

ORIGINAL ARTICLE

THE OUTCOME OF PEDICLED MEDIAL SURAL ARTERY PERFORATING FLAP FOR PROXIMAL LEG RECONSTRUCTION

Hira Katpar[✉], Rana Hassan Javaid, Rao Saood Ahmed, Abdul Rasool, Farah Naz, Sara Noor

Plastic Surgery Department, PNS Shifa Hospital Karachi-Pakistan

Background: Reconstruction of defects around the knee and proximal leg are difficult to reconstruct. Out of the multiple flaps described for reconstruction, the pedicled Medial Sural Artery Perforating Flap (MSAP) has recently gained popularity. We conducted this study to assess the clinical outcomes of pedicled MSAP for this purpose at our hospital. **Methods:** A descriptive case series was conducted from April 2022 to March 2023. All patients above 18 years with defects around the knee and proximal leg were included. Patients with tissue loss in the calf area were excluded. **Results:** A total of 14 patients were included. Twelve (86%) were males, while only 2 were females (14%). The mean age was 33.5 years (± 8.76). The most common cause of the defect was trauma ($n=11$, 85%). The Mean distance of the distal-most perforator from the popliteal crease was 12.714 (± 1.990) cm (range 9–16 cm). It was observed that the most distal perforator is usually present in a 2 cm radius of the medial musculo-tendinous junction of the gastrocnemius. Complications were seen in 2 (14%) patients. The mean duration of hospital stay was 4.2 (± 0.96) days. Patients were followed up weekly for the first two weeks and then at 1, 3 and 6 months. **Conclusion:** MSAP Flap is a reliable thin, long pedicled fasciocutaneous flap with low donor site morbidity and aesthetically good results for reconstruction around the knee and proximal leg.

Keywords: Medial Sural Artery Perforator flap; Proximal leg reconstruction; Perforator flap

Citation: Katpar H, Javaid RH, Ahmed RS, Rasool A, Naz F, Noor S. The outcome of pedicled medial sural artery perforating flap for proximal leg reconstruction. J Ayub Med Coll Abbottabad 2023;35(3):375–9.

DOI: 10.55519/JAMC-03-11969

INTRODUCTION

Wounds around the knee and proximal leg are commonly due to road traffic accidents (RTAs), tumours, and infections. These wounds are difficult to reconstruct because there is sparse soft tissue cover available in surrounding areas.

Flaps described in the literature to reconstruct defects in the proximal leg and knee include local, pedicled and free flaps. Gastrocnemius muscle only and gastrocnemius musculocutaneous flap are commonly used but they have short pedicles and high donor site morbidity. Reverse Anterolateral Thigh Flap (ALTF) is also used for proximal leg and knee reconstruction but due to reverse flow, there is a high chance of venous congestion. Free flaps are also used; they need microantomosis and have a longer surgery time. The radial forearm flap has gained popularity in the past but with the disadvantage of significant donor site morbidity.¹ Medial Sural Artery Perforating Flap is a relatively new perforator flap and has gained recent popularity. It was first described by Cavadas *et al.* in 2001.²

The MSAP flap is a thin fasciocutaneous flap with a long pedicle. It offers flexible and durable soft tissue reconstruction with low donor site morbidity compared with the gastrocnemius muscle flap. It is an ideal choice for reconstructing small-to-moderate defects of the knee.^{3–5} It has easy mobilization with a great axis

of rotation, it preserves muscle bulk and function and if defect size is smaller, it can be closed primarily without graft.^{6,7} The bodily structure of the MSAP flap has been properly distinguished, the medial sural artery (MSA) branches from the popliteal vessels and enters the medial gastrocnemius muscle. Typically, MSAP flaps have 1–4 perforators, with a mean of two fasciocutaneous perforators.⁸

We conducted this study to share the results of our lower limb reconstruction around the knee and proximal leg with MSAP. We believe it to be a very good addition to the armamentarium of reconstructive plastic surgery.

MATERIAL AND METHODS

A descriptive case series was conducted from April 2022 to March 2023. A non-probability consecutive sampling technique was employed to recruit participants in the study.

All patients above the age of 18 years with defects around the knee and proximal leg were included. Patients with tissue loss in the calf area were excluded. The study was commenced after ethical approval was obtained from the institutional review board via letter no: ER/2021/Plastic Surgery/173.

All data were documented on a predefined proforma and were analyzed using SPSS for Windows version 22.0 (IBM SPSS, Chicago, IL,

USA). All continuous variables were presented as mean and standard deviation including mean age etc. All categorical values, including indications for surgery and any complications, were presented as frequency and proportion.

All patients underwent careful history taking and physical and radiological assessment. All patients were counselled for postoperative complications. Informed written consent was taken.

