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A STUDY ON THE VERSATILITY AND OUTCOME OF FREE ANTEROLATERAL THIGH FLAP FOR COVERAGE OF LARGE COMPLEX DEFECTS.

Plastic Surgery

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ABSTRACT

Introduction: Free tissue transfer is warranted when local flaps cannot be harvested outside the zone of injury or when soft tissue defects are extensive and are complicated by exposure of bone, tendon, vessel, nerves or implants. The free anterolateral thigh flap is one such option. It is a fasciocutaneous (FC) flap based on the septocutaneous or musculocutaneous perforators of the descending branch of the lateral circumflex femoral artery. **Materials And Methods**: This prospective study was conducted from June 2021 to December 2022. A total of 10 patients were included in the study **Results**: Out of 10 patients, 6 were females and 4 were males. The maximum patients were in the age group of 41-60 years. Maximum patients had malignancy as the etiological factor. The flap was used for lower extremity defect reconstruction in 5 patients while for the rest it was done for upper extremity, scalp and abdominal defect reconstruction. The maximum length of the flap taken was 22cm and the maximum width taken was 18cm. The average pedicle length was 11cm. All required STSG coverage for closure of donor site. The mean duration of flap harvest was 2hrs 10min and the mean duration of surgery was 6hrs 52min. Flap congestion was seen in 3 patients which required re-exploration. Out of these, 2 flaps had complete necrosis.**Conclusion:** The free anterolateral thigh flap is a workhorse flap for reconstruction of large complex defects. It is easy to harvest with relatively constant anatomy, offers long and large pedicle, and has minimal donor site morbidity.

KEYWORDS

Versatility, anterolateral thigh flap, complex defects.

INTRODUCTION

Radical debridement allows the surgeon to prevent infection by skilful use of the scalpel and is the necessary foundation for the microsurgical techniques of applying free flap coverage [1].

Free-tissue transfer has become the accepted standard for reconstruction of complex defects. With the growth of this field, anatomic studies and clinical work have added many flaps to the armamentarium of the microvascular surgeon. Since the first reports of successful free-tissue transfer [2-8], multiple flaps have been described [9-12] that have allowed for increased success rates, improved reconstructive results, and a reduction in donor-site morbidity [13-16]. Perforator-based [17] free-tissue transfer is a relatively new method that has added significantly to the facility of the microsurgeon.

The free anterolateral thigh (ALT) flap was first introduced by Song et al. in 1984.[19] Since then the ALT flap has gained international popularity, especially after the publication from Wei et al. [18] The flap has become a workhorse for the reconstruction of soft tissue defects in the head and neck, extremities, and the trunk.[20],[21],[22],[23]

It is a fasciocutaneous (FC) flap based on the septocutaneous or musculocutaneous perforators of the descending branch of the lateral circumflex femoral artery. It is well established in Asian countries, where it has also first emerged and has been in regular use ever since [24]. As a result of its great success, the ALT has become an increasingly popular technique in Europe [25], [26], [27]. To achieve better cosmetic results, bulky flaps can be thinned out during primary or in following second procedure [28],[29],[30]. Over the years the ALT flap has become the workhorse for reconstruction of skin and soft tissue defects and especially over the past decade, replacing many other flaps [27],[28],[29],[30],[18].

MATERIAL AND METHODS

This is a Prospective observational study, done on patients attending Plastic surgery OPD or referral from other departments requiring coverage of large complex defect, at Medical College and Hospital, Kolkata; between June 2021 to December 2022 with sample size of 10 patients selected as per inclusion and exclusion criterias.

Inclusion criteria: –

i. All patients of age group 15-70 years
ii. Patients having large complex wound defect due to any etiology like malignancy, trauma, infection, etc requiring coverage.
iii. Patients who are fit for anaesthesia, and
iv. Patients who are willing to give consent and participate in the study will be included in the study.

Exclusion criteria: –

I) Scar or previous operation or radiotherapy on the donor area.
ii) History of DVT
iii) Associated co-morbidities like uncontrolled diabetes, chronic renal diseases.
iv) Patients who are not willing to give consent and refusing to take part in the study.

Operative Procedure

Preoperative flap marking: It is done by drawing a line from the anterior superior iliac spine (ASIS) to the superolateral border of the patella, which represents the septum between the rectus femoris and vastus lateralis muscles, and serves as the longitudinal axis of the flap. The midway point on this line is marked, and a circle with a 3 cm radius is drawn around it. Most perforators will be found in the outer, lower quadrant of this circle. Using a handheld Doppler, the dominant cutaneous perforators are identified and marked, and the flap is designed according to the defect size. The flap can be planned with perforators in a central position or in an eccentric position; the latter yields a greater pedicle length. Finally, prepping and draping is accomplished to facilitate a two-team approach to simultaneous flap harvest and recipient site preparation.

