



Role of ALT Perforator Flaps in Head and Neck Reconstruction

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Abstract

Background The anterolateral thigh flap is a versatile flap that offers many advantages. These include a long and reliable pedicle that enables a wide arc of rotation, the possibility to harvest a large skin area, raising the flap with underlying fascia and minimal donor site morbidity. The purpose of this study is to show better esthetics and function with the use of ALT perforator flap in head and neck region. It is a large prospective case study done in our institute with regular follow-up which shows the outcomes of ALT flap. **Materials and Method** From 2020 to 2022, hundred patients were reconstructed with anterolateral thigh flap. The flap was used for reconstruction in head and neck region. The patient group consisted of 53 males and 47 females. The age range was 30–90 years with a mean age of 61 years. Patients who had extensive soft tissue defect in the head and neck and had been reconstructed by free ALT flap have been reported. Flap data (type, length, and width), duration of flap elevation, donor-site morbidity, post-operative

complications, and follow-up data including aesthetic and functional outcome were recorded.

Results We experienced no flap loss. The donor site was closed directly in twenty-eight out of eighty patients, and the remaining twenty patients were closed by split thickness skin grafting. Satisfactory aesthetic and functional outcome were achieved in all patients.

Conclusion Our experience illustrates the versatility in the clinical application of the anterolateral thigh flap. The many advantages of the flap, such as the long and reliable pedicle, a large area of skin that can be harvested, the potential to supercharge the flap and the minimal donor site morbidity, highlight the diversity of defects that can be reconstructed using this flap.

Keywords Anterolateral · Flaps · Microsurgery · Thigh

Introduction

The free anterolateral thigh (ALT) flap was introduced by Song et al. in 1984. Since then, the ALT flap has gained international popularity, especially after the publication from Wei et al. The flap has become a workhorse for the reconstruction of soft tissue defects in the head and neck, extremities, and the trunk. Kimata et al. were the first to use the flap as a pedicled flap for an abdominal reconstruction. Their work has led to an increased application of the pedicled ALT flap [1]. There are many advantages to the pedicled ALT flap, the primary one being the wide arc of reach that is created by the long and reliable pedicle. The flap is supplied by the descending branch of the lateral circumflex femoral artery, a branch from the profunda femoris artery. The length of the pedicle is mostly reported to be between 4 and 20 cm. In addition to the possibilities mentioned above,

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the pedicled ALT flap offers minimal donor site morbidity and can be closed primarily if the flap does not exceed 21×9 cm in size [2]. In this series, we present our experiences with the flap in hundred patients.

The goal of reconstruction in the head and neck involves three fundamental components: wound healing, function, and cosmesis. When deciding which reconstructive option is best suited for a particular patient, the reconstructive ladder must be taken into consideration.

The free anterolateral thigh (ALT) flap has emerged as a popular option for the reconstruction of head and neck defects. It has the attributes of a 'workhorse' flap that include the absence of patient repositioning, remote location from the potential defect, and a long pedicle.

The main indication of using free ALT flap is the five major types of extensive soft tissue head and neck defects.

- a. Subtotal or total glossectomy defects;
- b. Extensive skull base defects.
- c. 'Through-and-through' buccal defects;
- d. Extensive scalp defects; and
- e. Extensive orbitomaxillofacial defects. With respect to the orbit, the ALT provides sufficient soft tissue and skin to fill the dead space within an exenteration cavity, and to cover any implants or plates required for adjacent midface reconstruction.

The unique anatomy of the thigh permits several methods of harvesting the ALT flap. The type of tissues to be included in the flap can be selected according to the defect to be reconstructed. The ALT flap can be harvested at the suprafascial level to include just the skin and subcutaneous fat, which is useful when a thin flap is desired. When harvested at the subfascial level, the flap can bring additional tissue bulk including the fascia lata on the deep surface. The fascia is particularly useful in several situations, such as when repairing dural or tendon defects and when creating a sling to support the oral commissure. A musculocutaneous flap can be harvested by including a part of the vastuslateralis muscle. The muscle can be attached to the overlying skin or splayed out on a separate vascular branch that arises from the same vascular pedicle to create a chimeric flap.

The ALT flap possesses many of the important properties that make a flap ideal for head and neck reconstruction, namely:

- a. Anatomically constant with a long and sizeable pedicle;
- b. Good match for recipient-site tissue characteristics;
- c. Flexibility of tissue volume, be it thick, bulky, or thin and pliable;
- d. Flexibility in design, including the availability of different tissue types for harvesting on the same pedicle, as in a chimeric flap;

- e. The option to harvest two separate flaps from the same site;
- f. Insignificant donor-site morbidity;
- g. Simultaneous flap harvest and tumour ablation afforded by a two-team approach; and
- h. The option for sensory reinnervation.

Keeping these facts in mind, ALTs have recently taken an increased role in head and neck reconstruction.

Thus, the aim of the study was to evaluate indications, advantages, disadvantages, and complications of the usage of free ALT flap in head and neck reconstruction.

Patients and methods

In this prospective case series, we have analyzed data from 100 patients who underwent surgical reconstruction using the ALT flap at Vydehi Institute of Medical Sciences and Research Centre from 2020 to 2022. The patients were diagnosed with oral carcinoma, majorly squamous cell carcinoma.

It includes all patients who had extensive soft tissue defect in the head and neck and had been reconstructed by free ALT flap. The patients included were those with extensive soft tissue head and neck defects, which could not be closed by local flaps, and were fit for surgery. The patients excluded were those with small defect, which could be closed by local flaps, and were not fit for surgery (old age, cardiac, diabetic, etc.). Informed consent was obtained from all patients included in the study that was approved by the local ethics committee. All the patients were subjected to pre-operative history taking, clinical examination, laboratory investigations, and radiological examination. The patient group consisted of 53 men and 47 women. The age range was 30–90 years with a mean age of 61 years. Further patient details are described in Table 1.

Pre-operative management

Pre-operative evaluation of the perforators was performed using a Doppler probe by auscultating the skin in the region of the lateral intermuscular septum and over the medial parts of the vastuslateralis muscle.