The flap was marked pre-operatively by a longitudinal line joining the middle of the popliteal crease and superior margin of medial malleolus as described by Cavadas *et al.*^{1,2} Perforators were identified by hand-handled Doppler (Hunt Leigh duplex MD-2, 10 MHz probe) As many good perforators as possible along this line were identified and marked (usually 1–4 perforators were identified). Figure-1 All patients were given an antibiotic (Coamoxiclav 1.2 gm.) dose 60 minutes before surgery. All patients operated under spinal anaesthesia, in supine position, with the knee flexed at 45 degrees and the hip internally rotated, under a thigh tourniquet.

Flap was planned in reverse and size was marked by taking a template of the recipient wound. Figure-2,³ Flap dissection was done in the subfascial plane starting from the anterior (medial flap border), and perforators were identified and preserved. In our all cases, we found more than 2 perforators, but only those perforators were kept on which the flap could be rotated into the defect. After identification of the perforators, all borders were raised, flap was dissected proximally up to the pedicle through intramuscular dissection, it was islanded towards the defect. Haemostasis was secured with bipolar diathermy and flap inset was done with 3/0 vicryl and 4/0 prolene. The donor site

was grafted in all cases with vacuum assisted dressing applied over the graft. Patients were mobilized with partial weight bearing on 3rd post-operative day. Patients were followed up weekly for the first two weeks then at the 1, 3 and 6 months. On each follow-up visit patients were assessed for complications.

RESULTS

A total of 14 patients were included. Twelve (86%) were males, and only 2 patients were females (14%). The mean age was 33.5 years (± 8.76). The most common cause of the defect around the knee and proximal leg was trauma (n=11; 85%), followed by tumour (n=2, 14%) and infection (n=1, 1%). The mean distance of the distal most perforator from mid popliteal crease was 12.5 cm (± 2.53) (range 8–15 cm). The largest flap raised was 8×16 cm. In 3 cases (21%) only one perforator was incorporated in the flap. In all other cases, 2 perforators were taken. We observed that the most distal perforator is usually present in a 2 cm radius of the medial musculo-tendinous junction of gastrocnemius. In 5 flaps that were crossing the midline, we incorporated the sural neurovascular bundle pedicle for better blood supply of the larger flaps and less chances of congestion. Table-1. Figure-4

The mean duration of hospital stay was 4.2 (± 0.96) days. Patients were followed up weekly for the first two weeks and then at 1, 3 and 6 months.

One flap developed partial necrosis of the edges which healed by secondary intention. We had one flap failure due to venous congestion which we believe was due to pressure by a tight fascial band in the skin tunnel. All other flaps survive with satisfactory results. Figure-5, 6.

Table-1

Age	Gender	Disease	Flap size	No. of perforators	Distance of distal perforator	Sural NV bundle taken	Complications
35	Male	RTA	8 cm	02	10 cm	No	Partial necrosis
25	Male	RTA	9 cm	02	14 cm	No	No
45	Female	Adxenal tumour knee	16 cm	02	15 cm	Yes	No
22	Female	Haemangioma knee	8 cm	01	9 cm	No	No
35	Male	RTA	9 cm	02	10 cm	No	No
35	Male	RTA	10 cm	02	14 cm	Yes	No
39	Male	RTA	10 cm	02	15 cm	Yes	No
42	Male	RTA	9 cm	02	15 cm	No	No
50	Male	Infection	11 cm	02	16 cm	No	Total flap loss
35	Male	RTA	8 cm	01	9 cm	No	No
25	Male	RTA	8 cm	02	12 cm	Yes	No
22	Male	RTA	7 cm	01	10 cm	No	No
35	Male	RTA	10 cm	02	14 cm	No	No
25	Male	RTA	11 cm	02	14 cm	Yes	No