Under all aseptic precautions with patient in supine position, surgery is started.

Step 1 - Flap and perforator dissection: The subfascial dissection technique is more commonly performed, and allows the surgeon to map the perforator anatomy and tailor the flap accordingly.

The incision is made on the medial border of the flap and carried down to the fascia. Once the subfascial plane is entered, the septum between the rectus femoris and vastus lateralis is identified as a yellow fat stripe. It represents the site where septocutaneous perforators may emerge. If no septocutaneous perforator vessels are encountered, then dissection is carried out laterally in the subfascial plane to look for musculocutaneous perforators arising from the vastus lateralis. All potential perforators are identified, and one or two vessels with larger calibers and strong pulses are chosen; they will become the primary supply to the flap.

Step 2 - Pedicle dissection and isolation: Once the perforator anatomy is confirmed, the rectus femoris is retracted medially to

expose the septum entirely and trace the course of LCFA. The next step involves either a straightforward dissection, in the case of septocutaneous perforators, or a tedious dissection wherein the musculocutaneous perforators are traced proximally by painstakingly deroofing the vastus lateralis. Dissection proceeds until the selected perforators' take-off from the descending branch of LCFA is reached. Alternatively, some muscle can be included with the flap, thereby avoiding this time-consuming and challenging step of perforator isolation. The motor nerve to vastus lateralis accompanies the descending branch of LCFA and must be preserved, although branches entering any muscle harvested may be included. Further proximal dissection of the LCFA is carried out depending on the length of the pedicle required for anastomosis with the recipient vessels. Another critical point to note in the proximal dissection is that the lateral femoral cutaneous nerve is usually found proximally along a line connecting the ASIS to the superolateral patellar border. This nerve must be preserved if not harvesting a sensory flap.

Step 3 - Pedicle division & microvascular anastomosis: The next step is flap pedicle division, and the time is noted ("flap off" or "ischemia" time). Then the flap is transferred to the defect and temporarily inset with a few stay sutures in order to permit proper orientation of the flap pedicle and to prevent twisting of the vessels should the flap shift. The microvascular anastomosis is sewn between the flap vessels and the recipient vessels under the operating microscope. After completion of vessel anastomosis ('flap on' time noted), the adequacy of flow and any anastomotic site leaks should be evaluated. Flap perfusion and viability should also be confirmed by observing the color, warmth, and bleeding from edges of the flap.

Step 4 - Flap inset: After confirmation of vessel flow and flap perfusion, the final inset of the flap is performed. Suction drains or corrugated rubber drains are inserted beneath the flap. The site of the anastomosis is marked on the flap for postoperative monitoring. Dressing is applied with a 'flap window' for postoperative flap monitoring. Tight compressive dressings are avoided in order to prevent flap pedicle compromise.

Step 5 - Donor site closure: The donor site can be closed primarily, or if the donor defect is significant and primary closure would require excessive tension, a split thickness skin graft (STSG) can be applied.

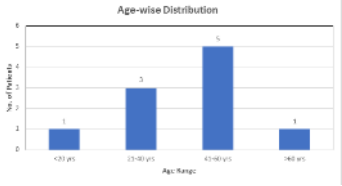
RESULTS AND ANALYSIS

In our study we have examined the results of the use of free anterolateral thigh flap for coverage of large complex defects in 10 patients.

The youngest patient in this study was 18 years while the oldest patient was 62 years. The maximum patients were in the age group of 41-60 years, with 5 patients being in the age range of 41-60 years, 3 being in the age range of 21-40, 1 patient being in the age range of <20 years and 1 in the range >60 years. The mean age was 43.5 years.

Table 1: Distribution Of Study Population According To Age Group

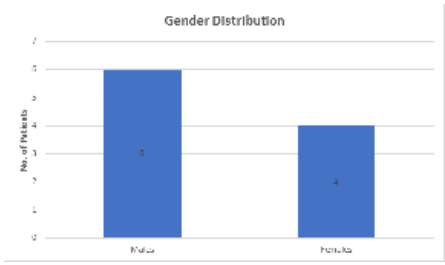
Age	Frequency	Percentage
<20 years	1	10%
21-40 years	3	30%
41-60 years	5	50%
>60 years	1	10%
Total	10	100%



Out of the 10 patients examined, 6 were males and 4 were females.

