International Journal of Research in Medical Sciences
Rajgor DK et al. Int J Res Med Sci. 2025 Dec;13(12):5232-5237
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012
DOI: https://dx.doi.org/10.18203/2320-6012.ijrms20253760

Original Research Article

Microvascular free flap reconstruction in head and neck cancer cases with vessel depleted necks and distorted anatomy due to prior intervention

Darshil K. Rajgor[1]*, Nilesh B. Ghelani[2], Sankit D. Shah[2], Chintan A. Godhani[2], Virank V. Shah[2]

[1]Department of Burns and Plastic Surgery, L. G. Hospital, Narendra Modi Medical College, Ahmedabad, Gujarat, India
[2]Department of Burns and Plastic Surgery, Smt. S.C.L. Hospital, Smt. N. H. L. Municipal Medical College, Ahmedabad, Gujarat, India

Received: 01 November 2025
Revised: 12 November 2025
Accepted: 13 November 2025

***Correspondence:**
Dr. Darshil K. Rajgor,
E-mail: darshil1182007@gmail.com

ABSTRACT

Background: Microvascular reconstruction is crucial in head and neck oncoplastic surgery following ablative procedures. However, prior surgery, radiation or tumor recurrence often leads to a vessel-depleted neck, making free flap transfer technically challenging.
Methods: This prospective study included 30 patients undergoing microvascular reconstruction in a vessel-depleted neck over two years' period. Preoperative imaging with doppler ultrasonography was performed for vessel mapping. Intraoperatively, meticulous dissection of ipsilateral vessels was attempted first. Free flaps used included anterolateral thigh, free fibula, and radial forearm, chosen for their long vascular pedicles.
Results: All patients achieved successful flap survival, with no flap failures (100% survival). In all cases, ipsilateral vessels were usable despite prior surgery or radiotherapy. Contralateral dissection and vein grafting were not required in our series. End-to-side or end to end anastomosis to the internal jugular vein or its branches with corresponding arteries proved reliable. Prior radiotherapy did not adversely affect outcomes.
Conclusions: Microvascular reconstruction in vessel-depleted necks is surgically demanding but feasible with careful planning, patience, and detailed anatomical knowledge. Meticulous dissection and use of flaps with long pedicles allow consistently high success rates, minimizing the need for vein grafts or contralateral vessel exploration.

Keywords: Microvascular reconstruction, Vessel-depleted neck, Free flap, Head and neck reconstruction

INTRODUCTION

Microvascular free flap reconstruction is a gold standard in the management of head and neck cancer. Evolution of microsurgical techniques over last 7 to 8 decades improves free flap survival rate upto 95%.[1,2] Previously treated necks with either surgery with or without flap reconstruction, radiation with or without chemotherapy, or a combination of both are unique challenges for such kind of reconstruction. Cervical anatomy is distorted due to prior interventions, inflammation, scarred vessels, radiation or previous flap anastomosis or neck dissections. It makes identification and dissection of recipient vessels more difficult in the neck and such necks are referred as vessel depleted neck. Incidence of such condition is around 7% of all patients receiving microvascular reconstructions in the head and neck.[3] The lack of suitable recipient vessels, difficulty in tissue dissection as well as the delayed healing are demanding challenges even for experienced surgeons.[4] The aim of our study is to evaluate

feasibility of microvascular reconstruction in the vessel-depleted neck (VDN) and finding solution for such challenging situation.

METHODS

Study design and setting

This was a prospective observational study conducted in the Department of Plastic Surgery, S. C. L. Hospital, Ahmedabad, India, over a two-year period from October 2023 to October 2025.

Patient selection criteria

Patients with recurrent head and neck malignancies who had previously undergone surgery, radiotherapy, chemotherapy, or a combination thereof and required microvascular reconstruction were included.

Inclusion criteria

Patients with history of prior neck surgery or flap reconstruction, prior radiotherapy and/or chemotherapy, and with presence of recurrent malignancy or osteoradionecrosis requiring free flap reconstruction were included.

Exclusion criteria

Patients unfit for prolonged general anaesthesia, and patients refusing microvascular reconstruction were excluded.

A total of 30 patients who met the above criteria were enrolled.

Preoperative assessment and planning

All patients underwent detailed preoperative assessment, including neck Doppler ultrasonography or computed tomography (CT) angiography for recipient vessel mapping. A multidisciplinary discussion with the oncologic surgery team was held for every case to plan the most suitable flap based on defect site, size, and available vessels.

