

Single perforator-based anterolateral thigh flap, the workhorse flap, in oral cancer reconstruction: A tertiary care institution experience

ABSTRACT

Background: Ablative procedures of the oral cavity require composite removal of tissues, which results in compromise of both functional activities and esthetic mutilation and proves to be a reconstructive challenge. This paper focuses on the reliability and versatility of a single perforator-based anterolateral thigh (ALT) flap in oral cancer reconstruction.

Materials and Methods: All patients who underwent reconstruction with a single perforator-based ALT for oral cancer defects at our center were included in the study.

Results: Forty-seven patients who underwent reconstruction with a single perforator-based ALT flap were included in our study. The average flap size in our series was 111 cm², with the largest measuring 375 cm². They was a complete loss of flap in two patients; both of them underwent salvage procedure and were reconstructed with pectoralis major myocutaneous flap. One had a partial loss that underwent re-exploration.

Conclusion: We conclude that a single perforator-based ALT is a very safe, reliable, and versatile flap for head and neck reconstruction. The microvascular anastomosis may be expensive and technically a limitation; however, it has found a permanent place in our head and neck reconstructive toolkit and is the workhorse flap for head and neck reconstruction.

KEY WORDS: Anterolateral Thigh Flap, head and neck reconstruction, oral cancer

INTRODUCTION

Oral cancer has been reported to be the most common cancer worldwide and it accounts for approximately 274,300 new cases and 127,500 deaths happening each year. The maximum number of cases have been reported from developing countries like India. The poor prognosis in these patients usually indicates advanced stage of the disease at the time of diagnosis.^[1] Studies have found that tobacco and betel nut quid chewing, smoking, and alcohol are the risk factors for oral cancer and its precancerous lesions.^[1,2] Complete resection of advanced tumors will result in large composite defects of the maxilla, mandible, floor of mouth, tongue, and infratemporal fossa, which require functional reconstruction and rehabilitation. Reconstruction of such defects is an extremely challenging task.^[2] The main objectives of reconstruction are to achieve adequate oral function and esthetics with less donor

site morbidity, thereby preserving speech and swallowing.^[3] The advent of free flap reconstruction of orofacial defects using tissue-like structures has improved the quality of life in cancer patients.

The usage of free flaps has been followed for three decades, and their survival rate has increased from 79% to 96%.^[4] In 1984, Song *et al.*^[5] described the first septocutaneous perforator-based flap, which is the anterolateral thigh (ALT) flap. Koshima *et al.*^[6] reported its use in the Japanese population in the year 1993 and since then, there have been countless reports on its usage in head and neck reconstruction in the Asian population.^[7-9] There have been numerous advantages of this flap for the

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reconstruction of head and neck. The flap has a large cutaneous area that can be thinned out to a moderate thickness which will fulfill functional and aesthetic refinement.^[7,10,11]

The flap is used for the reconstruction of large defects in the head and neck area either as a subcutaneous flap, a fasciocutaneous flap, or a myocutaneous flap.^[9,11,12]

It may also be included along with vascularized vastus lateralis, rectus femoris, ilium, tensor fascia lata, and anteromedial thigh flap, which is significant in reconstructing large composite defects in the head and neck.^[10,11,13]

It can also be used when there is skin involvement, where it can be used as a double-skin paddle flap.^[13] It also has a large, long vascular pedicle and the vessel diameter is compatible with the recipient's vessels in the neck region. It can be used as a sensate flap and also as a flow-through flap wherein the pedicle could be interposed between vascular gaps in the extremity.^[4,9,11,13]

The flap can be easily harvested with a two-team approach because of the distance of the donor site from the head and neck and as a result, the operative time is shorter. Postoperative donor site morbidity is minimal, especially in sites that can be closed directly. In such cases, the scars are less noticeable and the quality of life is better as well.^[8,11,14,15]

The disadvantage of the flap includes the fluctuating anatomy of the perforating arteries and the relatively cumbersome dissection technique.^[7,8,10,14,15]

The main purpose of our study was to assess the reliability and versatility of a single perforator-based ALT flap in oral cancer reconstruction.

MATERIALS AND METHODS

All patients who underwent reconstruction with a single perforator-based ALT flap for oral cancer defects at our center were included in the study. Details regarding the patient's age, sex, site of the lesion, pathology of the neoplasm, and characteristics of the flap were collected.

