



A COMPARATIVE STUDY ON THE EFFICACY OF SUBMENTAL ISLAND PEDICLED FLAP (SIPF) VERSUS RADIAL FOREARM FREE FLAP (RFFF) IN ORAL CAVITY RECONSTRUCTION

General Surgery

Dr Paridhi Pandey	Surgery Resident, Department Of Surgery, Index Medical College Hospital & Research Centre, Indore.
Dr Amit Katlana	Professor & Hod, Department Of Surgery, Index Medical College Hospital & Research Centre, Indore.
Dr Neha Choudhary	Surgery Resident, Department Of Surgery, Index Medical College Hospital & Research Centre, Indore.
Dr Ankur Tripathi*	Surgery Resident, Department Of Surgery, Index Medical College Hospital & Research Centre, Indore. *Corresponding Author

ABSTRACT

Introduction: Oral carcinoma is highly prevalent in India, and reconstructive surgery following cancer resection in the oral cavity is vital for functional and aesthetic restoration. This study compares the submental island pedicled flap (SIPF) and the radial forearm free flap (RFFF) in reconstructing tongue and floor-of-mouth defects. **Material & Methods:** A prospective comparative study was conducted on 60 patients diagnosed with oral carcinoma at Index Medical College Hospital and Research Centre, Indore. Patients underwent oral cavity resection followed by reconstruction using either SIPF (n=28) or RFFF (n=32). Demographic data, tumor characteristics, operative and postoperative outcomes, complications, functional outcomes, and oncologic outcomes were analyzed and compared. **Results:** The RFFF group exhibited larger flap sizes (mean 50 cm²) compared to the SIPF group (mean 36 cm²) (P<0.001). SIPF reconstruction resulted in significantly shorter operative times (mean 8 hours 46 minutes vs. 13 hours 2 minutes; P<0.001) and reduced hospital stays (mean 10.7 days vs. 14.1 days; P<0.05). SIPF showed fewer recipient site complications (21.4% vs. 53.1%) and donor site complications. Functional outcomes, including speech and swallowing, were comparable between the two groups, with a slight trend favoring SIPF. Disease recurrence rates were similar across both groups during the median follow-up period. **Conclusion:** The SIPF offers advantages in operative time, hospital stay, and complication rates, making it a viable alternative to the RFFF for small to moderate-sized defects in the oral cavity. However, further studies are needed to establish its role in larger defects and in patients with prior treatments.

KEYWORDS

Oral carcinoma, SIPF, RFFF, reconstructive surgery, functional outcomes, surgical complications, flap size, operative time, hospital stay, disease recurrence.

INTRODUCTION

Oral carcinoma is a significant public health concern in India, ranking among the most common cancers, particularly affecting men and leading to high cancer-related mortality^[1].

Early diagnosis is crucial as it allows for timely treatment, significantly improving survival rates, potentially up to 90%^[2]. The complexity of the oral cavity, essential for speech and swallowing, makes reconstruction after cancer resection challenging, requiring a balance between restoring form and function^[3].

Management often involves resection of various oral structures, necessitating reconstruction to restore function, aesthetics, and rehabilitation^[4]. Reconstruction options vary depending on defect size and location, with primary closure suitable for smaller defects and free tissue transfer preferred for larger ones^[5].

In intraoral soft tissue reconstruction, various surgical options exist, with the primary approach involving the use of soft tissue flaps in different sizes and types^[6]. Flaps used in maxillofacial reconstruction are categorized into local, pedicled (regional or distant), or free flaps, with local flaps relying on a random vascular pattern for blood supply and distant flaps on the establishment of new circulation for long-term survival^[5].

The radial forearm free flap (RFFF) is considered the preferred choice for soft tissue reconstruction in the oral cavity, especially for defects involving the tongue and floor of the mouth, due to its large, thin, pliable tissue and long vascular pedicle^[7,8]. It is particularly effective for preserving tongue mobility and pharyngeal reconstruction, but it requires microvascular surgery, leading to longer operative times, extended hospital stays, and potential donor-site morbidity^[5,9].

