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CASE REPORT

Utilizing Multiple Pedicled Muscle Flaps in Complex Soft Tissue Reconstruction - A Case Report

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Abstract

Utilizing multiple muscle flaps is a safe and reliable technique to provide stable soft tissue cover for major post-traumatic defects of the lower limbs.

A fifty-five-year-old female patient presented to the emergency department with a huge crush/degloving injury of the whole anteromedial aspect of the right lower limb with open comminuted fracture of the femur, the tibia, and the fibula. Radiological computerized tomography (CT) study showed displaced comminuted fractures involving the lower shaft of the femur, proximal fibula, and middle third of the shaft of the tibia, with tangential bone loss in the knee joint.

The patient underwent multiple sessions of wound and bone debridement with bone fixation which was followed by multiple reconstructive surgeries.

Patient recovered well and was discharged home with the ability to mobilize with Zimmer frame and knee brace support.

Keywords: Comminuted fractures, Degloving injuries, Muscles, Reconstructive surgical Procedures, Surgical flap

Introduction

Huge soft tissue defects involving the lower limb remain a real reconstructive surgery challenge.

Muscle flaps are frequently used in lower limb reconstruction. Mathes and Nahai, classified muscle flaps according to their blood supply into type I (single dominant vascular pedicle), type II (1 dominant and 1 minor pedicle), type III (2 dominant pedicles), type IV (segmental branches), and type V (1 dominant and multiple minor pedicles). They sometimes require a skin graft on the transposed muscle to complete closure of the defect.[1, 2]

Free flaps either musculo or fasciocutaneous are used to refer to the transfer of tissue with its vascular pedicle from an origin donor site to a recipient site; the pedicle is anastomosed to local vessels using

microsurgery techniques. These flaps technique can cover a larger surface area and can be shaped and fitted to any cavity. However, the disadvantages of free flaps include donor site morbidity, longer operative time, and delayed rehabilitation of the lower limb, mainly the knee.[3-5]

The repair of defects after severe trauma with extended soft tissue loss over the anterior aspect of the upper and middle third of the leg is challenging due to the shortage of available local options for coverage of large defects.[6,7]

One of the options is the gastrocnemius muscle flap. It is a regional workhorse flap for reconstruction of defects of the upper third of the leg and defects of the knee. This can be attributed to its reliable anatomy and powerful blood supply.[8] The gastrocnemius muscle has two heads: medial and lateral. Each head can be mobilized on its own neurovascular pedicle.[9] The medial and lateral sural arteries, supply the medial and the lateral head of the gastrocnemius muscle, respectively. Each musculocutaneous perforator can supply a large area of skin proximally and a significant amount distal to the muscle belly.[10]

The Sartorius muscle is the body's longest muscle. It is used to cover the abdominal wall, the inguinal zone, and the distal third of the thigh as a pedicled flap or as a reconstructive flap.[11-13] The Sartorius muscle is supplied with blood via various branches of the femoral artery.

The Tibialis anterior flap procedure is a useful option for providing soft tissue cover for exposed open tibial injuries in the middle and distal thirds of the tibia. The Tibialis anterior muscle is an indispensable as its important function of dorsiflexion and inversion of the foot. Thus, only part of it can be used to provide soft tissue coverage.[11] This case study reports the effectiveness of usage of multiple muscle flaps as a potential alternative cover for a large post-traumatic defect involving the lower limb instead of free flaps.

Case Presentation

A fifty-five-year-old female patient presented to the Emergency department with a crush /degloving injury of the right lower limb involving (right thigh and leg) with an open comminuted fracture of the femur, the tibia, and the fibula. The patient experienced a motor car accident in which the patient was stuck in between a heavy truck and a wall and was dragged by that heavy truck.