Dissection and isolation of the pedicle of the flap with tumor resection were performed simultaneously by two team approaches. The flap-harvesting technique previously described by Wei *et al.* in 2002 has been used.^[4] A portable handheld pencil Doppler probe was used to localize the perforator, which usually lies at the center of the line joining the anterior superior iliac spine and the superolateral corner of the patella. The major pedicle included the perforator arising from the descending branch of the lateral circumflex femoral artery associated with two concomitant veins. In those patients in whom skin was involved, the flaps were bi-paddled to provide both external and internal lining. All

patients were assessed for donor site morbidity. Approval from the institutional ethical committee was obtained. IRB No 2019/S/OS/65 dated 06.06.2019.

RESULTS

Forty-seven patients who underwent reconstruction with a single perforator-based ALT flap were included in our study [Table 1]. The median age of our patients was 50 years and the range was 20–67 years. They consisted of 40 male patients and 7 female patients. All our patients presented to us in the T4 stage of the lesion, which required composite resection that resulted in the compromise of both functional activities and esthetic mutilation. The majority of our patients had primary in the buccal mucosa extending to the gingivobuccal sulcus area and retromolar trigone region [Figures 1 and 2], while primary in the lip [Figure 3], maxilla, and retromolar trigone region was shown by two patients each and only one patient had primary in the tongue. The average flap size in our study was 111 cm² with the largest measuring 375 cm²; 43 patients had musculocutaneous perforators and only four patients had septocutaneous perforators. The majority of our patients required composite resection, which included removal of a variable amount of mandible, maxilla, tongue, lip, and skin. Skin involvement was seen in around 21 patients and bi-paddled ALT was performed [Figure 4]. They were complete loss of flap in two patients, who underwent salvage procedure and reconstruction with pectoralis major myocutaneous (PMMC) flap; one had partial loss, who underwent re-exploration and was managed successfully. One flap was lost due to venous thrombosis as the flap was bi-paddled, and one flap was lost due to infection. Our patients did not have any donor site complications, and healing was satisfactory in all the cases.

DISCUSSION

Microsurgical reconstruction has been popularized only after the 1980s. With the recent advances in techniques and armamentarium, there is a decrease in failure rate and importance has been shifted toward refinement, donor site function, and esthetics than flap anatomy and survival.^[4]

The main objectives of reconstruction in composite defects of the head and neck area are to achieve facial contour with inner and outer lining, oral seal, adequate coverage for the exposed vessels, and restoration of the functions including swallowing, speech, and articulation.

PMMC flap is a versatile and reliable flap and has been a workhorse flap for head and neck reconstruction. The disadvantages of this flap include difficult contouring, bulkiness, limited reach superiorly, and unreliability of the skin paddle in female patients. To overcome the limitations of PMMC, a free flap has been considered and an ALT flap has been the flap of choice.^[2,16]

Table 1: Flap characteristics of 47 patients

Age (years)	Sex	Size (cm ²)	Perforators	Bi-paddled	Complications and management
64	M	8×5=40	MC	No	None
59	M	9×5=45	MC	No	None
63	M	11×6=66	SC	Yes	PF (re-explored)
39	F	12×9=108	MC	No	None
52	F	15×7=105	MC		None
46	M	14×8=112	MC	Yes	None
45	F	11×6=66	MC	No	None
56	M	15×5=75	SC	No	TF (PMMC)
50	M	15×6=90	MC	No	None
45	M	15×8=120	MC	No	None
48	M	16×8=128	MC	Yes	TF (PMMC)
38	M	15×7=105	MC	No	None
65	M	10×7=70	MC	No	None
60	M	13×8=104	MC	No	None
57	M	10×6=60	MC	No	None
51	M	10×8=80	MC	Yes	None
26	M	20×8=160	MC	Yes	None
35	M	15×7=105	SC	No	None
44	M	10×7=70	MC	Yes	None
31	M	15×7=105	MC	Yes	None
20	M	14×8=112	MC	Yes	None
32	M	15×6=90	MC	No	None
30	M	23×8=184	MC	Yes	None
60	M	13×5=65	MC	No	None
44	M	11×6=66	MC	Yes	None
52	F	15×6=90	MC	Yes	None
58	M	20×9=180	MC	Yes	None
45	M	25×8=200	MC	Yes	None
38	M	24×10=240	MC	Yes	None
47	F	10×5=50	MC	No	None
53	M	14×6=84	MC	No	None
49	M	21×9=189	MC	Yes	None
57	F	16×9=144	MC	Yes	None
59	M	25×15=375	MC	Yes	None
62	M	20×12=240	MC	Yes	None
42	M	12×6=72	MC	No	None
56	M	13×8=104	MC	No	None
50	M	11×8=88	MC	No	None
45	M	16×9=144	MC	No	None
39	M	18×9=162	MC	Yes	None
62	F	12×7=84	MC	No	None
58	M	10×6=60	SC	No	None
46	M	15×9=135	MC	Yes	None
67	M	14×8=112	MC	No	None
56	M	11×9=99	MC	No	None
33	M	18×8=114	MC	Yes	None
57	M	12×7=84	MC	No	None

