

## Statement of Purpose

The purpose of this poster is to present an advanced strategy for limb salvage of diabetic patients with difficult to treat foot ulcerations. We present a case series of three diabetic patients with non-healing foot ulcerations who underwent an anterolateral thigh (ALT) free tissue transfer. We present short term outcomes (twelve months) of the three patients. All patients were treated by the same plastic surgeon at a single institution (MI). The donor flaps were taken from the anterolateral thigh and transferred to the affected limb for coverage of the ulceration. Prior to transfer a wide debridement of the ulceration was performed by a podiatric surgeon. We discuss the ALT flap as well as important factors to consider when deciding if this procedure is of benefit to the patient.

## The ALT Free Flap

Diabetic Foot Ulcerations can often be difficult to heal. In a multidisciplinary approach plastic surgeons are often asked to assist with limb salvage. Plastic surgeons have been using free tissue transfer for treatment of large difficult wounds since the 1970's (1). The Anterolateral Thigh Free Tissue Transfer (ALT), has been recently gaining popularity in lower extremity limb salvage of diabetic patients.

The anterolateral thigh (ALT) flap is a fasciocutaneous free tissue flap. The anatomy of the thigh allows for a wide range of tissue harvest with minimal donor site morbidity (4). The flap can be harvested at the suprafascial level to include just skin and subcutaneous fat, and can be trimmed when a thin flap is desired. The flap is supplied by a reliable vascular pedicle that is large and long (4). The flap is supplied by the descending branch of the lateral circumflex femoral artery, the largest branch of the profunda femoris system. This artery, usually associated with two concomitant veins, traverses obliquely with the nerve to vastus lateralis within the groove formed between the rectus femoris and vastus lateralis muscles (Figure 3). The size of the flap needed for soft tissue coverage is determined and mapped out on the thigh. Microsurgical techniques are then used to harvest the tissue flap with associated neurovascular structures (Figure 4). The flap can be as large as 20x40 cm and trimmed to fit almost any lower extremity ulceration (4). The flap is placed over the defect, the nervous and vascular networks are connected, and the flap sutured in place. The patient and flap are monitored in the hospital postoperatively for several days.

There are several key preoperative factors that need to be examined prior to free tissue transfer. These include vascular status, presence of infection, and the overall biomechanics of the limb and whether the foot is still functional.

Vascular supply to the affected area should be optimized for improved flap survival. A study by Kallio et al (2) looked at 63 diabetic patients with chronic lower extremity wounds undergoing free flap transfer. They found that the patients with native in line arterial supply had 79% 5 year amputation free survival while those patients with uncorrectable ischemia had 42% 5 year amputation free survival. Tae Suk et al (5) found that patients with peripheral arterial disease had a 10.2 times higher odds of flap failure compared to those without. Using a multidisciplinary team approach a vascular surgeon should be consulted to maximize blood flow to the area of interest. The vascular surgeon can help to improve the vascular supply with endovascular procedures, arterial bypass, or a hybrid of both. The plastic surgeons are even able to connect the free tissue flap into a bypass to further aid in establishing blood flow to the tissue.

If the lower extremity wound is found to have underlying deep infection, including osteomyelitis, treatment of the infection should take place prior to the free tissue transfer. Aggressive debridement by a podiatric surgeon should be utilized and it may take multiple debridements to clear the infection. Once the area is deemed to be clean by microbiologic and pathologic testing the free tissue transfer can take place. In some cases it can be beneficial to involve a member of the Infectious Disease team in order to help with selection of antibiotic and treatment duration for the infection. Hong et al (7) looked at treatment of ulcerations complicated by chronic osteomyelitis using debridement, antibiotics and perforator free flaps. They found that use of adequate debridement, bone reconstruction, and obliteration of dead space resulted in a primary remission rate of osteomyelitis of 91.6% when combined with a perforator free flap.

The biomechanics and overall function of the foot for ambulation is another important aspect when assessing patients who would benefit from a free tissue transfer. Radiographic and clinical assessment of the lower extremity should be examined. Points with increased pressure due to bony abnormalities should be assessed and resected. Any areas of abnormal pressure can cause breakdown of the flap once the patient begins ambulating and lead to failure of the procedure. Sato et al (3) concluded that the use of orthotics and team approach with pedorthists was effective to prevent recurrence following the reconstruction. Karakostas et al (6) investigated the dynamics, shear forces, and gait adaptations following free flap transfer to the plantar foot. They found that patients used the reconstructed area of the foot effectively and weight bear with adaptations that result in reduction of shear forces in the anterior posterior direction protecting the flap from ulceration. It should be emphasized that if the foot will not be functional following the flap then other options should be considered.

