

# Surgical Management of Charcot Wounds with Intrinsic and Extrinsic Muscle Flaps: A Case Series



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## Purpose

Wound dehiscence is a potential postoperative complication, especially in the diabetic population. Local muscle flaps have been used as a method of revascularizing the wound bed as well as filling the deficit. However, muscle flaps may also provide coverage over hardware and bone to avoid occurrence of osteomyelitis. The purpose of this case series is to present our protocol of intrinsic and extrinsic muscle flap use in prevention of osteomyelitis after acutely infected wounds with exposed bone.

## Methodology:

Five patients included in this case series each presented with a chronic wound with exposed bone; two wound dehiscences and three non-healing diabetic wounds. Location of wounds involved posterior heel, plantar heel, and medial midfoot. Average follow up time was 22 months (range 10-36). Primary outcomes measured were wound healing time with secondary measures being functional outcomes.

The hypothesis we pose is with muscle being integrated as the wound bed, the wounds would heal at an accelerated rate and prevent further infection into bone due to the rich vascular supply and added soft tissue layer.

## Literature Review:

Diabetes is not a contraindication for muscle flap reconstruction in the foot and ankle and will not affect the success of the surgery (1-2). There are reported to be six intrinsic muscles with useful in foot and ankle defects (3). Extrinsic muscle flaps include soleus and peroneus brevis as most commonly utilized.

A proximally based abductor hallucis muscle flap is regarded as versatile and reliable for reconstruction of foot and ankle soft tissue defects with excellent wound coverage over the medial midfoot (3-6).

Ramanajam and Zgonis (3) acknowledged the successful use of intrinsic muscles for flaps including abductor hallucis, flexor digitorum brevis, abductor digiti minimi, and the extensor digitorum brevis muscles.

Local muscle flaps provide a simpler, less expensive, and successful alternative to free flaps for foot and ankle defects that have exposed bone (with or without osteomyelitis), tendon, or joint at their base (2).

Post-operative survival of diabetic patients was superior to the national survival rate of major lower extremity amputees in the 2011 study by Ducic and Attinger (1). Although the presence of diabetes does not determine the success of a flap, albeit twice as many surgeries and twice the healing time is what is incurred. In that same study, they also conclude that intrinsic muscle flaps also have the capacity to extend the life of diabetics facing amputation. In lieu of diabetic foot infections, muscle flaps have provided increased profusion for bacterial clearance, antibiotic availability, and have the capacity to decrease mortality rates of diabetics facing amputation (1,9).

## Procedure:

All patients initially underwent incision and drainage of infected ulceration, bone biopsies, with application of external fixator and appropriate antibiotic therapy. Once bone biopsies returned negative for osteomyelitis and infection stabilized, local muscle flaps were utilized:

**Abductor Hallucis Muscle:** Incision was made medially over the head of the 1<sup>st</sup> metatarsal to the distal tip of the medial malleolus. The abductor hallucis was dissected distally from its attachments at the flexor hallucis brevis. The main blood supply enters the abductor hallucis proximally at the distal tarsal tunnel and care is taken to keep the main pedicle intact proximally. Once freed, the muscle belly with its intact proximal pedicle, the muscle can be used as a local flap over medial wound bases

**Flexor Digitorum Brevis Muscle:** The major pedicle of this muscle is located near the origin of the muscle near the calcaneus. A full-thickness longitudinal incision can be made along the plantar midline to the distal aspect of the calcaneus near its insertion. The muscle belly is dissected away from its soft tissue attachments but care is taken to keep the major pedicle, proximally, intact. This muscle belly can be used as a local flap over plantar heel wounds.

**Abductor Digiti Minimi Muscle:** The major pedicle of this muscle is located near the origin of the muscle near the calcaneus. An incision was made from the lateral 5<sup>th</sup> MPJ to the distal aspect of the calcaneus near its insertion. The muscle belly was dissected away from its soft tissue attachments but care is taken to keep the major proximal pedicle intact. This muscle belly can be used as a local flap over lateral wounds to the foot.

**Peroneus Brevis Muscle:** The peroneus brevis receives its blood supply distally from the peroneal artery. This flap can be up to, approximately, 10 cm long and is 3 cm wide. A longitudinal incision was made over the lateral leg. The brevis was identified, deep to the longus and was dissected off the fibula and freed from attachments to the longus muscle. This flap can be rotated both anteriorly and posteriorly. Care was taken to keep distal pedicles intact arising from the peroneal artery.

Once the respective muscle flaps were mobilized with viable pedicles preserved, each were transpositioned over bone and covered by a synthetic graft as part of the staged procedure. External fixation was removed four weeks later and a split-thickness skin graft was applied to the wound.



From left to right: (1,2,3) July 2016 initial surgery with incision and drainage of left foot and FDB muscle flap and synthetic graft and application of external fixator (4) Application of split thickness skin graft from left thigh to left foot 3 weeks after muscle flap surgery (5) Follow-up appointment in October 2017

## Results:

All patients had initial bone biopsies negative for osteomyelitis. Serial plain films reveal no evidence of osteomyelitis to date. Average follow up time was 22 months with complete wound healing of all five patients. No secondary complications were noted. No significant functional limitations were noted in patient's gait or muscle strength.

## Discussion:

Muscle flap reconstruction in the lower extremity has been well reported in the literature for various complicated wounds involving joints and vascular grafts. Ger et al. appears to be the first to popularize it for the leg, ankle, and foot as a vascular flap for complicated wounds (7) and even prevention of osteomyelitis (8). In his 1977 study, he had successful results in 43 patients with muscle transposition and delayed skin grafting in open tibial fractures. Ger postulated that with early coverage of bone with muscle would prevent osteomyelitis, ulcerations, and potentially non-unions (8).

In a case series by Schwabegger et al., an abductor hallucis muscle flap was used for medial foot defects. Four-year follow up showed durable coverage with complete healing and no gait deficits.

Ducic and Attinger (1) compared 38 diabetic and 42 non-diabetic patients undergoing foot and ankle muscle flap reconstruction with no statistically significant difference in success rates. However, it was noted that the diabetic patients required more debridements and longer healing times with shorter survival rates.

In 2012, Ramanajam and Zgonis (3) concluded that the flexor digitorum brevis muscle also provided successful wound coverage for a plantar wound, and that the use of the flexor digitorum brevis muscle provides low donor site morbidity and well-vascularized tissue.

In conclusion, muscle flaps serve to accelerate the healing process and decrease osteomyelitis by providing a rich vascular bed, adding soft tissue layers, and providing a barrier from outside pathogens during the healing process of the Charcot wounds. This case series details the use of multiple intrinsic and extrinsic muscle flaps as a treatment for open wounds with exposed bone and hardware to prevent osteomyelitis and accelerate regeneration.

## References:

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