MC=musculocutaneous, PF=partial failure, PMMC=pectoralis major myocutaneous, SC=septo-cutaneous, TF=total failure

The implementation of ALT flap, with special emphasis on the reconstruction of the head and neck defects, was described by Koshima *et al.*^[6] in 1993 and Kimata *et al.*^[8] in 1997. Song *et al.*^[5] demonstrated that the septicutaneous perforators are derived from the descending branch of the lateral circumflex femoral vessels. However, there may be some variations such as the perforators may be musculocutaneous or they may be derived from the transverse branch of the deep femoral artery. Therefore, preoperative stereo angiograms or simple angiograms combined with 3D software and Doppler audiometry are essential to locate the perforators and their vascular variations.^[17]

The ALT flap is suitable for the reconstruction of head and neck defects and has the following advantages:

- (1) The surgery is performed by two teams, where resection and dissection of the flap pedicle are carried out simultaneously and repositioning of the patient is unnecessary, unlike other flaps like scapular, parascapular, and latissimus dorsi. Hence, the duration of the operative time is reduced.^[4,8,12,15]
- (2) An average of 10 ± 2 cm vascular pedicle can be obtained, which is sufficient to anastomose with recipient vessels in the neck region^[10,15] without compromising any major vessel, when compared to the radial forearm flap.^[2,18]
- (3) The diameter of the artery is approximately 2.0–2.5 mm, which is always accompanied by veins with a diameter around 1.8–3.0 mm, which are highly favorable for microvascular anastomosis.^[15,19,20]
- (4) The most important aspect of ALT in the reconstruction of head and neck cancer is its versatility in design and composition, and that it can satisfy all types of defects.^[14] It is very flexible and can be designed as either a single-skin paddle or double-skin paddles for skin involvement.^[15,16,21]
- (5) The flap offers moderate thickness, which can be further thinned out and can be made suitable for intraoral reconstruction, in comparison with other septicutaneous flaps from the thigh.^[8,12,15] The chimeric component of ALT with vastus lateralis muscle can be used to reconstruct defects of the tongue.^[22]

The vascularized fascia along with the muscle can also be used as a sling to suspend the lower or upper lip margins in full-thickness defects of the lip.^[2,6,12,22]

- (6) The ALT flap can be combined with the neighboring tissues like fascia lata and greater saphenous vein graft, and thus can be planned as a composite flap according to the chimeric flap principle.^[8,15,21]

In 2011, Acarturk *et al.*^[23] gave the first report about the femur–vastus intermedius muscle–anterolateral thigh osteomyocutaneous free flap (FVATLO flap) applied in the reconstruction of a case with complex lower extremity defects. Five years later, Brody *et al.*^[24] introduced its first application in head and neck reconstruction.^[25]

Rectus abdominis myocutaneous free flap can be used for composite defects, but has potential disadvantages like a prominent abdominal scar, the associated risk of problems like hernia, and deterioration of the pulmonary function.^[2,14]

- (7) The flap can be included with the lateral femoral cutaneous nerve and thus made sensate.^[6,15]
- (8) The donor defect of <8 cm in width is usually closed primarily with no tension and only a hidden scar over the thigh.^[6,8,15,26] There are only a few other sites in the body that can offer such an ample amount of skin and muscle for extensive reconstruction in the head and neck region with as little donor site morbidity.^[4,18] Even though we have not encountered any donor site complications in our series, quadriceps dysfunction, distolateral thigh anesthesia/paresthesia, and pain are all described as

