

Original Research Article

Comparative assessment of early surgical recovery and functional outcomes following anterolateral thigh and radial forearm free flap reconstruction for oral soft-tissue defects in a tertiary care centre

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ABSTRACT

Background: Reconstruction of oral cavity soft-tissue defects following oncological resection is essential for restoration of oral function and minimization of donor-site morbidity. Anterolateral thigh free flap (ALTFF) and radial forearm free flap (RFFF) are commonly used reconstructive options. This study compared their early surgical and functional outcomes.

Methods: A prospective observational study was conducted in the Department of Plastic Surgery, King George Hospital, Visakhapatnam, from May 2025 to April 2026. Fifty patients requiring free-flap reconstruction of oral cavity defects were included. Twenty-eight patients underwent ALTFF reconstruction and 22 underwent RFFF reconstruction. Flap survival, defect and flap dimensions, donor-site complications, and postoperative mouth opening were assessed.

Results: The mean age was 54.64 ± 8.89 years, and 60% of patients were female. ALTFF was used in 56% and RFFF in 44% of cases. Mean defect and flap surface areas were significantly greater with ALTFF than RFFF (61.53 ± 19.51 vs 42.22 ± 10.77 cm², $p=0.0001$; 138.62 ± 42.26 vs. 74.46 ± 15.89 cm², $p<0.0001$). Flap survival was 89.3% with ALTFF and 86.4% with RFFF. RFFF donor-site graft loss occurred in 40.9% of cases. Mean mouth opening improved from 4.15 ± 1.15 cm preoperatively to 4.71 ± 0.58 cm postoperatively.

Conclusions: Both ALTFF and RFFF provided satisfactory early surgical and functional outcomes. ALTFF facilitated reconstruction of larger defects with lower donor-site morbidity, while RFFF provided reliable reconstruction with acceptable functional outcomes. Flap selection should be individualized according to defect characteristics and tissue requirements.

Keywords: Anterolateral thigh free flap, Radial forearm free flap, Oral cavity reconstruction, Soft-tissue defects, Flap survival, Donor-site morbidity

INTRODUCTION

Oral squamous cell carcinoma (OSCC) is the predominant histological malignancy of the oral cavity

and represents an important clinical problem because of its potential for cervical lymph node metastasis. Accurate assessment of cervical nodal status is therefore an important component of the management of patients with

oral cavity malignancies.¹ Oral cancer represents a significant health burden in India, with a substantial number of new cases and cancer-related deaths reported annually.² Among the different anatomical sites, the buccal mucosa is frequently involved, which has been associated with the widespread use of tobacco and betel quid and their prolonged retention within the oral vestibule.³ Surgical treatment of oral cavity malignancies often requires extensive oncological resection, which may result in large soft tissue or composite defects requiring reconstruction.⁴ The reconstruction of these defects aims to restore adequate tissue coverage while preserving oral function and minimizing morbidity at both the recipient and donor sites. With advances in reconstructive surgery, microvascular free flaps have become an important option for the reconstruction of oral cavity and head and neck defects. Their reliable vascularity, versatility and ability to provide tissue appropriate for complex defects have contributed to their widespread use in oral and head and neck reconstruction.^{5,6}

Among the commonly used free flaps for oral cavity reconstruction, the radial forearm free flap (RFFF) and anterolateral thigh free flap (ALTFF) are important options. Comparative studies have demonstrated their usefulness in reconstruction following ablative surgery, with both techniques providing reliable tissue for restoration of oral and oropharyngeal defects.⁷ The RFFF is particularly useful because of its thin, pliable skin paddle, long vascular pedicle and consistent vascular anatomy, making it suitable for intraoral reconstruction.^{8,9} However, RFFF reconstruction is associated with donor-site morbidity, particularly because the forearm donor site generally requires skin grafting and may develop graft-related complications.⁷ In contrast, the ALTFF provides a long vascular pedicle, suitable vessel calibre and considerable versatility in flap design. It can also provide a larger amount of skin and subcutaneous tissue when required for extensive defects and may allow relatively less donor-site morbidity.^{4,10}

