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Versatility of the Free Anterolateral Thigh Flap for Reconstruction of Soft Tissue Defects

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Abstract:

Introduction: Reconstruction of soft tissue defect always poses a reconstructive challenge. The objective of this study was to evaluate the outcome of anterolateral thigh free flap as a versatile flap for soft tissue reconstruction.

Materials & Methods:: In this prospective study carried out in the Department of Plastic Surgery of Dhaka Medical College and Hospital (DMC&H), Dhaka between July 2016 to June 2017, total thirty patients with soft tissue defect in different regions of the body underwent reconstruction of defects with anterolateral thigh free flap. Twenty (60%) patients had defect in lower extremity, seven (23%) in head and neck, two in the trunk, one in upper extremity. The flaps were raised as a standard subfascial flap in 56.67% cases, as suprafascial thin flap in 23% cases and in 20% cases it was raised along with part of vastus lateralis muscle.

Results: Out of 30 cases, 73.3% flaps survived completely, 20% patients had total flap loss and 3.3% patients had partial flap loss and another 3.3% had marginal necrosis. Donor site complications were observed in four patients.

Conclusions: The study concluded that anterolateral thigh free flap was found to be a reliable option to reconstruct soft tissue defects in different regions of the body with minimal donor site morbidity.

Key Words: anterolateral thigh flap, free flap, soft tissue defect.

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Introduction

Extensive soft tissue defects may result from burn, trauma, resection of neoplasm, infection or congenital defect. Reconstruction of these soft tissue defects are always challenging. Free tissue transfer, located at the top of the reconstructive ladder, are usually considered when local or regional tissues are insufficient for reconstruction. In some cases, the complexity of the defect and the volume of soft tissue loss may require the versatility afforded by free tissue transfer for optimal reconstruction.

Microvascular free flap can be applied to any area of body where suitable vessel for anastomosis is available[1].

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During the last three decades due to continued improvement in microsurgical techniques, a wide range of free flaps such as latissimus dorsi, radial forearm, rectus abdominis, and scapular flaps have been used for resurfacing defects following trauma or cancer ablative surgery with variable results. To overcome the limitations of conventional free flaps, there was always a search for a better one to cover the defect with minimal donor flap morbidity[2].

The anterolateral thigh (ALT) flap was first reported by Song and colleagues in 1984. ALT free flap can be harvested as either a septum-cutaneous or a muscle-cutaneous flap, and the thickness and volume can be adjusted to match the defect[3]. The free ALT offers versatile reconstructive capabilities in the head and neck regions as well as upper and lower limbs on the basis of the many advantages that it offers, such as its reliable vascularity, provision of large-caliber vessels with a long pedicle, a large donor flap area, ease of dissection[4,5] possibility of modifying tissue components of the flap (suprafascial, subfascial and myocutaneous by including vastus lateralis muscle), minimal donor site morbidity[6-10] and decreased operative time with two-team approach[11].

Athough many of these advantages are beign shared by other free flaps, anterolateral thigh free flap (ALT) is

superior to them in few points. Radial forearm free flap has also a long pedicle with good caliber vessel, but harvesting the RFFF implies sacrifice of an important vessel, namely, the radial artery. Latissimus dorsi free flap and arteria dorsalis pedis free flap can be harvested with reasonably long pedicle with good caliber vessels but may not be suitable for defects where a large skin area is needed.

The ALT flap can be used as a thin flap as the thickness of the flap can be adjusted upto the subdermal fat level which is needed to reconstruct defects of hand[6], dorsum of foot, full thickness cheek and lip defects. Groin free flap is thin but not a choice where long pedicle is needed to anastomose to a suitable recipient vessel. Free muscle flaps are not suitable to be used in face and neck defects as these flaps needs to be skin grafted which gives aesthetically unpleasant result. Moreover for defects in distally localized weight bearing area of foot, ALT is more suitable as the latissimus dorsi muscle flaps needs to be skin grafted[12].