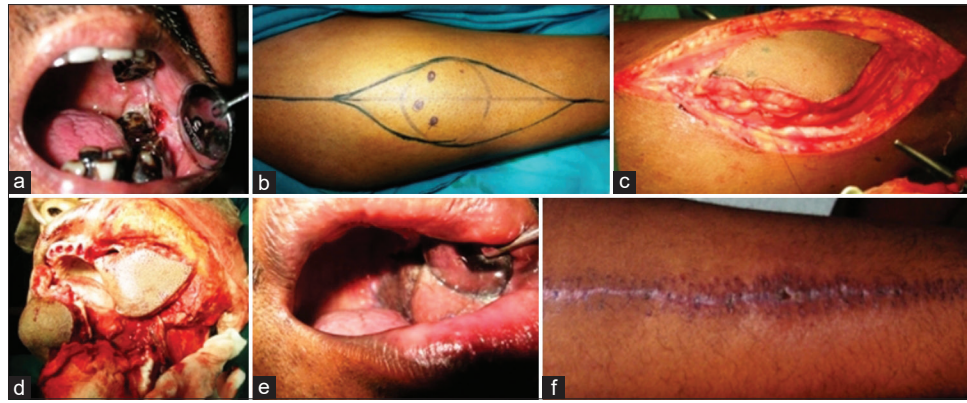


Figure 1: (a) Preoperative intraoral lesion. (b) Flap markings. (c) Elevation of the flap. (d) Flap positioning. (e) Postoperative intraoral lining. (f) Postoperative donor area

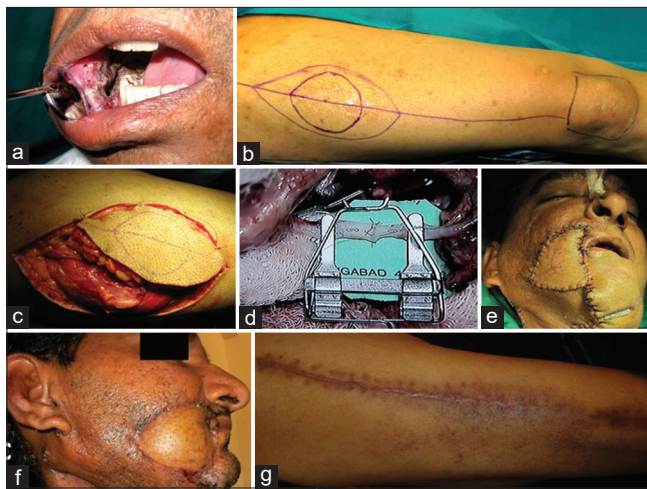


Figure 2: (a) Preoperative intraoral lesion. (b) Flap markings. (c) Elevation of the flap. (d) Microvascular anastomosis. (e) Immediate reconstruction. (f) Postoperative extraoral lining. (g) Postoperative donor area

potential complications following ALT dissection.^[3] There have been reports which suggest that even though the vastus lateralis muscle was severely damaged, there was no muscle weakness due to the recovery of the muscles by natural rehabilitation.^[27]

Nevertheless, there are still several disadvantages of this flap, which are as follows:^[6,15]

- (1) The ALT flap learning curve is undoubtedly longer when compared to other flaps because the perforator dissection is more challenging.^[3] The main disadvantage of the ALT flap is its variations in the vascular pedicle and small cutaneous perforator, which are difficult to dissect without compromising the vastus lateralis muscle and its peripheral motor nerves.^[16,27]
- (2) The flap is hairy, especially in male patients.
- (3) The donor area may require a second skin graft if a large flap is harvested, which may not be accepted in female patients.^[14]

Contraindications for the use of this flap are patients who have a history of major vascular bypass procedures and patients with excessive subcutaneous fat due to obesity or body habitus. In such patients, the flap may be too big for a head and neck defect and may prove to be technically cumbersome.^[9]

ALT flap can be harvested on multiple perforators, but in our study, a single perforator was used. A phenomenon universal to perforator flaps is the ability of a single perforator to reliably support a relatively large fasciocutaneous vascular territory, which may occur because of a hyperperfusion phenomenon through the isolated perforator vessels.^[28] Cadaver perfusion studies of isolated ALT flaps have proven that skin areas as large as 240 cm² can be harvested based on the perforating vessels.^[2] However, recent literature shows that flaps as large as 630 cm² can be harvested based on a single perforator for post-traumatic limb soft tissue reconstruction.^[28] These findings together with other studies^[21,29] support the notion that massive flaps can be harvested in both Asian and Caucasian populations. Our study includes reconstruction of complex oral cavity defects with a single perforator-based ALT flap.

