

## Research Article

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# Free Lateral Thigh Flap for Coverage of Complex Extremity Defects: A Retrospective Case Series at a Tertiary Care Hospital in an LMIC

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## Abstract

**Background:** The lateral thigh flap is a versatile flap that provides many advantages over other free flaps. It has become a mainstay in soft tissue reconstruction of defects in the head and neck, upper and lower extremities. We present our experience with perforator based free lateral thigh flap in a tertiary care center.

**Method:** A retrospective cross sectional analysis of cases done by a single surgeon over a period of 5 years from 1998 to 2003. Those patients were included in the study in which free lateral thigh was done for extremity defects only; flaps done for head and neck reconstruction were excluded. The data of these patients were collected from the medical records and variables included demographic data, mechanism of injury, site and size of defect, pattern of vascularity, complications and flap survival. Data analysis was done by using SPSS version 25.0.

**Results:** We treated 8 patients with lateral thigh flap. All patients were male with a mean age of 28±13 years (ranged from 16 to 55 years). The mean defect size was 25×15 cm (ranged from 20×12cm to 30×15cm). Flap tip necrosis was seen in 2 patients while 6 cases (75%) had no complications with 100% flap success rate. The mean follow-up time was 226 months, without significant morbidity at the donor site. The donor site was covered with a split thickness skin graft.

**Conclusion:** Our study has concluded that perforator based free lateral thigh flap is safe and reliable for reconstruction of complex and large soft tissue defects in the extremities, that provides excellent, robust skin coverage. It has the added advantage of minimal donor site morbidity. This flap is ideally suited for defects where the recipient vessel is located in the center of defect.

**Keywords:** Perforator based free Lateral Thigh Flap; Reconstruction of defects; Profunda femoral artery perforator; Large soft tissue defects; Flow through flap

## Introduction

Reconstruction of soft tissue defects of extremities is challenging and demanding for reconstructive orthopedic and microvascular surgeons. The most common injured body regions include distal parts of extremities that often result in composite tissue defects with loss of tendons, ligaments, neurovascular structures and bony tissue [1]. The causes of these injuries include trauma, resection of tumors, blast injuries, infections and neuropathic ulcers [2]. According to Fernandez WG et al. [3], trauma was main cause of soft tissue defects (52.8%) in the

lower extremity among children and young adults. Peek C et al highlighted the importance of preventable motor cycle accidents, where 80% of injuries involve the lower extremity skeleton and such open injuries end up in infections [4]. The open injuries with composite tissue loss pose a challenge to both orthopedic and plastic surgeons. The ultimate solution to these complex and composite defects is reconstruction with free flaps. Cormack GC et al. defined the cutaneous flaps based on the composition of tissue and pattern of vascular supply [5]. There are various options of free flaps coverage including free skin flaps, muscle and myocutaneous flaps such as gracilis, free latissimus dorsi, rectus abdominis. The skin flaps can be made sensate by incorporation of cutaneous nerves if recipient site requires sensate skin coverage [6]. The reconstruction of defects depends upon the site, type

of tissue defects, requirements of the patient and subsequent reconstruction of underlying tissue loss (bone, tendon, nerve and vessel) [7]. The free cutaneous flaps suitable for reconstruction of soft tissue defects include scapular, para-scapular, groin flap, lateral arm flap, tensor fascia latae, anterolateral and lateral thigh flap. Lateral thigh and anterolateral thigh flaps are suitable for coverage of very large and composite defects; as both of these flaps are thin, pliable and relatively hairless. Both flaps can be made sensate with incorporation of the lateral cutaneous nerve of thigh. Baek described medial and lateral thigh flaps in 1983 [8] and following his description the free lateral thigh flap was popularized for reconstruction of head and neck defects. Miller, Truelson and Baek Ch et al. [9-11], used lateral thigh flap quite frequently and it became the workhorse for reconstruction of head and neck. This flap is based on the third perforator of the Profunda femoral artery that arises at the midlevel of the thigh between the greater trochanter and lateral epicondyle of femur. This gives a largest cutaneous branch to the lateral and posterior aspect of thigh [8-11]. A large paddle of skin, with dimensions almost 25-30cm long and 12-15cm wide, can be harvested based on this cutaneous branch of third perforator. The exact dimensions of this flap are not known.