Therefore, the ALT free flap has most of the characteristics of an ideal free flap to reconstruct a wide variety of soft tissue defects in different parts of the body and thickness and volume can be adjusted for the extent of the defect[13,14]. That is why ALT free flap is gaining popularity as a useful, reliable as well as a versatile flap. This study was performed to see it's outcome in reconstructing soft tissue defect in different parts of the body with variable flap components with a goal to find out this flap as a versatile and useful method of soft tissue reconstruction.

Flap Anatomy

The flap occupies the anterolateral portion of the thigh from approximately 10 cm below the anterior superior iliac spine (ASIS) to within 7 cm superior of the patella. The medial margin of the flap territory is at the midpoint of the rectus femoris muscle. Laterally the anterolateral thigh (ALT) flap extends to the midlateral thigh. The vascular basis of this flap is the descending branch of the LCFA which passes downward between the rectus femoris muscle and the vastus lateralis muscle[15]. During its course, it presents either a septocutaneous or musculocutaneous perforator or both to supply the anterolateral aspect of the thigh.

Patients and methods

This was a prospective observational study which was performed in Department of Plastic Surgery at Dhaka Medical College & Hospital, Dhaka, Bangladesh from July 2016 to June 2017. Thirty patients with soft tissue defects in different parts of the body following trauma, burn, cancer surgery requiring free flap for reconstruction admitted in department of Burn & Plastic surgery, DMC&H during study period were included in the study.

Detailed Operational Procedure

Flap Design and Markings

A line was drawn connecting the anterior superior iliac spine (ASIS) to the superolateral border of the patella which determines the axial line of the flap. Midpoint of this line is identified and a circle with 3 cm radius is drawn taking this midpoint as a centre. Majority of the main cutaneous perforators from the descending branch of the lateral circumflex femoral artery (LFCA) are located in the inferolateral quadrant of the circle and was detected with a hand held doppler probe and marked on the skin. The flap was designed around the perforators with the long axis of the flap running parallel with the long axis of the thigh. The patient was placed in the supine position without tourniquet applied.

Guide to flap elevation

A medial incision was made down through thigh fascia, which exposes the rectus femoris muscle. Dissection was proceeded in a subfascial plane laterally toward the septum between the rectus femoris and the vastus lateralis muscle. The descending branch of the lateral circumflex femoral artery was visualized within the septum or perforating through the medial most portions of vastus lateralis muscle by retracting the rectus femoris medially.

Perforators to skin were either septocutaneous or running through the vastus lateralis muscle (musculocutaneous).The dissection was simplified when these were septocutaneous. An intramuscular dissection was performed for perforators running through the muscle to reveal the course of the vessel. Once the perforator emerges from the under surface of the muscle, the remaining dissection is similar to the septocutaneous case. A portion of vastus lateralis muscle was included to add bulk when needed.

Flap design was readjusted according to location of dominant perforator. Lateral incision was then made and flap raised subfascially or in a suprafascial plane keeping 2 cm fascial attachment all around the pedicle according to the requirement of defect. Pedicle length was measured from the entry point of perforator (proximal perforator where more than 1 perforator was taken) through the fascia, after completely harvesting the flap.

Dermal bleeding from the flap margins were evaluated before ligation and division of the pedicle. The donor site was usually closed directly. If it was not possible to close the defect directly because of a large skin paddle was harvested, then the skin edges were advanced and sutured to the muscle to reduce the size of the defect and the remaining area was covered with skin graft taken from the medial aspect of the same thigh. Recipient site vessels were dissected out, whereas the flap was harvested allowing a two team approach and thus saving valuable anesthesia time.

Variation of ALT free flaps

Standard flap (Subfascial)

The medial incision is done first down to the deep fascia and dissection proceeds laterally in a subfascial plane to locate the perforators, the biggest of which is selected and the flap is elevated in a subfascial plane keeping that perforator intact. The perforator is then followed to the main pedicle (transverse or descending branch of lateral circumflex femoral). This is done either by intramuscular or intermusclar dissection according to the type of perforator.

