Utilization of External Fixation for the Management of Complicated Soft Tissue Wounds Across the Foot and Ankle

Student Club @ DMU

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[1]Robert Clements MS, BBA, [1]Briana Gebert-Oberle MS, BS, [2]Jonathan Nigro BS, [2]Joseph Brown BS, [2]Michael Radcliffe BS, [2]Ryan Larsen BS

[1]CPMS-III, College of Podiatric Medicine and Surgery, Des Moines University, Des Moines, IA

[2]CPMS-II, College of Podiatric Medicine and Surgery, Des Moines University, Des Moines, IA

DES MOINES UNIVERSITY

Statement of Purpose

In the absence of wound protection and stabilization, the wound healing process can be fraught with complications, delayed healing, and associated healthcare costs. This concept is especially relevant when managing comorbid patient populations with lower extremity wounds refractory to conservative treatment. Through this case study, we evaluate the utility of external fixation for protecting and stabilizing complicated soft-tissue wounds of the foot and ankle.

Literature Review

The initial goal of wound management is to optimize wound healing by addressing patient comorbidities, improving arterial perfusion, and eliminating infection through aggressive wound debridement[1,2]. An orthoplastic approach using soft-tissue reconstruction ladder guidelines[3,4] [Figure 1] and its variations[5-7], is used to optimize wound management, improve patient outcomes, and prevent unnecessary amputation. Total contact casting (TCC) is commonly used for protecting and stabilizing lower extremity wounds against direct and indirect pressures[8,9]. However, TCC may be inadequate when addressing complicated wounds featuring gross instability, compromised soft-tissue, persistent infection, and excessive edema and drainage[2,10-13].

When conservative offloading measures are inadequate, external fixation has been utilized as an effective adjunct for wound management and soft-tissue reconstruction without osseous involvement[2,10,11,14,15]; most notably with flap applications[12,16-25] and offloading diabetic ulcers[6,15,26,27]. Similar uses of external fixation are described in upper extremity literature for managing burns, wrist contractures, congenital defects, and severe trauma[28-34].

As an offloading device, external fixation provides protection and immobilization at the ankle joint, eliminating direct compressive forces and indirect shear forces secondary to motion[10,17,21,24,27,35]. As a wound care device, external fixation is beneficial for providing direct visualization of the wound site for continuous monitoring during ancillary procedures and wound healing[2,10,36]. Additional benefits of external fixation include osseous stability, vascular preservation, edema control, management of compartmental pressures, and improved ambulation[10,11,15,37].

Case Study

Consultation was requested for an 83-year-old diabetic male with left distal anterior leg cellulitis with a new wound secondary to a punch biopsy performed two weeks prior on a small chronic leg ulcer to rule out malignancy [Figure 2]. Patient's history was significant for type II diabetes mellitus, chronic lateral leg ulceration, hyperlipidemia, PVD with history of left femoral and popliteal stent four months prior, and partial hearing loss resulting in balance issues.

Patient was admitted to hospital for increased left leg swelling, redness, and pain. Wound measured 2x3x0.8 cm with thick-tan drainage. DVT was excluded per duplex. Patient was started on Vancomycin and Zosyn with WBC 24.72 on admission. Patient was admitted to ICU for hypotension and SIRS and was medically stabilized. MRI revealed intramuscular abscess and gas formation within entire length of tibialis anterior. Patient received additional debridement of tibialis anterior muscle and tendon the next day [Figure 3], and deep cultures were taken for IV antibiotic guidance and management. Limb salvage and amputation options were discussed with the patient and his family.

Case Study Cont.

The decision was made to salvage the patient's leg, so he could remain functional while living at home independently. Three days after initial debridement, vascular surgery performed an angiogram and peroneal atherectomy to optimize arterial leg perfusion. Six days after initial debridement, patient received further debridement and skin substitute graft application secured with negative pressure wound therapy (NPWT) [Figure 4]. An ankle-spanning circular ring fixator was applied to manage pain and control motion across ankle joint [Figure 5], which facilitated partial weight bearing for rehabilitation and activities of daily living.

Patient was discharged to a skilled nursing facility for IV antibiotics, NPWT wound management, and physical therapy. At 6 weeks an autologous split-thickness skin graft was applied to the patient's left foot, ankle, and lower leg. External fixator was removed at 8 ½ weeks, and posterior splint was applied. Over the next 4 weeks, remaining wounds healed with local wound care and patient was fitted for AFO before returning home. Sixteen months following initial consult, the patient remained well healed and fully ambulatory [Figure 6].