Table 2: Distribution Of Study Population According To Gender

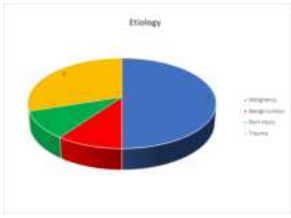
Patients	Frequency	Percentage
Males	6	60%
Females	4	40%
Total	10	100%



The etiology of the defect was either trauma due to RTA, burn injury, benign tumours or malignancies. Malignancy was the etiological factor in 5 patients. 3 patients had trauma as their etiology, 1 patient had benign tumour while 1 had electrocution burn injury as the etiology.

Table 3: Distribution Of Study Population According To The Etiology.

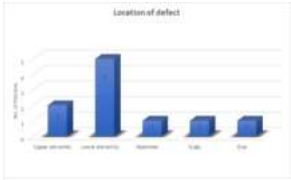
Etiology	Frequency	Percentage
Malignancy	5	50%
Benign tumour	1	10%
Burn injury	1	10%
Trauma	3	30%
Total	10	100%



The defects were on variable locations over the body. Out of 10 patients, 5 patients had lower extremity defects, 2 patients had upper extremity defects, 1 patient had an abdominal defect, 1 patient had a composite oral defect and 1 patient had a scalp defect.

TABLE 4: Distribution of study population according to the location of the defect.

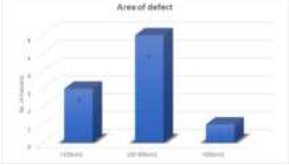
Location of defect	Frequency	Percentage
Upper extremity	2	20%
Lower Extremity	5	50%
Abdomen	1	10%
Oral	1	10%
Scalp	1	10%
Total	10	100%



The defect size ranged from 108 cm^2 to 323 cm^2. Defect size of <150 cm^2 was seen in 3 patients. 6 patients had defect size between 150-300 cm^2 while 1 patient had a defect size of >300cm^2.

Table 5: Distribution Of Study Population According To Area Of Defect.

Area of the defect	Frequency	Percentage
<150 cm2	3	30%
150-300 cm2	6	60%
>300 cm2	1	10%
Total	10	100%

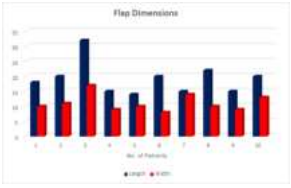


The maximum length of the flap taken was 32cm and the maximum width taken was 17cm with the mean length being 19.1cm and mean

width being 11.1cm.

Table 6: Depiction Of Dimension Of The Flap Harvested For The Entire Study Population.

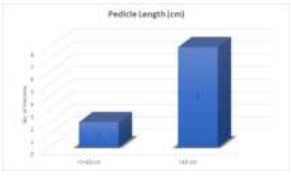
Patient	Length (in cm)	Width (in cm)
1	18	10
2	20	11
3	32	17
4	15	9
5	14	10
6	20	8
7	15	14
8	22	10
9	15	9
10	20	13
Mean	**19.1**	**11.1**



The length of the pedicle ranged from 9cm to 12cm with mean pedicle length being 11cm. In 2 patients, it was </=10cm while in rest it was >10cm.

Table 7: Distribution Of Study Population According To The Pedicle Length.

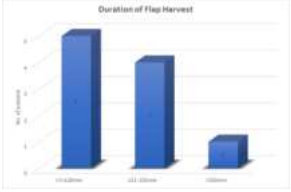
Length of Pedicle (cm)	Frequency	Percentage
</=10cm	2	20%
>10cm	8	80%
Total	10	100%



In 50% of patients, the flap was harvested under 120 min. In others, it took a longer duration for harvest of the flap with the longest duration being 165 min for the flap with largest size of 544 cm^2.

Table 8: Distribution Of Study Population According To The Duration Of Flap Harvest.

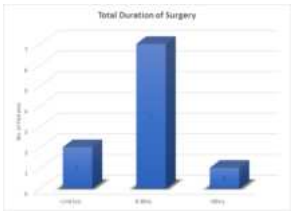
Duration of flap Harvest	Frequency	Percentage
</= 120 min	5	50%
121-150min	4	40%
>150 min	1	10%
Total	10	100%



The total duration of surgery was calculated on the basis of time of incision to the time of dressing. The excision or debridement to the duration of flap harvest and in-setting along with graft harvest for donor area and fixation of the graft to dressing all comprised of total duration of surgery. The longest operative time was 9hrs and the mean duration of surgery was 6hrs 52min.

Table 9: Distribution Of Study Population According To The Total Duration Of Surgery.