Technique

The surgery is a two-team approach, and the patient is placed in a supine position. A straight line is made from the anterior superior iliac spine to the lateral edge of the patella. The majority of perforators are located in a circle of 3–5 cm inferolateral around the midpoint of this

Table 1 Distribution of Baseline Characteristics of study patients

Variable	Category	<i>n</i>	%
Age	31–40 yrs	4	4
	41–50 yrs	18	18
	51–60 yrs	41	41
	61–70 yrs	27	27
	> 70 yrs	10	10
	Mean		SD
	Mean	57.91	10.54
	Range	31–81	
Gender	Males	53	53%
	Females	47	47%

line. The perforators are mapped by a handheld Doppler ultrasonography probe. A medial incision is made 1–3 cm medial to the straight line, depending on what flap size is required. Skin and subcutaneous tissue are dissected off the fascia laterally until the perforators are located. The perforators can either be septocutaneous (12–15%) or musculocutaneous (85–88%). The perforators are dissected until the main pedicle is reached. When the perforator is septocutaneous, the dissection is straight forward and fast. The musculocutaneous perforators always give off many branches to the vastus lateralis muscle. These branches should be carefully cauterized. The main pedicle is the descending branch of the latera circumflex femoral artery and is located in the intramuscular space between the rectus femoris and vastus lateralis muscles. Usually, a pedicle length of more than 8 cm can be achieved. The flap size is determined by the defect that is to be covered. The donor site can usually be closed directly (flap width less than 8 cm) or with a split-thickness skin graft [3, 4].

For the harvesting of the flap, we use the same standard technique which is used. After harvesting for anastomosis, the standard protocol which we use is end to side anastomosis for vein and it is done directly to internal jugular vein. For the artery, maximum anastomosis is done to facial artery followed by superior thyroid.

The suture material which we use for anastomosis is 9–0 ethilon for artery and 8–0 ethilon for vein.

In case of shorter length of the vein, additionally vein graft is harvested.

After surgery flap, hourly flap monitoring is done according to the protocol and we also used infrared thermographic camera which helped us in early detection of vascular obstruction (Fig. 1).

**Fig. 1** Harvested ALT flap with the pedicle in its origin**Case 1***Pre-Operative*

See Fig. 2a–c.

Intra-operative

See Fig. 2d–k.

Post-operative

See Fig. 2l, m.

Case 2*Pre-Operative*

See Fig. 3a, b.

Fig. 2 **a:** Frontal view. **b:** Tumour penetrating the skin extra orally. **c:** Intraoral lesion in relation to left buccal mucosa involving the retromolar trigon. **d:** Marking of the flap. **e:** Marking of the perforators. **f & g:** Harvested flap with its skin paddle and pedicle. **h & i:** Resected lesion. **j:** Primary closure of thigh. **k:** Flap covering the defect. **l & m:** Post-operative flap in situ

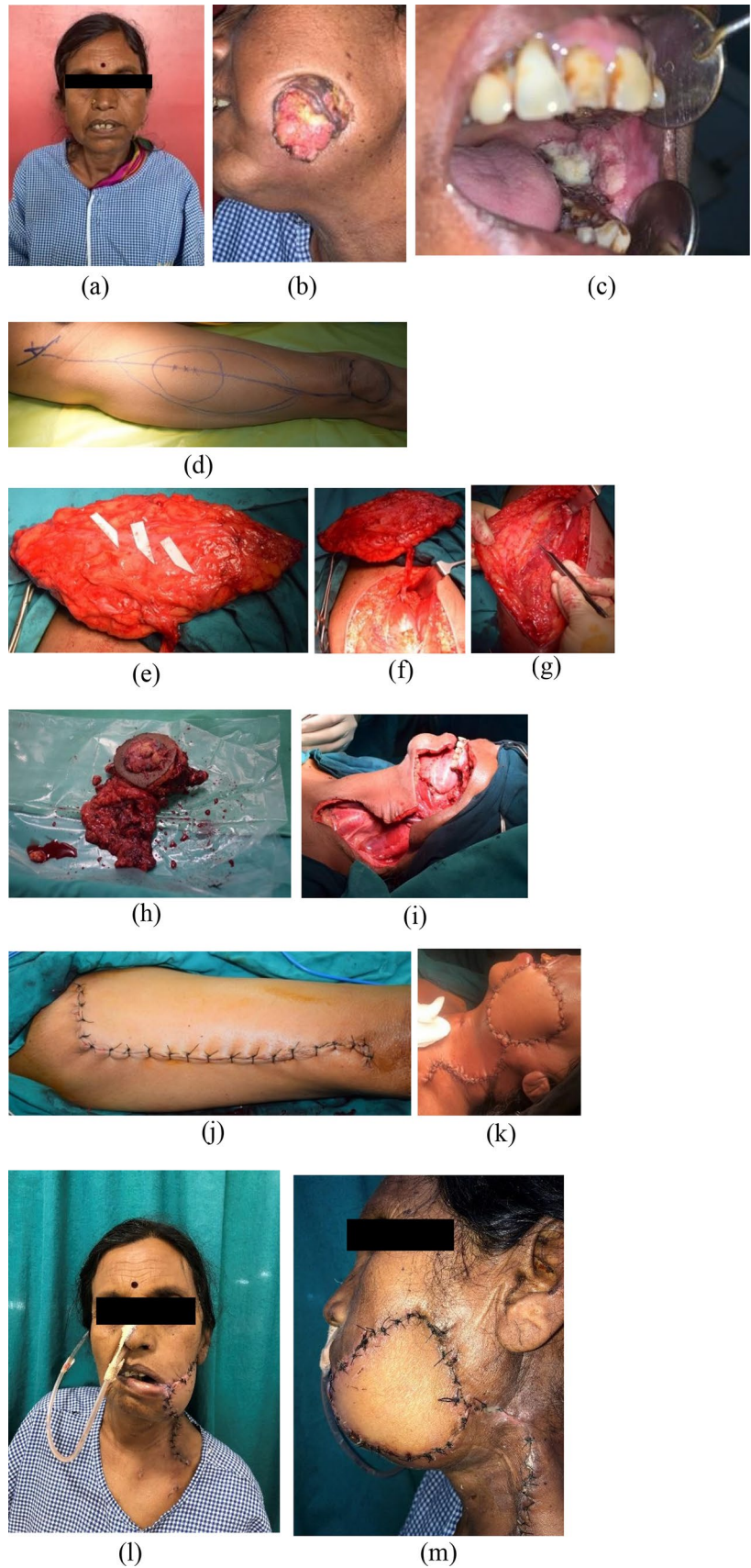


Fig. 3 **a:** Profile view. **b:** Squamous cell carcinoma in relation to left buccal mucosa. **c:** Chimeric flap – Flap is islanded to cover both intraoral and extraoral defect. **d:** Intraoral coverage. **e:** Primary closure achieved in relation to donor site. **f:** Extraoral coverage. **g:** 5-day post. **h:** Flap inset operative