Most of these flaps have an axial pattern of blood supply and their neurovascular pedicles are located on one end of the flap but the vascular pedicle of the lateral thigh flap is situated in the center of flap and its length is 5-7cm long. Considering the location of the vascular pedicle, this flap is ideal for those defects in which the recipient vessels are also located in the center of defect. The lateral thigh flap is a fasciocutaneous flap, relatively thin with robust blood supply and can be used to cover large defects of extremities.

Orthopedic and reconstructive surgeons also used this perforator flap for reconstruction of large extremity defects [12,13]. Sharma Devnash [14], used this flap as a flow through flap, based on the second and third perforator with a segment of profunda artery, for reconstructions of segmental loss of vessel and soft tissue.

Early coverage of complex defects with free tissue transfer provides preservation of limb, prevention of infection and early return to normal function [15]. Song et al. in 1984 described the anterolateral thigh flap that has replaced the lateral thigh flap, as dissection of the lateral thigh flap is difficult, tedious and demanding. Presently anterolateral thigh flap has become a workhorse for soft tissue in the head and neck region, upper and lower extremities.

In the early days of microsurgical reconstruction, we used lateral thigh flap quiet frequently for reconstruction of complex defects of extremity, before the anterolateral thigh flap became popular. We conducted a cross sectional retrospective review of free lateral thigh flaps done for reconstruction of extremity defects.

## Material and Methods

From 1998 to 2003, a retrospective review of cases who underwent perforator based free lateral thigh flaps for reconstruction of soft tissue defects of the extremities all performed by a single surgeon was done. Data of these patients was collected through review of medical records. The various variables included demographic parameters, mechanism of injury, cause of soft tissue defects, site and size of defect, pattern of donor vessels; perforator based or flow through, recipient vessel, postoperative complications and final outcomes in terms of flap survival.

Follow up records of patients were also taken from medical records including complications like partial, tip or complete necrosis, wound dehiscence, venous congestion, revision of venous or arterial anastomosis, infections and subsequent procedures like debridement and skin grafting. The functional outcomes of these patients were assessed based on flap survival.

Analysis was done using SPSS version 25.0. Categorical variables like gender, mechanism of injury, defect site, size etc. were recorded as frequency and percentages. Discrete and continuous variables like age, defect size etc. were recorded as mean and standard deviation. P-value of  $\leq 0.05$  was considered as significant with 95% confidence interval (Table 1).

Case No	Age, Gender	Mechanism of Injury	Defect site	Defect Size	Recipient vessel	Flap survival	Complications	Follow up (in years)
1	18, M	Forequarter amputation in Ewing sarcoma	Shoulder	25×15cm	Suprascapular artery, single perforator	100%	None	22
2	22, M	Amputation at elbow with crushing of skin	anterior aspect arm, forearm and elbow	24×13cm	Radial artery, flow through vessel	100%	None	21
3	55, M	Diabetic leg with necrotizing fasciitis	Anterior aspect of leg with exposed tibia	30×15cm	Posterior tibial artery, flow through	100%	None	20
4	24, M	Gas gangrene and infection	Anterior aspect of knee and leg	27×14cm	Anterior tibial artery	95%	Distal tip necrosis	20
5	30, M	Road traffic accident	Anterior leg with exposed bones	25×15cm	Anterior Tibial artery, flow through	100%	None	18
6	16, M years	Road traffic accident	Anterior aspect of elbow	20×12cm	Radial artery Flow through	100%	None	16
7	2, M	Bomb blast injury	Dorsum of hand, wrist and forearm	22×12cm	Radial artery, Run through	100%	None	16
8	40, M	Road traffic accident	Defect over the hip disarticulation	25×15cm	Superficial Femoral artery	95%	Distal tip necrosis	16