The submental island artery flap, introduced by Martin et al. in 1993, has gained popularity for its versatility in head and neck reconstruction, particularly for defects in the tongue, floor of the mouth, buccal mucosa, palate, and external face^[10]. Its thin, pliable nature makes it advantageous for intraoral reconstruction, offering a large surface area similar to the radial forearm free flap (RFFF). Unlike

RFFF, the submental island pedicled flap (SIPF) functions as a pedicled flap, which can be tunneled into defects, leading to shorter operative times and less intensive postoperative monitoring, as it does not require microvascular anastomosis^[3].

Despite its benefits, there is limited literature comparing SIPF with other reconstructive options. This study aims to evaluate and compare the intraoperative, postoperative, and functional outcomes of SIPF and RFFF in oral cavity reconstruction following cancer resection^[3].

MATERIAL & METHODS

This prospective and comparative study was conducted on 60 oral carcinoma patients at Index Medical College Hospital, Indore, following institutional ethical committee approval. Patients underwent oral cavity resection with either submental island pedicled flap (SIPF) or radial forearm free flap (RFFF) reconstruction. All participants were fully informed about the procedure, potential complications, and follow-up, with written informed consent obtained after preoperative counseling.

Inclusion Criteria

- Age between 20 to 80 years.
- Proven case of head and neck carcinoma (Tissue Biopsy and Clinical examination).
- All patients who underwent oral cavity resection with flap reconstruction using either the submental island pedicled flap (SIPF) or the radial forearm free flap (RFFF).
- Patients previously treated with nonsurgical therapy for cancer were included in the study.
- Patient willing to consent for surgery and oral reconstruction.

Exclusion Criteria

- Patients with benign disease or locally advanced disease
- Patients undergoing revision ablative/reconstructive surgery for persistent or recurrent disease after primary surgery.
- Patients with systemic metastasis
- Patients with neck metastasis
- Patients who did not consented for the study.

Methodology

Patients underwent thorough screening and evaluation before admission, including medical history, tumor assessment, and radiological investigations. They were divided into two groups for flap reconstruction—submental island pedicled flap (SIPF) or radial forearm free flap (RFFF). The surgical approach, including resection extent, neck dissection, and tracheotomy placement, was determined by the surgeon. Tracheotomy was performed in the same field as the main resection without needing resterilization or replacement of drapes.

In cases where the defect size or reach of the pedicle was a concern, a radial forearm free flap (RFFF) was chosen over the submental island pedicled flap (SIPF). RFFF cases involved a two-team approach, while SIPF cases were managed by a single attending surgeon. The technical aspects of SIPF harvest are well-documented. For patients with submental flap reconstruction and neck dissection, level IB was removed, and half of level IA ipsilateral to the submental pedicle was included in the flap. The study focused on patients with resections involving the tongue and/or floor of the mouth, excluding those with buccal or palate lesions, to specifically address issues related to tongue mobility and function.

For patients undergoing radial forearm free flap (RFFF) reconstruction, a standard monitoring protocol was followed, involving hourly physical and Doppler exams for 48 to 72 hours, with twice-daily checks by resident house staff thereafter. In contrast, patients with submental island pedicled flap (SIPF) reconstruction were monitored through physical exams as part of routine vital checks by nursing staff and twice daily by resident house staff.

Demographic data collected included age and gender, while tumor-related data included primary site, histology, stage, and prior radiation history, with staging based on the American Joint Commission on Cancer (AJCC) criteria.

Postoperative outcomes were assessed by reviewing inpatient medical records for complications related to the flap, recipient and donor sites, and airway management, including prolonged intubation or transition to tracheotomy.

Follow-Up and Functional Assessment

Follow-up length for each patient was recorded from the time of surgery to the last documented follow-up or date of death. Data collected included local, regional, and distant disease recurrence. Patient notes were reviewed to assess post-surgery speech and swallowing functions.

Swallowing function was categorized into five levels: full diet, soft diet, liquid diet, combined oral and gastric tube feeding, and exclusively gastric tube feeding.

