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Evolving Modalities in Lower Lip Reconstruction Over the Past Quarter Century: -A Comparative Case Report

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ABSTRACT

The landscape of reconstructive surgery has transformed dramatically in the 21st century. Advances in digital technology, surgical instrumentation, perioperative care, and microvascular techniques have expanded the boundaries of what is surgically possible. Procedures once considered unfeasible-particularly complex or tertiary reconstructions-are now routinely performed with predictable outcomes.

Oncosurgical management has also evolved. Today, even extensive T4+ lesions and recurrent malignancies are excised and reconstructed using microvascular free flaps, enabling single-stage reconstruction. In contrast, during the early part of the century, most lower lip defects were managed with multistage pedicled flaps, often requiring prolonged treatment timelines. Modern free flap reconstruction allows earlier initiation of adjuvant radiotherapy and faster functional and social rehabilitation.

Keywords: Pedicled flap; Free RAFF; Free ALT flap; Reverse forearm flap; Microvascular flaps; Lower lip reconstruction.

CASE REPORT

This report presents a comparative analysis of three patients with squamous cell carcinoma of the lower lip, treated more than twenty-three years apart.

Case 1 (performed over two decades ago, in 2003)

The patient presented with a complicated clinical scenario following multiple flap failures, resulting in a severely compromised condition. Both local and free flap options were unsuitable. A rarely used distant flap-the pedicled reverse radial forearm flap from the left forearm-was selected as a salvage procedure. Despite its complexity, it provided a viable reconstructive solution at a time when microvascular options were limited.

Case 2 and 3 (performed recently)

In case 2, the patient underwent a straightforward single-stage reconstruction using a free radial artery forearm flap (free RAFF), while in case 3 the patient underwent reconstruction with an anterolateral thigh (ALT) flap. The procedure was uncomplicated, and the reconstructive outcome was achieved efficiently with modern microvascular techniques.

Purpose of the Report

This case report highlights the evolution of reconstructive modalities over the last quarter century, comparing:

- Pedicled distant flaps versus microvascular free flaps
- Technical challenges and advantages
- Functional and aesthetic outcomes
- Impact on treatment timelines and rehabilitation

The comparison underscores the paradigm shift from staged pedicled flaps to reliable single-stage free flap reconstruction in lower lip defects.

INTRODUCTION

This study highlights the evolution of lower lip reconstruction techniques over the past two decades, comparing the use of a pedicled reverse radial artery forearm flap (2003) with a free radial artery forearm flap or ALT flap (2025). These cases illustrate how reconstructive options, surgical planning, and perioperative care have transformed with advances in microsurgery, improved infrastructure, and better patient awareness.

MATERIALS AND METHODS

This is a comparative case report describing the changing modalities of lower lip reconstruction over the last quarter century. The first case was performed in 2003 using a pedicled reverse radial artery forearm flap, while the second and third cases were performed recently, utilising a free radial artery forearm flap or an ALT flap [1,2].

Case 1 (2003): Pedicled Reverse Radial Artery Forearm Flap

The patient had undergone multiple surgeries for recurrent lower lip malignancy, including several local flaps as well as PMMC and forehead flaps, all of which ultimately failed. The patient presented in a severely compromised condition. Bilateral radical neck dissection had been performed previously, so the patency of the internal jugular vein was doubtful, and a free flap was therefore not an option. Previous surgery had resulted in dense scarring and adherence of the skin to the neck.

There are multiple ways to reconstruct the lower lip, including local advancement and rotation flaps such as the Karapandzic flap, Webster-Bernard flap, Abbe-Estlander flap (cross lip), and step-ladder flap, as well as regional flaps. Given the absence of suitable local or regional options and the need for a thin, pliable flap for lip reconstruction, a distant pedicled flap was considered. Although a Tagliacozzi flap was an option, the forearm flap was more widely used in the early 21st century. Therefore, a pedicled reverse radial artery forearm flap was selected.

The elbow was immobilised with a POP slab over the scalp for three weeks to maintain the flap position. This was an extremely uncomfortable posture, and the patient became uncooperative during the postoperative period. After three weeks, the flap was divided and the final inset was completed. Despite the difficult postoperative course, the final outcome was satisfactory, and the patient regained confidence with the aesthetic and functional result.

Surgical Technique: Reverse Radial Artery Forearm Flap

The reverse forearm flap is based on the proximal forearm. The radial artery is ligated proximally, and the flap receives retrograde blood flow through the palmar arch supplied by the ulnar artery. Patency of the ulnar artery and palmar arch is essential [3].

