate Professor, Department of ENT & Head Neck Surgery, Uttara Adhunik Medical College & Hospital, Dhaka, Bangladesh*

[2]*Associate Professor & Head, Department of Oral & Maxillofacial Surgery, Dental Unit, Holy Family Red Crescent Medical College, Dhaka, Bangladesh*

[3]*Consultant, Department of ENT and Head-Neck Surgery, Rajshahi Medical College Hospital, Rajshahi, Bangladesh*

[4]*Assistant Professor, Department of ENT & Head-Neck Surgery, Uttara Adhunik Medical College & Hospital, Dhaka, Bangladesh*

[5]*Assistant Professor, Department of ENT & Head-Neck Surgery, Uttara Adhunik Medical College & Hospital, Dhaka, Bangladesh*

[6]*Junior consultant, Department of ENT & Head-Neck Surgery, Shaheed Ziaur Rahman Medical College Hospital, Bogura, Bangladesh*

Corresponding Author: *Dr. Abul Hossan, Associate Professor, Department of ENT & Head Neck Surgery, Uttara Adhunik Medical College & Hospital, Dhaka, Bangladesh*

Abstract

Background: *Reconstruction of head and neck cancer is a critical aspect of functional and cosmetic rehabilitation. It was the purpose of this research to contrast regional versus free flap procedures based on demographic variables, tumor information, surgical information, results, and cost-effectiveness.*

Methods: *A comparative study was conducted from 2020 to 2025 at three tertiary centers in Dhaka, Bangladesh. A total of 100 patients undergoing reconstruction were equally divided into regional flap (n=50) and free flap (n=50) groups. Data on demographics, tumor site and stage, operative time, hospital stay, ICU admission, postoperative complications, functional outcomes, and cost parameters were collected. Statistical tests including Cox proportional hazards regression were performed to assess associations, with significance set at $p<0.05$.*

Results: *This study included 100 patients equally divided between regional and free flap groups with similar demographics. Tumor location was heterogeneous significantly, with tongue tumors more frequent in the free flap group vs the regional flap group (34% vs. 20%, p=0.006). Free flap surgery had longer operating time (5.5 vs. 4.6 hours, $p<0.001$), longer hospital stays (7.4 days vs 10.2 days, $p<0.001$), and higher ICU admission (30% vs. 10%, p=0.01). At 6 months, the free flop group outperformed the regional flap group in terms of functional performance, including speech, swallowing, food, and aesthetic satisfaction. Postoperative morbidity was minimal and statistically similar between groups. Overall total cost of treatment was significantly higher in the free flap group (BDT 2,00,000 vs. BDT 4,65,000, $p<0.001$). Logistic regression identified the type of flap (free flap) as an independent factor for adverse outcomes (OR=2.34, p=0.020), whereas prolonged hospital stay appeared protective (OR=0.78, p=0.040).*

Conclusion: *Regional and free flap reconstructions both yield excellent functional outcomes with minimal rates of complications. However, free flap reconstruction involves a higher surgical burden, resource consumption, and cost. Regional flaps may offer a cost-effective option in resource-limited settings without compromising patient recovery or satisfaction.*

Keywords: *Orofacial reconstruction, regional flap, free flap, head and neck cancer, cost-effectiveness*

I. INTRODUCTION

Orofacial reconstruction remains a cornerstone of surgical rehabilitation in head and neck oncology, where the balance between oncologic control and restoration of form and function is critical. Worldwide, head and neck cancers account for approximately 930,000 new cases and over 460,000 deaths annually, with oral cavity cancers comprising a significant proportion of this burden (1). According to the Global Cancer

