

## Original Research Article

# Distally based split vastus lateralis myocutaneous flap for reconstruction of post electrical injury defects around knee joint

Manish Zade\*, Jitendra Mehta, Dhananjay Nakade, Pawan Shahane

Department of Plastic Surgery, NKP Salve Institute of Medical Sciences and Lata Mangeshkar Hospital, Digdoh, Hingna Road, Nagpur-440019, Maharashtra, India

**Received:** 29 September 2016

**Accepted:** 03 October 2016

**\*Correspondence:**

Dr. Manish Zade,

E-mail: [drmanishzade@gmail.com](mailto:drmanishzade@gmail.com)

**Copyright:** © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

### ABSTRACT

**Background:** Large soft tissue defects around knee joint remains challenge to reconstructive surgeon due to limited size of local fasciocutaneous flap or muscles flaps and deeper recipient vessels for free flap. Presence of electrical injury further makes it difficult due to progressive necrosis of tissue and vessel damage. We present our experience with distally based split vastus lateralis myocutaneous flap for post electric burns large soft tissue defect over knee with open knee joint in three patients.

**Methods:** Distally based split vastus lateralis myocutaneous flap was done in three patients for large soft tissue defects over knee secondary to electric contact burns. Two of the three patients had wound with open knee joint draining synovial fluid. All patients needed skin grafting for donor area of flap. Patients were followed up for functional outcome of knee and appearance of donor area.

**Results:** Two out of three patients had uneventful recovery. One patient with skin paddle size 24 x 17 cm. developed necrosis of distal 2-3 cm. of skin and muscle which was managed by excision of necrosed flap with advancement. Donor area of flap was skin grafted in all three patients which healed without any complications. Postoperative knee function was normal in two patients.

**Conclusions:** This new flap is a reliable option for extensive soft tissue defects around knee secondary to high voltage electric burns where free flap is challenging due to deeper location of recipient vessels and damage due to burn injury. Donor area in upper thigh remains hidden and is with no functional deficit.

**Keywords:** Defects around knee, Distally based vastus lateralis myocutaneous flap, Electric burns

### INTRODUCTION

Large soft tissue defects around the knee remains a challenge to reconstructive surgeon. The pedicled gastrocnemius flap is classically the first choice for reconstruction. However for large soft tissue defects, it is not always sufficient.<sup>1</sup>

Free tissue transfer remains challenging because of the few recipient vessels available around the knee and their deeper location. Free flaps for soft tissue defects due to electric contact burns needs special attention as the level of vessel damage is more than the soft tissue damage and

anastomosis needs to be done at distant site.<sup>2</sup> Reverse ALT fasciocutaneous flap, though reliable option for large defects, at times is inadequate for exposed knee joints and large soft tissue deficits which need sufficient tissue volume to fill the defect.<sup>3</sup>

Distally based vastus lateralis myocutaneous flap is easily accessible and provides adequate tissue for reconstruction of large defects around knee.

We present our experience with distally based split vastus lateralis myocutaneous flap for post electric contact burns large defects over knee region.

## METHODS

A total of three patients underwent reconstruction of large soft tissue defect knee secondary to exit wound of high tension electric contact burns using distally based split vastus lateralis myocutaneous flap during the period 2013 to 2016. All the patients were male with age group 18 to 30 years.

Two patients were farm labourers, while one patient was construction site worker. The tissue defect over knee ranged from 10 x 10 cm to 18 x 14 cm. All the patients had wound deep up to knee joint of which two patients had open joints draining synovial fluid. One patient had partial loss of quadriceps tendon and patella.

All the patients needed multiple debridement of knee region before flap cover. The associated injuries

secondary to entry wounds were treated which needed scalp rotation flap in one patient, amputation of upper limb and skin grafting for multiple wounds in other two patients. All patients underwent distally based split vastus lateralis myocutaneous flap cover for knee defects under spinal anaesthesia.

Duration between injury and flap surgery ranged from 4 weeks to 6 weeks. Skin paddle size ranged from 14 x 12 cm to 24 x 17 cm. Postoperatively knees were kept in extension using posterior slabs. One patient with paddle size 24 x 17 cm developed necrosis of distal 2-3 cm of skin and muscle due to venous congestion.

Necrosed flap was debrided and flap was resutured after advancement. Knee joint mobilisation was started 3 – 4 weeks post operatively. Follow up period ranged from 6 months to 2 years (Table 1).