The donor site is skin grafted. The flap is inset over the lower lip defect, while the vascular pedicle remains extracorporeal and is covered with a skin graft. Forearm and elbow positioning is maintained using POP and crepe bandage. After approximately three weeks, the pedicle is divided, the hand is freed, and excess tissue is trimmed. This completes the reconstruction of the lower lip.

Cases 2 and 3 (recent): Free Radial Artery Forearm Flap / ALT Flap

The second and third patients, treated recently, also had squamous cell carcinoma of the lower lip. Following excision and modified neck dissection, a significant defect was created. Because the internal jugular vein was preserved, free flap reconstruction was performed.

A free radial artery forearm flap was harvested from the non-dominant forearm, including the radial artery, venae comitantes, and cephalic vein. The donor site was skin grafted. The flap was inset over the lower lip, with microvascular anastomosis to the facial artery and internal jugular vein. The neck wound was closed primarily. Similarly, an ALT flap was harvested from the thigh, based on the descending branch of the lateral circumflex femoral artery, and inset over the lower lip. Reconstruction was completed in a single stage.

The flap provided excellent contour, oral competence, and aesthetic restoration of the lower lip, inner lining, and left oral commissure. The patient was satisfied with the final outcome.

Comparison of the Two Methods

In the first case, free flap reconstruction was not possible because the internal jugular vein had been removed during prior radical neck dissection. In contrast, the second and third cases benefited from preserved neck vessels, enabling microvascular reconstruction.

Over the past two decades, oncological excision techniques, neck dissection patterns, and reconstructive strategies have evolved significantly. Modern operating rooms, improved ICU care, experienced microsurgeons, and better informed patients have contributed to the widespread adoption of free flaps.

Earlier, most reconstructions were performed using multistage pedicled or local flaps, and free flaps were used sparingly. Today, single-stage microvascular reconstruction is preferred, with high success rates and superior functional and aesthetic outcomes [4].

Quality of Life

Free radial artery forearm flaps and ALT flaps provide excellent oral competence, improving swallowing, speech, and overall quality of life. Aesthetic restoration of lip contour and symmetry is also superior. The ALT flap looks bulky initially, but thinning can be performed later.

Advantages and Disadvantages

Pedicled Reverse Radial Artery Forearm Flap

Advantages:

- Nearly 100% flap viability
- Comparable final result to a free flap after division
- Useful in cases with absent or unsuitable neck vessels (e.g., post-RND, irradiated neck, dense scarring)
- Avoids reopening the neck
- Suitable where microsurgical facilities are unavailable
- Shorter operative time

Disadvantages:

- Requires multiple stages
- Extremely uncomfortable limb positioning for three or more weeks
- Higher psychological stress for the patient

Free Radial Artery Forearm Flap/ALT Flap

Advantages:

- Flap of choice for lower lip reconstruction
- Thin, pliable, and durable (the ALT flap is a little bulkier)
- Allows precise reconstruction of the vermilion, lip height, and oral commissure (with palmaris tendon support)
- Single-stage procedure
- Excellent functional and aesthetic outcomes [5,6]

Disadvantages:

- Requires microsurgical expertise and infrastructure
- Not feasible when neck vessels (especially the IJV) are absent
- Unsuitable for medically unfit patients
- Scar over Forearm/ Thigh

Comparative Assessment of Aesthetic and Functional Outcomes

(Scores out of 5)

Parameter	Pedicled Reverse Forearm Flap	Free Radial Artery Forearm Flap (RAFF)/ALT Flap
1. Symmetry	3+	4
2. Commissure position	3	4
3. Vermilion shape	3	4.5
4. Lip Size and contour	3.5	5
5. Scar quality	3.5	4.5
6. Lip mobility	3	4.5
7. Oral closure	3.5	4.5
8. Articulation	3	4.5
9. Control of lip movement	3	4.5
10. Speech quality	3.5	4.5
11. Salivary control (drooling)	3	4.5
12. Patient experience during treatment	Difficulty maintaining limb position	Straightforward postoperative course
13. Patient's visual field / positioning	Difficult to maintain position	No difficulty
14. Overall satisfaction	Satisfied but with compromise in outcome	Satisfied with both aesthetic and functional results

SUMMARY

- The comparative evaluation demonstrates a consistent advantage of the free radial artery forearm flap (RAFF) and ALT flap across nearly all aesthetic and functional domains. These flaps provide superior symmetry, contour, vermilion definition, mobility, and oral competence, translating into improved speech, articulation, and salivary control.
- In contrast, the pedicled reverse forearm flap, though effective in complex salvage situations, shows limitations related to flap positioning, patient comfort, and overall functional refinement.
- Patient satisfaction reflects these differences: with the pedicled flap, the outcome was acceptable but involved compromises, whereas the free flap produced high satisfaction with both form and function.

