

Extended Medial Myocutaneous Gastrocnemius Flap for Coverage of Wounds around Knee Joint

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ABSTRACT

Objective: To evaluate the effectiveness of the extended medial myocutaneous gastrocnemius flap in providing coverage for wounds around the knee joint.

Study Design: Case series.

Place and Duration of Study: Combined Military Hospital, Lahore Pakistan, from Jan to Dec 2023.

Methodology: Twenty individuals were added through convenient sampling for coverage of wounds around their knee joints. They had either spinal or general anaesthesia for the operation. Wound management, flap monitoring, and physical therapy were all part of postoperative care. Assessments including flap survival, wound recipient and donor site function, and wound healing were done at one week, one month, and three months.

Results: The study included 20 patients, 18(90%) were male, and their mean age was 42.4±7.24. The 80% of the patients had full wound healing within a month, and 20%, needed three months to heal completely. 2(10%) of cases had postoperative wound infection, and 4(20%) of patients had partial wound dehiscence. There have been no partial or complete flap necrosis and no significant donor site morbidity, proving the procedure's effectiveness and safety.

Conclusion: Results of the study support extended medial myocutaneous gastrocnemius flap as a versatile and viable option for reconstruction of wounds around the knee, demonstrating a high success with a low complication rate with 80% healing within a month providing durable wound coverage with no flap necrosis or donor site morbidity.

Keywords: Myocutaneous Flap; Plastic Surgery Procedures; Wounds and Injuries

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INTRODUCTION

Globally, traumatic injuries are a leading cause of disability with approximately 1.3 million road traffic accidents annually. In the South Asian region, including Pakistan these road traffic accidents contribute significantly to knee injuries, with a reported incidence of 40 per 100,000 population.^{1,2} Other causes, such as gunshot wounds, wounds after removal of infected implant or burns also contribute to the burden of knee injuries. In most surgical settings, general and orthopaedic surgeons manage these patients, while plastic and reconstructive surgeons are usually consulted for soft tissue coverage when wounds involve exposed bones, joints, or major vessels.³

To address these complex injuries, reconstructive options include skin grafting, local muscle flap, and free tissue transfer.⁴ Local flaps, like the gastrocnemius muscle flap, have long been regarded as a workhorse

in covering such defects due to its favourable position, robust vascular supply and versatility. However, these traditional muscle flaps often require additional skin grafting, which can compromise wound pliability contour and functionality. A recent modification is the extended medial myocutaneous gastrocnemius flap, which involves dissecting the medial gastrocnemius muscle up to its origin on the medial epicondyle of the femur and integration of skin paddle with the muscle on the base of myocutaneous perforators.^{5,6} Only a few studies have focussed exclusively on this procedure, highlighting the need for robust local data.⁷

The rationale of this study was to address these gaps by assessing the efficacy of the extended medial myocutaneous gastrocnemius flap in providing adequate coverage to complex wounds around knee joints, its healing time, joint mobility and the donor site morbidity. This research seeks to enhance reconstructive practices and improve patient care for severe knee injuries in Pakistan and beyond, by addressing the limitations of conventional methods and tailoring modified techniques to local tissue needs.⁸

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METHODOLOGY

This case series was carried out over 12 months, from January 2023 to December 2023, at the Combined Military Hospital (CMH) Lahore, Pakistan. Ethical approval was obtained from the Institutional Review Board with a reference of 532/2024. Sample Size was calculated using WHO Sample Calculator with approximately 70% Proportion, 95% Confidence interval and 16% absolute precision.⁹ By convenient sampling technique, twenty patients who presented with a wound around the knee joint were added.

Inclusion Criteria: Patients with wounds around knee post-trauma, gunshot, removal of infected implant, chronic wounds and burns

Exclusion Criteria: Patients with diabetes mellitus, active smokers, peripheral vascular disease, and those on immunosuppression.