Case Study Figures

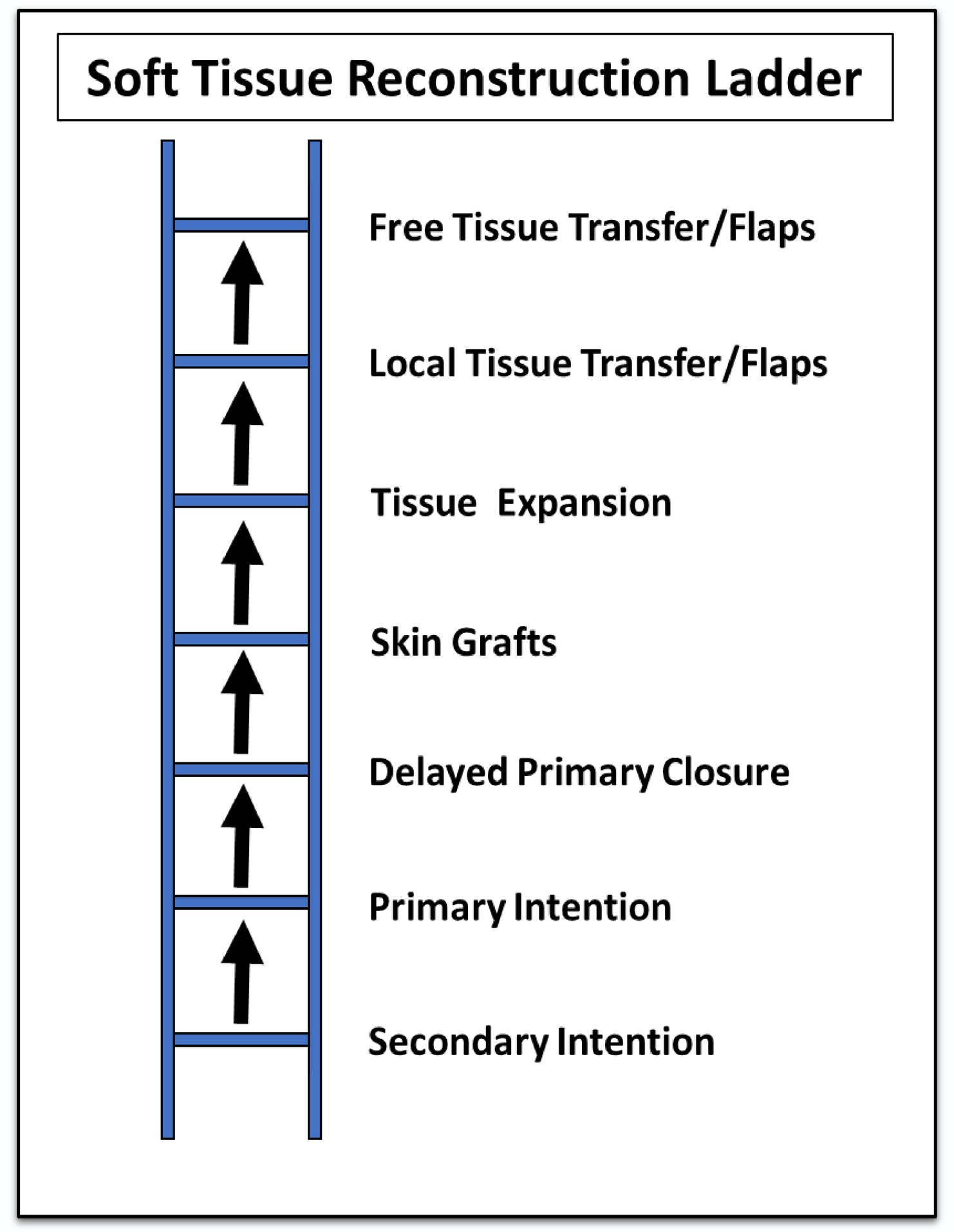

Figure 1. The Soft-Tissue Reconstruction Ladder. A systematic approach for selecting the most appropriate modality for wound closure. Initial treatment consists of the least aggressive modality including wound care products and dressings healed by secondary intention. As indicated, more invasive modalities are progressively introduced on the upper rungs of the ladder to achieve successful wound closure.