Duration of Surgery (in hrs)	Frequency	Percentage
</=6	2	20%
6-8	7	70%
>8	1	10%
Total	10	100%



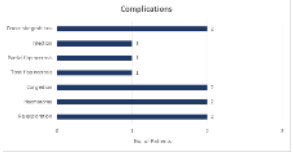
The surgery was uneventful in 7 cases out of 10. However, 3 of the patients had complications.

2 patients were re-explored for vascular issues and haematoma formation was seen which was evacuated. Flap congestion was seen in these 2 patients. Subsequently, 1 of the flaps developed complete necrosis while 1 had partial necrosis of the flap.

1 patient had developed infection at the flap site. Partial graft loss at donor site was seen in 2 patients.

Table 10: Depiction Of Complications In The Study Population.

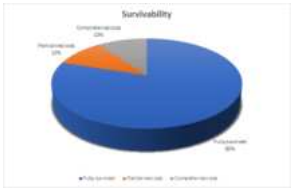
Complications	Frequency	Percentage
Re-exploration	2	20%
Haematoma	2	20%
Congestion	2	20%
Total flap necrosis	1	10%
Partial flap necrosis	1	10%
Infection	1	10%
Donor site graft loss	2	20%



The flaps had fully survived in 8 cases while there was complete necrosis of the flap in 1 case. In rest 1 case, there was partial necrosis of the flap in which 16% area (3cm x 10cm) of the flap got necrosed. The rest 84% area of flap was salvaged out of the total 180cm^2 area (18cm x 10cm).

Table 11: Distribution Of Study Population According To The Survivability Of The Flap.

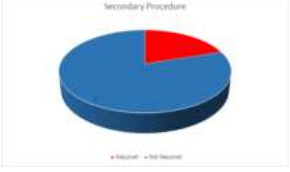
Survivability	Frequency	Percentage
Fully Survived	8	80%
Partial Necrosis	1	10%
Complete Necrosis	1	10%
Total	10	100%



Patients who had developed complications were managed initially with regular dressings and debridement followed by secondary procedures done in 20% cases.

Table 12: Distribution Of Study Population According To Requirement Secondary Procedures.

Procedure	Frequency	Percentage
Required	2	20%
Not Required	8	80%
Total	10	100%



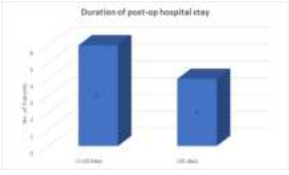
The postoperative stay included regular monitoring of the flap for the

first 48 hours followed by first dressing change of the skin graft on post operative day 5 and second dressing on postoperative day 7, at which time the sutures or the staples used for graft fixation were removed. Only after satisfactory take of the skin graft the patients were discharged. Patients with partial loss of skin graft were discharged with the advice of dressing on every alternate day following up in the outpatient department every week. 6 patients were discharged within 20 days of surgery.

Patients who had developed complications had a longer duration of post-op hospital stay.

Table 13: Distribution Of Study Population According To Duration Of Post-op Hospital Stay.

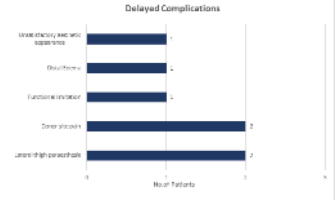
Duration of post-op hospital stay	Frequency	Percentage
</=20 days	6	60%
>20 days	4	40%
Total	10	100%



On review of patients on follow up, it was noticed few patients had some delayed complications. 1 patient had decreased range of motion of the involved joint and was managed with regular physiotherapy. 2 patients developed lateral thigh paraesthesia and 2 patients had donor site pain. 1 patient developed distal limb edema which was addressed by limb elevation post operatively. 1 patient had unsatisfactory aesthetic appearance owing to the bulkiness of the flap.

Table 14: Depiction Of Delayed Complications In The Study Population.

Delayed complications	Frequency	Percentage
Lateral thigh Paraesthesia	2	20%
Donor site pain	2	20%
Functional limitation	1	10%
Distal Edema	1	10%
Unsatisfactory aesthetic appearance	1	10%



DISCUSSION

The aim of this study was to evaluate the versatility of the ALT free flap in a group of patients with coverage of defects which had heterogeneous origin, size, depth and location.

In head and neck reconstruction, the use of ALT free flap is widely spread, and there are multiple series showing their versatility and efficiency in such location On the other hand, the ALT free flap is also most useful for reconstruction in limb coverage defects of varied origins such as trauma, oncologic resection and burns.