Extended medial myocutaneous gastrocnemius flap procedure performed under general and spinal anaesthesia. All patients were preoperatively counselled about the procedure, expected hospital stay, possible complications and follow-ups. To ensure sufficient coverage of the wound the donor site skin marked 1cm more than the calculated size of the defect around the knee joint over the medial aspect of the calf. The incision given over the medial most aspect of the skin paddle up to the fascia of the medial gastrocnemius muscle. Which is then incised and raised over its medial aspect separating it from the underlying soleus muscle up to the insertion of both on the Achilles tendon. After identification of the middle raphae which joins the lateral and medial gastrocnemius, the medial gastrocnemius muscle divided at its insertion with the Achilles tendon and median raphae from the lateral muscle up to its origin from the medial condyle of the femur. The medial sural artery, the branch of the popliteal artery identified and presented near the head of the medial gastrocnemius muscle. The skin paddle is divided over the marked part up to the fascia of the muscle making it island over the muscle. The myocutaneous muscle was then passed through a subcutaneous tunnel to the defect on the knee joint. The distal aponeurosis of the muscle sutured at the most proximal end of the wound followed by the inset of the island skin paddle over the wound with interrupted half-buried mattress sutures of Prolene 3/0, (Figure-1). The donor site was partially closed primarily with interrupted sutures of Prolene 3/0 and

partially with a thick split-thickness skin graft taken from the other thigh.¹⁰

Using standardized grading systems, follow-up evaluations were carried out one week, one month and three months after surgery. The main objectives were wound healing time, wound dehiscence, flap survival, recipient and donor site infection and mobility of the limb at the end of the 3rd month.

The data were summarized using descriptive statistics, flap survival, wound healing, wound infection, wound dehiscence, wound healing time and mobility of the limb at 3rd month serving as the main outcome variables. Frequencies and percentages were calculated for qualitative variables, while mean and standard deviation were calculated for quantitative variables using Statistical Package for Social Sciences (SPSS) version 26. The Declaration of Helsinki's ethical criteria were followed in this study, which only used patient data for research and preserved patient anonymity.



Figure-1: (a) The Wound At The Right Knee Joint Post Removal of Infected Implant, (b) After Debridement, (c) Elevation Of The Extended Medial Myocutaneous Gastrocnemius Flap In-Setting of The Flap

RESULTS

The study included 20 patients, ages ranging from 29 to 56 years with a mean of 42.4 ± 7.24 years, indicating that the participant's ages were fairly dispersed across the people. In terms of demographics, the study population was biased toward men, with men making up 90% (n=18) of the cohort and women making up 10% (n=2)

Evaluation of the following parameters was performed over 1 week, 1 month, and 3rd month (until the healing of the flap of the last included patient). (Table). The most common complications in 1st week were flap tip discoloration and wound dehiscence in

4(20%) of patients in which the flap discolouration settled down before 1 month and the wound dehiscence resutured and healed over 3 months (Figure-2).

Table-I-Outcome Variables of the Study (n=20)

Study parameter	1st Week n (%)	1st Month n (%)	3rd Month n (%)
Flap Tip Discoloration	4(20%)	0(0%)	0(0%)
Wound Dehiscence	4(20%)	4(20%)	0(0%)
Recipient Wound Infection	4(20%)	2(10%)	0(0%)
Donor Wound	2(10%)	0(0%)	0(0%)
Healing Time	0(0%)	16(80%)	4(20%)

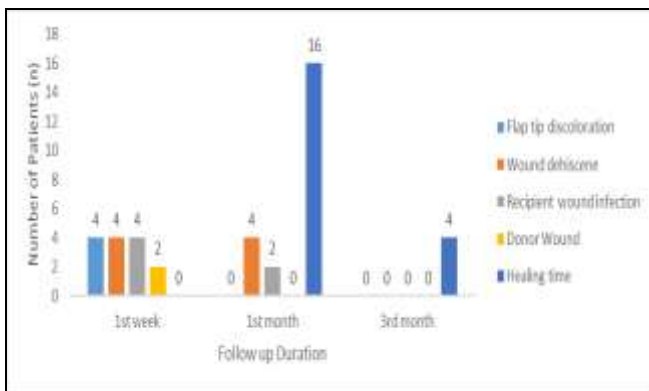


Figure-2: Follow-up Parameters of 30 Patients at 1st Week, 1st Month and 3rd Month Interval (n=20)