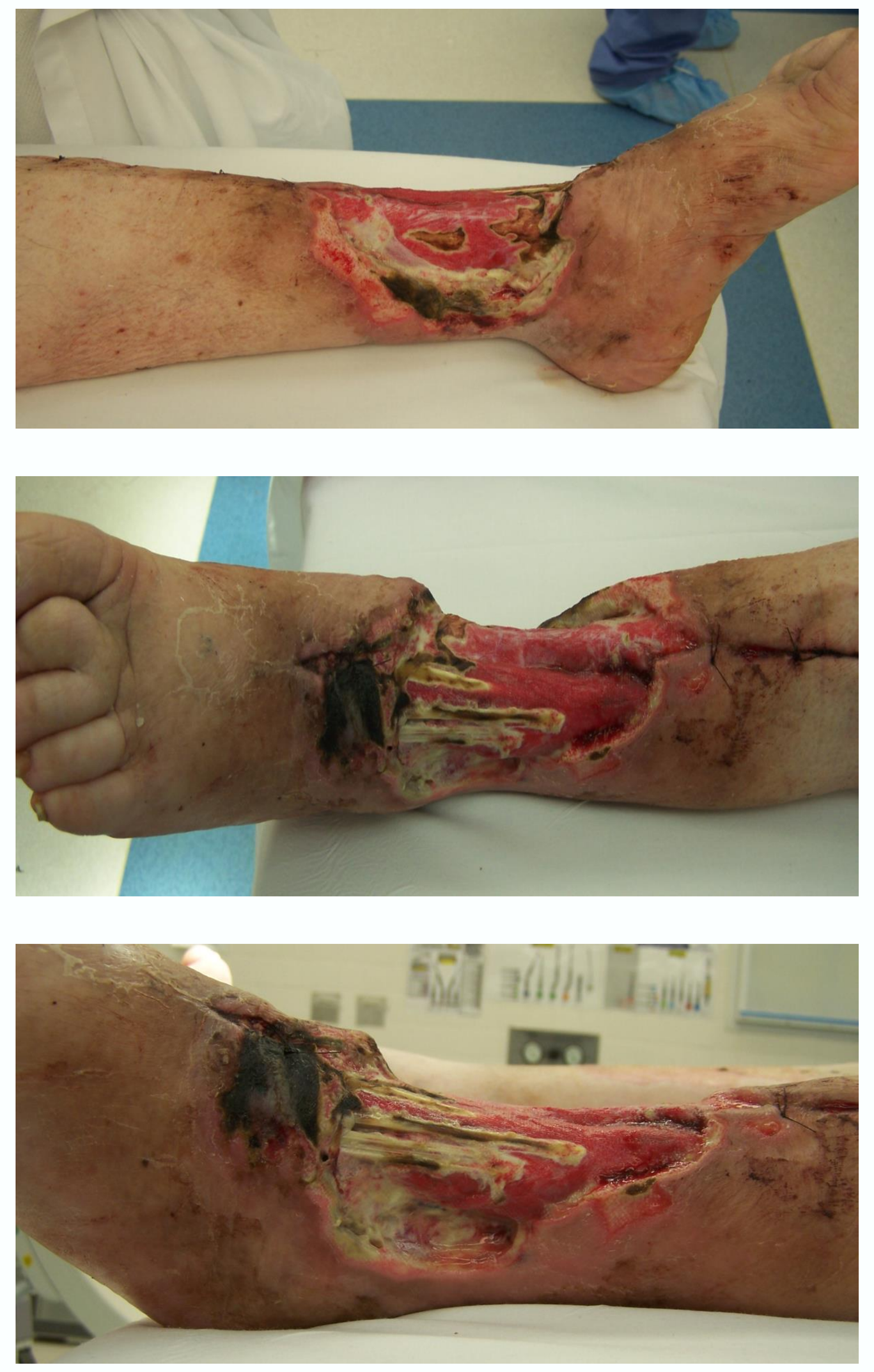

Figure 2. Left leg wound with exposure of the tibialis anterior tendon and muscle. A. Medial. B. Frontal. C. Lateral.

Figure 3. Debridement of tibialis anterior tendon.

Figure 4. Application of skin substitute graft.