Case 2

PRE – OPERATIVE

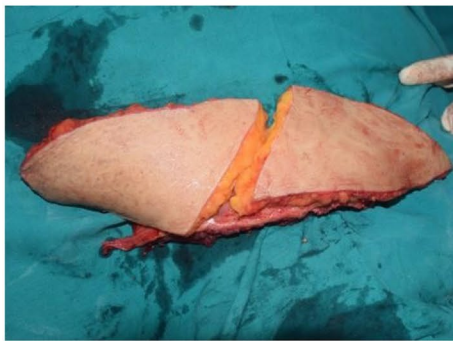


(a)



(b)

INTRA – OPERATIVE



(c)



(d)



(e)



(f)

POST – OPERATIVE



(g)



(h)

Intra-operative

See Fig. 3c–f.

Post-operative

See Fig. 3g, h.

Case 3*Pre-operative*

See Fig. 4a, b.

Intra-operative

See Fig. 4c–f.

Post-operative

See Fig. 4g, h.

Case 4*Pre-Operative*

See Fig. 5a, b.

Intra-operative

See Fig. 5c–e.

Post-operative

See Fig. 5f, g.

Case 5*Pre-operative*

See Fig. 6a, b.

Intra-operative

See Fig. 6c–e.

Post-operative

See Fig. 6f–h.

Results

We reconstructed 100 patients with an ALT flap which included 53 males and 47 females with a mean average age of 57 years (Table 1; Figs. 7 And 8). Most common pathology involved was noted to be squamous cell carcinoma (Table 2; Fig. 9). Sixty-eight (38 females and 30 males) patients had existing comorbidities like hypertension, type 2 diabetes, hypothyroidism and asthma. 72 (48 males, 24 females) patients gave history of tobacco chewing. The extent of the defect varied from intraoral to sometimes penetrating the extraoral skin as well. Most common site was noted to be buccal mucosa followed by retromolar trigon area and floor of the mouth.

The flap size ranged from 10×5 cm (50 cm²) to 15×30 cm (450 cm²) with a mean size of 222 cm². In 17 patients, only single perforator was harvested while in the other 83 patient's multiple perforators were used (Table 3; Fig. 10).

All the flaps survived. Minor intra-operative complications which included arterial and venous obstruction after the anastomosis and hematoma after the closure, occurred in 11 patients. Intra-operative complication was addressed by doing re-anastomosis. For example, if side to end anastomosis is done to the superior thyroid artery and thrombosis is noted so either re-anastomosis is done in an end-to-end manner or completely different vessel like facial artery is considered (Fig. 11).

Similarly, this is done for venous obstruction as well and sometimes additional vein graft is harvested when there is inadequate length of the vessel.

Hematoma is managed by opening the site and draining it out. (Table 4; Fig. 12).

Minor post-operative complications like wound dehiscence, flap necrosis, necrosis of the skin graft, infection, congestion occurred in 31 patients (Table 4; Fig. 12). These were treated with antibiotics and regular dressings. One major complication occurred: temporary clotting of the greater saphenous vein used to supercharge the flap which required re-exploration on post-operative day one.

None of the complications resulted in loss of function or poor aesthetic outcome. Eighty out of 100 patients had their donor site closed primarily. The remaining 20 patients were treated with a split-thickness skin graft (Table 3; Fig. 11). Primary closure was not possible in one of the two patients because of the considerable flap size 15×30 (450 cm²).

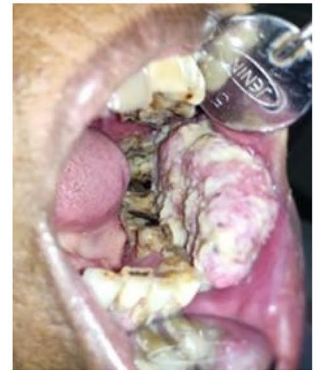
In all cases, satisfactory functional and aesthetic outcome was achieved. Patients were evaluated using.

Fig. 4 **a:** Frontal view. **b:** Squamous cell carcinoma in relation to left buccal mucosa. **c:** Marking of flap in the region of maximum perforators. **d:** Harvested flap. **e:** Pedicle of length. **f:** Closure done using split thickness skin graft. **g:** Frontal view. **h:** Flap in situ

CASE 3 PRE – OPERATIVE



(a)

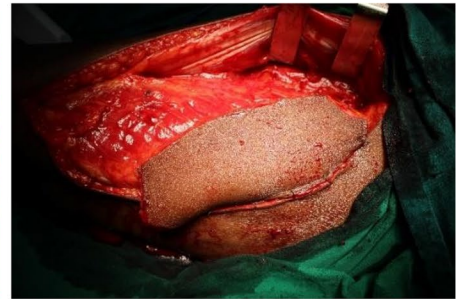


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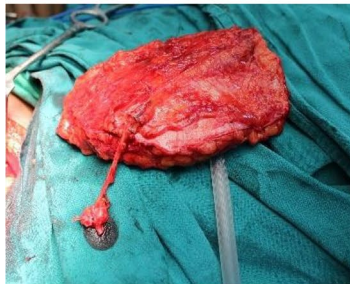
INTRA -OPERATIVE



(c)



(d)



(e)



(f)

POST – OPERATIVE



(g)



(h)