The use of the ALT free flap has been on the increase, especially due to its versatility. These features have to do with their inclusion of different types of tissues in different combinations, and with the possibility of taking a large, up to 25 x 35 cm-skin square, and a long, up to 12 cm-long pedicle with adequate diameter. This allows the surgeon to carry out reconstruction with a tailor-made design for every patient's needs. As a matter of fact, this flap is so rich in available tissues that it offers not only adequate soft tissues coverage but also the tools for tendon and vessel reconstruction, and also for muscle transfer.

Table 15: Depiction Of Gender Distribution In Various Studies.

Gender	Our study	Candia et al	Bennice et al
Male	6	39	7
Female	4	16	5
Total	10	55	12

Table 16: Comparison Of Age Between Different Studies.

Study	Our study	Wei et al	Candia et al	Bennice et al
Mean Age (in years)	43.5	55.8	52	44
Age Range (in years)	18-62	3-94	13-73	17-78

Table 17: Comparison Of Etiology For The Defect Between Different Studies.

Etiology	Our study	Wei et al	Candia et al	Bennice et al
Tumours	6	482	34	9
Trauma	3	140	21	3
Burn injury	1	8	0	0
Others	0	42	0	0

Table 18: Comparison Of Location Of Defects Between Different Studies.

Location of defect	Our study	Wei et al	Candia et al	Bennice et al
Upper extremity	2	58	9	4
Lower extremity	5	121	12	8
Head and Neck	2	484	28	0
Trunk	1	9	6	0

Table 19: Comparison Of Flap Dimensions Between Different Studies.

Flap dimensions	Our study	Candia et al	Bennice et al
Mean flap length	19.1	24	13
Flap length range	15-32	12-35	6-20
Mean flap width	11.1	9	8
Flap width range	8-17	4-11	3-12

Table 20: Comparison Of Pedicle Length Between Different Studies.

Pedicle	Our study	Candia et al
Mean Length (cm)	11	12
Length Range (cm)	9-12	10-16

Table 21: Comparison Of The Total Duration Of Surgery Between Different Studies.

Total duration of Surgery (hrs)	Our study	Candia et al
Mean operative time	6.8	9.3
Range	5.3-9	5.5-11.5

Table 22: Comparison Of Complications Between Different Studies.

Complications (%)	Our study	Wei et al	Candia et al	Bennice et al
Flap congestion	20	4.3	3.6	8.3
Partial donor site graft loss	20	1.5	3.6	16.6
Partial flap necrosis	10	2.5	0	0
Total flap necrosis	10	1.8	0	8.3

Table 23: Comparison Of Success Rates Between Different Studies.

Success rate	Our study	Wei et al	Candia et al	Bennice et al
%	90	95.6	100	91.6

CONCLUSION

The free anterolateral thigh flap is now well-established in reconstructive microsurgery as a workhorse flap. Its anatomical and logistical features make it the flap of choice in a wide range of soft tissue reconstructive situations. It contains the right tissue components in the correct amounts to fulfil the functional and cosmetic requirements of the recipient defect; it is harvested from a convenient location, in a convenient position with minimal donor site morbidity. Flap design only requires a handheld Doppler and a measuring tape. The flap, thanks to its easy orientation, can be tailored to the individual's defect by positioning for pedicle length, incorporating skin/muscle/sensory nerve and thinning for a perfect contour.

Our study has hence shown that it can represent a valid substitute for most of the commonly used soft-tissue flaps done for reconstruction of large complex defects.

Clinical Photographs

Flap Marking:

Preoperative flap marking is done by drawing a line from the anterior superior iliac spine (ASIS) to the superolateral border of the patella,

which represents the septum between the rectus femoris and vastus lateralis muscles, and serves as the longitudinal axis of the flap. The midway point on this line is marked, and a circle with a 3 cm radius is drawn around it. Most perforators will be found in the outer, lower quadrant of this circle. Using a handheld Doppler, the dominant cutaneous perforators are identified and marked, and the flap is designed according to the defect size.

Case 1:

- Case Of Dfsp Of Anterior Abdominal Wall
- Resultant Defect
- Defect Reinforced With Prolene Mesh

- Flap Harvest
- After Flap Inset

- Post-op Image Showing Partial Graft Loss At Donor Site
- Follow-up

Case 2

- Case Of Defect Over Leg With Exposed Implant
- Flap Marking

- Flap Elevation
- Starting Of Flap

- Immediate Post-op
- Follow-up

Case 3:

- Defect Following Excision Of Soft Tissue Sarcoma Over Left Shoulder

- After Flap Inset

- Post-op
- Follow-up

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