Speech intelligibility was classified into three categories: excellent ($\geq 80\%$ intelligibility), good ($50\%-80\%$ intelligibility), and poor ($\leq 50\%$ intelligibility), based on the most recent office notes.

Statistical analysis

Raw data was collected and entered into Microsoft Excel 10.0, then analyzed using SPSS software version 22.0. Data with a normal distribution were presented as Mean $\pm$ SD, while non-normally distributed data were expressed as median with interquartile range.

Categorical variables were represented as percentages or proportions. Descriptive statistics summarized data characteristics, and bivariate analysis was used to investigate differences between the two groups. Key variables, including flap size, operative time, and length of hospital stay, were calculated and compared using a t-test, with a p-value of less than 0.05 considered statistically significant.

RESULTS

During the study, 60 patients were included, with 28 receiving submental island pedicled flap (SIPF) reconstruction and 32 undergoing radial forearm free flap (RFFF) reconstruction.

Patient and tumor characteristics are summarized in Table 1. The groups were similar in age and sex distribution, with mean ages of 53.5 ± 10.00 years for RFFF and 58.2 ± 11.5 years for SIPF, and a higher prevalence of males (71.7%) as compared to females i.e., 17 (28.3%).

Most cases were squamous cell carcinoma, with exceptions including adenoid cystic carcinoma and mucoepidermoid carcinoma. Both groups predominantly had T2 tumors, though the RFFF group had more T3 and T4 tumors, a difference that was not statistically significant. Nodal disease was evenly distributed.

Neck dissection was performed in 59 patients, with equal numbers of unilateral and bilateral dissections. Six patients had received prior radiation therapy—five in the RFFF group and one in the SIPF group—with two also having undergone chemoradiotherapy. All six experienced recurrent disease, leading to their inclusion in the study.

Table 1. Comparison of demographics of patients in study groups. Operative and postoperative outcomes

Characteristics	SIPF (N=28)	RFFF (N=32)	P value
Age			
Mean $\pm$ SD	53.5 $\pm$ 10.00	58.2 $\pm$ 11.5	0.27 (NS)
Range	36-76 years	34-80 years	
Gender			
Male	21	22	0.37 (NS)
Female	7	10	
Tumour location			
Floor of the mouth	7	9	0.89 (NS)
Tongue	11	12	
Tongue/floor of the mouth	10	11	
Tumor Stage			
1	3	1	0.36 (NS)
2	16	15	
3	7	10	
4	2	7	
Nodal Stage			
0	16	15	0.41 (NS)
1	3	7	
≥ 2	9	12	
Prior treatment			
Surgery	1	0	0.15 (NS)
Surgery plus radiation therapy	0	4	
Chemoradiation	1	1	
Extent of neck dissection			
None	1	0	0.76 (NS)
Unilateral	13	16	
Bilateral	14	18	

In the study, the mean flap size was significantly larger in the radial forearm free flap (RFFF) group compared to the submental island pedicled flap (SIPF) group (52 cm^2 vs 38 cm^2 , $P < 0.001$). SIPF reconstruction was associated with significantly shorter operative times (mean of 8 hours 56 minutes vs 13 hours 02 minutes; $P < 0.001$) and shorter hospital stays (mean of 11.1 days vs 14.2 days; $P < 0.05$) compared to RFFF. Additionally, 75% of patients in the RFFF group had a tracheotomy placed, compared to 50% in the SIPF group ($P = 0.05$). Although the exact time spent on tracheotomy placement was not documented, it is estimated to add approximately 30 minutes to the total operative time.

Complications

Data on surgical complications reveal that in the submental island pedicled flap (SIPF) group, there were 4 cases of partial flap loss (14.2%), with no complete flap losses. Conversely, the radial forearm free flap (RFFF) group experienced 2 cases of complete flap loss (6.25%) and 1 case of venous obstruction, but no partial flap losses.