Fig. 5 **a:** Profile view. **b:** SCC in relation to left buccal mucosa involving the alveolus. **c:** Defect after flap harvest. **d:** Two pedicles. **e:** Primary closure achieved. **f:** Profile view. **g:** Flap in situ on day 5

CASE 4
PRE – OPERATIVE



(a)



(b)

INTRA – OPERATIVE



(c)



(d)



(e)

POST – OPERATIVE



(f)

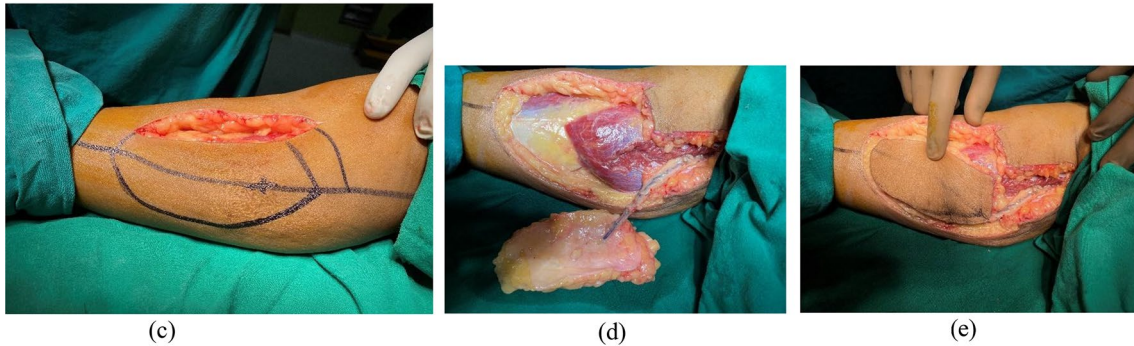


(g)

CASE 5
PRE – OPERATIVE



INTRA – OPERATIVE



POST – OPERATIVE

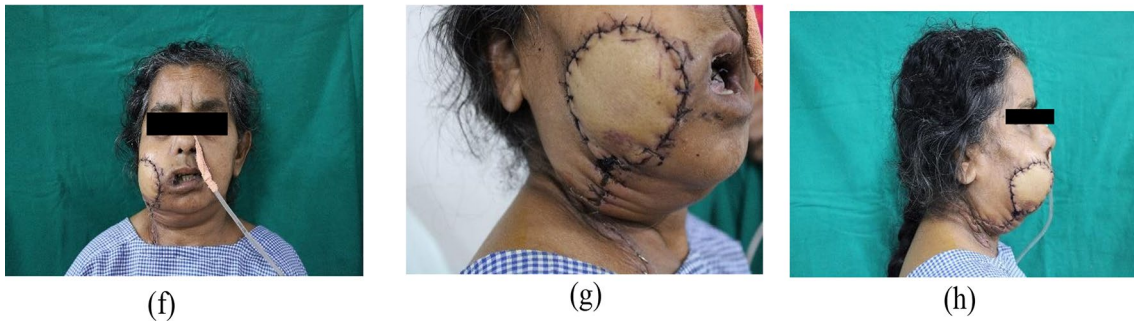


Fig. 6 **a:** Frontal view of the patient. **b:** SCC in relation to right buccal mucosa involving the RMT region. **c:** Flap marking. **d:** Flap elevation. **e:** The skin paddle. **f:** Post-operative profile view. **g & h:** Flap inset

(a) University of Washington Quality of Life questionnaire.

(b) Functional intra-oral Glasgow scale (figs) with a total score of 15 points.

(c) The Vancouver scar scale.

Table 2 Distribution of Pathological & site-based Characteristics of study patients

Variable	Category	n	%
Pathology	SCC	98	98
	Adenocarcinoma	2	2
Site	Right thigh	22	22.0
	Left thigh	75	75.0
	Both	3	3.0
Bipaddled	Yes	16	16
	No	84	84

Recipient site functions (chewing, swallowing and speech) and aesthetics was found to be satisfactory (Tables 5 and 6; Fig. 13). These were assessed at post-operative day 5, after 2 weeks, after 1 month and every 3 months thereafter.

Donor site functions was found to be satisfactory in 79 patients (Table 7; Fig. 14 and aesthetics was assessed based on the Vancouver scar scale (Table 8; Fig. 15).

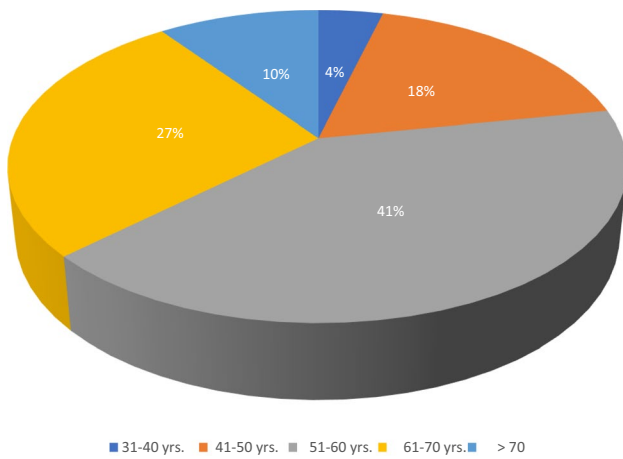


Fig. 7 Age distribution among study

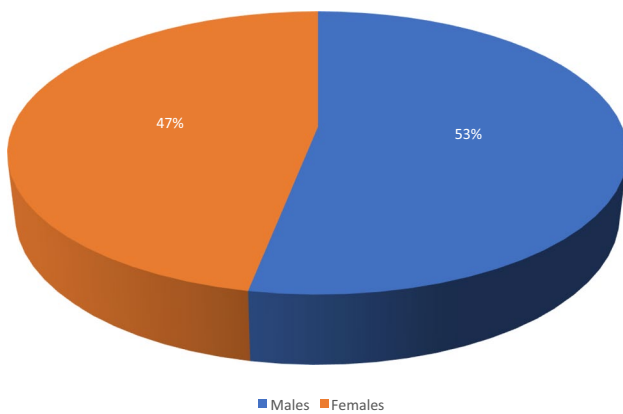


Fig. 8 Gender distribution among study patients

Discussion

Radical tumour ablations in the head and neck region can significantly impair function and aesthetics and usually require complex reconstructions. In the past, options for soft tissue coverage were limited only to pedicled flaps. Traditional free flaps were either too thin or too bulky, or were not ideal for texture matching. The introduction of perforator-based flap harvest and the chimeric flap concept allowed the surgeon to choose a more accurate single-stage reconstruction that could both restore good function and achieve an