Thin flap (suprafascial)

The main nutrient vessel, after piercing the deep fascia, ran perpendicularly toward the overlying skin and then radiated horizontally in the subcutaneous layer. This vessel form a dense subdermal plexus and connected with the cutaneous arteries of the adjacent vascular system. Although there are vascular connections in the loose areolar layer of the deep fascia, the dominant connection occurs within or just beneath the subdermal plexus[5]. This is why flap thining is possible. Thinning is done before division of the pedicle to aid in hemostasis. The entire flap is thinned except the area 2cm all around the perforating vessel.

Flap with part of vastus lateralis muscle

The anterolateral thigh flap can include surrounding tissues such as fascia lata, vastus lateralis muscle and even part of iliac bone when needed.

Post operative care and monitoring

Light dressing was applied on the flap. Flap was monitored hourly for 1st 24 hours, then 2 hourly for next 24 hours,then 4 hourly for another 48 hours for venous congetion or diminish arterial supply by checking colour, temperature, capillary refill, turgor and by Doppler. Need to arrange operation theater and keep patient NPO for early re-exploration if there was venous congestion or arterial insufficiency.

Presence of infection, marginal necrosis, and flap loss also needed to monitor. Flap donor site was also inspected to identify any infection and graft loss. First dressing change was done on the fourth post-operative day. Drains were removed when seroma drainage decreases to 10 ml in 24-hour period. Prolonged bed rest was avoided. On 7th post operative day, dressing was changed again on flap site as well as flap donor site and decision was made regarding discharge of patient or planned for reconstruction in case of flap or graft related complications. Graft donor area was checked on 14th post operative day. To assess the outcome of the procedure, all the operative areas were observed on 30th postoperative day.

All patients were counseled for surgery and informed written consent for surgery as well as pre-operative & post-operative photographs were taken. All data obtained by interview with the patient and the attendants as well as findings of observation were recorded in prescribed data collection sheet.

Results

Mean age of the patients was 32 + 9.97. The youngest and the oldest patients were 15 years old and 51 years old respectively. A male predominance was observed. Majority (53.3%) of the defects were due to RTA, 23.3% were due to burn injury and another seven patients had soft tissue defect following excision of malignant tumor.

The mean transverse dimension of the defects was 7.3cm +1.42. The mean longitudinal dimension of the defects was 13.7 cm ± 2.87. Largest soft tissue defect size was 20 cm x12 cm. The mean length of the flap was 16.3 cm +3.12. The mean width of the flap was 8.8 cm ±1.30. Mean pedicle length was 10.4 cm. Majority of the perforators (60%) of ALT free flap was musculocutaneous type. The rest of the perforators were

septocutaneous type. Flap component used mostly was a standard subfascial flap in 56.67% cases. In seven cases the flap was raised as suprafascial thin flap and in six cases it was raised along with part of vastus lateralis muscle.