Both RFFF and ALTFF have demonstrated satisfactory flap survival and functional outcomes in oral cavity reconstruction. Comparative studies have reported high success rates with both techniques, while differences have been observed in flap dimensions, donor-site management and complications.^{7,10} Therefore, assessment of flap survival, defect and flap characteristics, donor-site morbidity and early functional recovery is important when selecting an appropriate reconstructive technique. Therefore, the present study was undertaken at King George Hospital, Visakhapatnam to evaluate and compare the early surgical and functional outcomes of ALTFF and RFFF in the reconstruction of soft tissue defects of the oral cavity. The study focuses on flap survival, defect and flap characteristics, donor-site morbidity and early postoperative functional recovery, with the aim of assessing the relative usefulness of these two free-flap techniques in oral cavity reconstruction.

Objectives

The main objective of the study was to evaluate the early surgical and functional outcomes of ALTFF and RFFF in the reconstruction of soft tissue defects of the oral cavity.

METHODS

This prospective observational study was conducted in the Department of Plastic Surgery, King George Hospital (KGH) over a period of one year from May 2025 to April 2026. A total of 50 patients who required free flap reconstruction following surgical resection of oral cavity lesions, with or without adjacent soft tissue or bone involvement, were included in the study. Patients were reconstructed using either ALTFF or RFFF. Tumor resection or defect creation and flap harvesting were performed simultaneously by two surgical teams. The RFFF was designed over the radial forearm, incorporating the radial artery, its venae comitantes and the cephalic vein, with the donor site resurfaced using a split-thickness skin graft. The ALTFF was harvested based on perforators identified using Doppler ultrasound, either as septocutaneous or musculocutaneous perforators, and the donor site was closed primarily or with a local advancement flap. Microvascular anastomosis was performed using standard end-to-end or end-to-side techniques. All patients received standardized postoperative care with strict flap monitoring, including assessment of colour, temperature, tissue turgor, pinprick bleeding and Doppler signal. Donor sites were evaluated for healing and complications. Patients were followed up at the 1st, 2nd and 4th postoperative weeks to assess flap survival, mouth opening and donor-site morbidity. Written informed consent was obtained after full explanation of the study, and ethical approval was obtained from the Institutional Ethics Committee.

Statistical analysis

All data were recorded systematically in a preformed data collection form. Quantitative data were expressed as mean and standard deviation, and qualitative data were expressed as frequency distribution and percentage. Statistical analysis was performed using SPSS (Statistical Package for Social Sciences) software. Confidentiality was strictly maintained.

RESULTS

Table 1 shows the baseline characteristics of the 50 patients included in the study. The mean age of the patients was 54.64 ± 8.89 years, with 36% belonging to the 40–49 years age group and 34% aged ≥ 60 years. Females constituted 60% of the study population, while 40% were males. More than half of the patients (56%) had no comorbidities, while hypertension (24%) was the most common comorbidity.

Table 1: Baseline characteristics (n=50).

Variables	Category	N	%
Age (years)	40–49	18	36.0
	50–59	15	30.0
	≥60	17	34.0
	Mean±SD	54.64±8.89	
Gender	Male	20	40.0
	Female	30	60.0
Comorbidities	None	28	56.0
	DM	3	6.0
	HTN	12	24.0
	IHD	2	4.0
	DM+HTN	5	10.0

Table 2: Adjacent structure and lymph-node involvement.

Variables	Category	N	%
Adjacent structure involvement	Mandible	28	56.0
	Lip	20	40.0
	Angle of mouth	30	60.0
	Maxilla	5	10.0
	Tongue	3	6.0
Lymph-node involvement	Yes	40	80.0
	No	10	20.0

Table 3: Surface area of defects and corresponding flaps.

