

Short And Long-Term Adverse Outcomes of Soleus Muscle Rotation Flap For The Coverage of Soft Tissue Defects of Middle And Distal Leg

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ABSTRACT

Objective: To observe the short and long-term adverse outcomes of soleus muscle rotation flap for the coverage of soft tissue defects of middle and distal leg.

Study Design: Case series.

Place and Duration of the Study: Departments of Plastic and Reconstructive Surgery Bahawal Victoria Hospital Bahawalpur, Combined Military Hospital Bahawalpur and Combined Military Hospital Quetta from Dec 2014 to Feb 2020.

Methodology: A total of 33 patients were enrolled for the study through consecutive sampling. All the patients were reviewed at first and second week (early morbidity) and six months (late morbidity) after the operation. They were examined for hematoma at the donor site, wound infection, sural nerve injury, graft loss and flap necrosis during early follow-up. In late follow-up, patients were examined for muscle weakness, sensory abnormalities, hypertrophic scarring, hyperkeratosis, soleus muscle contractures, and reduced knee mobility.

Results: There were 30 (90.9%) male patients and 3 (0.9%) female patients. The mean age was 35 ± 11 years (range: 16 to 64) years. The hematoma was the commonest complication found in two (6.06%) patients. Wound infection, partial loss of flap, partial loss of skin graft and wound infection occurred in one patient each. Late follow-up revealed contractures of the soleus muscle and reduced knee mobility in three (9.09%) patients.

Conclusion: The soleus muscle rotation flap is reliable, versatile and very useful for providing soft tissue coverage for defects in the middle and distal leg.

Keywords: Ambulation, Lower extremity, Reconstruction, Surgical flaps, Soleus muscle, Soft tissue injuries.

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INTRODUCTION

Lower limb trauma is common among the trauma patients worldwide. It is also more prevalent in our setup, where an increase in population and a rising number of automobiles, especially motorbikes, have compounded the problem. Lower limb trauma can be attributed to an increased number of road traffic accidents,¹ due to over-speeding, lack of international safety standards in vehicles, poorly maintained road networks, and an increasing number of violations of traffic laws. General and orthopaedic surgeons manage most trauma patients in surgical setups. Plastic and reconstructive surgeons often provide soft tissue coverage in lower limb trauma patients with exposed bones, joints or main vessels.²

Managing high-energy lower extremity trauma with bone and soft tissue injuries remains a challenge. These injuries often occur in trauma patients with mul-

tle other injuries making management even more difficult. The tools in the armamentarium of a reconstructive surgeon include skin grafting, local flaps, perforator flaps, muscle flaps, microvascular free flaps, artery, nerve and bone repairs. The decision to choose the best out of many available options depends on multiple factors like aetiology of defect, size and shape of the defect, clinical condition of the patient, presence of comorbidities, available health facilities, and experience of the surgeon.³

The option of free tissue transfer to cover a defect requires a team approach, long operative time, prolonged hospital stay, and involves donor site morbidity and a definitive risk of total failure compared to local rotation flaps.⁴ For soft tissue coverage in legs, a soleus muscle rotation flap (SMRF) is among many options. The soleus muscle has a robust blood supply.⁴ The dominant vascular pedicle is the sural artery, a muscular branch of the popliteal artery. Due to its constant anatomy and ease of harvest, it is the workhorse flap for soft tissue defects in the middle third of the leg.⁵ It is commonly used as a muscle only flap along with

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split-thickness skin graft (STSG), but it can be modified as a myocutaneous flap or segmental flap. The bony component can be added as required.⁶ The effectiveness and the outcomes associated with SMRF have been studied in the Pakistani population.⁷⁻⁹ In this study, we wanted to share our experience with SMRF surgery, especially regarding the short and long-term adverse outcomes associated with the use of this versatile flap. The observations also hold value as the patients were gathered from three centres of excellence for plastic and reconstructive surgery. The added observations would augment Pakistani data and help devise further studies and management plans in the future.