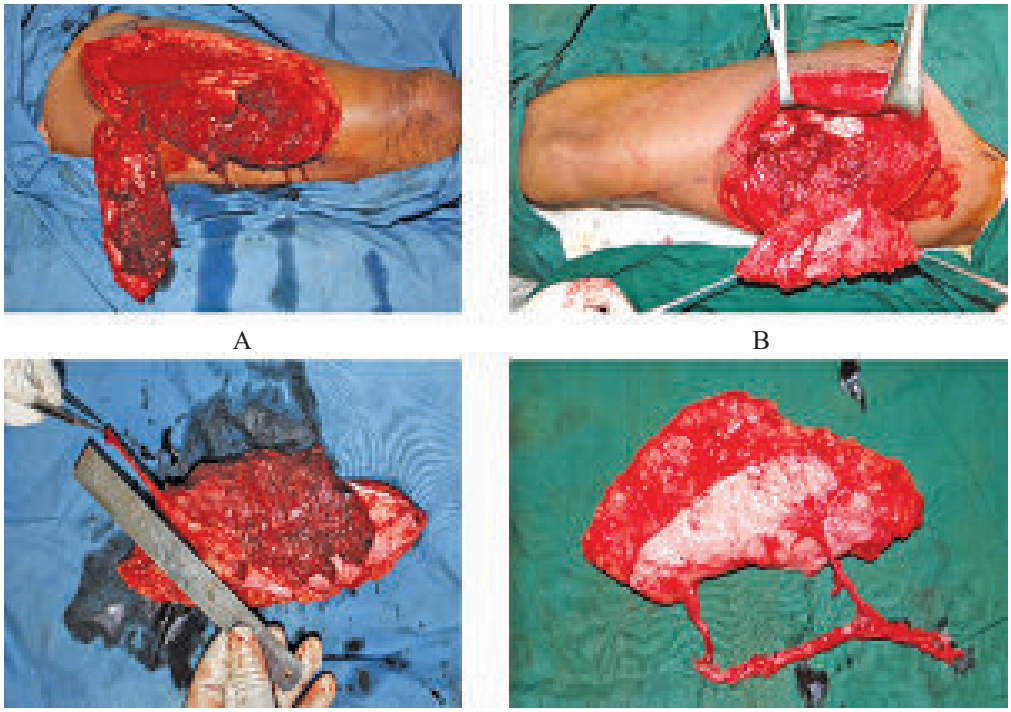
About 73.3% flaps survived completely. Only 20% patients had total flap loss and one patient had partial flap loss and another one had marginal necrosis. Donor site closed primarily in 90% cases and rest were skin grafted.

Table-I

Details of patients undergoing reconstruction with ALT free flaps (n =30)

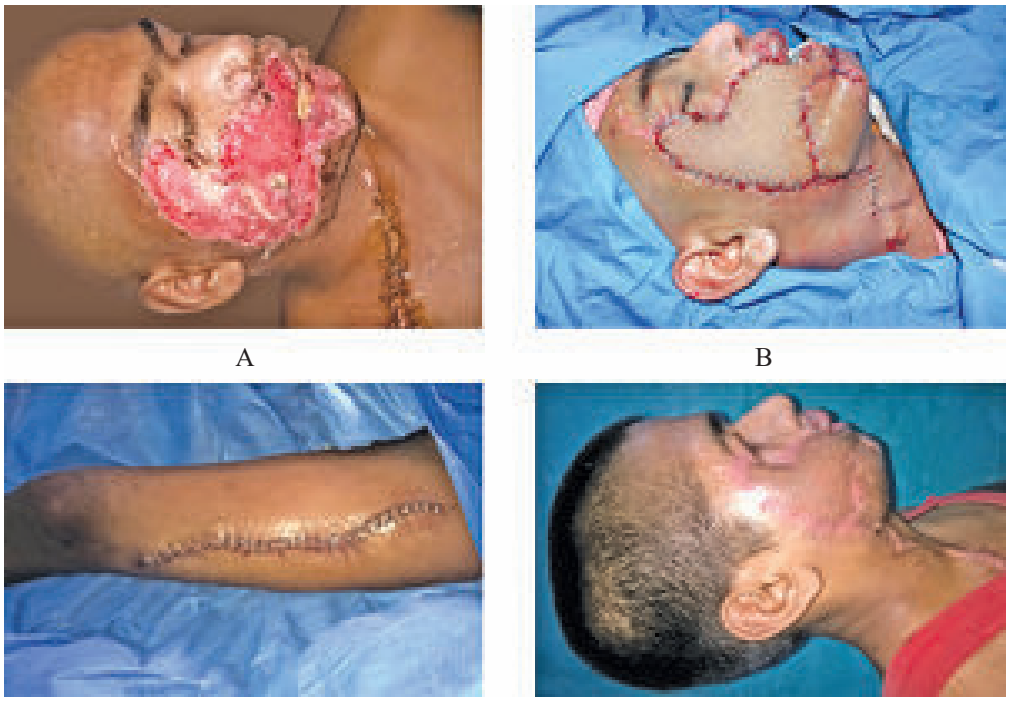
S. no	Cause of defect	Location of defect	Flap components	Flap survivability
1	RTA	Lower 3rd leg	With muscle	Total flap loss
2	RTA	Lower 3rd leg	With muscle	Total flap loss
3	RTA	Dorsum of foot	Suprafascial	Survived
4	Cancer excision	Buccal mucosa	Suprafascial	Survived
5	Cancer excision	Maxilla and RMT	Subfascial	Survived
6	RTA	Middle 3rd leg	With muscle	Total flap loss
7	Neurofibrosarcoma	Abdominal wall	Subfascial	Survived
8	Electric burn	Lower 3rd leg	With muscle	Total flap loss
9	Electric burn	Lower 3rd leg	With muscle	Total flap loss
10	RTA	Face	Suprafascial	Survived
11	RTA	Lower 3rd leg	Subfascial	Total flap loss
12	Adenocarcinoma	Abdominal wall	Subfascial	Survived
13	Burn contracture	Front of neck	Subfascial	Partial flap loss
14	Electric burn	Flexor aspect of forearm	Subfascial	Survived
15	RTA	Upper 3rd leg and knee	Subfascial	Survived
16	Electric burn	Lower 3rd leg	With muscle	Marginal flap loss
17	RTA	Lower 3rd leg	Subfascial	Survived
18	Cancer excision	Buccal mucosa	Suprafascial	Survived
19	RTA	Middle 3rd leg	Subfascial	Survived
20	Cancer excision	Buccal mucosa and outer skin	Subfascial	Survived
21	RTA	Dorsum of foot	Suprafascial	Survived
22	Electric burn	Lower 3rd leg	Subfascial	Survived
23	RTA	Planter aspect of foot	Subfascial	Survived
24	RTA	Lower 3rd leg and ankle	Subfascial	Survived
25	Cancer excision	Buccal mucosa	Suprafascial	Survived
26	Electric burn	Lower 3rd leg	Subfascial	Survived
27	RTA	Dorsum of foot	Suprafascial	Survived
28	RTA	Lower 3rd leg	Subfascial	Survived
29	RTA	Middle 3rd leg	Subfascial	Survived
30	RTA	Lower 3rd leg	Subfascial	Survived