Examination of the right lower limb showed an open comminuted fracture of the femur, the tibia, and the fibula with bone loss of the anterior surface of the femur and the tibia. Besides, there was an avulsion of skin covering the anterior-medial aspect of the thigh and knee. Muscles of the anterior compartment of the thigh were devitalized. Muscles of the anterior, posterior, and lateral compartments of the leg were viable, femoral vessels and nerves were not exposed. Distal pulsation was felt with no signs of limb ischemia (Figure 1A and 1B).

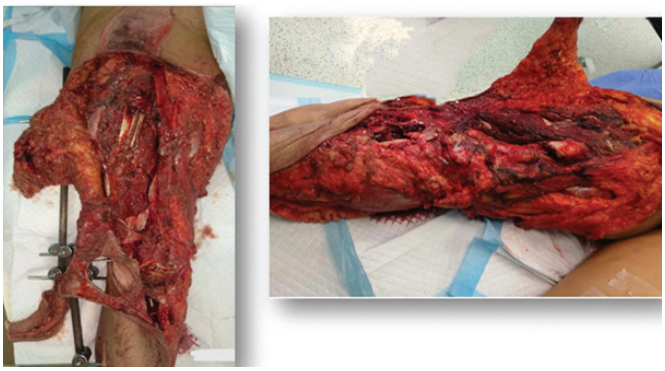

Figure 1A: Anterior view of comminuted fracture of the femur with avulsion of skin covering the anterior-medial aspect of the thigh, knee, devitalized muscles, and loss of the patella

Figure 1B: Medial view of comminuted fracture of the femur with avulsion of skin covering the anterior-medial aspect of the thigh, knee, devitalized muscles, and loss of the patella

Radiological computerized tomography (CT) study showed displaced comminuted fractures involving the lower shaft of the femur, proximal fibula, and middle third of the shaft of the tibia, tangential bone loss of 1/3 of the thickness of the lower shaft of the femur, and upper 1/3 of the tibia and loss of the patella.

The patient underwent external fixator application and multiple sessions of wound debridement of the avulsed soft tissue and excision of necrotic bony fragments along with the orthopedic team. This ended in an exposed bone marrow cavity of the distal femur and the proximal tibia with major

loss of the bone of the tibial condyle and the tibial tuberosity.

Application of antibiotic beads (Gentamycin 40 G) in the bone cavity was done to guard against bone infection. The exposed area of the midshaft of the femur was covered by an approximation of the surrounding muscles (Figure 2A and 2B).

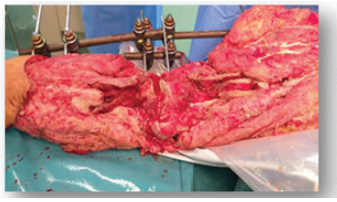

Figure 2A: Comminuted fractures involving the lower shaft of the femur and loss of patella

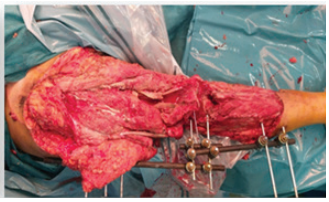

Figure 2B: Coverage of the mid shaft of the femur by approximation of the surrounding muscles

The patient underwent multiple reconstructive sessions to cover the huge defect in the right lower limb, involving the lower third of the femur, knee, upper and mid-third of the leg. In the following order (Figure 3):

1. Medial Gastrocnemius muscle flap (Island Flap) to cover the knee (Type I)
2. Lateral Gastrocnemius muscle flap (Island Flap) to cover the upper third of Tibia (Type I)
3. Sartorius muscle distally based transposition flap used to cover lower part of the femur (Type IV)
4. Tibialis anterior muscle used as split open book flap to cover the exposed middle third of Tibia (Type IV)