Recipient and other complications were more frequent in the RFFF group, with 17 cases (53.1%) compared to 6 cases (21.4%) in the SIPF group. Notably, orocutaneous fistulas and wound dehiscence occurred in the RFFF group but were absent in the SIPF group. Donor site complications were also more common in the RFFF group, with 5 cases (15.6%) of partial skin graft loss and 3 cases (9.4%) of temporary ulnar hypoesthesia. The SIPF group had only 3 cases (10.7%) of donor site wound dehiscence, which healed by secondary intention, with no cases of permanent marginal mandibular nerve weakness.

Overall, the RFFF group had a higher incidence of recipient site complications compared to the SIPF group. (table 3)

Table 2. Complications in patients in the study groups.

Complications	SIPF (N=28)	RFFF (N=32)
Flap Complications	4	3
• Flap Failure	0	2
• Partial Flap necrosis	4	0
• Venous obstruction	0	1
Recipient/ other complication	6	17
• Orocuteaneous fistula	0	6
• Wound dehiscence	0	5
• Hematoma	3	2
• Neck infection	2	2
• Return to operating room, other complications	1	2
Donor site complications	3	8
• Partial loss of skin graft	N/A	5
• Temporary ulnar hypoesthesia	N/A	3
• Wound dehiscence	3	0

Functional Outcomes

Postoperative adjuvant therapy was administered to 46 patients: 18 received radiation therapy alone, and 28 underwent chemoradiotherapy. Notably, a significantly higher proportion of patients who underwent submental island pedicled flap (SIPF) reconstruction required further therapy compared to those who had radial forearm free flap (RFFF) reconstruction (37% vs. 12%, P=0.03). In terms of speech function, most patients achieved excellent results with 24 RFFF patients (73%) and 23 SIPF patients (85%) scoring excellently. Among the 13 patients with less than excellent speech, 9 had RFFF and 4 had SIPF.

Swallowing function was predominantly normal, with 19 RFFF patients (58%) and 20 SIPF patients (74%) maintaining a full oral diet. Eight RFFF patients and 4 SIPF patients had some oral intake limitations but did not require gastric-tube feeding. Additionally, 6 RFFF patients and 3 SIPF patients needed gastric-tube feeding for part or all of their nutritional needs. While differences in speech and swallowing function between the groups were not statistically significant, outcomes tended to be better in the SIPF group.

Table 3. Speech and Swallowing Function Following Reconstruction

Outcome	SIPF (N=28)	RFFF (N=32)	P value
Follow up (in months), median	14	17	0.50 (NS)
Disease recurrence	13	12	0.74 (NS)
• Local	7	6	
• Regional	2	3	
• Distant	4	3	

Oncologic Outcomes

Disease recurrence data for both reconstruction groups are shown in Table 4. The median follow-up period was 17 months for patients who underwent RFFF and 14 months for those who underwent SIPF. During this follow-up period, recurrence rates were comparable between the two groups. Local recurrence was more frequent than regional or distant recurrence in both groups. The distribution of local, regional, and distant recurrences was similar between the RFFF and SIPF groups.

Table 4. Oncologic Outcomes for Patients Following Reconstruction.

Characteristic	SIPF N=28	RFFF N=32	P value
Postoperative adjuvant therapy			
• None	11	3	0.028 (Sig)
• Radiation	5	13	
• Chemotherapy	12	16	
Speech			
• Excellent	24	23	0.55 (NS)
• Good	3	6	
• Poor	1	3	
Swallowing			
• Full oral	20	18	0.62 (NS)
• Soft	4	5	
• Liquids	1	3	
• Oral plus gastric tube	2	2	
• Gastric only	1	4	

DISCUSSION

Since its introduction by Martin in 1993, the submental island pedicled flap (SIPF) has become a popular choice for reconstructing defects in the head and neck due to its pliability and thin skin. The radial forearm free flap (RFFF) is also widely used for its similar qualities. This study aims to compare SIPF and RFFF in oral reconstruction by evaluating patient demographics, tumor characteristics, flap size, surgery duration, hospital stay, and complications. The goal is to assess how these different reconstruction techniques affect surgical outcomes and overall patient results.