DISCUSSION

In general, managing soft-tissue defects in the knee region is quite challenging which comes from the paucity of soft tissues, proximity between the skin, and the underlying profound structures such as bone and tendons limiting the possibility Of primary closure and wound healing by secondary intention.^{11,12} The local Gastrocnemius muscle flap with its modifications into the extended medial myocutaneous gastrocnemius flap represents a robust option for managing extensive wounds around the knee joint.^{12,16} This study demonstrated excellent outcomes with the implication of this modified form of the gastrocnemius flap. A significant 16(80%) of patients achieved complete wound healing within one month, while the remaining 4(20%) fully healed by three months. In 16(80%) of the patients the flap remained viable while in 4(20%)of the patients Flap tip discoloration and wound dehiscence were noticed at the same point in 1st week but with adequate management it improved over the 1st month without any evidence of the flap tip necrosis, showing the efficacy of the robust

vascular supply of the flap. On the donor site over the first week 18(90%) of the patients showed adequate graft uptake while only 2(10%) showed less than 30% of the graft uptake which later on healed by the growth of the surrounding epithelium over 1 month. All the patients started bearing weight on the leg over 3 months with the help of physiotherapy no significant morbidity was seen as lateral gastrocnemius muscle was left intact during the dissection. These results collectively emphasize the effectiveness and safety of this technique for managing complex knee defects.

To contextualise our findings reviewed some other studies related to gastrocnemius muscle flap.^{13,14} Rony et al in a study demonstrated the segmentation of gastrocnemius to increase its reach to the defect.¹⁵ They used skin graft over the flap which affected the knee mobility, initially due to the skin graft loss and later on with the difficulty in movement due to graft contractions. In our study, the medial muscle was extended with the dissection up to its origin to increase the arc of rotation and the skin paddle over the muscle was used to avoid the skin graft. Which provided more adequate contour and improved mobility.^{13,14}

Narayan et al, considering the bulkiness of the gastrocnemius muscle, used fasciocutaneous MSAP flaps to reconstruct the knee wounds in 10 patients. 3 patients had flap discoloration and epidermolysis of the skin leading to coverage of the flap with the skin graft in another operation.¹⁶

Innocenti et al used the same propeller flaps’ principles and raised skin paddle after muscle transfer on a perforator of the medial sural artery and then rotated it over the defect, but their results showed a high rate of partial necrosis.(17) Moreover, this technique requires preoperative investigations by Doppler ultrasound to identify the perforator vessels with longer and more technical surgery.Ali *et al* conducted a study using gastrocnemius muscle flap for soft tissue defects around the knee and proximal tibia in 33 patients and found wound infection, partial loss of flap, partial loss of skin graft and reduced knee joint mobility in 3.03% of patients. In contrast, the results of our study were far better than this, explaining the advantage of the muscle extension and incorporation of the skin paddle with the muscle.⁹

Our study is further supported by Mayoly *et al.* reporting the fact that gastrocnemius flaps with skin paddle can be harvested 5 cm beyond the muscle itself, next to the Achilles tendon, which increases the

effective surface of the flap and little chance of necrosis.¹⁸ Finally, our research provides evidence in favour of the extended medial myocutaneous gastrocnemius flap when treating severe wounds surrounding the knee joint. The results demonstrate the procedure's high rate of success and low rate of complications, adding to the surgical armamentarium for treating complicated knee injuries. Subsequent investigations may concentrate on contrasting analyses with alternative flap methodologies, enduring further functional consequences, and the incorporation of supplementary treatments to augment the process of healing and recuperation.

CONCLUSION

Results of the study support extended medial myocutaneous gastrocnemius flap as a versatile and viable option for reconstruction of wounds around the knee, demonstrating a high success with a low complication rate with 80% healing within a month providing durable wound coverage with no flap necrosis or donor site morbidity.

Conflict of Interest: None.

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Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

SA & RSA: Data acquisition, data analysis, critical review, approval of the final version to be published.

AAM & MTK: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

MA & NJ: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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