Figure-1: Intramuscular dissection of perforator



Figure-2: Adnexal tumour right knee pre-operative



Figure-3: After wide local excision of tumour with 3mm normal skin margin

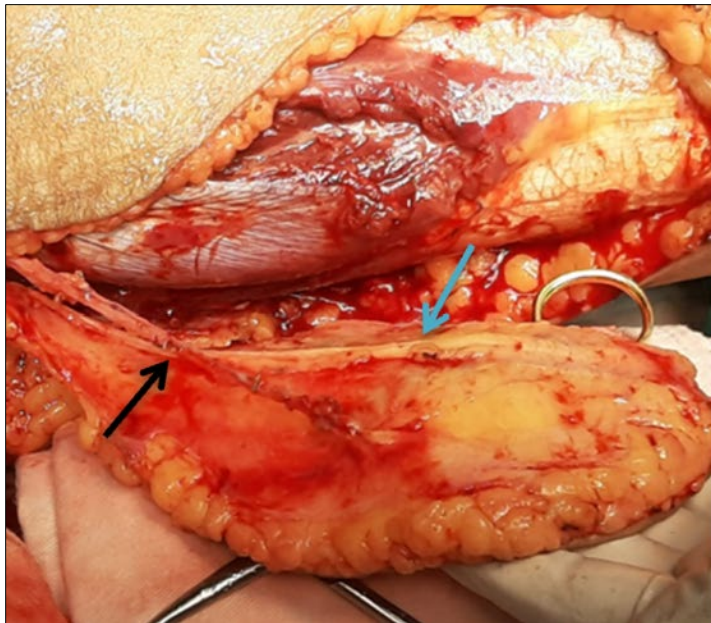


Figure-4: Blue arrow: Sural NV bundle Black arrow: MSAP Perforator



Figure-6: Grafted donor Site



Figure-5: 6 months post-operative flap site

DISCUSSION

MSAP is a good alternative to free flaps and loco regional muscle flaps for knee and proximal leg reconstruction. It has less subcutaneous fat, and

provides coverage to the exposed extensor mechanism with low donor site morbidity. Skeletonizing the perforator and vascular pedicle increases the range of flap advancement with a greater arc of rotation. In our study, we operated upon 14 cases out of which 2 were

female. Most cases operated were of trauma (85%) which could be one reason for the high male-to-female ratio. Other studies also show that the causes of defects around the knee and proximal leg are usually trauma, oncological resection, implant infection and chronic ulcers.⁹⁻¹¹

Quite a large MSAP flap can be raised of the calf. The largest flap we raised was 16 cm. Hallock *et al* raised a 17 cm large flap with a single perforator. Luca Puzner *et al* described flaps as large as 7–22×5–8 cm.⁴ We incorporated the sural neurovascular bundle in 36% as an extra precaution and when the flap was already crossing the midline it was quite large. We also wanted to reduce the chances of congestion. This modification has not been previously described in the literature.

In 3 cases (21%) only one perforator was taken. In all other cases, 2 perforators were taken. We found the distal most perforator at a mean distance of 12.714 (±1.990) cm (range 9–16 cm) from the popliteal crease. Al Hamdani *et al* found the distal perforator at 11.9 cm and a mean of 2.1 perforators³ Dusseldrop *et al* described an average perforator location at 13 cm from the popliteal crease and transversely at 2.5 cm from the midline.¹² Both these studies show that the mean distal perforator distance from the popliteal crease is within 11–13 cm, which is similar to our findings. We also noted and observed that the distal most perforator was within a radius of 2cm from the medial musculoaponeurotic junction. This observation has not been reported previously.

Out of our 14 cases, two flap complications were observed. One flap had partial necrosis of one of the edges which we debrided later on and it healed with secondary intention. Al-Hamdani *et al*, Luca Puzner and Narayan reported complications of partial necrosis in 2, 2 and 1 patients respectively, which later healed by excision and secondary suturing.^{3,4,14} Sue described complications in 7.3% of cases.⁸ We had one complete flap loss, Hegazy *et al* and Narayan stated 2 and 1 complete flap failure respectively.^{1,14} Hallock used a free flap for free MSAP failure.¹³ In our case we debrided the flap and put on vacuum assisted dressing and later the area was grafting after granulation occurred as per the Crane principle.¹⁵

We grafted all our donor sites as all flaps raised were quite large. In the literature, the requirement for skin graft of the donor site depends on the width of the flap and it ranges from, 6.9% up to 32%.^{16,17} The donor site morbidity is quite low with an overall donor site morbidity rate of 1.9% as shown in the 2019 systematic review and meta-analysis performed by Daar.¹⁸ We had no donor site morbidity in our 14 patients.

The limitations are that it is more technically demanding than the Gastrocnemius flap. It is also

more time consuming as requires perforator dissection and the failure of the flap makes the harvest of the hemi gastrocnemius flap not possible. The intramuscular perforator dissection in MSAP flap is more tedious as compared to the ALTF, but we found the perforator to be more consistent in MSAP flap and no need for a microvascular anastomosis for the reconstruction of our wounds. Moreover, our study is a case series and a direct comparison with other methods of reconstruction was not conducted.

CONCLUSION

A pedicled MSAP flap is an appropriate flap for reconstruction of defects in the proximal leg and around the knee. Skeletonizing the perforator and vascular pedicle increases the range of flap advancement with a greater arc of rotation. In large flaps crossing midline including the sural neurovascular bundle with the flap improves reliability.

AUTHORS' CONTRIBUTION

HK: Literature search, data collection, write-up. RHJ: Study design, data interpretation. RSA, RHJ: Data analysis. AR, SN, FN: Proofreading.