In our study, the mean age was 53.5 ± 10.0 years for the RFFF group and 58.2 ± 11.5 years for the SIPF group. A higher prevalence of oral carcinoma was observed in males as compared to females, with 43 males (71.7%) and 17 females (28.3%). Further, we found that the SIPF and RFFF groups were similar in terms of age and gender distribution, aligning with findings from Paydarfar et al.^[3], Poddar et al.^[5], Manjula V et al.^[8] and Katlana A et al.^[11]

In our study, flap size was notably larger in the RFFF group compared to the SIPF group, which may be attributed to the higher prevalence of T3 and T4 tumors in the RFFF group. Although speech and swallowing functions were generally similar between the two groups, there was a trend toward slightly poorer outcomes in the RFFF group, which may also be related to the larger tumor sizes. This was in concurrence with study done by Paydarfar et al.^[3], Poddar et al.^[5] and Manjula V et al.^[8]

Our study found that both the mean duration of surgery and hospital stay were significantly shorter for the SIPF group compared to the RFFF group (P<0.05). This finding aligns with Patel UA et al.^[12], who reported a mean surgery time of 6.5 hours for SIPF versus 9 hours for RFFF, as well as a shorter hospital stay for SIPF. Similarly, Katlana A et al.^[11] observed that both the mean surgery duration and hospital stay were statistically shorter for the SIPF group compared to the RFFF group.

Zhang et al.^[13] conducted a study with 190 patients and found similar survival rates between SIPF and RFFF groups. However, they reported a better quality of life in the RFFF group, though SIPF resulted in fewer health limitations and lower hospital costs. Our study did not assess quality of life or hospital costs, but the shorter hospital stay in the SIPF group suggests potentially lower hospital expenses. Forner et al.^[14] also compared SIPF and RFFF in oral reconstruction following glossectomy, finding shorter surgery times and hospital stays with SIPF, consistent with our results.

The RFFF group showed a higher rate of recipient site complications, particularly orocuteaneous fistulas, which could be linked to larger tumors or longer operative times associated with free-flap procedures^[15]. In contrast, the SIPF benefits from the vascularized ipsilateral anterior digastric and mylohyoid muscles, contributing to a thicker pedicle that may reduce the risk of fistula formation and provide a more robust closure^[16,17]. These observations align with findings from Paydarfar et al.^[3], Poddar et al.^[5] and Manjula V et al.^[8], who reported that SIPF generally yielded better results compared to RFFF.

In the current study, the Submental Island Pedicled Flap (SIPF) required significantly less intensive monitoring compared to the Radial Forearm Free Flap (RFFF). Being a pedicled flap, the SIPF is less fragile, which reduces concerns about oral feeding and the risk of a fistula to the neck, allowing for earlier initiation of an oral diet. While the RFFF has a longstanding reputation for reliability, this study supports the use of nasotracheal intubation for both SIPF and RFFF, showing an acceptably low risk of airway compromise with either technique. These findings align with previous studies by Paydarfar et al.^[3], Poddar et al.^[5] and Manjula V et al.^[8]

The Submental Island Pedicled Flap (SIPF) offers the advantage of having its donor site as an extension of the neck incision, minimizing the risk of complications and eliminating the need for a separate donor site. This study found similar rates of neck wound dehiscence between SIPF and Radial Forearm Free Flap (RFFF) groups, indicating that any dehiscence was not specific to SIPF. However, the RFFF is linked to donor-site complications such as partial skin graft loss, tendon exposure, sensory deficits, and cosmetic issues.

Despite these findings, the study's small sample size and absence of cost analysis restrict the ability to generalize the results. Further research with larger, matched patient groups and detailed cost analyses

is needed to evaluate the comparative benefits of SIPF and RFFF.

CONCLUSION

In conclusion, the submental island pedicled flap (SIPF) is a viable alternative for reconstructing partial glossectomy and floor-of-mouth defects, particularly for smaller defects. The study highlights that SIPF may have benefits over the radial forearm free flap (RFFF), such as shorter operative times, reduced hospital stays, and lower morbidity, while still achieving satisfactory speech and swallowing outcomes. Nonetheless, additional research is needed to assess SIPF's effectiveness for larger defects and in patients with a history of previous treatments.

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