METHODOLOGY

This was a case series conducted at the Plastic and Reconstructive Surgery departments of Bahawal Victoria Hospital Bahawalpur, Combined Military Hospital Bahawalpur, and Combined Military Hospital Quetta from December 2014 to February 2020 in collaboration with Rehabilitation Departments of these hospitals. After approval from the Hospital Ethical Committees of the respective hospitals patients were enrolled in the study through consecutive sampling after written informed consent.

Inclusion Criteria: Patients reporting for soft tissue coverage to middle and distal leg soft tissue defects were included in the study.

Exclusion Criteria: Patients with knee arthritis, diabetes mellitus, pre-existing pain in legs, and smoking history were excluded from the study.

Before enrollment, the patients were guided regarding the treatment and possible adverse outcomes. Information regarding present illness, previous treatment, occupation, pre-existing pain, diabetes mellitus, and smoking were obtained and recorded in the specially designed proformas. Pre-operatively, the patients were counselled about the procedure in detail. They were informed about the nature of the operation, duration of hospitalization, possible adverse outcomes and follow-up in the outpatient department.

The surgical procedures were carried out under the general or spinal anaesthesia, depending upon the patient's condition. Tourniquet was used in all the cases and the tourniquet pressure was kept at 100 mm of Hg above systolic blood pressure. After general or spinal anaesthesia, the surgical site was prepared with Povidone-iodine solution. The recipient site was primed by debridement and defect size was measured. An incision was made on the medial side for the

medial half of the muscle, while the lateral half was approached through the posterior incision. Soleus muscle was identified after identifying the plantaris tendon and elevated from the deep flexor tendons. After careful dissection and hemostasis, the medial or lateral half of the soleus muscle was placed over the defect and stabilized with Vicryl sutures followed by STSG. The drain was placed at the donor site to avoid hematoma formation. The first dressing was changed after 4-5 days.

During patient selection, three patients were excluded from the study. One patient had diabetic neuropathy, one patient had severe knee arthritis and was a smoker, while the third had a positive smoking history. All the patients were followed up at the first and second week (early morbidity) and six months (late morbidity) after the operation. They were examined for hematoma at the donor site, wound infection, sural nerve injury, skin graft loss, and flap necrosis during early follow-up. In late follow-up, patients were examined for motor weakness, sensory abnormalities (paresthesia, numbness, etc.), hypertrophic scarring, hyperkeratosis, soleus muscle contractures and reduced knee mobility.

Statistical Package for Social Sciences (SPSS) version 20 was used for the data analysis. Frequencies and percentages were calculated for qualitative variables, while mean and standard deviation were calculated for quantitative variables.

RESULTS

A of total 33 patients were included in the study. There were 30 (90.9%) male patients and 3 (0.9%) female patients. The mean age was 35 ± 11 years (range: 16-64) years. In early follow-up, hematoma formation at the donor site was seen in two (6.1%) patients. This was followed by surgical site infection, loss of skin graft, and flap necrosis. All these complications occurred in one patient each (Table). Sural nerve injury did not occur in any patient.

Late follow-up revealed that contractures of the soleus muscle and reduced knee mobility developed in three (9.1%) patients. Hypertrophic scarring and hyperkeratosis were not observed in any patient. None of the patients complained about sensory abnormalities or muscle weakness.

DISCUSSION

The lower extremities are designed mechanically to bear bodyweight and ambulate. There is a paucity of soft tissues on the anteromedial aspect of the legs. This

Table-I: Early and late complications of the patients (n=33).

Early Follow-Up		
Complications	Number of Patients	Percentage
Hematoma at donor site	2	6.06%
Wound Infection	1	3.03%
Sural nerve injury	0	-
Skin graft loss	1	3.03%
Flap necrosis	1	3.03%
Late follow-up		
Reduced Knee Mobility	3	9.09%
Soleus Muscle Contractures	3	9.09%
Motor weakness	-	-
Sensory abnormalities	-	-
Hypertrophic scar	-	-
Hyperkeratosis	-	-

paucity of soft tissue, along with biomechanical requirements, makes reconstruction of the leg more challenging as compared to other body parts. Moreover, there are attritional changes in the joints with advancing age that augment the problems. These limitations and requirements make an effective reconstruction in lower limbs more challenging. There are multiple aetiologies of lower limb ailments. The services of reconstructive surgeons are often called for the reconstruction of difficult defects resulting from trauma, diabetes, vascular disease, cancer ablation and other disease processes. The importance of a thorough understanding of all the reconstructive surgical tools and good surgical hands cannot be overemphasized.