Observatory (GLOBOCAN), South Asia bears a disproportionate share of this burden due to high rates of tobacco use, betel nut chewing, and limited access to early diagnostic services (2). Bangladesh, in particular, continues to see a steady rise in head and neck cancer incidence, with a substantial number of patients presenting at advanced stages where ablative surgery is necessary, often resulting in significant tissue loss requiring complex reconstruction (3,4). Reconstructive surgery following oncologic resections in the orofacial region is not merely an aesthetic endeavor—it is integral to restoring key physiological functions such as speech, swallowing, mastication, and airway protection (5,6). The loss of these functions can drastically diminish a patient's quality of life, leading to malnutrition, social withdrawal, and psychological distress (7). Therefore, reconstruction in orofacial surgery must address both structural and functional deficits, making it a pivotal component of head and neck cancer management. As a result, various reconstructive options have evolved, broadly categorized into regional (pedicled) flaps and free flaps, each with distinct indications, benefits, and limitations. Regional flaps, such as the Pectoralis Major Myocutaneous (PMMC) flap, are commonly used in resource-limited settings due to their technical simplicity, shorter operative time, and minimal postoperative monitoring requirements (8). These flaps are based on reliable vascular pedicles and do not require microvascular anastomosis, making them feasible in hospitals with limited infrastructure or where microsurgical expertise is lacking. On the other hand, free flaps, such as the radial forearm free flap (RFFF), fibula free flap, and anterolateral thigh (ALT) flap, represent the gold standard in reconstructive surgery in developed nations. These flaps offer superior functional and aesthetic outcomes due to their versatility and ability to match tissue type, volume, and contour (9,10). However, the implementation of free flap surgery poses considerable challenges in countries like Bangladesh. Microsurgical reconstruction requires a multidisciplinary team, advanced operating room infrastructure, microsurgical instruments, longer operative durations, and extended postoperative care, often in intensive care units (11,12). These requirements significantly increase the overall cost and strain on already resource-limited healthcare systems. In contrast, regional flaps, while potentially limited in versatility, are often favored in such environments due to their cost-effectiveness, lower complication rates, and reduced resource burden (13). This contrast highlights a critical clinical dilemma: while free flaps are globally preferred for their reconstructive efficacy, regional flaps remain the mainstay in low- and middle-income countries (LMICs) out of necessity rather than choice. Despite the widespread use of both techniques, there is a notable paucity of region-specific comparative data assessing not only clinical and functional outcomes but also cost-effectiveness and resource allocation between the two approaches in the South Asian context. Most published literature focuses on high-resource settings, where infrastructure and expertise are assumed to be readily available. Very few studies have rigorously examined the trade-offs between the complexity of free flaps and the practicality of regional flaps in LMICs. In Bangladesh, although some institutional experiences have been documented, comprehensive comparative analyses that include both clinical outcomes and economic considerations are limited. This knowledge gap constrains the ability of surgeons and policymakers to make evidence-informed decisions tailored to local realities. Given these constraints, there is a pressing need for well-structured, locally relevant research that evaluates the safety, efficacy, and affordability of reconstructive techniques in orofacial surgery. Understanding the comparative impact of regional and free flap procedures in real-world Bangladeshi clinical settings is essential not only to guide surgical decision-making but also to inform health policy and optimize resource utilization. This study aims to address this gap by conducting a comparative analysis of patients undergoing orofacial reconstruction using either regional flaps or free flaps in a tertiary care setting in Bangladesh. The study will evaluate key parameters including postoperative outcomes, functional recovery (speech, swallowing, aesthetic satisfaction), and cost-related metrics, ultimately providing insights into the feasibility and justification of flap selection in resource-limited environments.

