



# Comparison of Reconstruction of Maxilloalveolar Resections in Head and Neck Cancers with Chimeric Anterolateral Thigh Flap (ALT) versus Standard ALT Flap

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Indian J Plast Surg

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## Abstract

**Background** Oral malignancy that presents at a locally advanced stage needs complex surgical resections in which the maxillary cavity is usually left open. The constant maxillary secretions lead to problems like poor healing, fistula formation, and flap necrosis, causing longer hospital stays, delayed adjuvant therapy, and additional surgeries. Several methods have been tried to ameliorate this, each faced with its own difficulties. This study describes the use of chimeric free anterolateral thigh (ALT) with vastus lateralis (VL) muscle to tackle this problem.

**Methodology** With the aim to assess the advantage of reconstruction of maxilloalveolar resections using chimeric ALT + VL, we analyzed data from 20 cases reconstructed with chimeric free ALT + VL over a year. We compared them with twenty matched controls reconstructed with standard ALT. Analysis was done with respect to intraoperative ease, adequacy of maxillary sinus fill, postoperative secretions, length of hospital stay, duration to adjuvant therapy, and postoperative complications tabulated using the modified Clavien-Dindo classification.

**Results** It was found that chimeric ALT + VL gave greater freedom of movement to plug the maxillary cavity easily. The chimeric arm patients had fewer complications and a shorter mean hospital stay. Most of them received adjuvant therapy within their optimal time window.

**Conclusion** Chimeric ALT with vastus lateralis muscle is a reliable option for reconstructing complex defects, especially with dead space cavities like the maxillary sinus. Effective plugging of the maxillary sinus during the primary surgery results in better patient outcomes and must be done routinely.

## Keywords

- ▶ maxilloalveolar resections
- ▶ chimeric flaps
- ▶ free anterolateral thigh flap
- ▶ head and neck cancer
- ▶ head and neck reconstruction

DOI <https://doi.org/10.1055/s-0044-1782200>.  
ISSN 0970-0358.

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## Introduction

Head and neck malignancy is the most common site for cancer in India, constituting 25 to 30% of the cancer burden. Due to prevailing socioeconomic, educational, and cultural conditions, patients often present to tertiary care centers with advanced cancers.<sup>1</sup> The surgical resections of such advanced tumors often leave us with complex defects that need to be addressed, considering their three-dimensional nature to provide the best possible reconstruction.

In the case of maxilloalveolar resections, the integrity of the maxillary sinus is often lost. Free flaps have been considered ideal for the reconstruction of such defects. Care must be taken to ensure the sinus cavity is effectively obliterated while reconstructing such defects. Otherwise, the constant outpouring of the maxillary secretions will lead to poor wound healing, fistula formation, wound gape, and may even cause flap loss. This would further result in an increased hospital stay, delay in adjuvant therapy, and an unwarranted burden on the healthcare system.

Several methods, like using non-vascularized fat, the de-epithelialized paddle of the flap, and musculocutaneous flaps, have been tried to achieve an adequate obliteration of the maxillary sinus cavity and to avoid the complications associated, each with its own limitations. Chimeric flaps have the advantage of providing the benefit of two vascularized tissue subunits with independent freedom of movement, with the ease of a single set of vascular anastomoses.<sup>2</sup>

In our tertiary care cancer center, we used to obliterate the maxillary sinus cavity with either fat from the flap or its de-epithelialized end, till December 2021. We observed a high complication rate in the form of excessive maxillary discharge from the neck, wound infection and wound gape. These complications resulted in flap failures too. Many patients had delay in wound healing, and needed secondary procedures like debridements, resuturing, etc. either under local anesthesia (LA) or general anesthesia. This whole scenario eventually resulted in an increased hospital stay. To ameliorate this, we started routinely harvesting a chimeric vastus lateralis (VL) along with the anterolateral thigh (ALT) flap to plug the maxillary sinus. In this study, we present our experience, comparing the efficacy of using chimeric ALT flap with the VL compared with only ALT in reconstructing cases of oral malignancy who underwent a maxilloalveolar resection, leaving the maxillary sinus open.

## Materials and Methods

During the study period of March 2021 to July 2022, we performed 275 ALT flaps for head and neck reconstruction for oral cancer. Of these, we selected all cases fitting our inclusion criteria:

1. Age above 18 years
2. Patients undergoing surgery for the first time and as the first modality of treatment Brown class IIb maxillectomy with or without mandibular defect.<sup>3</sup> If the mandibular defect was present, those with posterior segmental

mandibulectomy (Brown class Ic and class IIc mandibulectomy)<sup>4</sup> or marginal mandibulectomy, undergoing only soft tissue reconstruction, were included.