Soleus flap was initially used for coverage of osteomyelitis and similar problems.¹⁰ Over time, various modifications in the composition of the flap were made as per requirements. The use of soleus muscle for reconstructive purposes in the management of middle leg injuries is associated with considerable morbidity because it is a major plantar flexor of the ankle and stabilizes the ankle joint during ambulation. Anatomically, this is a bipennate muscle and both halves have their independent blood supply. This structure enables a surgeon to use one half for reconstructive purposes and the other for a biomechanical purposes.

The adverse outcomes associated with SMRF surgery can be divided into early and late complications. In this study, early follow-up revealed the formation of a hematoma at the donor site in two (6.1%) patients. This happened despite the use of suction drains. In both cases, hematoma settled without surgical intervention. Though this is not a high number, it should be avoided in all the cases of SMRF surgery. Meticulous surgical technique and proper hemostasis

can help avoid this problem. Only one patient had surgical site infection, partial flap necrosis, and partial skin graft loss. Fortunately, there was no case of sural nerve injury. Contemporary studies have shown comparable outcomes of this flap. Rabbani *et al*,⁷ reported partial necrosis of flap without dehiscence in three (8.1%) cases and partial necrosis with dehiscence in one (2.7%) case. Bortolini and Fraga reported wound infection in one out of six cases.⁵ In addition, no necrosis of flaps or suture dehiscence or systemic complications were observed. Hassanpour *et al*, observed partial flap necrosis in one out of 12 patients in a case series.¹¹ Ata-ul-Haq *et al*, reported wound infection in one out of ten cases.⁷ Hendy *et al*, revealed partial necrosis of flap in two cases (20%), formation of hematoma in one case (10%), and surgical site infection in two cases (20%).¹² Abd-Almuktader revealed similar results.¹³ There was one case with postoperative hematoma and one case with wound dehiscence healed by local wound care. Another case with a lost skin graft needed regrafting.¹³ Nazneen and Sarkar reported partial flap necrosis in two (6.66%) patients, partial loss of skin graft in three patients (10%), and complete skin graft loss in one patient in a Bangladeshi case series.¹⁴ Shahzad *et al*, noted postoperative hematoma in 10 patients, wound dehiscence in six, infection in 20 and skin graft loss in 16 cases.⁹ Karbalaiekhani *et al*, reported flap necrosis in three and wound infection in two patients out of 28 patients.¹⁵

Long-term follow up in our study revealed soleus muscle contractures and reduced knee movement in three (9.1%) patients each. The former improved with physiotherapy and exercises. Daigeler *et al*,¹⁶ reported wound infections in 4%, one flap loss and peroneal nerve injury in 4.5% cases. Forty percent complained of vascular claudication after 200 meters of the walk and 24.4% complained of reduced muscle endurance strength. The study by Gad *et al*,¹⁷ registered that early complications included graft rejection in two (10%) patients, partial flap necrosis in two (10%) patients, wound infection in one (5%) patient, and postoperative hematoma in one (5%) patient. Late results during follow-up showed one (5%) patient with the hypertrophic scar of the donor area and one (5%) patient with hyperkeratosis. All postoperative complications were managed conservatively, and flaps provided a stable reconstructive option.

The SMRF is probably one of the safest flaps and can provide just enough muscle for soft tissue coverage of the extensive tibial soft tissue defect.¹⁸ The

reconstructive outcomes are usually quite good and it is cost-effective. In addition, the surgery can be performed by most reconstructive surgeons in selected patients.

CONCLUSION

The SMRF is a reliable, versatile, and handy flap for providing supple soft tissue coverage for defects in the middle and distal leg.

Conflict of Interest: None.

Authors' Contribution

GA: Direct contribution, SBA:, DA:, IA:, AM:, YSK: Intellectual contribution.

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