Informed consent was obtained from all patients before surgery.

Surgical procedure

Under general anaesthesia, exploratory dissection was first performed on the ipsilateral neck to identify potential recipient vessels.

The arterial flow was verified intraoperatively by confirming pulsatile flow on vessel dissection.

If ipsilateral vessels were unsuitable, alternative options were explored within the same field to avoid contralateral exploration.

Free flaps used included: radial forearm free flap (RFFF) for soft tissue defects, anterolateral thigh (ALT) flap for larger or bulkier defects, and free fibula osteomyocutaneous flap for mandibular reconstruction or osteoradionecrosis.

The lingual, facial, or superior thyroid arteries were primarily used as recipient arteries, and end-to-side or end-to-end anastomosis was performed to the internal jugular vein (IJV) or its branches for venous outflow.

All microsurgical anastomoses were performed under loupe magnification using 8-0 prolene sutures.

Postoperative care

Flap monitoring was done using color, temperature, and pin-prick tests for 5 days postoperatively as per standard microsurgery protocol. Early complications such as venous congestion or arterial insufficiency were recorded.

Statistical analysis

Continuous variables were presented as mean±standard deviation, and categorical variables as percentages. The Fisher's exact test was used to compare flap survival rates among patients with or without prior radiotherapy. A p value <0.05 was considered statistically significant.

RESULTS

Patient demographics and clinical characteristics

All patients achieved 100% flap survival. No microvascular revisions or flap failures were recorded. Chemoradiation did not significantly influence flap outcome ($p=0.72$).

A total of 30 patients underwent reconstructive procedures following ablative surgery. Of these, 13 patients (43.3%) underwent free flap reconstruction, while 17 patients (56.7%) received pectoralis major myocutaneous (PMMC) flaps. Among the entire cohort, 26 patients (86.7%) had a prior history of chemoradiation therapy, and 3 patients (10%) presented with osteoradionecrosis of the mandible.

Flap outcomes

The overall flap survival rate was 100%, with no instances of total or partial flap loss. There were no cases of flap necrosis, venous congestion, or need for re-exploration. Preoperative chemoradiation did not adversely affect flap survival ($p>0.05$). All flaps demonstrated satisfactory perfusion postoperatively, and no microvascular revisions were required.

Adequate recipient vessels were identified on the ipsilateral side in every case, eliminating the need for contralateral neck exploration or vein grafting.

Table 1: Demographic and clinical data of patients (n=30).

Parameters	Number of patients (N)	Percentage
Gender		
Male	22	73.3
Female	8	26.7
Age (in years)		
<40	5	16.7
40–60	18	60
>60	7	23.3
Previous treatment		
Prior surgery	30	100
Prior radiotherapy	26	86.7
Prior chemotherapy	24	80
Osteoradionecrosis	3	10
Prior reconstruction type		
Free flap	13	43.3
PMMC flap	17	56.7

Table 2: Recipient arteries used.

Recipient artery	No. of cases	Percentage
Lingual artery	14	46.7
Facial artery	9	30
Superior thyroid artery	7	23.3

Figure 1: Complex defect after oncosurgical resection woody frozen neck.

Recipient vessel selection

The lingual artery was identified as the most commonly available and reliable recipient artery. It was preserved in the majority of cases and was generally unaffected by prior surgical or radiation therapy. In recurrent tongue carcinoma cases, where the lingual artery had been previously ligated, alternative recipient vessels (facial or superior thyroid artery) were utilized.

For venous drainage, an end-to-side anastomosis to the internal jugular vein (IJV) was the preferred technique and was performed in 24 cases (80%). In 6 cases (20%), a branch of the IJV with an appropriate diameter match was identified, allowing end-to-end anastomosis.

Figure 2: Lingual artery identification with meticulous dissection (looped).

Flap selection and distribution

Among the free flap reconstructions, radial forearm free flap (RFFF) was the most frequently utilized in 16 cases (53.3%), followed by anterolateral thigh (ALT) flap in 9 cases (30%) and fibula osteomyocutaneous flap in 5 cases (16.7%).

The fibula flap was primarily employed in patients with mandibular osteoradionecrosis and adequate mouth opening. The radial forearm flap remained the flap of choice in most soft-tissue reconstructions due to its consistent anatomy, long vascular pedicle, and favorable vessel caliber.