Variables	ALTFF Mean±SD	Range	RFFF Mean±SD	Range	P value
Surface area of defect (cm ²)	61.53±19.51	23.77-101.42	42.22±10.77	19.87-63.73	0.0001
Surface area of flap (cm ²)	138.62±42.26	71.66-219.43	74.46±15.89	52.54-108.62	<0.0001

Table 4: Outcome measures.

Outcomes	ALTFF (n=28)	RFFF (n=22)
Flap outcome	N (%)	N (%)
No flap necrosis	23 (82.1)	19 (86.4)
Marginal necrosis	2 (7.1)	0
Complete necrosis	3 (10.7)	3 (13.6)
Donor-site management		
Local advancement flap	28 (100)	—
STSG	—	22 (100)
Donor-site complications (RFFF)		
No graft loss	—	13 (59.1)
5% graft loss	—	5 (22.7)
10% graft loss	—	4 (18.2)
Functional outcome	Mean ± SD	
Mouth opening-preoperative	4.15±1.15 cm	
Mouth opening-postoperative	4.71±0.58 cm	

Table 2 shows the distribution of patients according to adjacent structure and cervical lymph node involvement. The angle of the mouth was the most commonly involved adjacent structure (60%), followed by the mandible (56%) and lip (40%). Cervical lymph node involvement was present in 80% of the patients.

Table 3 shows the surface area of oral cavity defects and corresponding flap dimensions in the ALTFF and RFFF groups. The mean defect surface area was greater in patients reconstructed with ALTFF (61.53±19.51 cm²) compared with RFFF (42.22±10.77 cm²), and the difference was statistically significant (p=0.0001).

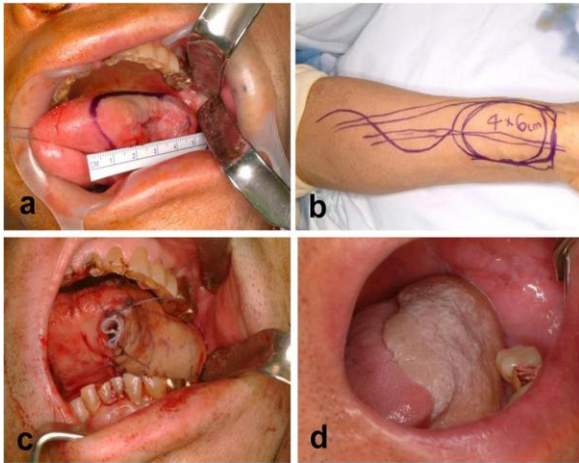


Figure 1 (a-d): Harvesting and reconstruction using RFFF.

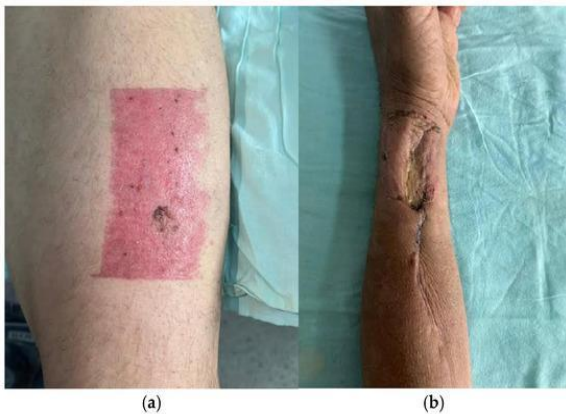


Figure 2 (a and b): Harvesting using RFFF.



Figure 3 (a-c): Harvesting of anterolateral thigh free flap.

Similarly, the mean flap surface area was significantly greater in the ALTFF group ($138.62 \pm 42.26 \text{ cm}^2$) than in the RFFF group ($74.46 \pm 15.89 \text{ cm}^2$, $p < 0.0001$).