### Exclusion criteria:

1. Recurrent cases, previously irradiated patients, patients who have undergone neoadjuvant chemotherapy and previously operated patients for head and neck pathology.
2. Defects that required either two free flaps or a large free flap that required skin grafting at the donor site were excluded.

The patients were divided into the ALT-only group and the chimeric group based on the type of flap used for reconstruction. We started doing chimeric ALT as a routine after December 2021. That's why we used control arm of ALT only group from March 2021 to December 2021 and case arm, that is, chimeric ALT group from December 2021 to July 2022. The 39 patients in the ALT-only group and 26 patients in the chimeric group were matched based on age, comorbidities, size, and type of defect, and after matching 20 patients could be included in each arm.

A predesigned proforma was used to collect data from patient examinations and interviews, hospital electronic medical records, and department case record forms. Data were tabulated and analyzed with respect to the following:

- Intraoperative ease and adequacy of maxillary fill
- Postoperative secretions from the neck and suture lines
- Length of hospital stay
- Duration of adjuvant therapy
- Postoperative complications, which were tabulated using the modified Clavien-Dindo Classification for free flaps in head and neck reconstruction.<sup>5</sup>

## Surgical Technique

Preoperatively, the thigh perforators were marked, using an 8 MHz handheld Doppler device, at the standard site, using a circle of 3 cm radius, centered on the mid-point of the line joining the anterior superior iliac spine to the superolateral border of the patella.

The reconstruction team began raising the flap, while the resection team resected the primary tumor and dissected the neck nodes.

A linear exploratory primary incision was taken approximately 2.5cm medial to the perforator marking, as this allows for proximal or distal extension, if needed, depending on the perforator availability.

The perforators were identified and dissected in the standard manner until the pedicle was dissected sufficiently. Care was taken to preserve the nerves to VL and rectus femoris. When chimeric flap was harvested, the distal runoff to the VL muscle was preserved, and the required chimeric muscle was harvested based on it.

The maxillary sinus mucosa was scooped out thoroughly in all cases. In the ALT-only group, the fat from the flap or the de-epithelialized edge of the flap was used to obliterate the maxillary sinus. In the chimeric group, the VL muscle was used as filler for dead space obliteration in the maxillary sinus. The

amount of muscle harvested was according to need of the filler as per defect size measurements. The muscle was hitched in the maxillary sinus with Vicryl 2/0 after drilling holes in maxillary wall and to the surrounding tissue.

The microvascular anastomosis was done after the inset. We use 14 French suction drain with single tube for all the cases. We placed the drain tube under the sternocleidomastoid muscle.

### Postoperative Protocol and Follow-Up

The flap was monitored clinically by pinprick every 2 hours for the first day and every 6 hours for the next 5 days. We did not routinely prescribe anticoagulants or blood thinners to the patients except as a part of deep venous thrombosis prophylaxis. We try to express the neck secretions on daily basis and measure the amount of collection as per the number of gauzes or gamjee pad soakage. If the discharge is serous and reducing in quantity, we included it under minor discharge and a part of the normal postoperative sequence. If the discharge is not reducing or is increasing trend or there is change in character (like salivary/ mucoid/ purulent), we considered it as a complication and dealt with accordingly.

As a routine, the patients were mobilized on the first postoperative day, oral liquids were started on the fifth postoperative day, and discharge from in-hospital care was given on the seventh postoperative day for all patients without any complications, precluding the same. We remove drains, when drain output is less than 20 mL in 24 hours for consecutive 2 days.

The patients were followed up in the plastic surgery outpatient department twice a week for 2 weeks after discharge, once a fortnight for a month after and once in 3 months. As indicated, they were also followed up in the surgical, medical, and radiation outpatient departments.

## Results

**Patient characteristics:** 31 out of 40 patients were males (80% in the ALT-only arm and 75% in the chimeric arm.) The mean age of the study population was 65 years, with the ALT-only group having a mean of 64 years and the chimeric arm having a mean of 66 years. There was no significant difference between the groups' patient characteristics or comorbidity profiles (► **Table 1**).

While the resecting team was operating at the head end, simultaneous harvest was done in all our patients. No significant difficulty was faced in the harvest of a chimeric flap over the harvest of an ALT in any of our patients. The mean time to harvest completion was comparable in both groups (75.5 minutes in the ALT group and 78 minutes in the chimeric group).

Defects included Brown class IIb maxillectomy with or without mandibular defect, as described in ► **Table 2**. Eight patients in the ALT-only group and seven in the chimeric group had skin defects (► **Fig. 1B**).

Primary closure of the donor site was achieved in all patients.