REFERENCES

- Hegazy SI, Gozlan NA, Elkafrawi HY, Elshafei MM, Kholosy HM. Medial sural artery perforator flap in reconstruction of soft tissue defect in upper and lower extremities: a clinical study. *Alex J Med* 2020;56(1):210–9.
- Cavadas PC, Sanz-Giménez-Rico JR, Gutierrez-de la Cámara A, Navarro-Monzonis A, Soler-Nomdedeu S, Martínez-Soriano F. The medial sural artery perforator free flap. *Plast Reconstr Surg* 2001;108(06):1609–15.
- Al-Himdani S, Din A, Wright TC, Wheble G, Chapman TWL, Khan U. The medial sural artery perforator (MSAP) flap: A versatile flap for lower extremity reconstruction. *Injury* 2020;51(4):1077–85.
- Luca-Pozner V, Delgove A, Kerfant N, Karra A, Herlin C, Chaput B. Medial Sural Artery Perforator Flap for Leg and Knee Coverage: Extended Skin Paddle With 2 Perforators. *Ann Plast Surg* 2020;85(6):650–5.
- Lin CH, Hsieh YH, Lin CH. The Medial Sural Artery Perforator Flap in Lower Extremity Reconstruction. *Clin Plast Surg* 2021;48(2):249–57.
- Tsou HJ, Tu CP, Chen YF, Yao WT. An early complication in the donor site of the medial sural artery perforator flap: necrosis of the medial head of gastrocnemius. *Case Reports Plast Surg Hand Surg* 2019;6(1):47–50.
- Dogan ZD, Özkan MÇ, Tuncer FB, Saçak B, Çelebiler Ö. A Comparative Clinical Study of Flap Thickness: Medial Sural Artery Perforator Flap Versus Anterolateral Thigh Flap. *Ann Plast Surg* 2018;81(4):472–4.
- Sue GR, Kao HK, Borrelli MR, Cheng MH. The versatile free medial sural artery perforator flap: An institutional experience for reconstruction of the head and neck, upper and lower extremities. *Microsurgery* 2020;40(4):427–33.
- Tee R, Jeng SF, Chen CC, Shih HS. The medial sural artery perforator pedicled propeller flap for coverage of middle-third leg defects. *J Plast Reconstr Aesthet Surg* 2019;72(12):1971–8.

10. Chiang IH, Wu CC, Chen SG, Wang CH. Pedicled medial sural perforator flap for the reconstruction of knee defects. *Int Wound J* 2017;14(4):673–7.
11. Scaglioni MF, Rodi T, Fritsche E. The versatility of the pedicled medial sural artery perforator flap: from simple to its chimeric pattern and clinical experience with 37 cases. *Plast Reconstr Surg* 2021;147(4):960–9.
12. Dusseldorp JR, Pham QJ, Ngo Q, Gianoutsos M, Moradi P. Vascular anatomy of the medial sural artery perforator flap: A new classification system of intra-muscular branching patterns. *J Plast Reconstr Aesthet Surg* 2014;67(9):1267–75.
13. Hallock GG. Medial sural artery perforator free flap: legitimate use as a solution for the ipsilateral distal lower extremity defect. *J Reconstr Microsurg* 2014;30(03):187–92.
14. Narayan N, Berner JE, Saeed A, Zanchetta F, Troisi L. Outcomes of the Pedicled Medial Sural Artery Perforator Flap for Soft Tissue Reconstruction Around the Knee: When to Use It and How to Look After It. *J Hand Microsurg* 2020;14(3):216–21.
15. Millard DR. The crane principle for the transport of subcutaneous tissue. *Plast Reconstr Surg* 1969;43(5):451–62.
16. Kao HK, Chang KP, Wei FC, Cheng MH. Comparison of the medial sural artery perforator flap with the radial forearm flap for head and neck reconstructions. *Plast Reconstr Surg* 2009;124(4):1125–32.
17. Gulati A, Patel P, Maini N, Butler D, Dhanda J, Bisase B, *et al.* Medial sural artery perforator flap—indications, tips and pitfalls: a narrative review. *Front Oral Maxillofac Med* 2021;4(3):126–51.
18. Daar DA, Abdou SA, Cohen JM, Wilson SC, Levine JP. Is the medial sural artery perforator flap a new workhorse flap? A systematic review and meta-analysis. *Plast Reconstr Surg* 2019;143(2):e393–403.

Submitted: April 6, 2023

Revised: May 12, 2023

Accepted: May 13, 2023

Address for Correspondence:

Hira Katpar, Plastic Surgery Department, PNS Shifa Hospital Karachi-Pakistan

Cell: +92 333 712 1177

Email: h_saleem49@yahoo.com