Table 3 Distribution of perforator-based characteristics of study patients

Variable	Category	n	%	
Perforator	Single	17	17	
	Multiple	83	83	
Closure	Primary	80	80	
	Skin graft		20	20

Table 4 Distribution of intra- & post-op complications among study patients

Variable	Category	n	%	
Intra-op complication	Arterial obstruction	3	3	
	Venous obstruction	4	4	
	Both	2	2	
	Hematoma	2	2	
	None	89	89	
Post-op complication	Wound dehiscence	10	10	
	Infection	6	6	
	Congestion	3	3	
	Flap necrosis	5	5	
	Necrosis of skin graft	7	7	
	None		69	69

Table 5 Descriptive for Recipient Site Function scores among study patients

Parameter	N	Mean	SD	Min	Max
Chewing	100	3.40	0.71	2	5
Swallowing	100	3.90	0.69	3	5
Speech	100	4.02	0.71	2	5
Total	100	11.35	1.40	8	15

Table 6 Distribution of Recipient Site Aesthetic score among study patients

Variable	Category	n	%
Recipient site aesthetics	Adequate	100	100.0

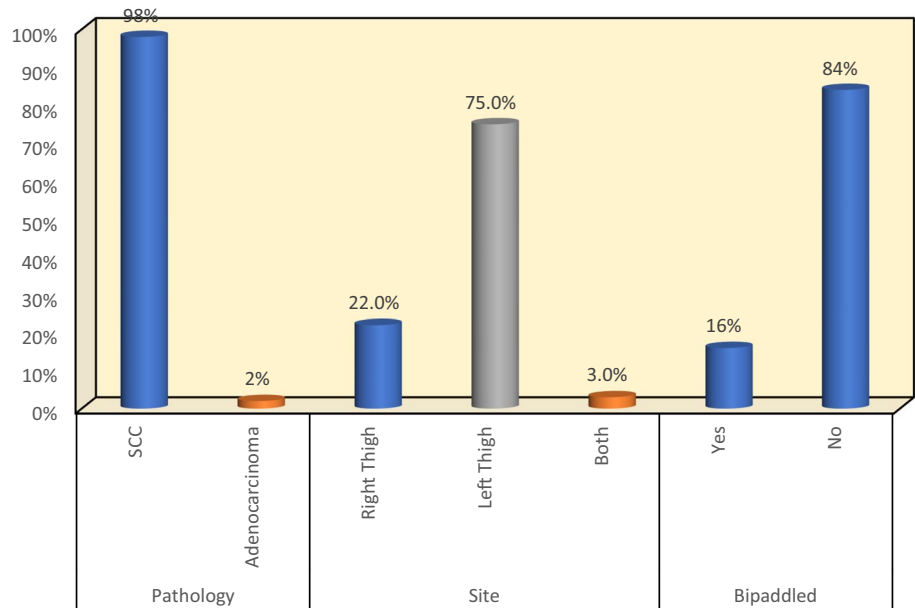
aesthetically acceptable result in the majority of patients [5] (Figs. 16, 17, 18 and 19).

Since the introduction of the ALT free flap in 1984 by Song et al., the flap has gained popularity and is often described as the workhorse for the reconstruction of skin and soft tissue defects. The pedicled flap has since gained an increase in the application. The flap is very versatile and can be designed to match the defect that requires reconstruction. The flap can be raised as an adipocutaneous, fasciocutaneous or a myocutaneous flap, depending on the requirements of the defect being reconstructed. When harvested as

Table 7 Distribution of Donor Site Function scores among study patients

Variable	Category	n	%
Donor site function scores	Satisfactory	79	79
	Compromised	5	5
	Reduced	16	16

Fig. 9 Pathological & site-based characteristics of study patients



a myocutaneous flap, it is possible to use part of the rectus femoris muscle, the vastus lateralis muscle or the tensor facia lata muscle. The muscle harvested with the myocutaneous flap depends on the individual anatomy of the patient and the requirements of the recipient site. Free flaps are a good option that provides sufficient coverage. However, they require surgical expertise, prolonged operating time compared to pedicled flaps, and deep location of recipient vessels in this region [6]. The ALT flap is technically more demanding, but offers a larger variety in size and shape, with better skin match and less bulkiness.

We have found that the ALT flap possesses many of the important properties that make a flap ideal for head and neck reconstruction, namely (1) anatomically constant with a long and sizeable pedicle; (2) good match for recipient-site tissue characteristics; (3) flexibility of tissue volume, be that thick,

bulky, or thin and pliable; (4) flexibility in design, including the availability of different tissue types for harvesting on the same pedicle, as in a chimeric flap; (5) the option to harvest two separate flaps from the same site; (6) insignificant donor-site morbidity; (7) simultaneous flap harvest and tumour ablation afforded by a two-team approach; and (8) the option for sensory reinnervation [7]. We have only rarely encountered cases that required vein grafts, even when reconstructing cases following recurrent cancer, difficult neck dissections, or when having to turn to the contralateral neck to find suitable recipient vessels (Tables 7, 8, 9, 10, 11 and 12).