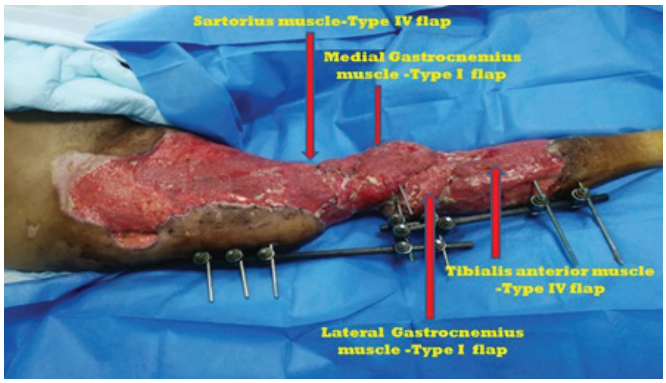

Figure 3: Description of multiple muscle flaps used in reconstruction as illustrated in pointed arrows after their final inset

Finally, the patient underwent a split-thickness skin graft over the whole exposed granulated tissues of the right lower limb in a separate operative procedure session (Figure 4).

During recovery, the patient was on regular sessions of physiotherapy and rehabilitation utilizing Zimmer frame/ Crutches. The patient was discharged home after being able to mobilize with knee brace support and non-weight bearing on her injured lower limb. Patient consent was obtained for the publication of this case report.

Figure 4: Split- thickness skin graft was applied on the exposed granulated tissue

Discussion

Skin and soft tissue defects of the lower limb after trauma are commonly encountered in plastic surgery practice. The reconstructive options chosen for the patients, aims to improve the overall outcome aesthetically and functionally. The large defects involving multiple zones (thigh, upper, mid, and lower third of the leg) have very limited options like fasciocutaneous flaps, muscle flaps, and free flaps.[11]

Recently, free flaps have been the most frequently employed flap for coverage of most defects of lower limbs. Free flaps are the most advanced level of the reconstructive ladder and should be used only for defects that cannot be covered by regional or local flaps. Nevertheless, free flaps lead to donor site morbidity and needs intensive post-operative monitoring and there are chances of re-exploration.[11]

The advantage of the gastrocnemius muscle flap is that the flap can cover soft tissue defects up to the middle third of the leg successfully without any complications. Its main disadvantage is contour deformity, which can be acceptable if the muscle is harvested alone and not as a myocutaneous flap.[8]

In the era of microsurgery procedures, the usage of gastrocnemius muscle flap for the reconstruction of soft tissue defects involving the upper and middle third of the leg requires a simple technique. It allows a reliable coverage of these defects without sacrificing a major nerve or vessel to the foot. Moreover, donor site morbidity is negligible compared to fasciocutaneous flap. Fasciocutaneous flap was not available as an option for this patient due to large soft tissue loss of the whole anteromedial aspect of the mid-thigh, knee, and upper third of the leg.[8]

Due to its segmental blood supply, the Sartorius flap is useful for covering wounds around the knee as well as the superior part of the leg. It is most frequently supplied by branches of the saphenous artery or the descending genicular artery via anastomoses with the posterior tibial artery and the medial inferior genicular artery. Muscle harvesting technique is a relatively simple. The procedure has a low rate of flap morbidity.[12]

Similarly, the tibialis anterior muscle has a type IV pattern, with eight to twelve short segmental branches originating from the anterior tibial artery and having connections at the anteromedial portion of the muscle. The Tibialis anterior flap is harvested by severing the muscle laterally or medially and turning it over the tibia, while retaining some segmental pedicles.[14, 15]

The preservation of function of the tibialis anterior muscle following its use as a split turnover flap may be explained by the tibialis anterior muscle fibers being arranged in a "circumpennate" pattern with fibers radiating from the central tendon. This arrangement lends the axial tendon considerable strength.[15]

Conclusion

Multiple muscle flaps options that utilize dispensable muscles or part of it, is a safe and reliable technique in providing stable soft tissue cover for major post-traumatic defects of the lower limbs.

These simple multiple flaps require short operative time, no microsurgery expertise, short hospital stay, and expedite the postoperative rehabilitation.

Conflict of Interest

None

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