Table 3: Recipient veins used.

Recipient vein	Type of anastomosis	No. of cases	Percentage
Internal jugular vein	End-to-side	24	80
Branch of IJV	End-to-end	6	20

Table 4: Flap type distribution.

Type of flap	No. of patients	Percentage
Radial forearm free flap (RFFF)	16	53.3
Anterolateral thigh (ALT) flap	9	30
Free fibula osteomyocutaneous flap	5	16.7

Figure 3: Dissection of IJV with its tributaries for end to side and end to end anastomosis respectively.

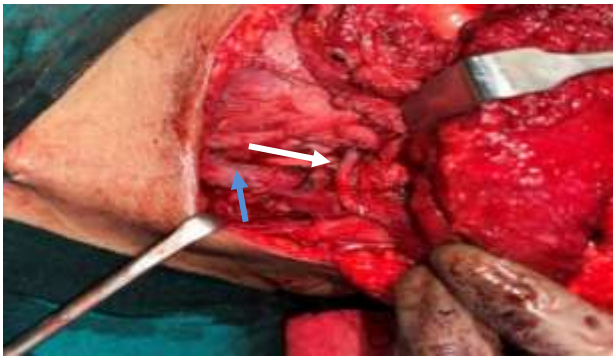

Figure 4: Anastomosis of vessels: end to end of lingual artery to peroneal artery (white arrow) end to side vena commitant to IJV (blue arrow).

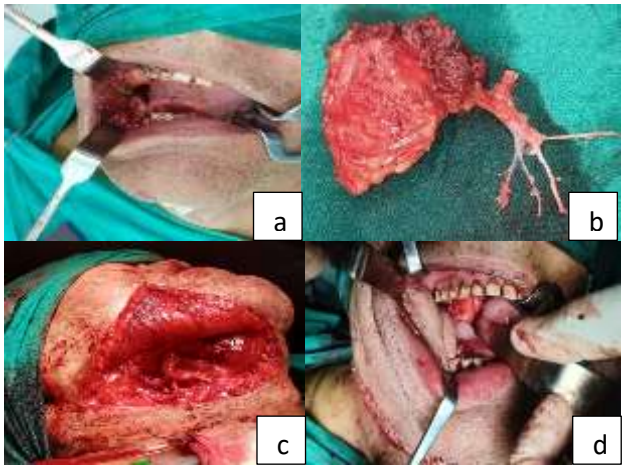

Figure 5 (a-d): Another case of ALT free flap for buccal mucosa reconstruction. Anastomosis of vessels seen from a small dissection window from woody neck.

Statistical analysis

Comparison between patients who received preoperative chemoradiation and those who did not revealed no statistically significant difference in flap survival or complication rates (p=0.72, Fisher's exact test). Similarly, flap survival did not differ significantly between different flap types (p=0.64). There was no correlation between the type of recipient artery used and the postoperative flap outcome (p>0.05).

DISCUSSION

In priorly treated necks, branches of the external carotid artery and the jugular vein tributaries are not available for microsurgical reconstruction. They are used as standard vascular protocol in normal circumstances. It is challenging to find recipient vessels in a field of radiation induced skin damage, scar contraction and disrupted anatomy with a risk of uncontrollable bleeding, consecutive wound healing disorders and aggravation of functional impairment. In our series with meticulous dissection and proper presurgical planning we were able to find good quality vessels for anastomosis. Other alternative recipient vessels are also available. The ideal condition for alternative vessels are based on three principles: the vessels need to be of reliable anatomical appearance, length and calibre as there is little or no room for alternatives in cases of failure; surgical exposure of the recipient vessels should not bring any further damage to the pretreated neck; and the vessels should lie in a non-radiated part of the body.[4] Prior treatments with any combination of surgery, chemotherapy, and radiation can cause significant inflammation and scarring of the surgical bed and associated vasculature.[5]

Microvascular reconstruction following head and neck oncologic surgery continues to be the gold standard for restoring form and function. In our series, we achieved a 100% flap survival rate, with no incidences of flap necrosis or vascular compromise. This finding underscores the reliability of free flap surgery even in patients who have undergone prior chemoradiation therapy—a population often considered high risk due to radiation-induced fibrosis and vascular damage.[6,7]

Impact of chemoradiation on flap survival

Previous studies have reported variable effects of preoperative chemoradiation on flap outcomes, with some suggesting increased risk of thrombosis and flap loss due to vessel sclerosis and friability.[8] However, our results are consistent with recent evidence indicating that with meticulous surgical technique and careful vessel selection, preoperative chemoradiation does not significantly compromise flap survival.[6,9] In our study, flap success was not statistically different between irradiated and non-irradiated patients (p=0.72), reaffirming that prior chemoradiation should not be viewed as a contraindication for free tissue transfer.

