

Utility of Pedicle Muscle Flaps in Soft Tissue Reconstruction of the Distal Leg:

A Retrospective Study and Systematic Literature Review

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Statement of Purpose

Pedicle muscle flaps play a pivotal role in lower extremity reconstruction and are an essential tool in covering large, penetrating wounds (Figures 1-2). The use of pedicle muscle flaps illustrate a promising method of not only providing soft tissue coverage, but also aid in limb salvage and restoration of function. This case series provides further exploration of the utility of pedicle muscle flaps for lower extremity limb salvage.

FIGURE 1: Hemisoleus pedicle flap harvest for Achilles wound (left);

FIGURE 2: skin substitute applied over flap (right)



Case Study #1

A 42-year-old female with a medical history significant for HIV with an undetectable viral load involved in a motor vehicle accident, resulting in an open pilon fracture to her right leg. The patient underwent ORIF with primary closure. She then presented with a 5 month history of ulceration to the anterolateral ankle in the location of the initial trauma. The ulceration was debrided and covered with a peroneus brevis muscle flap. The patient was put in an external fixation device for stability. At one week post-op, skin graft was placed over the exposed muscle. At 10 weeks postoperatively, the flap was fully healed. (Figures 3-5)



FIGURE 3-4(Above): Preoperative and 10 week postoperative photos of peroneus brevis flap

Figure 5 (Below): Harvesting P.B. flap



Case Study #2

A 68-year-old male with a history significant for diabetes type 2, CHF and a former smoker consulted for a chronic heel and medial ankle ulcer present for 26 months and gas gangrene with septicemia. This patient underwent a course of 6 weeks of IV antibiotics and was given a vascular assessment. His left superficial femoral artery was occluded and angioplasty was performed to open the vessel. The patient was cleared from a vascular standpoint to proceed with a soleus muscle flap (Figure 6-8) for wound coverage. At 11 weeks, the medial ankle wound was healed and at 14 weeks the plantar heel wound was fully healed.

Figure 6-8:
Soleal muscle flap for medial ankle and heel wound



Case Study #3

A 64-year-old male with no significant past medical history was consulted for a chronic posterior ankle wound with exposed Achilles tendon present for 10 months. The patient underwent a prior surgical debridements and advanced wound care dressings by another physician with no improvement in the wound. The patient's vascular status was optimal. After an initial debridement (Figure 9-11), the patient underwent a medial hemisoleal pedicle muscle flap, application of an external fixator for offloading, and coverage with wound VAC and skin substitute. At 13 weeks, the wound was healed.

Figure 9-11: Hemisoleus pedicle flap for exposed achilles tendon



Literature Review

Lower extremity soft tissue defects have been reconstructed with reliable results using distally based peroneus brevis flaps and hemisoleus muscle flaps. Peroneus brevis muscle flap procedure was first introduced in 1997 by Mathes and Nahai¹ and later described for distal application in 2001 by Eren et al.² In this technique, the peroneus brevis is dissected to 4-5 centimeters proximal to the lateral malleolus where the most distal peroneal artery pedicle enters the muscle. At this juncture, the muscle can be transpositioned to cover the defect. The soleus muscle flap, first described by Tobin³, has also shown to be effective in lower extremity reconstruction. With its bipenniform shape and independent neurovascular supply to the medial and lateral muscle belly, the soleus can be split along the raphe to create a muscle flap which preserves the muscle's role in plantar flexion. Preoperative angiogram is typically used to find the most proximal posterior tibial artery perforator which is the pivot point for the muscle flap and determines flap length.

Lorenzetti et al. analyzed ten patients who were treated with a peroneus brevis muscle flap for deep wounds in the lower extremity.⁴ All flaps demonstrated complete survival with no need for a secondary flap and function and stability were maintained due to the preservation of the peroneus longus muscle. Hu et al. retrospectively studied 21 patients who were treated with peroneus brevis flaps for hole-shaped defects after debridement due to osteomyelitis, and neurocutaneous flaps, for repairing soft-tissue defects.⁵ Only 1 case developed necrosis in the distal part of the peroneus brevis muscle flap. At 24 month follow-up, the flaps kept optimal texture and shape with no recurrence of osteomyelitis observed. The muscle flap fills post debridement voids, and restores blood flow to the area which enhances antibiotic transport to help achieve infection control. Pu et al.⁶ evaluated 8 patients with open tibial wounds who were treated with reversed medial hemisoleus muscle flaps. In 2 patients there was distal flap necrosis that was treated with debridement and flap readvancement. There was reliable healing to all the wounds with good reconstructive and cosmetic outcomes. In a prospective study by Ahmad et al.⁷, 40 patients with leg wounds with exposed bone were treated with medial or lateral hemisoleus muscle flap. In this study one complete flap loss was observed which required below knee amputation. Limb salvage was achieved in all the patients in these series and they were able to ambulate postoperatively.

Figure 12: External fixator to offload the flap



Discussion

Pedicle muscle flaps have shown success in treating large deep wounds in the lower extremity. Traditionally large wounds that penetrated deep to tendon or bone were treated with free muscle flaps. The difficulty with free muscle flaps is donor site morbidity and need for a microsurgical skill set which necessitates longer and more complicated surgery. Pedicle muscle flaps have been shown to reliably provide full tissue coverage of defects with minimal donor site morbidity and patients are able to achieve functional recovery of their limb. In addition, the surgical procedure does not require microsurgical skills or instruments and is relatively quick compared to free muscle flaps. Pedicle muscle flaps are a valuable and versatile tool for soft tissue reconstruction of the distal leg and should be considered as an option for wounds ranging from traumatic to deep chronic wounds with underlying osteomyelitis.

Figure 13: Harvesting of flap with perforator vessels identified



References

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