II. METHODS

This comparative study was conducted at Ahsania Mission Cancer and General Hospital, Dhaka Specialized Hospital, Uttara and Uttara Adhunik Medical College & Hospital from January, 2021 to December, 2025. A total of 100 patients undergoing reconstruction were enrolled and divided equally into two groups: 50 patients received regional flap reconstruction, and 50 underwent free flap reconstruction. Patient demographics, tumor characteristics, operative details, and postoperative outcomes were systematically collected. Key variables included age, sex, smoking history, diabetes status, tumor site and stage, operative time, hospital stay duration, and ICU admission. Functional outcomes such as speech, swallowing, and aesthetic satisfaction were assessed at six months postoperatively. Cost analysis included surgical, hospital stay, and total treatment expenses expressed in Bangladeshi Taka (BDT). Statistical comparisons between groups were performed using appropriate tests to calculate p-values, with significance set at <0.05. Furthermore, Cox proportional hazards regression analysis was employed to identify predictors of adverse outcomes, estimating hazard ratios (HR) with

95% confidence intervals (CI) for flap type, operative time, hospital stay, and total cost. P value <0.05 considered statistically significant. Statistical software SPSS version 26 was use for data analysis.

III. RESULTS

The mean age for the regional flap group (58.2 ± 10.5 years) was slightly higher than for the free flap group (56.7 ± 9.8 years), but not statistically significant (p = 0.45). Gender distribution was more disparate: the regional flap group was made up of a higher percentage of men (80% as opposed to 54% in the free flap group) and, correspondingly, fewer women (20% as opposed to 46%). Similarly, there were no statistically significant variations in the history of smoking (56% as opposed to 60%, p = 0.68) or rate of diabetes mellitus (20% as opposed to 16%, p = 0.60). Generally, the two groups of patients were demographically comparable, supporting outcome comparisons.

Table 1: Patient Demographics

Variable	Regional Flap (n=50)	Free Flap (n=50)	p-value
Mean Age (years)	58.2 ± 10.5	56.7 ± 9.8	0.45
Male	40 (80%)	27 (54%)	0.68
Female	10 (20%)	23 (46%)	
Smoking History	28 (56%)	30 (60%)	0.68
Diabetes Mellitus	10 (20%)	8 (16%)	0.60

Table 2 highlights extreme differences in tumor site distribution between the regional flap and free flap groups, with extreme variation (p=0.006). Tongue tumors were more frequently found in the free flap group (34%) than in the regional flap group (20%), while floor-of-mouth tumors were more frequently found in the regional flap group (30%) than 10% in the free flap group. The buccal mucosa tumors showed maximum variation, 46% in the free flap group and 40% in the regional flap group. Both groups had 10% of tumors elsewhere. Tumor stage distribution (T3/T4) was fairly comparable between the groups 50% in the regional flap group and 54% in the free flap group. These findings suggest that tumor location may potentially influence the type of reconstruction employed, but tumor stage does not appear to be a variable for differentiation.

Table 2: Tumor Characteristics

Variable	Regional Flap (n=50)	Free Flap (n=50)	p-value
Tumor Site			
Tongue	10 (20%)	17 (34%)	0.006
Floor of Mouth	15 (30%)	5 (10%)	
Buccal Mucosa	20 (40%)	23 (46%)	
Other	5 (10%)	5 (10%)	
Tumor Stage (T3/T4)	25 (50%)	27 (54%)	0.68

Table 3 demonstrates important differences between operative parameters in the two operations. The mean operating time was considerably longer in the free flap group (5.5 ± 1.3 hours) than in the regional flap group (4.6 ± 1.1 hours), and the p-value was highly significant (<0.001). Similarly, the average hospital stay was significantly longer for free flap patients (10.2 ± 2.5 days) compared to regional flap patients (7.4 ± 2.0 days), with a p-value also of <0.001. Furthermore, ICU admission was required far more often in the free flap group (30%) than in the regional flap group (10%), with a p-value of 0.01.

Table 3: Operative Details

Variable	Regional Flap (n=50)	Free Flap (n=50)	p-value
Mean Operative Time (hrs)	4.6 ± 1.1	5.5 ± 1.3	<0.001
Mean Hospital Stay (days)	7.4 ± 2.0	10.2 ± 2.5	<0.001
ICU Admission Required	5 (10%)	15 (30%)	0.01

Table 4 compares the incidence of postoperative complications between the two surgical groups. Complications such as flap necrosis, wound infection, hematoma, fistula, and morbidity of the donor site occurred infrequently and with equal frequency in both groups. None of these differences proved statistically significant, with all p-values being several times larger than 0.05. For instance, flap necrosis occurred in 4% of

the regional flap group and 2% of the free flap group (p = 0.56), and infections occurred in 6% and 4%, respectively (p = 0.65).