## Case Series

### The ALT Free Flap



**Patient 1: Preoperative**

65-year-old male with diabetes, neuropathy, arterial insufficiency, renal failure, Charcot deformity, and chronic ulcer on plantar left foot with history of osteomyelitis.



**Patient 2: Preoperative**

33-year-old male with type 1 diabetes, neuropathy and chronic ulceration of his left heel and history of osteomyelitis.



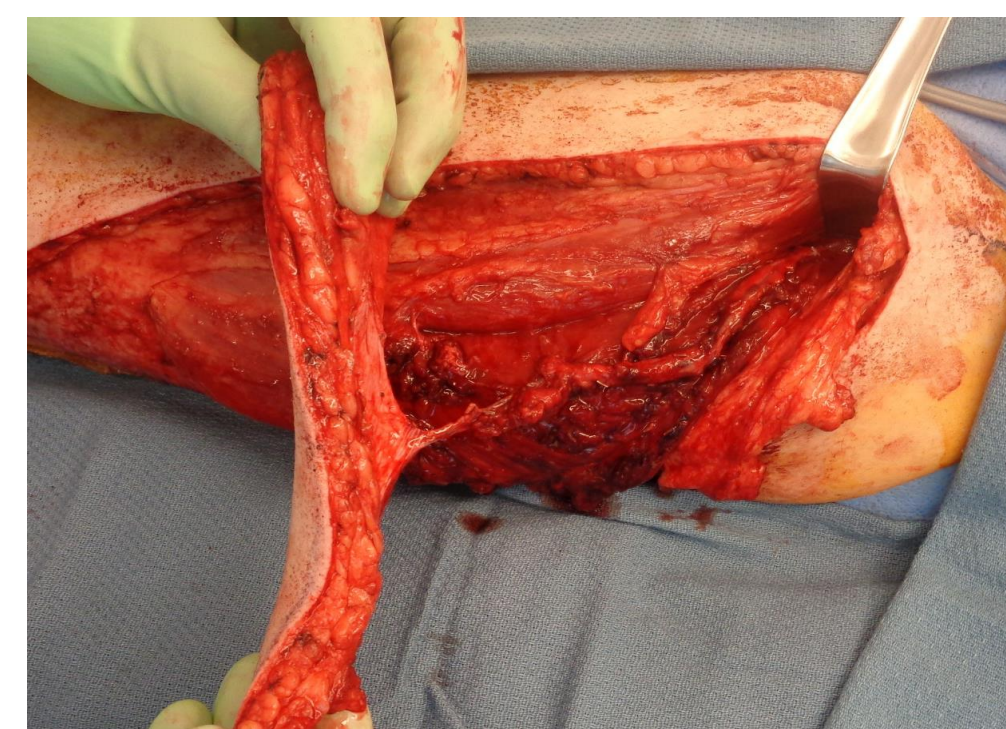
**Patient 3: Preoperative**

63-year-old female with diabetes, neuropathy, and a chronic left heel ulcer with severe underlying osteomyelitis.