A particularly important advantage of the ALT flap is the relatively low donor-site morbidity that accompanies even a substantial flap harvest. An increase in the size of

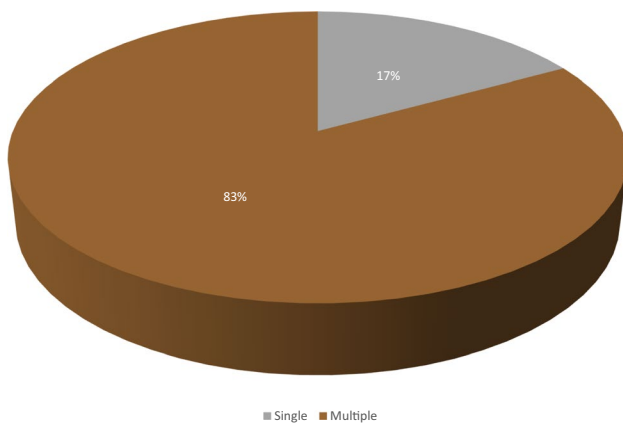


Fig. 10 Distribution of number of Perforators among study patients

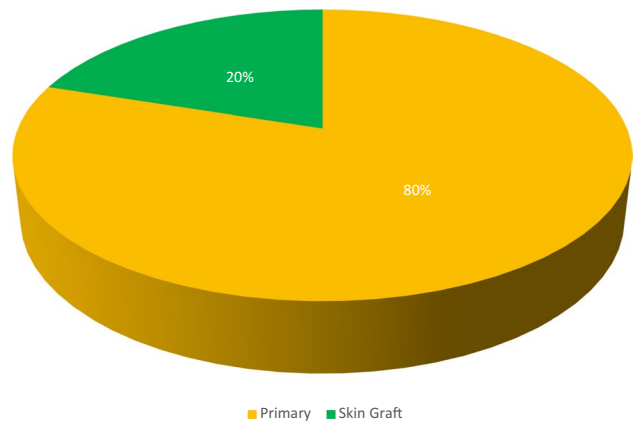


Fig. 11 Distribution of type of wound closure among study patients

Fig. 12 Intra- & Post-op complications among study patients

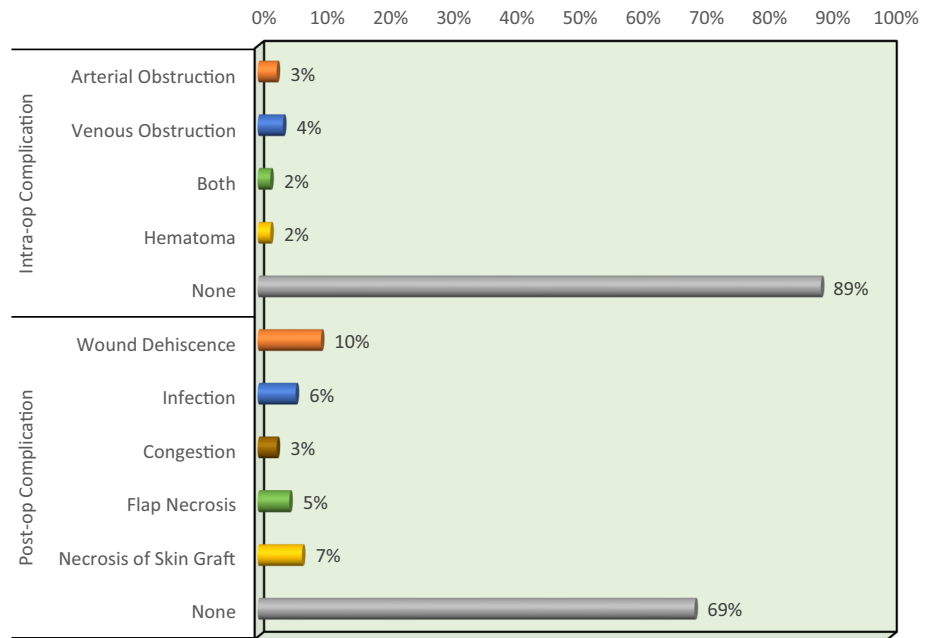


Table 8 Descriptive for Donor Site Aesthetic scores among study patients

Parameter	N	Mean	SD	Min	Max
Vascularity	100	1.78	0.56	0	3
Pigmentation	100	1.76	0.65	0	3
Pliability	100	1.55	0.72	0	3
Height	100	0.55	0.63	0	2
Total	100	5.63	1.65	0	10

a cutaneous flap does not appear to cause a proportional increase in donor-site morbidity. Dissection and protection of the nerve to the vastus lateralis muscle should be performed carefully to preserve maximal quadriceps function when harvesting a cutaneous ALT flap. The inclusion of a

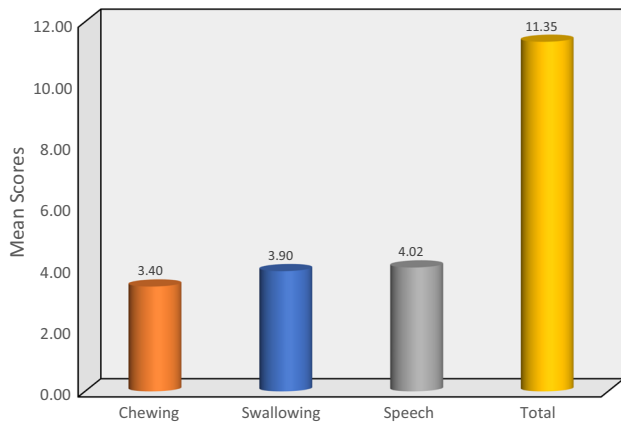


Fig. 13 Receptient Site Function scores among study patients

segment of the vastus lateralis muscle might be expected to increase donor-site morbidity; however, it was objectively demonstrated at long-term follow-up with a kinetic communicator machine that only a minimal weakness of the thigh results.

An article by Nicholas Platt et al. [7] shows case series of 92 patients but with a retrospective view while our study showcases a prospective view done in our institute.

In our experience, no significant functional deficits were noted either by the patient or examining physician [8].