DISCUSSION

Reconstructive methods in head and neck surgery have undergone remarkable transformation over the past two decades. Earlier, most defects were reconstructed using local or pedicled flaps such as the pectoralis major myocutaneous (PMMC) flap, deltopectoral (DP) flap, nasolabial flap, forehead flap, latissimus dorsi flap, or other regional options. At that time, many advanced T4 malignancies and complex composite defects were considered inoperable due to limited reconstructive possibilities.

With the advent of improved surgical instruments, safer anaesthesia, well equipped ICUs, and better trained nursing teams, the scope of oncological surgery has expanded significantly. Surgeons today are more confident in performing extensive resections because modern reconstructive techniques, particularly microvascular free tissue transfer, allow reliable restoration of form and function [7-9].

Over the last 20 years, flap design and indications have continued to evolve. Before the widespread use of osteocutaneous fibula flaps described by Fu Chan Wei, vascularised bony fibula combined with pedicled flaps was commonly used for mandibular reconstruction [10]. Similarly, the radial artery forearm flap, once a workhorse flap, has gradually been replaced in many centres by the anterolateral thigh (ALT) flap, as described by Peter Cordeiro [11]. Nowadays the MSAP flap (medial sural artery perforator flap) and SCIP flap (superficial circumflex iliac artery perforator flap) are also used as thin, pliable flaps.

Pedicled flaps have also evolved. Surgeons began performing larger PMMC or DP flaps and, in selected cases, bilateral PMMC or single-stage DP flaps with excellent outcomes. In complex supramajor reconstructions, combinations of free and pedicled flaps have been used to achieve reliable coverage and functional restoration [12].

During supramajor reconstruction, the goal is not only to close the defect but also to restore aesthetics and function, achieving a near-normal appearance and acceptable speech, swallowing, and oral competence. With the availability of multiple reconstructive modalities, including both free and pedicled flaps, even extensive defects can now be reconstructed in a single stage using the full armamentarium of plastic surgery. This approach facilitates faster recovery, early rehabilitation, and improved quality of life.

CONCLUSION

Reconstructive modalities in oncosurgery have changed significantly in recent years. Advances in microvascular tissue transfer and refinement of surgical techniques have shifted practice from multistage pedicled flaps to reliable single-stage microvascular free flaps. Today, any defect of the lower lip following oncological resection can be reconstructed using microvascular techniques. This evolution has improved functional outcomes and aesthetic results, and has enabled early recovery and rehabilitation for patients undergoing major head and neck cancer surgery.

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FIGURES

Figure 1: Lower lip reconstruction by reverse radial artery forearm flap (performed in 2003).

Figure 2: Lower lip reconstruction by free radial artery forearm flap (performed recently).

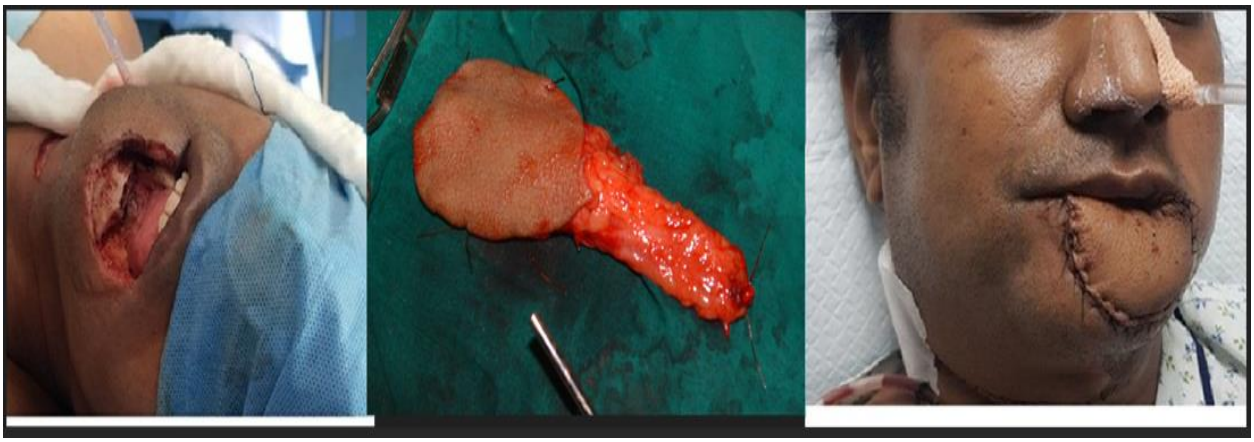

Figure 3: Lower lip reconstruction by ALT flap (performed recently).