Table 4 shows the surgical and functional outcomes of the patients. Among ALTFF patients, 23 (82.1%) had no flap necrosis, 2 (7.1%) had marginal necrosis and 3 (10.7%) had complete necrosis. In the RFFF group, 19 (86.4%) had no flap necrosis and 3 (13.6%) had complete necrosis. All ALTFF donor sites were managed with local advancement flaps, while all RFFF donor sites were resurfaced with split-thickness skin grafts. Among RFFF patients, graft loss occurred in 9 (40.9%) cases. The mean mouth opening improved from $4.15 \pm 1.15 \text{ cm}$ preoperatively to $4.71 \pm 0.58 \text{ cm}$ postoperatively.

DISCUSSION

This prospective observational study was conducted over a period of one year in the Department of Plastic Surgery, King George Hospital, Visakhapatnam, in association with Andhra Medical College. The purpose of the study was to evaluate the early surgical and functional outcomes of RFFF and ALTFF in the reconstruction of oral cavity soft tissue defects. A total of 50 patients were included, of whom 28 underwent reconstruction with ALTFF and 22 with RFFF.

RFFF and ALTFF are two broadly accepted options for oral reconstruction following tumor ablative surgery. With advances in microsurgical techniques and instruments, free-flap failure rates have decreased over the last few decades, while increasing attention has been directed towards the functional and aesthetic outcomes of both recipient and donor sites.⁷ RFFF is effective in restoring function and appearance following excision of oral cavity tumors and provides a relatively hairless, thin and pliable skin paddle with a long and consistent vascular pedicle.⁹ On the other hand, an important advantage of ALTFF is avoidance of sacrifice of a major vascular axis and reduced exposure of important structures such as tendons and nerves. It also provides versatility in flap design and availability of a larger amount of tissue for reconstruction.¹⁰

The majority of patients in the present study were above 50 years of age, and the mean age was 54.64 ± 8.89 years. Both male and female patients were included, with females comprising 60% of the study population. More than half of the patients had no associated comorbidities, while hypertension was the most frequent comorbidity. Previous studies have also included patients from a wide adult age range undergoing free-flap reconstruction for oral cavity malignancies.⁹

Cervical lymph node involvement was present in 80% of patients in the present study. Patients with node-positive oral cavity squamous cell carcinoma commonly require appropriate neck management as part of oncological treatment. Hashmi et al reported the role of selective neck dissection in node-positive oral cavity squamous cell carcinoma, with good regional control in appropriately selected patients.¹² In the present study, among the adjacent structures involved in the oral cavity defects, the angle of the mouth and mandible were the most frequently involved structures. Buccal mucosa is one of the common sites of oral cancer, and its association with tobacco and betel-product use has been reported previously.³

ALTFF reconstruction was performed in 28 (56%) cases, whereas RFFF was used in 22 (44%) cases. The choice of flap was based on the location and dimensions of the defect, patient preference and surgeon's judgment. Loreti et al reported a similar distribution, with 25 (59.5%) patients reconstructed with ALTFF and 17 (40.4%) with

RFFF.¹⁰ The availability of a large skin paddle and versatility of ALTFF make it particularly useful when extensive soft tissue reconstruction is required. Camaioni et al also reported that the ALT flap provided sufficient tissue for more extensive tumour resections while maintaining comparable recipient-site functional results.⁷

Patients reconstructed with ALTFF had significantly larger defect areas ($61.53 \pm 19.51 \text{ cm}^2$) compared with those reconstructed with RFFF ($42.22 \pm 10.77 \text{ cm}^2$, $p=0.0001$). Similarly, the mean flap surface area was significantly greater in the ALTFF group ($138.62 \pm 42.26 \text{ cm}^2$) than in the RFFF group ($74.46 \pm 15.89 \text{ cm}^2$, $p<0.0001$). The larger flap dimensions observed with ALTFF may be related to the greater availability of skin and subcutaneous tissue and its versatility in reconstruction of larger defects. Suh et al reported a larger average flap size with ALTFF compared with RFFF, supporting its usefulness for extensive head and neck defects.⁵

Flap survival was satisfactory in both groups in the present study. In the ALTFF group, 23 (82.1%) patients had no flap necrosis, 2 (7.1%) had marginal necrosis and 3 (10.7%) had complete necrosis. In the RFFF group, 19 (86.4%) had no flap necrosis and 3 (13.6%) had complete necrosis. Thus, the observed flap survival was 89.3% for ALTFF and 86.4% for RFFF. The difference in flap survival between the groups was small, indicating that both techniques provided reliable reconstruction in the present study.