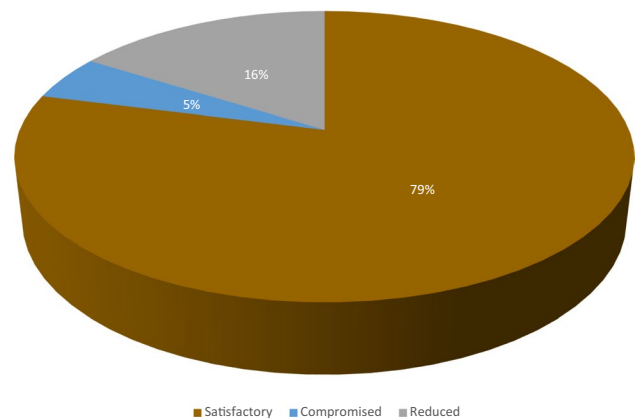


Fig. 14 Distribution of Donor Site Function scores among study patients

Fig. 15 Descriptive for Donor Site Esthetic scores among study patients

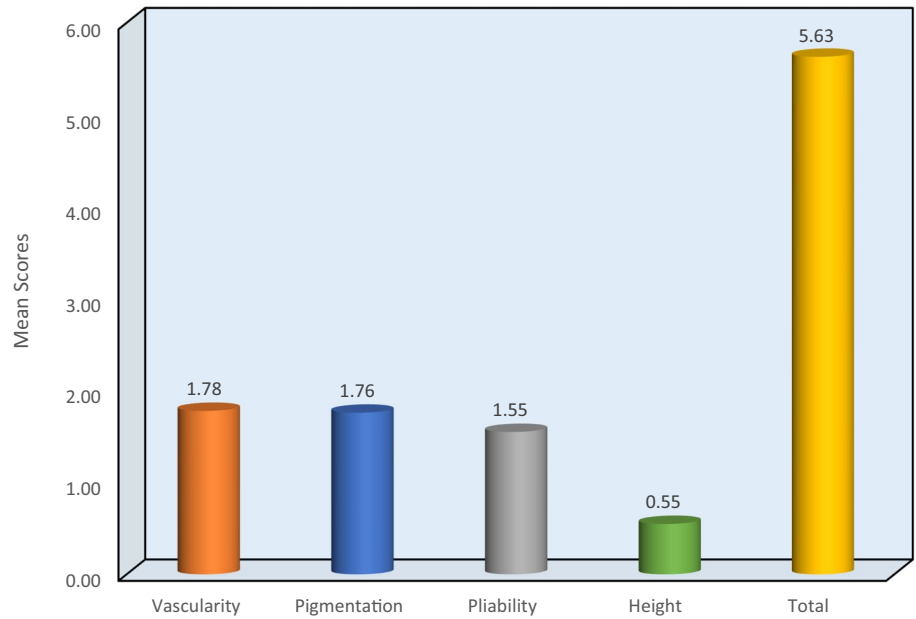


Fig. 16 Mean values of Receptent site Functional scores based on the number of perforators

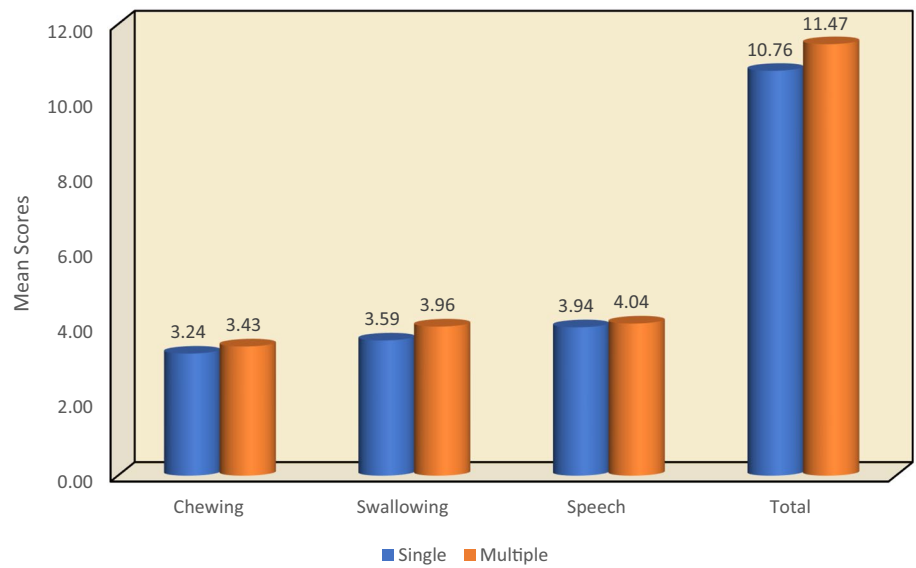


Table 9 Comparison of mean values of Receptent site Functional scores based on the number of perforators using Mann Whitney Test

Parameter	Perforators	N	Mean	SD	Mean diff.	p-value
Chewing	Single	17	3.24	0.75	-0.19	0.37
	Multiple	83	3.43	0.70		
Swallowing	Single	17	3.59	0.51	-0.37	0.04*
	Multiple	83	3.96	0.71		
Speech	Single	17	3.94	0.75	-0.10	0.58
	Multiple	83	4.04	0.71		
Total	Single	17	10.76	1.25	-0.71	0.04*
	Multiple	83	11.47	1.41		

*Statistically Significant

Fig. 17 Mean values of Donor site Esthetics scores based on the number of perforators