**Table 1: Master table.**

Age	Defect size in cm	Other injuries	Flap size in cm	Donor site closure	Complications	Knee joint function
30	18 x 14	Scalp defect, loss of patella and quadriceps tendon	24 x 17	Skin grafting	Necrosis of distal 2-3 cm of flap	Loss of active knee extension however stable gait without knee support
18	12 x 10	Gangrene Rt. upper limb, raw areas both feet and left wrist	16 x 12	Skin grafting	Nil	Full range
21	10 x 10	Gangrene Rt. upper limb, raw areas both feet	14 x 12	Skin grafting	Nil	Full range

### *Surgical technique*

Preoperative planning involved identification of perforators using the hand held Doppler along the line connecting anterior superior iliac spine and superolateral margin of patella. Planning in reverse was done considering the size of defect and taking pivot point at 10cms from the knee joint as described by Pan SC. et al.<sup>4</sup>

Cutaneous paddle was marked and a narrow skin bridge was taken till the pivot point. Initial incision was made along the lateral of skin paddle to locate the musculocutaneous perforators from the vastus lateralis muscle.

Medial incision was then taken to reach the intermuscular plane between vastus lateralis and rectus femoris and descending branch of lateral circumflex femoral artery identified. The artery was ligated at distal margin of flap and 4-5 cms wide strip of vastus lateralis muscle was harvested along the skin paddle till the pivot point was

reached. Flap was transferred to defect after incising the skin bridge between pivot point and defect.

Donor area was skin grafted after suturing the remaining vastus lateralis muscle to rectus femoris. In case 1, patient had defect of quadriceps tendon and loss of patella. Proximal and distal ends of quadriceps tendon were anchored to the segment of vastus lateralis muscle in the flap.

## RESULTS

Two out of three patients had uneventful recovery with full knee joint function. Case 1 developed venous congestion with necrosis of distal 2-3cms of muscle and skin paddle which was debrided on 3<sup>rd</sup> postoperative day and flap was resutured to the defect after advancement. Donor areas healed well in all the patients without any donor site morbidity. Case 1 with loss of patella and quadriceps tendon had stable knee joint and was able to walk without any knee support by the end of three

months. The other two patients had full range of knee movement with physiotherapy at the end of three months. The aesthetic appearance of the flap and donor site was satisfactory.



**Figure 1: (A) Case 2 - Preoperative knee defect; (B) Flap harvested.**



**Figure 2: Case 2 - Flap sutured to defect and skin grafting over donor site.**



**Figure 3: Case 2 - Post operative result (one month follow-up).**

## DISCUSSION

Injuries associated with high tension electric contact burns have high morbidity and mortality. Adults are at high risk to such injuries mainly as a professional hazard. Such wounds are usually bone deep with extensive adjacent soft tissue necrosis requiring a bulk of tissue to

be transferred for its reconstruction. Deeply situated recipient vessels around knee and vessel damage beyond the extent of soft tissue damage make microvascular surgery difficult in such patients. Though distally based ALT flaps are reliable for large defects around knee, deep cavities and open knee joints draining synovial fluid require muscle to be transferred to such wounds. Large paddle size of ALT flap has risk of venous congestion with necrosis. Hence we decided to use distally based split vastus lateralis myocutaneous flap for reconstruction of such defects.



**Figure 4: (A) Case 1 - Preoperative knee defect; (B) Post-operative result (2 year follow-up).**

The distally based vastus lateralis muscle flap was first described by Wang et al in 1999.<sup>5</sup> Though vastus lateralis muscle has been classified as Type I muscle by Mathes SJ, it receives its blood supply from DLCFA and lateral superior genicular artery.<sup>6</sup> A study by Wang et al demonstrated three arteries from the superior lateral genicular artery penetrating the distal part of vastus lateralis muscle.<sup>5</sup>

The vascular basis of the flap is the reverse flow in the anastomosis between DLCFA and lateral superior genicular artery.<sup>7</sup> Shahastrabudhe et al demonstrated the connection between Lateral superior genicular artery and descending branch of Lateral circumflex femoral artery near the periarticular anastomosis of knee joint in cadaveric study.<sup>8</sup>

Pivot point for the flap can be taken between 3 to 10 cm from lateral condyle as demonstrated in previous studies.<sup>9</sup> In our study we have taken pivot point at 10 cm to preserve maximum number of connections between lateral superior genicular artery and descending branch of lateral circumflex femoral artery considering the burn injury.