**Table 1:** Clinical Summary of Patients.

## Results

There are eight patients in this retrospective case series from 1998 to 2003, which underwent reconstruction of soft tissue defects of extremities. All patients were male with a mean age of  $28 \pm 13$  years ranging from 16 to 55 years. The site of defect in 50% was the upper limb, in the other half it was the lower limb. The various sites within each limb were as follows: the lower limb – the leg and around the knee in 3 (37.5%), hip in 1 (12.5%), and the upper limb – one site (12.5%) each in shoulder, elbow, forearm and hand of upper limb. The mean defect size was 25×15 cm (ranged from 20×12cm to 30×15cm). The majority of large soft tissue defects was related to Trauma (50%) in 4 cases (RTA 3 and machine injury 1), Infection in 2 cases (25%), Tumor in 1 case (12.5%) and blast injury in 1 (12.5%). Out of 8 flaps, 6 flaps (75%) showed complete healing and functional recovery with no complication. Distal tip

necrosis was observed in only 2 patients (25%) with more than 95% flap survival rate. This distal tip flap necrosis occurred due to crushing injury of donor site. The distal flap necrosis did not require subsequent surgical procedure; it healed with simple daily dressings and reepithelialization. There were no venous congestion and infections observed in patients. In 50% (4) case flaps were based on the perforator and single artery anastomosis while in the remaining 50% (4) cases, flaps were used as flow through with reconstruction of recipient arterial defect with two arterial anastomosis.

All of these patients were followed up in a clinic till the time of wound healing. The mean follow-up was 226 months, without significant morbidity at donor site. All patients were satisfied with functional and cosmetic outcomes. No surgery related mortality occurred (Figures 1-3).

## Case Examples

### Case 1:



**Figure 1:** 16 year old boy who underwent forequarter amputation of right upper limb due to stage III Ewing sarcoma of proximal humerus. **A.** Showing per-operative dissection of lateral thigh flap with attached vessels. **B.** Shows per-operative picture following anastomosis and attachment of flap at recipient site. **C.** Shows recipient site after six weeks and **D.** Shows recipient site with skin graft.

### Case 2:



**Figure 2:** 55 year old known case of diabetes mellitus, hypertension and ischemic heart disease had fulminating infection around the left leg. Following multiple debridement, resulted in large wound with exposed shaft of tibia and soft tissue. **A.** Shows the defect of leg with exposed bone. **B.** Shows peroperative dissection of flap. **C.** Shows coverage of defect with lateral thigh flap immediately after anastomosis. **D** and **E.** show long term result of lateral thigh flap for leg defect.

### Case 3:



**Figure 3:** 24 years old gentleman met a road traffic accident and the wheel of a bus ran over his arm with crushing of elbow and almost an amputation. Following fixation of supracondylar fracture of humerus and restoration of circulation with vein grafts in both arteries and veins, he had necrosis of skin on anterior aspect of elbow, arm and forearm, that was reconstructed with lateral arm flap. **A.** Shows patient presentation in the emergency room after 6 hours of injury. **B.** Shows peroperative marking of flap at Donor site. **C** and **D.** Show functional outcome.

### Discussion

The free lateral thigh flap is based on the third perforator profunda femoral artery. This perforator gives a large cutaneous branch to the skin of the lateral and posterior aspect of thigh. Although the origin of this perforator is posteriorly from the profunda femoral artery, the perforator runs through the lateral intermuscular septum anteriorly over the fascia lata and gives cutaneous branches in a T or Y shaped manner to supply the skin of the lateral side of thigh. As the origin of this perforator is posterior at the level of linea aspera, and the vessel course is posterior to anterior, some authors have reported it as a posterior thigh flap [13,15]. The anatomy and location of this perforator is constant and predictable and can easily be marked out by Doppler. After its origin from the profunda femoris artery this perforator pierces through the adductor magnus and runs over the septum in between the vastus lateralis anteriorly and biceps femoris posteriorly. This perforator gives muscular branches to both muscles. In only 2% is the profunda absent, and so the perforator arises directly from femoral artery [8].

This flap has certain advantages. Firstly the size of the pedicle is large in terms of length (6-8cm) and diameter (3-4mm).