**Table 1** Patient characteristics

| Characteristic        | ALT only group<br>n = 20<br>No. of patients (%) | Chimeric group<br>n = 20<br>No. of patients (%) |
|-----------------------|---|---|
| Sex                   |   |   |
| Male                  | 16 (80)   | 15 (75)   |
| Age (years)           |   |   |
| Median (range)        | 64 (32–76)                                      | 66 (30–73)                                      |
| Medical comorbidities |   |   |
| Diabetes mellitus     | 5 (25)  | 4(20)   |
| Hypertension          | 9(45)   | 6(30)   |
| Cardiac disease       | –   | 1(5)  |
| Pulmonary disease     | –   | –   |
| Morbid obesity        | 1(5)  | 2(10)   |
| Underweight           | 1(5)  | –   |
| Tobacco use           | 18(80)  | 16(80)  |
| Alcohol use           | 12(60)  | 10(50)  |

Abbreviation: ALT, anterolateral thigh.

**Table 2** Mandibular defect characteristics

| Mandibular defect       | ALT only group<br>n = 20 | Chimeric group<br>n = 20 |
|-------------------------|--------------------------|--------------------------|
| None                    | 6                        | 5                        |
| Marginal mandibulectomy | 3                        | 4                        |
| Brown class Ic          | 8                        | 8                        |
| Brown class IIc         | 3                        | 3                        |

Abbreviation: ALT, anterolateral thigh.

We compiled the complications in both groups and tabulated them using the modified Clavien-Dindo classification for free flaps in head and neck reconstruction. The patients in the chimeric group were found to have lesser complications causing deviation from the routine postoperative course ( $p < 0.05$ , chi-squared test). The chimeric group also required fewer secondary procedures with or without general anesthesia (► **Table 3**).

Excessive secretions leading to neck collections and delay in discharge occurred in three patients in the ALT-only group and in two patients in the chimeric group (grade I).

Culture-positive neck wound infection occurred in three patients in the ALT-only group and one patient in the chimeric group, requiring higher antibiotics (grade II).

One patient in the ALT-only group had to undergo resuturing of the neck wound under LA due to the breaking down of the wound, while in the chimeric group, one patient underwent wound wash and resuturing of the neck suture line under LA and one patient underwent resuturing of the facial suture line (grade IIIa).

Three patients in the ALT-only group had grade IIIb complications, requiring general anesthesia administration for management. Two of these patients underwent closure of



**Fig. 1** (A) Preoperative photograph. Patient carcinoma of the right buccal mucosa involving both jaws, with involvement of skin. (B) Intraoperative picture of the defect postsurgical extirpation. The defect involves both jaws, Brown class IIb maxillectomy with Brown class Ic mandibular defect, right buccal mucosa, and skin. (C) Harvested chimeric free anterolateral thigh skin paddle (white arrow) with vastus lateralis muscle (black arrow) on a single vascular pedicle. (D) Postoperative picture of the patient.



**Fig. 2** Late postoperative, photograph of the same patient (at 1-year follow-up).

the orocutaneous fistula and neck wound wash, and one underwent neck wound wash with secondary suturing.

One total flap failure due to venous thrombosis, requiring a second flap for reconstruction on postoperative day 4 and one partial flap loss requiring debridement and reinsert, was found in the ALT-only group (grade IIIc).

On comparing the mean duration of hospital stay of patients in both the groups, the mean was found to be 15.52 days, with the ALT-only group having a mean of 18.75 days, while patients in the chimeric flap group had a mean duration of hospital stay to be 12.3 days. There was a significant difference in the duration of hospital stay between the two groups ( $p < 0.05$ , unpaired *t*-test). Further, we found that one patient from the ALT-only group had to be readmitted for in-patient care due to a neck wound infection.

Following the histopathology report, adjuvant radiation was indicated in all the patients in the study. In the chimeric group, all 20 patients received adjuvant radiation within the optimum time window. In comparison, two patients in the ALT-only group did not, as the wounds were not adequately healed and ready for radiation therapy within the optimum time window. One of them defaulted from care ( $p > 0.05$ , Fisher's exact *t*-test) (► **Table 4**).

All the donor sites were closed primarily. None of our patients had significant donor site complications, and all healed well. No functional disability in walking and daily routine activities was found in any group.

## Discussion

In a country like India, where the oral cancer burden is high, and the age of presentation is relatively younger, it is of utmost importance that the patients get the best possible treatment with the shortest duration of hospital stay possible, an uneventful transition to adjuvant therapy and an early return to a productive life. We face challenges in achieving these goals because many patients present to tertiary centers with locally advanced malignancies. The surgical resection of such tumors results in large, complex, three-dimensional defects that require the reconstructive surgeon to have a thorough knowledge of the available armamentarium, meticulous planning, and surgical skill (► **Fig. 1B**).