Previous studies have similarly demonstrated high success rates with both techniques. Camaioni et al reported flap survival of 93.5% with ALTFF and 94.1% with RFFF, with comparable functional results at the recipient site.⁷ Loreti et al reported a success rate of 94.2% for RFFF and comparable outcomes with the ALT flap.¹⁰ Kesting et al also compared ALTFF and RFFF in a large study of 161 cases and reported the perioperative outcomes of both techniques.¹⁴ These findings, together with the present observations, support the use of either flap depending on the characteristics of the defect and the requirements of reconstruction.

Regarding flap complications, complete necrosis was observed in 3 patients in the ALTFF group and 3 patients in the RFFF group, while marginal necrosis occurred in 2 patients in the ALTFF group. The occurrence of flap necrosis remains an important early surgical outcome because vascular compromise can adversely affect reconstruction and may require secondary intervention. Previous comparative studies have also reported occasional complete and partial flap losses with both ALTFF and RFFF.^{9,14}

Functional outcome at the recipient site was satisfactory in the present study. The mean mouth opening improved from $4.15 \pm 1.15 \text{ cm}$ preoperatively to $4.71 \pm 0.58 \text{ cm}$ postoperatively, indicating improvement following

reconstruction. Fang et al reported a mean postoperative mouth opening of approximately 4.3 cm in patients undergoing RFFF reconstruction of buccal defects, which is broadly comparable with the postoperative mouth opening observed in the present study.¹¹ Functional comparisons between ALTFF and RFFF have also demonstrated generally comparable recipient-site function, suggesting that both flaps can provide satisfactory restoration of oral function when appropriately selected.¹¹

All ALTFF donor sites in the present study were managed with local advancement flaps, whereas all RFFF donor sites required split-thickness skin grafting. Among the RFFF cases, 13 (59.1%) had no graft loss, 5 (22.7%) had 5% graft loss and 4 (18.2%) had 10% graft loss. Thus, donor-site graft loss was observed in 40.9% of RFFF cases. No comparable graft-loss complication was observed in the ALTFF group. Camaioni et al reported greater donor-site functional impairment with RFFF, while ALTFF allowed primary closure with reduced donor-site morbidity.⁷ Loreti et al likewise emphasized the donor-site advantages of ALTFF compared with RFFF.¹⁰

The findings of the present study therefore demonstrate that both ALTFF and RFFF are useful options for reconstruction of oral cavity soft tissue defects. ALTFF was associated with significantly larger defect and flap dimensions and avoided the need for skin-graft resurfacing at the donor site, whereas RFFF provided reliable reconstruction with satisfactory early functional outcomes. Although the present study showed a slightly higher flap survival proportion with RFFF, the difference was small and should not be interpreted as evidence of superiority of one flap over the other. The selection of flap should be individualized according to the size and location of the defect, tissue requirements, patient-related factors and surgeon's experience.

Limitations

This was a single-center study with a relatively small sample size, which may limit the generalizability of the findings to larger populations. In addition, the short follow-up period may not adequately reflect long-term outcomes, such as recurrence rates and late complications.

CONCLUSION

With advances in surgical techniques and microsurgical instruments, the focus of oral cavity reconstruction has shifted from flap survival alone towards the functional and aesthetic outcomes of both recipient and donor sites. In the present study, both ALTFF and RFFF provided satisfactory flap survival and functional outcomes in the reconstruction of oral cavity soft tissue defects. ALTFF offered the advantage of reconstruction of larger defects with lower donor-site morbidity, whereas RFFF also

provided reliable reconstruction with acceptable early functional outcomes. Both flaps are reliable options for oral cavity reconstruction, and the choice should be based on the defect characteristics, tissue requirements and clinical judgment.