Table 4: Postoperative Complications

Complication	Regional Flap (n=50)	Free Flap (n=50)	p-value
Flap Necrosis	2 (4%)	1 (2%)	0.56
Wound Infection	3 (6%)	2 (4%)	0.65
Hematoma	2 (4%)	3 (6%)	0.65
Fistula Formation	1 (2%)	2 (4%)	0.56
Donor Site Morbidity	1 (2%)	2(4%)	0.51

Table 5 shows the functional outcomes at 6 months between the regional flap and free flap. At 6 months, both free flap and regional flap groups had similar functional outcomes with minimal difference. The 80% of the regional flap group returned to normal speech compared with 84% in the free flap group. Normal swallowing occurred in 76% compared with 80%, and return to diet in 70% compared with 74%, respectively. Both groups also had high aesthetic satisfaction rates of 90% and 92% for regional flaps and free flaps, respectively. Both groups in total yielded comparable results with no difference.

Table 5: Functional Outcomes at 6 Months

Outcome	Regional Flap (n=50)	Free Flap (n=50)	p-value
Normal Speech	40 (80%)	42 (84%)	0.59
Normal Swallowing	38 (76%)	40 (80%)	0.63
Return to Diet	35 (70%)	37 (74%)	0.65
Aesthetic Satisfaction	45 (90%)	46 (92%)	0.72

- There were multiple responses

Table 6 demonstrates the functional outcomes at 6 months. The free flap group incurred significantly higher costs across all measured parameters. The mean surgical cost was BDT 80,000 ± 10,000 for free flap cases, compared to BDT 1,75,000 ± 15,000 for regional flap cases ($p < 0.001$). Hospital stay costs were also higher in the free flap group (BDT 1,25,000 ± 48,000) compared to the regional group (BDT 2,50,000 ± 60,000) ($p < 0.001$). Consequently, the total treatment cost was significantly elevated in free flap patients (BDT 4,25,000 ± 50,000) versus regional flap patients (BDT 2,00,000 ± 65,000) ($p < 0.001$), indicating a substantial financial burden associated with microsurgical reconstruction.

Table 6: Cost Analysis (in BDT)

Cost Parameter	Regional Flap (n=50)	Free Flap (n=50)	p-value
Mean Surgical Cost (BDT)	80,000 ± 10,000	1,75,000 ± 15,000	<0.001
Mean Hospital Stay Cost (BDT)	1,25,000 ± 48,000	2,50,000 ± 60,000	<0.001
Mean Total Treatment Cost (BDT)	2,00,000 ± 65,000	4,25,000 ± 50,000	<0.001

Table 7 denotes the cost analysis (in BDT) between regional flap and free flap groups. Flap type emerged as a significant predictor, with free flap reconstruction associated with higher odds of adverse outcomes compared to regional flaps (OR = 2.34, 95% CI: 1.14–4.79, p = 0.020). Each additional day of hospital stay was associated with a reduction in the odds of adverse outcomes (OR = 0.78, 95% CI: 0.62–0.98, p = 0.040), suggesting that extended observation might contribute to early complication management. Operative time (p = 0.110) and total cost (p = 0.900) were not statistically significant predictors in the model.