In present study size of skin paddle ranged from 14 x 12 cm to 24 x 17 cm. Flap with paddle size 24 x 17 cm developed venous congestion and necrosis of distal 2-3 cm of skin and muscle. According to literature review

and our experience, larger flaps tend to have higher incidence of venous congestion.<sup>1,8</sup>

Full range of knee movement was achieved in two patients after physiotherapy by 3 months followup. One patient who had loss of quadriceps tendon and patella had loss of active knee extension, however he had stable gait and was able to walk without support. Various studies where authors have used whole of vastus lateralis muscle as distally based flap reported varying degree loss of knee extension.<sup>5,10-12</sup> However inclusion of part of muscle decreases the chances of venous congestion and increases reliability of skin paddle.<sup>11,13</sup> Preserving the major part of vastus lateralis along with its motor nerve preserves the knee joint extension and knee function.<sup>8</sup> Review of literature on split vastus lateralis myocutaneous flap shows two recent studies in which the flaps were done for post traumatic defects. There is no study showing use of this flap for electric burn wound reconstruction.

## CONCLUSION

The distally based vastus lateralis myocutaneous flap is a reliable flap to cover the large soft tissue defects around knee joint even in patients with electric contact burn wounds. The main advantages of this flap are its ability to cover large defects with hidden donor site. The muscle component of flap helps to obliterate the dead spaces.

*Funding: No funding sources*

*Conflict of interest: None declared*

*Ethical approval: The study was approved by the Institutional Ethics Committee*

## REFERENCES

1. Yeh HK, Hsu C, Lin CH, Hsiao YC, Lin YT, Lin CH. Reverse-flow anterolateral thigh flap without antegrade venous reconstruction for knee soft – tissue reconstruction. *Form J Surg.* 2015;48:21-5.
2. Sarangal A, Goil P, Srivastava S. Delayed reconstruction with free flap: answer to postelectric burn complex wounds: a 3-year experience. *Ind J Bur.* 2015;23:32-6.
3. Agarkhedkar N, Wahegaonkar C, Patil B, Dogra B. Novel technique for reconstruction of challenging defects around knee joint:distally based split vastus lateralis myocutaneous flap and review of literature. *Int J Res Med Sci.* 2016;4(6):2089-92.
4. Pan SC, Yu JC, Shieh SJ, Lee JW, Huang BM, Chiu HY. Distally based anterolateral thigh flap: an anatomical and clinical study. *Plast Reconstr Surg.* 2004;114:1768-75.
5. Wang Y, Begue T, Masquelet AC. Anatomic study of distally based vastus lateralis muscle flap. *Plast Reconstr Surg.* 1999;103:101-3.
6. Mathes SJ, Nahai F. Classification of vascular anatomy of muscles: experimental and clinical correlation. *Plast Reconstr Surg.* 1981;67:177-87.
7. Liu Ty, Jeng SF, Yang JC, Shih HS, chen CC, Hsieh Ch. Reconstruction of skin defect of knee using a reverse anterolateral thigh island flap:cases report. *Ann Plast Surg.* 2010;64:198-201.
8. Sahastrabudhe P, Panse N, Baheti P, Jadhav A, Joshi N, Chandanwale A. Reconstruction of complex Soft tissue defects around the knee joint with distally based split vastus lateralis musculocutaneous flap: A new technique. *J Plast Reconstr Aesthet Surg.* 2015;68:35-9.
9. Yildirim S, Avci G, Akan M, Misirlioglu A, Akoz T. Anterolateral thigh flap in the treatment of post burn flexion contractures of the knee. *Plast reconstr Surg.* 2003;111:1630-37.
10. Leev MJ, Yun IN, rah DK, Lee WJ. Lower extremity reconstruction using vastus lateralis myocutaneous flap versus anterolateral thigh fasciocutaneous flap. *Arch Plast Surg.* 2012;39:367-75.
11. Demirseren ME, Efendioglu K, Demirlap Co, Kilicarlan K, Akkaya H. Clinical experience with a reverse flow Anterolateral thigh perforator flap for the reconstruction of soft tissue defects of the knee and proximal lower leg. *J Plast Reconstr Aesthet Surg.* 2011;64:1613-20.
12. Swartz WM, Ramasastry SS, McGill JR, Noonan JD. Distally based vastus lateralis muscle flap for coverage of wounds about the knee. *Plast Rconstr Surg.* 1987;80:255-65.
13. Venkatramani H, Sabapathy SR, Nayak S. Free flap cover of complex defects around knee using the descending genicular artery as the recipient pedicle. *J Plast Reconstr Aesthet Surg.* 2014;67:93-8.

**Cite this article as:** Zade M, Mehta J, Nakade D, Shahane P. Distally based split vastus lateralis myocutaneous flap for reconstruction of post electrical injury defects around knee joint. *Int J Res Med Sci* 2016;4:4701-4.