Note. RTA= road traffic accident.



A B C D

Figure 1: *Harvesting of ALT free flap having musculocutaneous perforator A. ALT free flap along with part of vastus lateralis muscle B. ALT free flap by intramuscular dissection of perforator C. Flap harvest with part of vastus lateralis muscle. D. Standard subfascial flap after harvest.*



A B C D

Figure 2: *A 22 year old man with soft tissue defect involving right side of face following RTA A. Pre-operative soft tissue defect, B. Final flap inset, C. Donor site (7th postoperative day) , D. 30th post-operative day.*

Discussion:

This prospective study was carried out at Department of Plastic surgery and Burn unit, Dhaka Medical College & Hospital. The present study was done to qualify the ALT free flap for soft tissue reconstruction in different areas of the body with variable flap component according to the need of recipient site.

In this study, a male predominance was observed and road traffic accident (53.3%) was the most common cause of defect. Majority of the defects (60%) were in the lower limb due to lack of suitable local or regional flap options. Head and neck was the next common site as a good number of patient with malignant tumor in the head neck region got admitted and referred from other discipline in this department. Most of the hand defects in this department are reconstructed by local, regional or distant flap. So the defect in upper extremity was minimum in this study (one case). In two cases, defects was in anterior trunk following excision of malignant tumor. In the study done by Nebojsa Rajacic et al. fourteen patients had defects in the lower third of the leg, four in the head and neck, and two on the dorsum of the hand following contracture release, exposing tendons.[2]

The advantage of anterolateral thigh flap over other flap is that, a large skin area can be harvested even when only a single major cutaneous perforator is available. In this study, the mean length of the flap was 16.3 cm+3.12cm. The mean width of the flap was 8.80 cm ±1.30 cm. The largest flap was 20x12 cm (case 1). In the study done by Di Candia et al, the flap size ranged from 12 to 35 cm in length and 3 to 11 cm in width[4]. In other study by Ozkan O et al, the size of the flaps ranged from 11 to 34 cm long and 6 to 16 cm wide[20].