**Figure 1:**

Wide debridement to remove all nonviable and infected tissue



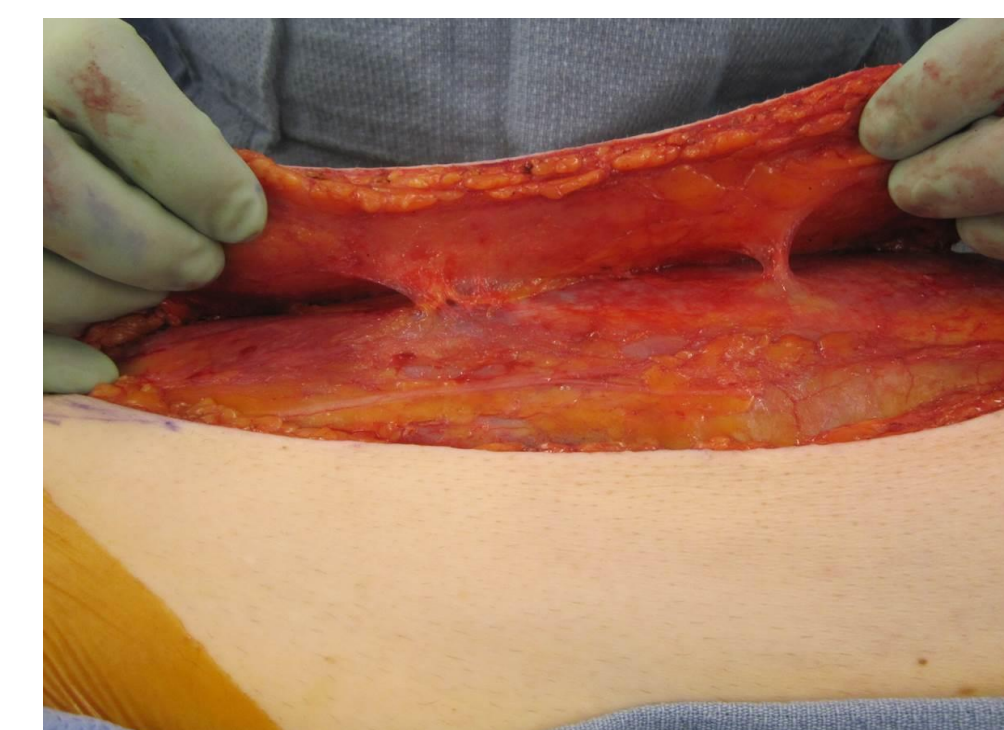
**Figure 3:**

Flap raised with intact nervous and vascular attachments



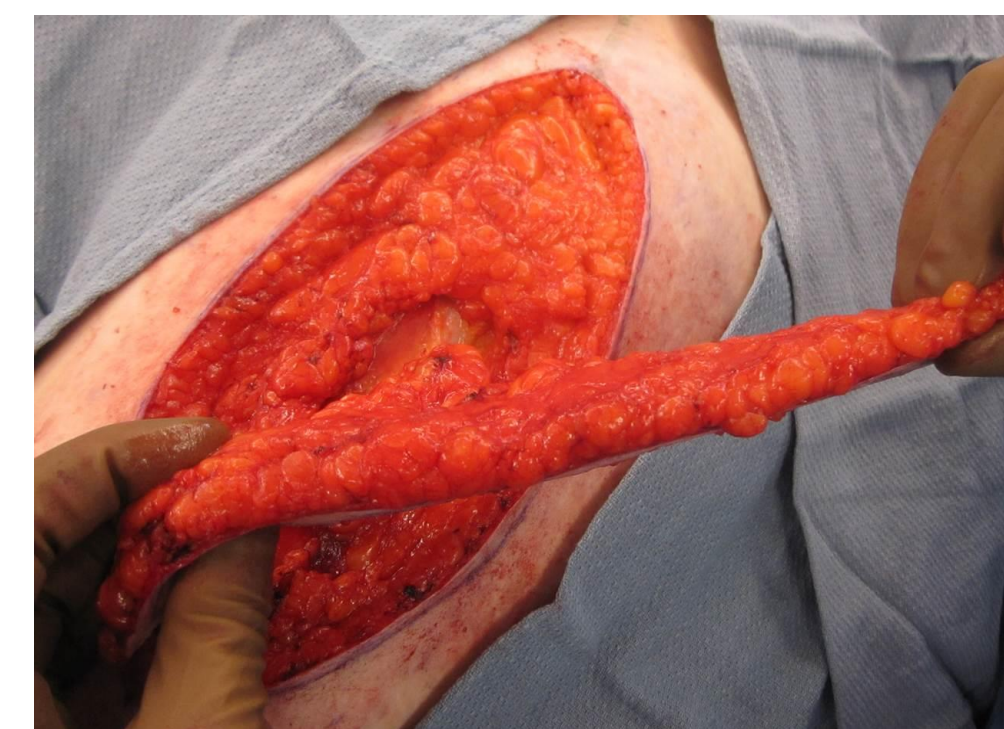
**Figure 5:**

Immediate postop



**Figure 2 :**

Flap Dissection from the anterolateral thigh



**Figure 4:**

Free tissue flap harvested and ready for transfer to ulceration



**Figure 6:**

Immediate postop



**Patient 1: Postoperative**

12 months postoperative the patient is ambulating in accommodative footwear.