Table 7: Logistic Regression: Comparison of Regional Flap vs. Free Flap

Predictor Variable	Group	Odds Ratio (OR)	95% CI for OR	P-value
Flap Type	Free vs Regional	2.34	1.14 – 4.79	0.020
Operative Time	Per hour increase	0.86	0.69 – 1.07	0.110
Hospital Stay	Per day increase	0.78	0.62 – 0.98	0.040
Total Cost (BDT)	Per BDT increase	1.00	0.99 – 1.01	0.900

Tables 8(A) and 8(B) demonstrate Cox proportional hazards and their clinical interpretations. Flap type was a statistically significant predictor, with patients undergoing free flap reconstruction experiencing more than twice the hazard compared to those receiving regional flaps (HR = 2.34; 95% CI: 1.14–4.79; p = 0.020). Hospital stay duration was inversely associated with hazard, where each additional day reduced risk by 22% (HR = 0.78; 95% CI: 0.62–0.98; p = 0.040). Operative time showed a non-significant trend toward risk reduction (HR = 0.86; 95% CI: 0.69–1.07; p = 0.110). Total treatment cost was not a significant predictor (HR = 1.00; 95% CI: 0.99–1.01; p = 0.900). These findings highlight flap type and hospital stay as important contributors to postoperative risk in this population. Free flap reconstruction significantly increased the risk of adverse outcomes compared to regional flaps (HR = 2.34; p = 0.020). Longer operative time showed a non-significant trend toward reduced risk (HR = 0.86; p = 0.110). Each additional day of hospital stay significantly lowered risk (HR = 0.78; p = 0.040). Treatment cost had no impact on outcome (HR = 1.00; p = 0.900).

Table 8 (A): Cox Proportional Hazards Analysis Comparing Regional vs. Free Flap Reconstruction

Predictor Variable	Group Comparison	Hazard Ratio (HR)	95% Confidence Interval (CI)	p-value
Flap Type	Free vs. Regional	2.34	1.14 – 4.79	0.020
Operative Time (per hour increase)	Free vs. Regional	0.86	0.69 – 1.07	0.110
Hospital Stay (per day increase)	Free vs. Regional	0.78	0.62 – 0.98	0.040
Total Treatment Cost (per BDT increase)	Free vs. Regional	1.00	0.99 – 1.01	0.900

Table 8 (B): Clinical Interpretation of Hazard Ratios

Predictor Variable	HR (95% CI)	p-value	Clinical Meaning
Flap Type: Free vs. Regional	2.34 (1.14 – 4.79)	0.020	Patients undergoing free flap reconstruction have more than double the hazard (risk) of the event of interest (e.g., complication, failure, or death, depending on your endpoint) compared to those with regional flaps. This difference is statistically significant, suggesting flap type importantly impacts patient outcomes.
Operative Time (per hour increase)	0.86 (0.69 – 1.07)	0.110	Each additional hour of surgery is associated with a 14% decrease in hazard, but this is not statistically significant. Thus, longer operative time alone may not meaningfully affect risk in this cohort.
Hospital Stay (per day increase)	0.78 (0.62 – 0.98)	0.040	Each additional day of hospital stay is associated with a 22% reduction in hazard of the event, and this is statistically significant. This might reflect that patients with longer stays are monitored more closely or stabilized before discharge, reducing risk.
Total Treatment Cost (per BDT increase)	1.00 (0.99 – 1.01)	0.900	Cost variation does not significantly affect hazard; treatment cost is not a predictor of the event in this study.

IV. DISCUSSION

This article showcases an extensive comparison of regional versus free flap reconstruction of orofacial defects following head and neck cancer resection, with specific emphasis on clinical, functional, and economic results in a setting of limited resources. Demographic comparability of the groups—mean age 58.2 ± 10.5 years (regional flap) and 56.7 ± 9.8 years (free flap), identical smoking histories (56% vs. 60%), and diabetes incidence (20% vs. 16%) allows for dependence on outcome comparison and concurs with demographic trends among head and neck oncology populations (14–16). The spread of tumor sites was significantly different (p=0.006), with tongue tumors more common in the free flap group (34%) than the 20% regional flap group, and with buccal mucosa tumors more common in the regional flap group (40% compared to 46%). Spread of tumor stage was similarly comparable (T3/T4: 50% regional vs. 54% free flap, p=0.68), minimizing stage as a confounding variable (17–19). These differences between sites most likely represent nuances of surgical planning since more complex anatomically tongue defects may require free flap reconstruction. Operative data note dramatic differences: free flap operations consumed much longer operative time vs regional flap (5.5 ± 1.3 hours vs. 4.6 ± 1.1 hours, p<0.001), longer hospitalization in free flap vs regional flap (10.2 ± 2.5 days vs. 7.4 ± 2.0 days, p<0.001), and greater ICU admissions as well in free flap vs regional flap (30% vs. 10%, p=0.01), confirming the heightened complexity and resource utilization that are part of microsurgical procedures (20–22). These findings are consistent with previous literature reporting increased logistical demand and greater expenses of free flap reconstruction (22,25). Postoperative complications such as flap necrosis (4% vs. 2%, p=0.56),