Second, a very large skin flap can be raised on this perforator with predictable outcome. Third, the flap can be made sensate if the lateral cutaneous nerve of thigh is harvested with it. Fourth, the perforator based free lateral thigh flap can be made musculocutaneous if harvested with the short head of biceps. Fifth, if the second and third perforator are included with a segment of profunda femoral artery, this flap can be used as a flow through flap, as we did in 4 of our cases and the same has been done by other authors also [13,14]. Sixth, this flap is quite thin and pliable, suitable for reconstruction of distal extremities like the dorsum of hand and foot. The disadvantages of this flap are: difficult dissection, thick and hairy. The dissection of the flap is slightly tedious and demanding and is contingent upon the sound surgical knowledge and microsurgical skills of the surgeon. It requires strong retraction of vastus lateralis with racks retractors and ligations of branches to the biceps, vastus lateralis and adductor magnus; that part of the dissection very difficult. The flap dissection becomes easy if the knee is flexed, hip internally rotated and sand bag placed under the hip with the table tilted to the opposite side. This flap is relatively thin, pliable with robust blood supply and hairless most of the time. However, it can be thick in many individuals and hairy as well. It can be raised as septocutaneous, myocutaneous and sensate with the lateral cutaneous nerve of thigh.

This flap has been used for a variety of situations both in limb reconstruction and in head and neck reconstruction. As this flap was introduced by Baek [8], he and his colleagues used this flap for coverage of head and neck defects. This flap became a routine procedure for head and neck reconstruction [8-11]. Orthopedic and reconstructive surgeons were impressed by the size of its pedicle, large lumen of vessels, utility, uniqueness and very large area of donor skin that can be harvested. They then used it in reconstruction of large and composite extremity defects [12-15]. This flap is ideally suitable for those defects of limbs where recipient artery is in the middle of defect or the defect requires reconstruction of segmental loss of vessel; there it acts as flow through flap. The scope and indication of flow-through flaps is increasing especially in those situations where the recipient vessels are deeply situated and anastomosis becomes tedious and difficult. Using the principle of flow through flap makes reconstruction of limb defects much easier. The deep recipient vessels are dissected and brought superficial along with veins, proximal anastomosis completed and circulated restored. Then the same recipient vessels are dissected and brought superficial to complete the distal anastomosis to reestablish the continuity of the recipient vessels. Although we have to do two arterial anastomoses but procedure becomes much easier and simpler without any difficulty and anatomy of original recipient vessel is also restored. The profunda femoral vessel has a pretty large diameter (3.5 to 5mm) and chances of blockage of vessels are minimized. In our series, flow through pattern anastomosis were done in 50% of our cases. We did not see any complication of thrombosis or vessel blockage postoperatively.

in our series. We noted two cases of distal flap tip necrosis that improved with daily dressing and reepithelialization and did not require any skin graft. These two flap tip necrosis were noted in those cases where there was element of crushing of donor site due to nature of injury. Incidentally both cases were in the group of single artery anastomosis without flow through vessels. In our series all donor sites required skin grafting that was acceptable to patient without any morbidity.

## Conclusion

Perforator based free lateral thigh flap is a highly versatile, reliable, predictable and thin with robust blood supply often overlooked. It has various advantages: a large pedicle in terms of length and diameter and can cover very large skin defects of extremities. It can be used as sensate, myo-cutaneous and septo-cutaneous flap depending upon the nature of defect. It is ideally suitable for those extremity defects in which recipient vessels are located in the center of soft tissue defects and to construct the segmental loss of recipient vessels, where it acts like a flow through conduit for reconstruction of vessel also. It is also suitable when recipient vessels are deeply located and anastomoses are difficult; flow through flap coverage facilitates the reconstitution of recipient vessels and make anastomosis easier. In the case of fatty individuals, the flap is thick and hairy in nature and so may not be acceptable to certain individuals. Its dissection is tedious, difficult and technically demanding. The dissection requires thorough knowledge of the relevant anatomy and meticulous dissection. The flap has minimal donor site morbidity and skin grafted area of donor site is acceptable to most individuals.

## Conflict of Interest Disclosures

We have no conflict of interest to declare.

1. We certify that we have no affiliation with or financial involvement with any organization or entity with financial or other interest in the matter discussed in the manuscript.
2. We certify that all authors listed on the title page have substantially contributed to the work.
3. The contents have not been submitted for publication elsewhere.
4. The manuscript is not under consideration for publication elsewhere.

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