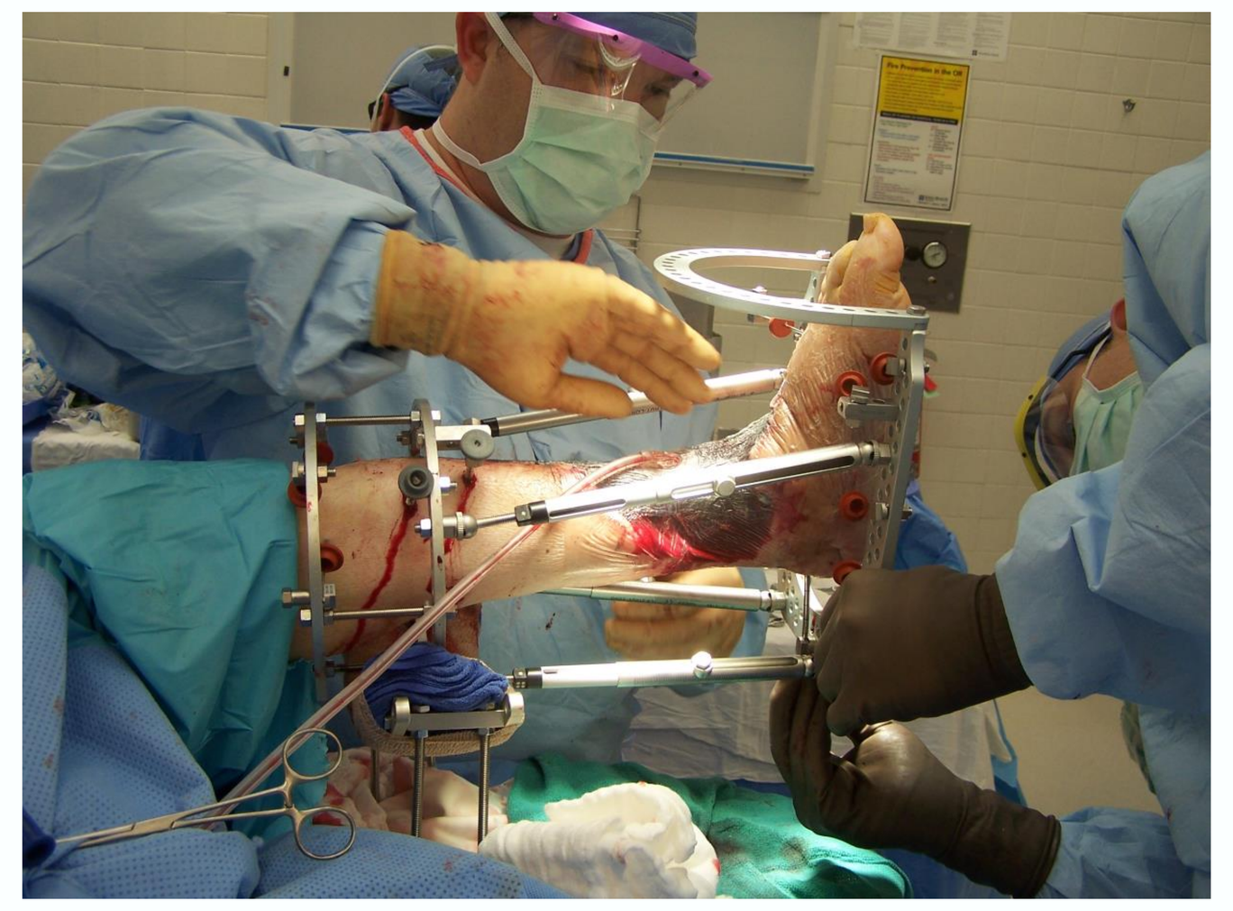

Figure 5. Application of ankle-spanning circular ring fixator.

Figure 6. Fully healed and functional limb 16 months after initial consult.

Analysis & Discussion

Although our current understanding of foot and ankle wound care and soft-tissue reconstruction has become more advanced through clinical and research efforts, wound management remains a challenging task for healthcare providers and their patients. With appropriate patient selection and close supervision, external fixation can be an effective instrument for offloading and observing complicated lower extremity wounds in comorbid patient populations.

Based on current lower extremity literature, external fixation is well documented for offloading flap applications[12,16-25] and diabetic ulcers[6,15,26,27]. However, limited lower extremity studies demonstrate the use of external fixation solely for skin graft application[38]. This area of study could be beneficial for diabetic patients with associated comorbidities, given that this patient population is at a significantly higher risk of delayed healing time, complications, and failure of skin graft application[39], especially when located over an active ankle joint[10].

In our case study, the patient's wound site remained fully healed and functional 16 months following initial consult using external fixation and guidelines outlined in the soft-tissue reconstruction ladder. When viewed in the context of current literature, this case helps to affirm the advantages of external fixation for managing complicated soft-tissue wounds of the lower extremity. Furthermore, we provide additional evidence for utilizing external fixation to facilitate skin graft application in comorbid patient populations refractory to conservative treatment[38].

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