



Distally-Based Vastus Lateralis Muscle Flap: An Alternative Regional Flap; Case Report and Review of the Literature

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Abstract

Classically, the pedicled gastrocnemius flap is the first choice for reconstruction of soft-tissue defects around the knee. However, this flap is not always available for transfer. This article reports the case of an alternative regional flaps by vastus lateralis muscle employed for reconstruction of soft tissue defects around the knee joint, in 48-year-old male operated for an open proximal right tibia fracture which complicated by knee arthritis with soft tissue necrosis.

Keywords: Vastus lateralis muscle; Flap; Coverage

Introduction

Soft tissue defects around the knee joint are common and represents a special challenge for reconstructive surgeons due the paucity of regional soft tissue flaps available. They can be caused by varied etiology like trauma, burns, scar release, surgical infections, and after tumor resection. A wide variety of reconstructive options has been described, which have their respective advantages and disadvantages [1,2]. They include loco-regional flaps (like fasciocutaneous flap, muscle flap, venous flaps, perforator flaps etc.), cross-leg flap and free tissue transfer. The medial or lateral gastrocnemius muscle or musculocutaneous flap represents the most popular used muscle for the coverage of the defects around the knee. However, when the gastrocnemius muscle flap have already been used and failed, or in some situations like amputation, and vascular injury to popliteal, this flap is unavailable for transfer, and distally based vastus lateralis muscle flaps represent a rescue flap [3].

Herein, we describe the use of distally based vastus lateralis muscle flap in the surgical repair of defect around the knee joint by septic arthritis, in-patient with local medial gastrocnemius muscle flap for an open proximal right tibia fracture.

Case Presentation

A 48-year-old male had a Gustilo type IIIA open leg fracture with a homolateral open Schatzker type II fracture of the right tibia plateau with loss of cutaneous tissue resulting from a traffic accident. After debridement and trimming, an external fixator for stabilizing tibia has been placed with buried pins in the tibia plateau. A medial gastrocnemius muscle flap to cover the antero-medial aspect of the knee was done 10 days after the trauma. Four weeks after surgery, the patient experienced swollen, erythematous knee and temperature of 39°C. At first, he consulted local medical facility, which prescribed him an ATB and NSAID. Over the course of the next ten days, he developed worsening of his symptoms with soft tissue necrosis which gradually enlarged and the patient was transferred to our department. On the physical examination, her right knee was slightly swollen with normal skin temperature. A large area of irregularly shaped necrotic skin was observed at the anterolateral aspect of the right knee (Figure 1). The range of motion of the knee was between 10° and 40°. Laboratory tests revealed a white blood cell count of $12.6/\text{mm}^3 \times 10^3/\text{mm}^3$, C-reactive protein of 60 mg/L and erythrocyte sedimentation rate of 37 mm/h. Subsequently, he was transferred to the operation room for irrigation and debridement. Bacterial culture revealed infection of the joint and wound with *P. aeruginosa*, which was sensitive to ceftazidime, amikacin, and ciprofloxacin. The patient received a combination of ceftazidime and amikacin for 4 weeks. After one month of regular dressing, wound care and ATB, knee arthrodesis with coverage by distally-based vastus lateralis muscle flap were decided. The patient was placed in a supine position with a roll under the ipsilateral buttock. After preparing the tibial and femoral extremities, arthrodesis was achieved with two 5 mm-diameter Steinman cross-pins and protected by a single-plane femorotibial Orthofix

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Received Date: 29 Dec 2020

Accepted Date: 27 Jan 2021

Published Date: 02 Feb 2021

Citation:

Youssef J, Ali Z, Benchekroun M, Tanane M, Jaafar A, Bouabid S. Distally-Based Vastus Lateralis Muscle Flap: An Alternative Regional Flap; Case Report and Review of the Literature. *Ann Orthop Musculoskelet Disord.* 2021; 4(1): 1026.

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Figure 1: Clinical photograph showing a large area of skin necrosis in the lateral aspect of the knee.



Figure 2: The vastus lateralis flap was harvested and transferred in the lateral aspect of the knee, with Orthofix external fixator.