wound infection (6% vs. 4%, p=0.65), hematoma, fistulae, and donor site morbidity were statistically similar between groups. This equivalence indicates that both procedures if performed with sufficient expertise, have identical safety outcomes (23). Functional outcomes at six months again attest to this parity. Normal speech returned in 80% of the regional flap and 84% of the free flap patients (p=0.59), normal swallowing in 76% versus 80% (p=0.63), and diet return in 70% versus 74% (p=0.65). Aesthetic satisfaction was also commensurate (90% vs. 92%, p=0.72). These findings undermine hypotheses favoring free flaps for better functional rehabilitation and are consistent with earlier observations that well-placed regional flaps can produce rehabilitative results equivalent to (24). Cost analysis showed glaring disparities with hospital stay cost being significantly higher for free flaps (BDT 2,50,000 ± 60,000) compared to regional flaps (BDT 1,25,000 ± 48,000), while the total cost of treatment of free flaps vs regional flaps is (BDT 4,25,000 ± 50,000 vs. BDT 2,00,000 ± 65,000, p<0.001). This economic disparity reflects the significant economic expense of free flap procedures in a setting like Bangladesh, in which there is limited availability of healthcare resources and a majority of patients are forced to assume out-of-pocket expenses (25,26). Regional flaps thus reflect a practical, cost-effective alternative without sacrificing safety or functional outcomes. Multivariate logistic regression identified free flap type as an independent risk factor for poor outcomes (OR=2.34, 95% CI: 1.14–4.79, p=0.020), while prolonged hospital stays were protective (OR=0.78, p=0.040), as would be expected with augmented postoperative surveillance and early intervention. Operative time and cost were not predictive of poor outcomes, supporting that quality of postoperative care could supersede procedural complexity in determining patient prognosis. This study closes an important knowledge gap by integrating clinical, functional, and economic data to inform flap selection in low-resource environments. It provides support for the continued use of regional flaps as a robust, effective reconstructive option where microsurgical facilities are not accessible. Its drawback is single-center enrollment and limited sample size; hence, multicenter randomized controlled trials with long-term follow-up are warranted to replicate these findings.

Limitations of The Study

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community.

V. CONCLUSION

This comparative study demonstrates that both regional and free flap reconstructions offer similar safety and functional outcomes in orofacial surgical patients, with no significant differences in complication rates or six-month speech, swallowing, and aesthetic recovery. However, free flap procedures entail a significantly greater operative burden, longer hospitalization, and markedly higher treatment costs. Importantly, flap type emerged as an independent predictor of adverse outcomes in multivariate analyses. These findings underscore the practical value of regional flaps, particularly in resource-constrained settings, as an effective and economically viable reconstructive strategy. The study advocates for a context-sensitive surgical approach, where cost, infrastructure, and outcome considerations are holistically integrated into decision-making.

VI. RECOMMENDATION

Given the comparable functional outcomes and significantly lower costs associated with regional flaps, they should be prioritized in resource-limited healthcare systems like Bangladesh, especially when microsurgical expertise or intensive care support is limited. Future multicenter, randomized trials with longer follow-up are recommended to validate these findings and further guide reconstructive protocols in low- and middle-income settings.

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