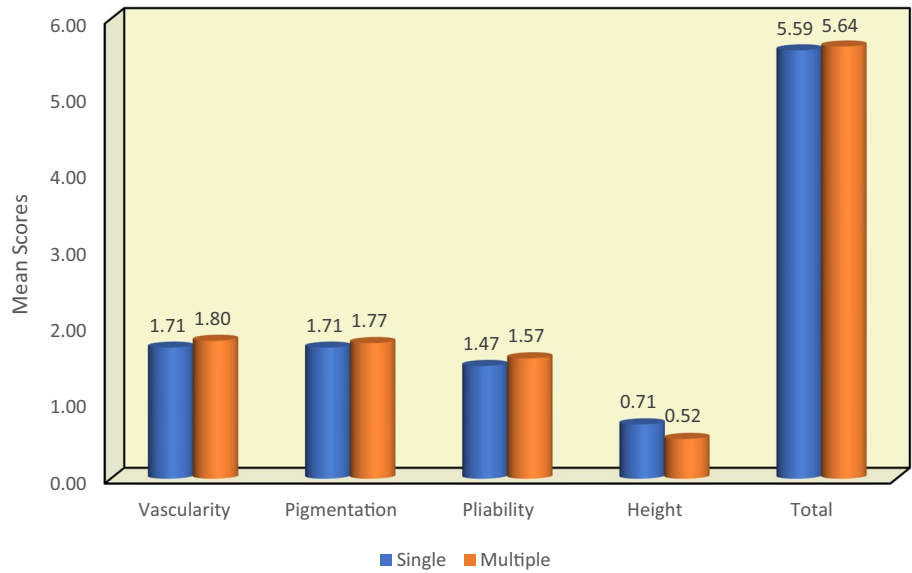


Fig. 18 Intra-op & Post-op complications based on the number of perforators

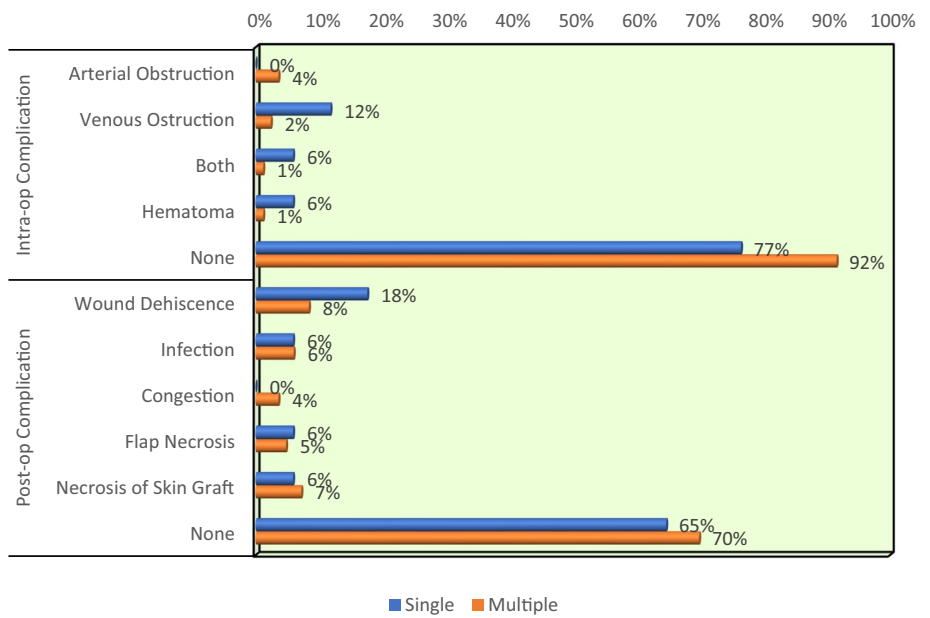


Table 10 Comparison of mean values of Donor site Aesthetics scores based on the number of perforators using Mann Whitney Test

Parameter	Perforators	N	Mean	SD	Mean diff.	p-value
Vascularity	Single	17	1.71	0.59	-0.09	0.67
	Multiple	83	1.80	0.56		
Pigmentation	Single	17	1.71	0.69	-0.06	0.82
	Multiple	83	1.77	0.65		
Pliability	Single	17	1.47	0.62	-0.10	0.75
	Multiple	83	1.57	0.74		
Height	Single	17	0.71	0.59	0.19	0.19
	Multiple	83	0.52	0.63		
Total	Single	17	5.59	1.73	-0.05	0.56
	Multiple	83	5.64	1.64		

Fig. 19 Donor site function scores based on the number of perforators

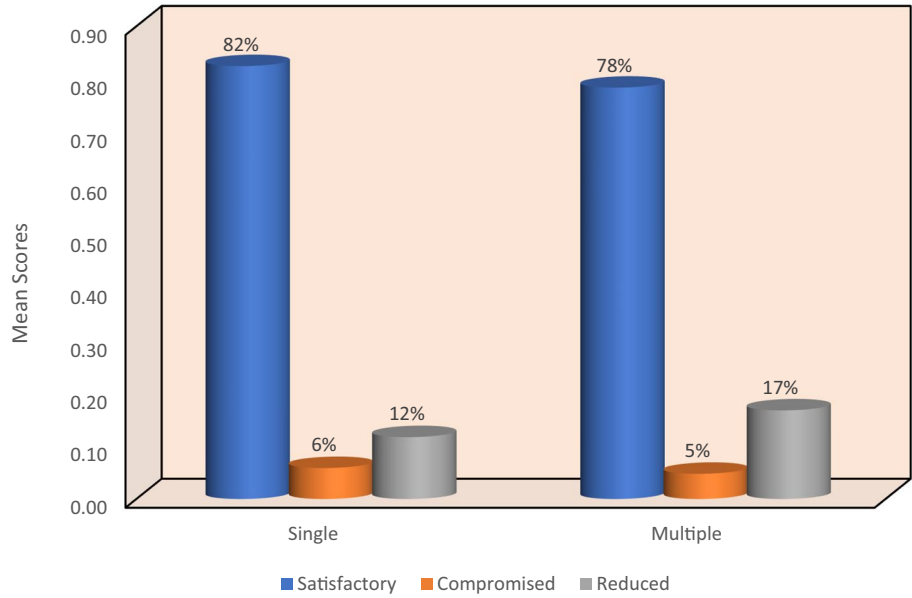


Table 11 Comparison of Intra-op & Post-op complications based on the number of perforators using Chi Square Test

Variables	Category	Single		Multiple		p-value
		n	%	n	%	
Intra-op Complication	Arterial obstruction	0	0	3	4	0.13
	Venous obstruction	2	12	2	2	
	Both	1	6	1	1	
	Hematoma	1	6	1	1	
	None	13	77	76	92	

Table 12 Comparison of Donor site function scores based on the number of perforators using Chi Square Test

Variables	Category	Single		Multiple		p-value
		n	%	n	%	
Donor site function scores	Satisfactory	14	82	65	78	0.87
	Compromised	1	6	4	5	
	Reduced	2	12	14	17	

Conclusion

Our experience with the ALT flap illustrates the versatility in the clinical application of the flap. The many advantages of the flap, including a long and reliable pedicle, the large area of skin that can be harvested, the potential to supercharge the distally based flap and the minimal donor site morbidity highlights the diversity of defects that can be reconstructed using the ALT flap.

Declarations

Conflict of interest None.

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