**Patient 2: Postoperative**

12 months postoperative the patient is ambulating in accommodative footwear.



**Patient 3: Postoperative**

12 months postoperative the patient is ambulating in accommodative footwear.

## Analysis & Discussion

Limb loss as a result of chronic diabetic foot ulcerations continues to be an important issue. A multidisciplinary effort with the plastic surgeons at our Institution has yielded an advanced option for limb salvage. Our small case series demonstrates that the use of free tissue transfer, using an ALT free flap, is a viable option for those patients with foot ulcerations that are not amenable using traditional techniques such as wound care, offloading, and local forms of closure.

Several small case studies have shown the effectiveness of the free tissue transfer with success rates over 90% (1, 8). A meta-analysis by Xiong et al (8) found that the rate of flap loss was 6.0% and concluded that microsurgical reconstruction of soft tissue defects in the lower extremity could be regarded as safe and reliable.

Our series also reveals that these flaps can hold up on weight bearing surfaces of the foot. All three patients are ambulating in accommodative footwear one year postoperatively.

The podiatric surgeon plays an important role in preparation and long term management of the patients who undergo this procedure. Debridement of the wound and eradication of underlying bone infection is the first important step to successful outcomes. Hong et al (7) looked at treatment of chronic osteomyelitis in 120 patients with a fasciocutaneous perforator flap. They reported a 4.2% flap loss and 8.3% recurrence of osteomyelitis. They concluded that perforator free flaps, such as the ALT flap, work efficiently to cover the defects with chronic osteomyelitis. In a retrospective series by Yazar et al (9), which looked at outcomes of 79 fasciocutaneous flaps used for open ankle and tibia fractures, they found a postoperative rate of osteomyelitis 12.7%. They cited adequate debridement as paramount to the success of the procedure and stated that the presence of underlying infection was a source of treatment failure.

At our institution, we have found promising results for the use of an ALT free tissue transfer for the limb salvage of chronic diabetic foot ulcerations. All three patients included in this series are healed at one year postoperative and ambulating in accommodative footwear. This is a treatment modality that should be considered in those patients facing limb loss. A multi-disciplinary team approach should be utilized to provide the best possible outcomes. Additional long term studies addressing this reconstructive option are needed to confirm its long term benefits in limb salvage.

## References

1. Fitzgerald O'Connor E.J., Vesely M., Holt P.J., et al. A Systematic Review of Free Tissue Transfer in the Management of Non-traumatic Lower Extremity Wounds in Patients with Diabetes. *Eur J Vasc Endovasc Surg* 2011; 41: 391-399.
2. Kallio M., Vikatmaa P., Kantonen I., et al. Strategies for Free Flap Transfer and Revascularization with Long Term Outcome in the Treatment of Large Diabetic Foot Lesions. *Eur J Vasc Endovasc Surg* 2015; 50: 223-230.
3. Sato T., Yana Y., Ichioka S. Free Flap Reconstruction for Diabetic Foot Limb Salvage. *J Plast Hand Surg.* 2017; 51(6): 399-404.
4. Chen H.C., Tang Y.B. Anterolateral Thigh Flap: An Ideal Soft Tissue Flap. *Clin Plast Surg* 2003; 30: 383-401.
5. Oh T.S., Lee H.S., Hong J.P. Diabetic Foot Reconstruction Using Free Flaps Increases 5-year survival rate. *J Plast, Recon, and Anest Surg* 2013; 66: 243-250.
6. Karakostas T., Hsiang S.M., Sarantopoulos C., Krause J. Dynamic Loading Performance of Fasciocutaneous Flaps and Implications for Gait. *Clin Biomechanics* 2007; 22: 478-485.
7. Hong J.P., Goh T., Choi D.H., et al. The Efficacy of Perforator Flaps in the Treatment of Chronic Osteomyelitis. *Plast and Reconstr Surg.* 2017; 140: 179-188.
8. Xiong L., Gazyakan E., Kremer T. et al. Free Flaps for Reconstruction of Soft Tissue Defects in Lower Extremity: A Meta-Analysis on Microsurgical Outcome and Safety. *Microsurgery* 2016; 36: 511-524.
9. Yazar S. et al. Outcome Comparison Between Free Muscle and Free Fasciocutaneous Flaps for Reconstruction of Distal Third and Ankle Traumatic Open Tibial Fractures. *Plast Reconstr Surg.* 2006: 117(7):2468-75.