Brown class IIb maxillectomy leaves the maxillary sinus opened<sup>3</sup> and very often, despite meticulous scooping-out of the residual sinus mucosa, there is continuous discharge that can be detrimental to the flap health, causing the patients to undergo additional procedures, have a prolonged hospital stay, have a delay in undergoing adjuvant radiation therapy, and even cause loss of the flap itself. Obliteration of the sinus dead space is effective in controlling this secretion. Various tissues have been used for this purpose. Nonvascularized fat

**Table 3** Modified Clavien-Dindo classification for complications

| Grade | Definition   | No. in ALT-only group<br>n = 20 | No. in chimeric group<br>n = 20 |
|-------|--|---------------------------------|---------------------------------|
| I     | Any deviation from the normal postoperative course WITHOUT the need for pharmacological or surgical, endoscopic, or radiological treatment | 3                               | 2                               |
| II    | Requiring pharmacological treatment (blood transfusions/TPN)   | 3                               | 1                               |
| IIIa  | Requiring surgical, endoscopic, or radiological intervention NOT under GA  | 1                               | 2                               |
| IIIb  | Requiring surgical, endoscopic, or radiological intervention under GA  | 3                               | –                               |
| IIIc  | Partial/ total flap failure  | 2                               | –                               |
| IVa   | Life-threatening complication—single organ failure   | –                               | –                               |
| IVb   | Life-threatening complication—multiorgan failure   | –                               | –                               |

Abbreviations: ALT, anterolateral thigh; GA, general anesthesia; TPN, total parenteral nutrition.

**Table 4** Postoperative characteristics

| Characteristic  | ALT only group | Chimeric group |
|---|----------------|----------------|
| Duration of postoperative hospital stay                       |                |                |
| Mean (days)   | 18.7           | 12.3           |
| Range (days)  | 10–35          | 7–20           |
| Successful and adequate adjuvant RT<br>Number of patients (%) | 17(85)         | 20(100)        |

Abbreviations: ALT, anterolateral thigh; RT, radiotherapy.

or muscle has a high failure rate with eventual necrosis and extrusion, adding to the problem.

When used, the distal de-epithelialized paddle of ALT poses difficulties because the thick ALT paddle forms a significant bulk when it is folded, and the inset becomes more difficult. This makes the patient more prone to develop orocutaneous fistulae, and their associated morbidity.<sup>6,7</sup>

A musculocutaneous ALT, when used for this purpose, does aim to provide a vascularized muscle to plug the dead space. Still, due to the restricted mobility of the distally placed muscle with respect to the skin paddle, it is often difficult to direct the muscle to fill the cavity effectively.<sup>8</sup>

A chimeric flap provides a suitable solution to the challenge of filling the sinus dead space adequately, along with the mucosal defect reconstruction.

Chimeric flaps based on the lateral circumflex femoral artery (LCFA) system have been well elaborated in literature and must be in the armamentarium of a reconstructive surgeon.<sup>9</sup> A chimeric flap refers to different tissue subunits on separate vascular leashes that naturally converge to a single vascular pedicle (►Fig. 1C). This gives each tissue component independent freedom of mobility, all with a single set of anastomoses, leading to ease of inset, lesser stretch on the paddle, and better approximation of the edges to provide a watertight seal. This facilitates better healing and less morbidity.<sup>10</sup> There have been multiple studies

wherein the principle of chimerism based on the LCFA axis has been used to successfully reconstruct complex mandibular and mid-face defects without additional donor morbidity.<sup>11,12</sup>

In the case of reconstruction done for oral malignancy, the adjuvant therapy that completes the patient’s treatment must be kept in mind. A poorly healing wound is unfavorable, and the patient might lose the optimum time window to receive radiation. Every attempt must be made to avoid wound and flap-related morbidity so that the cancer therapy is completed on time and the chance of a recurrence is lowered. Undue delay to adjuvant treatment due to additional procedures and flap loss, owing to the continued maxillary sinus secretions can be prevented by using the principle of chimerism to plug the sinus with vascularized VL muscle without any added donor morbidity or surgical difficulty (►Fig. 2).

### Conclusion

Chimeric ALT with VL muscle is a reliable option for reconstructing complex defects, especially with dead space cavities like the maxillary sinus.

Effective plugging of the maxillary sinus during the primary surgery results in decreased hospital stay and less number of secondary procedures.

### Declaration of Helsinki

The study was done in adherence to the Declaration of Helsinki Protocol. Proper preprocedural consent was taken for surgery, documentation, and research purposes. Data storage was performed in consistency with good clinical practice guidelines.

### Authors’ Contributions

D.J., S.M., M.M., V.K., and A.B. performed the surgeries. V.K.S. and V.K. had full access to all the data in the study and take responsibility for the data’s integrity and the data

analysis's accuracy. V.K. and S.J. wrote the manuscript. D.J. and V.K.S. reviewed the manuscript.

#### Conflict of Interest

None declared.

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