Hemisoleus Muscle Flap with Multiplane External Fixator in Infected Pilon Non Union with a Wound

Stephen Frania DPM, FACFAS[1], Naren Patel DPM, AACFAS[2], Benjamin Savasky DPM[3]

[1]Fellowship director, Foot and Ankle Specialists of Ohio, Mentor, OH,[2]Current Fellow, FASO, OH, [3]Resident, University Hospitals

Statement of Purpose

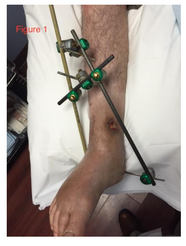
The purposee of this case is to demonstrate how the hemisoleus muscle flap is power option to ameliorate chronic wounds and how to utilize the muscle flap correctively.

Case Presentation

This patient is a 41-year-old male who presented to the hospital after falling out of a dumpster and sustaining a right tibia and fibula fracture. He was initially seen at a local hospital and underwent application of an external fixator. At some point, his prior physician recommended amputation (November 2015). Past medical history includes: cerebral vascular accident, myocardial infarction, hypertension, and dyslipidemia. Social history includes: everyday smoker (one pack per day for 35 years) and alcohol use. The patient is also extremely non-compliant. The patient was first seen by our group in July 2016 (fig. 1 & 2) and was taken to the operating room where we: removed his previous delta frame, applied a multi-planar external fixator to stabilize his open tibial fracture, debrided his wound (down to bone), resected the osteomyelitic bone, performed a tibial osteotomy measuring 3 cm x 2.2 cm x 1.5 cm, applied vancomycin cement, and applied negative wound pressure therapy. The patient was taken for a second surgery (August, 2016) to decipher the progression of osteomyelitis via a bone biopsy which came back positive. The patient was taken for a third surgery (November 2016) where we: harvested his right iliac crest (bone graft), harvested his left iliac crest (bone marrow aspirate), debrided his wound, applied Integra bilayer graft, applied negative wound pressure therapy, and adjusted his external fixator device. It was deemed necessary to take the patient for a fourth surgery (March 2017) after multiple attempts at wound closure. At this point, the continued compression of the external fixator did seem to improve fusion. This surgery consisted of: removal of external fixator, excision of wound down to the level of the bone, biopsy of bone, harvest of medial soleus muscle flap (hemisoleus) with rotation/transposition, application of Integra bilayer graft, application of negative wound pressure therapy, and tibial bone marrow aspirate. The patient's most recent surgery occurred in July 2017. The wound, which was covered with the hemisoleus muscle flap had progressively gotten smaller but would not close (fig 3). The wound was 0.4 cm x 0.2 cm x 1.0 cm. The wound was debrided and a transpositional skin flap was used to close the wound (fig 4). The wound is currently closed and the previous fracture sites now have consolidation. The patient is ambulating in an ankle brace with minimal discomfort (fig 5 &6).

Method

All perforators were pre-operatively identified with a Doppler and marked which coincided at the 5cm, 10cm and 15cm mark from the ankle joint region. A longitudinal incision was placed approximately 1.5cm posteromedial to the posteriomedial border of the tibia. The incision was dissected down to the superficial fascia which was incised. Gastrocnemius muscle was identified and separated distally from the soleus. Careful sharp dissection was performed from the gastroc-soleus myotendinous junction moving proximally separating the two muscles. The medial aspect of the soleus was freed from the gastrocnemius fascia and muscle proximally. At this point the soleus muscle was then dissected off of the tibial from distal to proximal. Care was taken to not violate the deep posterior compartments. Perforators proximal to the 10cm mark were sacrificed to allow for rotation of the muscle. Central raphae of the soleus muscle was identified and 1cm lateral to this the muscle was longitudinally split and rotated anteriorly over the wound bed that was prepared by sharp dissection and pulse lavage. The muscle was then covered with bovine collagen graft and negative pressure wound therapy. A static external fixator was then applied to immobilze the limb and offload the soft tissue reconstruction.



Figures: 1. Patient presented with delta frame placed at a different facility to treat an infected open pilon fracture. 2. Radiographs showing debridement with antibiotic beads. 3. Chronic open wound after hemisoleus muscle flap. 4 Advancement flap to cover chronic wound. 5. Healed scar.

Discussion

Here we saw how this chronic wound was successfully treated with a hemisoleus muscle flap. This is an important case as the number of chronic wounds augments daily. Further, many of these wounds harbor biological and social comorbidities that make traditional wound care unsuccessful. Therefore, the implementation of novel wound care is paramount to prevent the consequences of chronic wounds such as amputation. As illustrated, the hemisoleus muscle flap is a progressive reconstructive technique that should be considered when there is a full thickness wound to the middle of the leg to the proximal foot. However, as the Soleus is the prime ankle flexor and stabilizer of the ankle using this whole muscle as a flap does not go without morbidity (1). The Soleus is a bipennate muscle with independent vascular supply from each half (posterior tibial artery, fibular artery, sural artery). As Ata-ul-Haq et al. showed, utilizing one half of the Soleus muscle retains the function of the muscle and increases the arch of rotation of the flap thus making it easier to orientate the flap for coverage. Hence, it is a superior option then the whole muscle (1). While the hemisoleus muscle flap supports the production of new healthy tissue, there is still the potential for flap failure or revisional surgery which could have catastrophic consequences (2,3). Understanding the arterial supply to the medial soleus could help prevent these failures. Raveendran et al., previously displayed how the medial half of the Soleus muscle is supplied throughout its length by the Posterior Tibial artery. This is important because the muscle can be used accurately proximally or distally. They specifically showed that the perforators from the Posterior Tibial Artery arise 6.5 cm, 11.6 cm, and 16.8 cm from the medial malleolus (4). Being able to mark the perforators out pre-operatively by doppler and identifying them in surgery is paramount in avoiding flap failure

References

1. Ata-il-Haq et al. Hemisoleus muscle flap, a better option for coverage of open fractures involving middle third of tibia. J Ayub Med Coll. 2009 Oct-Dec;21(4):154-8.

2. Keys KA et al., Multivariate predictors of failure after flap coverage of pressure ulcers. Plast Reconstr Surg. 2010;125:1725–1734.

3. Ensat F, et al. The distally based peroneus brevis muscle flap-clinical series and review of the literature. Microsurgery. 2014;34:203–208

4. Raveendran SS, et al. Arterial supply of the soleus muscle: anatomical study of fifty lower limbs. Clin Anat. 2003 May;16(3):248-52.