In this study mean pedicle length was 10.4 cm. As the pedicle was long enough, a suitable recipient vessel could be chosen most of the time. Similarly in a study done by G.L. Ross et al. showed the vascular pedicle of ALT free flap of 10 cm or more in all cases[10].

The majority of the perforators (60%) of ALT free flap was musculocutaneous type. Only 12 (40%) cases, perforator type was septocutaneous. Study done by Di Candia et al showed during flap elevation, a direct septum-cutaneous perforator was observed in 11 patients (22%); In 38 patients (78%), a muscle-cutaneous perforator was found[4].

A unique property of the anterolateral thigh flap as described by Koshima[13] is that it can be raised and thinned to the superficial fascia and subdermal fat, except around the pedicle. This was particularly useful in covering defects where thin, pliable skin was required, such as the dorsum of the feet, upper limb and cheek defects, etc. (cases 4, 11, 12 and 15). Thinned flaps were de-epithelialized in the middle and proximal part of the flap covered buccal mucosa while folded distal part covered outer cheek skin without compromising the circulation in the most distal part of the flap (cases 5,12 and 20).

In this study flap component used mostly was a standard subfascial flap in 56.67% cases where flap raised on septocutaneous perforator and musculocutaneous perforator dissected through the muscle until its entry into fascia. In 7 cases the flap was raised as suprafascial thin flap and in six cases it was raised along with part of vastus lateralis muscle. Di candia et al in their study, standard flap (musculocutaneous true perforator type and septocutaneous type) used in 67.27% cases, thin flap in 7.27% cases, with a cuff of muscle in 32.72% cases, sensate flap in 3 cases[4].

Out of the 30 flaps, 73.3% flaps completely survived. Only 20% patients had total flap loss and 3.3% patients had partial flap loss and another 3.3% had marginal necrosis. In study of Kuo Y-R et al, the overall success rate was 92% (129 of 140)[3]. In the study of Yildirim et al the total flap survival rate was 90.5 percent with two partial flap necrosis.

Vascular complications were observed in eight patients during the post operative period. Six failing flaps were re-explored and found venous congestion in five cases and arterial occlusion in anastomotic site was observed in one case. Only two of them could be salvaged. In the study done by Kuo Y-R et al, re-operation was done in ten patients in which eight patients had venous insufficiency and another two had arterial insufficiency. Two flaps were salvaged successfully. Eight flaps failed because of the poor suitability of the recipient vessels[3].

While managing the post-operative complications, in one patient marginal flap loss was excised and secondary suturing was done, in two patients total flap loss was managed by reconstruction with other flap and in 16.67% cases partial and total flap loss was managed by excision followed by split thickness skin graft. Two patients had partial wound dehiscence at the donor site was managed by repeated dressing.

As per parameters set in the methodology, 63% of the patients showed excellent outcome where flap adhesion was very good, no feature of infection and absolutely no flap loss. In 20% patients, the outcome was poor where there was total flap loss, the complication had to be managed by alternative procedure (STSG or local flaps) and in five patients outcome was considered satisfactory where there was partial flap loss. So, the ALT free flap was used to cover defects in different parts of the body with variable flap components as per requirement of the defect with good outcome which is similar to other studies[3,4,7,8,14,19]. This is why, this flap is considered as a versatile flap.

Conclusion

ALT free flap can be tailored to the individual's defect by positioning for pedicle length, incorporating skin/ muscle/sensory nerve and thinning for a perfect contour. This unique features makes ALT free flap a versatile and useful flap for a variety of reconstructive problems. However, anatomic variation must be considered if the flap is to be used safely and reliably. Nevertheless, with an increasing knowledge of anatomy and the refinement of surgical technique, the ALT flap can be harvested easily and safely to reconstruct a wide variety of soft-tissue defects with minimal donor site morbidity.

Conflict of interest: None

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