Vasospasm may be one of the complications which may occur if careful dissection of the perforator through the muscle is not performed.^[2] Topical irrigation with relaxants such as papaverine or lignocaine is done to avoid drying of the perforator and subsequently prevents vasospasm^[2,20] which is used in all our cases. The vascular pedicle, which is dissected through the muscle, is small and sensitive to compression, which increases the risk of venous compression. To prevent this, the surgeon must take adequate measures to prevent local compression of the vascular pedicle and good postoperative monitoring is mandatory.^[9] Twisting of the perforator can be prevented with many techniques. According to Cascarini *et al.*, if the perforator is musculocutaneous, then around 5 mm cuff of muscle is taken, which not only prevents twisting but also helps to secure a suture, which is placed from the pedicle in a loop to the edge of the skin flap. If the perforator is septocutaneous, then some of the fascia and connective tissue

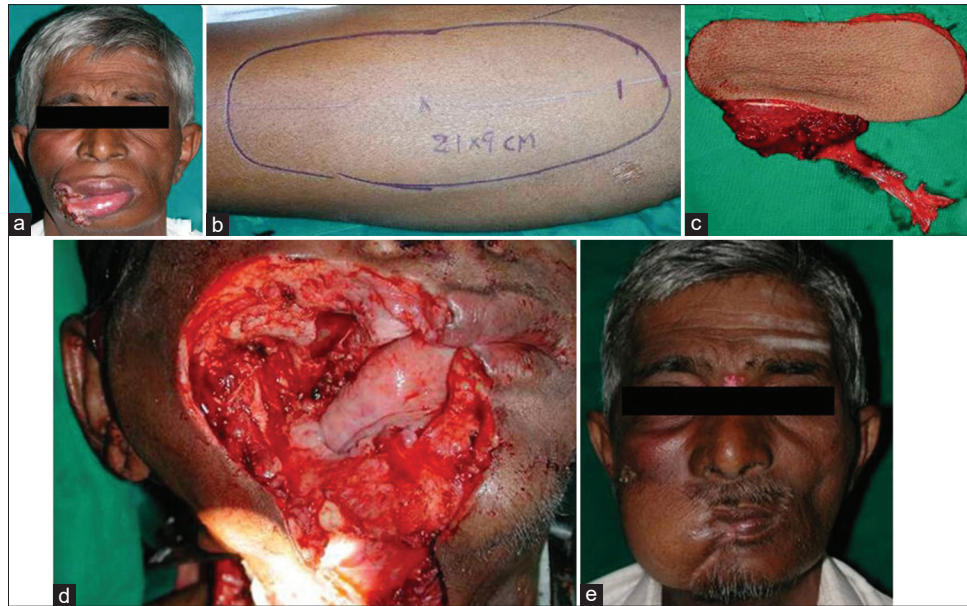


Figure 3: (a) Preoperative intraoral lesion. (b) Flap markings. (c) Elevation of the flap. (d) Intraoperative defect. (e) Postoperative extraoral lining



Figure 4: (a) Preoperative extraoral lesion. (b) Flap markings. (c) Elevation of the flap. (d) Immediate reconstruction. (e) Postoperative extraoral lining

from the intermuscular septum with the perforator is taken to help secure the suture. They have also ensured that during the time after raising the flap but before cutting the pedicle, the flap is always either carefully held or tacked to the thigh to prevent the weight of the flap from tearing out the relatively delicate perforators.^[30] We also follow these techniques to prevent twisting of the pedicle and failure of the flap.

In our series, we had complete loss of flap in one patient due to venous thrombosis and one had complete loss due to infection; both of them underwent salvage procedure and were reconstructed with PMMC flap. One patient had a partial flap loss and underwent re-exploration. The causes of flap failure

may be multifactorial. One of the causes may be that these were the early cases treated and may indicate a learning curve. To arrive at a definite conclusion was not possible in our series as we had a very insignificant number of failures.

To summarize, we have described our experiences with a single perforator-based ALT flap for reconstruction of head and neck defects following cancer ablation. ALT has gained popularity due to its versatility and reliability for massive skin and soft tissue defects with minimal donor site morbidity, and is hence considered as a universal flap in clinical practice.^[31] Very few studies have been reported in India to assess the reliability and versatility of single perforator-based ALT

flap in oral cancer reconstruction. Our study concludes that harvesting single perforator-based ALT can reconstruct extensive composite defects of the oral cavity. Even though microvascular anastomosis may be expensive and technically a limitation, it has found a permanent place in our head and neck reconstructive armamentarium. We propose that ALT can be the new workhorse flap for the reconstruction of orofacial defects in head and neck cancer patients.

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Conflicts of interest

There are no conflicts of interest.

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