Recipient vessel selection

The choice of recipient vessels plays a critical role in the success of microvascular reconstruction, particularly in previously treated necks.[7,9] In our series, suitable recipient vessels were consistently found on the ipsilateral side,

eliminating the need for contralateral neck exploration or vein grafting. This finding reflects the feasibility of ipsilateral vessel use even after radiation exposure, provided careful dissection and intraoperative assessment of vessel quality are performed.

The commonly used arteries in the neck include superior thyroid artery, facial artery, transverse cervical artery, lingual artery, ascending pharyngeal artery, and rarely the external carotid artery.[10] Arteries are also available outside of the neck for anastomosis like superficial temporal artery, thoracodorsal artery, thoracoacromial artery, and internal mammary artery.[11] We can also use the pedicle of pectoralis major flap performed in previous surgery.

The lingual artery was identified as the most reliable arterial recipient, being preserved and spared from the effects of radiation in the majority of cases. Other authors have similarly emphasized the reliability of the lingual and superior thyroid arteries due to their relatively protected course.[12] In cases of recurrent tongue cancer where the lingual artery had been ligated previously, the facial or superior thyroid arteries served as dependable alternatives.

Cephalic vein is commonly transposed for venous drainage in case of unavailability of veins in the neck.[4] Other outside the neck veins options are internal mammary vein (IMV), dorsal scapular vein, superficial temporal vein (STV), and supraclavicular vein.[4]

For venous outflow, the internal jugular vein (IJV) remains the most versatile and preferred recipient vein.[7,13] In our experience, end-to-side anastomosis with the IJV was used in 80% of cases, providing a high-flow, low-pressure drainage system. End-to-end anastomosis with a branch of the IJV was performed in 20% of cases when appropriate vessel caliber matching was available. These approaches align with previously reported practices demonstrating optimal outcomes and low venous thrombosis rates.[9,13]

Flap choice and indications

Among the various flaps used, the radial forearm free flap (RFFF) was the workhorse flap in our series due to its thin, pliable tissue, long pedicle, and reliable vascular anatomy. The anterolateral thigh (ALT) flap was selected for larger defects requiring bulk, while the fibula osteomyo-cutaneous flap was reserved for mandibular reconstruction, particularly in osteoradionecrosis cases. These preferences mirror trends in global reconstructive practice, where flap selection is tailored to defect characteristics, patient factors, and donor-site availability.[14]

Flap choice helped us to get better length & diameter of pedicle. Length of pedicle should be kept in mind for such circumstance and efforts were made to extend it when feasible. For example, the radial forearm flaps were harvested to the point of the brachial vein just proximal to the antecubital fossa. The skin paddle of the free fibula flaps was planned in the distal third of leg to utilize the pedicle length to the maximum. When using anterolateral thigh flap, the pedicle length could be gained by planning the perforator eccentrically and, if required, ligating the muscular branch to rectus femoris, thus gaining an additional couple of centimetres.[14]

Good success rate in our series with vessel-compromised neck is due to multiple reasons. The vessel dissection is done under loupe magnification. With meticulous dissection we were able to preserve recipient vessel with minimal trauma to it (Figures 2-4). Before flap harvest, the pulsations of the recipient vessel and pulsatile flow on dividing the vessel are confirmed. The reported rates of flap survival using vein interposition grafts range from 75% to 95%. These grafts are an additional potential source of thrombosis.[14]

Comparison with PMMC flap

While the pectoralis major myocutaneous (PMMC) flap remains a valuable option in resource-limited settings or for patients unfit for prolonged microsurgery, our study highlights the superior reliability and functional outcomes achievable with free tissue transfer. The PMMC flap, although robust, carries higher risks of bulkiness, limited reach, and restricted tongue mobility compared to free flaps.[6,15]

As microsurgical expertise becomes more widespread, free flaps should continue to be the preferred option whenever feasible.