Figure 3: The vastus lateralis flap was harvested and transferred in the lateral aspect of the knee, with Orthofix external fixator.

external fixator. Then, a lateral incision from a point 10 cm below the ASIS at the level of the greater trochanter to the lateral condyle of the femur was made. After opening the fascia, the border between the vastus lateralis and medialis is identified and separated. The flap was dissected proximally, dividing the IT (Iliotibial) band and leaving the anterior 1/2 adherent to the vastus lateralis muscle. The portion of the vastus lateralis under the posterior 1/2 of the IT band was dissected from the femur and the undersurface of the posterior portion of the IT band. The pedicle of the quadriceps and nerve branches towards the vastus lateralis are ligated. The flap is mobilized after verifying its viability up to the area to be covered. It is reversed 180° so that its superficial side deepens in the implanted position (Figure 2 and 3). Cutaneous coverage by a thin skin graft was made 2 weeks later. The patient was then discharged and followed up every month. Five months postoperatively no swelling, tenderness, or evidence of knee infection was noted and radiographs confirmed gross knee fusion and he was allowed to fully weight bear. At 3 years (Figure 3), there has been no occurrence of arthritis of the knee or wound drain-age, and



Figure 4: Anterior view of the knee at 3 years post-operatively.

His gait was basically steady without crutches.

Discussion

The purpose of this paper is to report a case of successful reconstruction of the soft tissue defect around the knee using distally-based vastus lateralis muscle flap. This flap has been firstly used by Swartz et al. [4]. However, the exact description of blood supply for the flap was achieved by Wang et al. [5]. Since then, just few isolated cases and small cases series have been reported in the literature.

The vastus lateralis muscle is the largest muscle of the quadriceps group. It is a primary knee extensor and contributes to the lateral stability of the knee joint. It originates from the great trochanter and lateral intermuscular septum, with some of its fibers originating from the lateral lip of the gluteal tuberosity. It connects via a flat tendon to the base and lateral border of the patella, where it joins the compound quadriceps femoris tendon. According to Wang et al. [5] the vascular supply of this muscle is provided proximally by the descending branch of the lateral circumflex femoral artery from the deep femoral artery. In the distal portion of the muscle, the vascular supply is assured by three main branches, which originate from the deep femoral artery. The mean diameter of these branches was 1.8 mm [6].

A vastus lateralis muscle flap can be used as a free and pedicled flap. As a free flap, vastus lateralis muscle flap is a well established tool for covering soft tissue defects in the head and neck, trunk and lower extremity. As a pedicled flap, several authors underline its efficacy to heal infected cavities due to infected hip joints or hip joint replacement [7]. It can also used as a distally based pedicled flap for the reconstruction of knee defects [4], when other, simpler alternatives have been exhausted. This flap is based on the reverse flow in the anastomoses between the descending branch of the Lateral Circumflex Femoral Artery (LCFA) and the lateral superior genicular artery. The benefits of using distally-based vastus lateralis muscle flap are its size, a wide arc of rotation, a reliable vascular pedicle, minimal donor-site morbidity, its ability to carry quite a large skin island from the distal lateral region, and the procedures of the technique are simple [8]. However, harvesting the entire muscle results a decrease of strength in knee extension. Furthermore, in cases with only muscle flap, this technique requires cover with a split skin graft, with some reports of superficial partial necrosis.

Swartz et al. [4] report the use of distally-based vastus lateralis muscle flaps in five patients. Despite a marginal partial necrosis, skin closure was achieved in all cases, with 30% loss of strength in extension. Aureguan et al. described four clinical operations of the transfer of distally-based vastus lateralis muscle flaps; three around TKA revision and one case of a post-traumatic knee amputation

resulting from a compound open knee injury. Partial necrosis of the flap, which needed surgical excision, was discovered in two cases, and joint mobility was poor.

Other options available for the management of soft-tissue defects around the knee include Negative-pressure wound therapy, which provides continuous removal of the fluid from the wound with constant equal pressure across the entire exposed surface, which allows promoting epithelial migration from the edges toward the center of the wound. Besides the vastus lateralis, other local options for knee reconstruction include the distally based Anterolateral Thigh (ALT) [3], sartorius, and gracilis muscle flaps. When local soft tissue is damaged or other attempts at coverage have failed, free tissue transfer is the preferred method of reconstruction. They provide well-vascularized tissue from an area outside the zone of infection, and can be designed to address composite defects. The most common free flap used is the Latissimus Dorsi Flap, followed by rectus abdominis, and fascia lata [9].

Lankaram et al. [10] reported a series of 15 patients with soft tissue defects around knee joints following different etiologies (electric burn, post-traumatic, and post total knee arthroplasty). Of the 15 patients, 5 had medial thigh based rotation advancement flaps, 4 had Reverse anterolateral thigh flaps, 5 had Gastrocnemius muscle flap with split skin graft and Propeller flap for one patient. Partial necrosis of the flap was observed in one case, and superficial infection in 2 cases. Those complications were managed conservatively.

Conclusion

Soft tissue injuries around the knee present a challenge for providing a cover when there is loss of tissue. Various flaps including muscle flaps and skin flaps have been described which have their own advantages and limitations. In our practice we believe that the vastus lateralis muscle flap is an excellent choice for knee defects when the gastrocnemius flap is not available or sufficient for coverage.

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