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Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Rahman N, Rahman MM, Nilomi E, Alievna MM, Sumon MAI, Awwal R. Evaluation of early surgical and functional outcomes of anterolateral thigh free flap and radial forearm free flap for reconstruction of soft tissue defects of oral cavity. *Int Surg J*. 2025;12:1933-9.
2. Sah R, Akhter M. Oral Cancer Senario in Multiple Centers of Dhaka, Bangladesh. *Biomed J Scientific Technical Res*. 2020;32(2):24867-70.
3. Rahman QB, Gautam S, Habib MA. A Study to Detect Sentinel Lymph Node by Methylene Blue Dye and Histopathological Confirmation of Metastasis in Oral Squamous Cell Carcinoma Patient. *Am J Oral Maxillofacial Surg*. 2018;5(1):13-21.
4. Ren ZH, Wu HJ, Tan HY, Wang K, Zhang S. Transfer of anterolateral thigh flaps in elderly oral cancer patients: complications in oral and maxillofacial reconstruction. *J Oral Maxillofacial Surg*. 2015;73(3):534-40.
5. Suh JM, Chung CH, Chang YJ. Head and neck reconstruction using free flaps: a 30-year medical record review. *Arch Craniofacial Surg*. 2021;22(1):38.
6. Pastars K, Zarins J, Tars J, Ivanova A, Skagers A. Microsurgical reconstruction of oral defects with free flaps for patients with oral cancer: an 8 year experience with 153 consecutive cases. *Stomatologija*. 2018;20(2):39-42.
7. Camaioni A, Loreti A, Damiani V, Bellioni M, Passali FM, Viti C. Anterolateral thigh cutaneous flap vs. radial forearm free-flap in oral and oropharyngeal reconstruction: an analysis of 48 flaps. *Acta Otorhinolaryngol Italica*. 2008;28(1):7-12.
8. Young AM, Bache S, Segaren N, Murphy S, Maraka J, Durrani AJ. Free flap selection and outcomes of soft tissue reconstruction following resection of intra-oral malignancy. *Front Surg*. 2019;6:53.
9. Jeremić JV, Nikolić ŽS. Versatility of radial forearm free flap for intraoral reconstruction. *Srpski Arhiv Cellokupno Lekarstvo*. 2015;143(5-6):256-60.
10. Loreti A, Di Lella G, Vetrano S, Tedaldi M, Dell'Osso A, Poladas G. Thinned anterolateral thigh cutaneous flap and radial fasciocutaneous forearm flap for reconstruction of oral defects: comparison of donor site morbidity. *J Oral Maxillofacial Surg*. 2008;66(6):1093-8.
11. Fang QG, Li ZN, Zhang X, Liu FY, Xu ZF, Sun CF. Clinical reliability of radial forearm free flap in repair of buccal defects. *World J Surgical Oncol*. 2013;11(1):1-4.
12. Hashmi SS, Abbas A, Bukhari A, Saeed J, Shafqat A, Siddique AH, et al. Selective Neck Dissection for Node-Positive Oral Cavity Squamous Cell Carcinoma: A Retrospective Cohort Study. *Int Arch Otorhinolaryngol*. 2022;26(4):e630-5.
13. Hsing CY, Wong YK, Wang CP, Wang CC, Jiang RS, Chen FJ, et al. Comparison between free flap and pectoralis major pedicled flap for reconstruction in oral cavity cancer patients—a quality of life analysis. *Oral Oncol*. 2011;47(6):522-7.
14. Kesting MR, Hölzle F, Wales C, Steinstaesser L, Wagenpfeil S, Mücke T, et al. Microsurgical reconstruction of the oral cavity with free flaps from the anterolateral thigh and the radial forearm: a comparison of perioperative data from 161 cases. *Ann Surg Oncol*. 2011;18(7):1988-94.

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