Limitations

Our study is limited by its retrospective design and relatively small sample size. Additionally, long-term functional outcomes such as speech, swallowing, and aesthetic satisfaction were not quantitatively assessed. Future studies with larger cohorts and functional outcome evaluation will further substantiate the advantages of specific flap choices and recipient vessel strategies in previously irradiated fields.

CONCLUSION

Microvascular reconstruction using free tissue transfer offers excellent results even in previously irradiated patients, with a high flap survival rate and minimal complications. The lingual artery and internal jugular vein remain reliable recipient vessels, and ipsilateral vessel selection is feasible in most cases. Careful intraoperative assessment and meticulous microvascular technique are key to achieving consistent success in this challenging cohort.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Khouri RK, Cooley BC, Kunselman AR, Landis JR, Yeramian P, Ingram D. A prospective study of microvascular free-flap surgery and outcome. Plast Reconstr Surg. 1998;102:711-21.
2. Suh JD, Sercarz JA, Abemayor E, Wang MB, Blackwell KE, St John M. Analysis of outcome and complications in 400 cases of microvascular head and neck reconstruction. Arch Otolaryngol Head Neck Surg. 2004;130:962-6.
3. Jacobson AS, Eloy JA, Park E, Roman B, Genden EM. Vessel-depleted neck: techniques for achieving microvascular reconstruction. Head Neck. 2008;30:201-7.
4. Frohwitter G, Rau A, Kesting MR, Mücke T, Wolff KD, Hölzle F. Microvascular reconstruction in the vessel-depleted neck: A systematic review. J Craniomaxillofac Surg. 2018;46:1652-8.
5. Bras J, de Jonge HK, van Merkesteyn JP. Osteoradionecrosis of the mandible: pathogenesis. Am J Otolaryngol. 1990;11:244-50.
6. Ogata Y, Ueda K, Katsuragi Y. Microvascular reconstruction in the previously operated and irradiated neck. Plast Reconstr Surg. 2008;121(1):29-35.
7. Chung JH, Kim KJ, Jung KY, Baek SK, Park SH, Yoon ES. Recipient vessel selection for head and neck reconstruction: A 30-year experience in a single institution. Arch Craniofac Surg. 2020;21(5):269-75.
8. Reddy TJ, Sham E, Ganesh MS, Menon PS, Vishwas K, Malick R. Feasibility and reliability of microvascular reconstruction in the vessel-depleted previously operated neck. Ann Maxillofac Surg. 2020;10(1):96-101.
9. Chia HL, Wong CH, Tan BK, Tan KC, Ong YS. An algorithm for recipient vessel selection in microsurgical head and neck reconstruction. J Reconstr Microsurg. 2011;27(1):47-56.
10. Garg RK, Poore SO, Wieland AM, Sanchez R, Baskaya MK, Hartig GK. Recipient vessel selection in the difficult neck: Outcomes of external carotid artery transposition and end-to-end microvascular anastomosis. Microsurgery. 2017;37(2):96-100.
11. Wong KK, Higgins KM, Enepekides DJ. Microvascular reconstruction in the vessel-depleted neck. Curr Opin Otolaryngol Head Neck Surg. 2010;18(4):223-6.
12. Dhondge R, Hussain M, Singh A, Nagarkar R. Lingual Artery as the Recipient Vessel of Choice in Patients Requiring a Second or Third Free Flap in Recurrent Oral Cancers and Vessel-Depleted Neck: A 5-Year Experience in a Single Institute. Indian J Plast Surg. 2023;56(6):494-8.
13. Sharma S, Kumar A, Patel P. Head and neck reconstruction of the vessel-depleted neck: A systematic review of the literature. Microsurgery. 2021;41(8):873-84.
14. Mahendru S, Singh H, Sarin D, Aggarwal A, Brajesh V, Singh S, et al. Microvascular free tissue transfer in vessel-compromised neck: Techniques and recommendations. Int Microsurg J. 2019;3(2):2.
15. Blackwell KE. Unsurpassed reliability of free flaps for head and neck reconstruction. Arch Otolaryngol Head Neck Surg. 1999;125(3):295-9.

Cite this article as: Rajgor DK, Ghelani NB, Shah SD, Godhani CA, Shah VV. Microvascular free flap reconstruction in head and neck cancer cases with vessel depleted necks and distorted anatomy due to prior intervention. Int J Res Med Sci 2025;13:5232-7.