ELSEVIER

Operative Techniques in
Orthopaedics

Fasciocutaneous Flaps for Open Fractures of the Tibia

Joao B. Panattoni, MD

The soft tissue envelope is crucial for proper healing in open tibia fractures. Fasciocutaneous flaps are effective in providing soft tissue coverage in open fractures with severe bone exposure, allowing for healing of the fracture and prevention of infection. Optimal flap selection and timing for definitive soft tissue coverage are controversial. With recent technological advances and surgical technique refinements, the options for flap selection have increased, with greater reliability of complex limb reconstruction procedures. Depending on the injury needs and patient characteristics, different levels of flap complexity can be used to achieve favorable functional and aesthetic outcomes. It is important to keep updated on the newly available technologies and to be aware of the existing surgical options to ensure the best patient care.
Oper Tech Orthop 25:288-297

KEYWORDS fasciocutaneous flaps, tibia fractures, limb reconstruction, limb salvage, mangled extremity, soft tissue coverage

Introduction

Fasciocutaneous flaps contribute greatly to limb reconstructive surgery. The soft tissue envelope and the blood supply provided by the flap are crucial for fracture healing and to avoid complications such as deep infection.[1] This article will discuss the most common flap options for soft tissue coverage of open fractures of the tibia and the indications for their use.

Timing

The presence of wound contamination or ongoing soft tissue necrosis presents a challenge and can delay limb reconstruction. A vascularized limb with stable skeletal fixation and a noncontaminated wound with healthy edges can be a good indication of the readiness for definitive coverage.

Early soft tissue coverage following excisional debridement has been widely accepted as a reliable strategy for limb reconstruction, as it promotes earlier recovery and lower infection rate. In his classic work from 1986, Marko Godina[2] recommended flap coverage within 3 days of injury. Since then, the advent of negative-pressure dressings and improved reconstructive surgical techniques have made this time window less restrictive.[3]

Vacuum-assisted closure (VAC) is a subatmospheric pressure dressing that can serve as a helpful bridge to delayed definitive coverage. It creates a closed environment that promotes rapid granulation tissue formation, reduces edema and may help reduce flap size.[4] Conversely, VAC can create a decreased sense of urgency for the surgeon and thereby delay the definitive coverage.

Several reports indicate lower infection and amputation rates when a VAC is used for less than 7 days.[5] However, other studies report no increased complications with the use of VAC for longer than the first week after injury.[6] Therefore, the debate regarding the best timing for flap application following VAC is ongoing.[7]

Although the optimal timing of definitive soft tissue reconstruction is controversial, it is important to understand that the main goal in reconstructive surgery is to provide the optimal conditions for the bone healing to occur. For that outcome, it is necessary to have a minimal chance of infection, stable skeletal fixation, adequate blood perfusion of the limb and, finally, satisfactory soft tissue coverage. Therefore,

Department of Orthopaedic Surgery, Saint Louis University School of Medicine, St. Louis, Missouri.
*Address reprint requests to Joao Panattoni, MD, Department of Orthopaedic Surgery, Saint Louis University School of Medicine, 3635 Vista Ave, 7th Floor Desloge Towers, St. Louis, Missouri 63110. E-mail: jpanatto@slu.edu

 http://dx.doi.org/10.1053/j.oto.2015.08.005
1048-6666//

definitive soft tissue coverage is not appropriate if the other factors have not been controlled.

Infection is the first item to be addressed. Most open fractures are contaminated with foreign matter and bacteria. Therefore, prompt administration of antibiotics can be viewed as a treatment for presumptive infection rather than simply prophylaxis. Delay of antibiotic administration beyond 3 hours increases the risk of infection. Wide spectrum antibiotic therapy should be maintained for a 3-day course or until 24 hours after definitive wound closure.[8]

A crucial adjunct of infection prevention is the surgical debridement and irrigation of the wound with low-pressure normal saline. Alternative irrigation solutions using bacitracin or soap and methods of pulsatile lavage have shown to be of no increased benefit when compared to low-pressure normal saline irrigation.[9] A surgeon who is familiar with the reconstructive strategies must perform the surgical debridement.[10] Treatment by a surgeon not well versed in this type of reconstructive surgery my result in a "too economic" debridement leaving contaminated necrotic tissue behind and therefore increasing the chance of infection. Alternatively, a debridement may be performed that is "too aggressive," compromising limb perfusion or damaging potential recipient site vessels that are useful for a future soft tissue reconstruction.

Repeat debridement may be required to obtain a healthy, biologically competent tissue before definitive wound closure. Cultures obtained after debridement can provide an objective measure to guide the timing of wound closure or coverage.[11] On occasion, serial debridements are not possible and soft tissue coverage is required even in the presence of positive wound cultures as is the case with severe limb degloving (Fig. 1) or a devascularized limb.[12] The strategy of early flap coverage, in this setting, is to protect the tissues from further necrosis, increase the local blood supply to prevent infection or to provide perfusion to the limb (by protecting a vein graft used for critical revascularization or by using a "flow-through" flap with arterial reconstruction).

Bridging external fixation can be performed as a damage control method if the patient is at risk bacause of concomitant life-threatening injuries or before emergent critical limb revascularization (Fig. 1A). Definitive bone stabilization with external fixators can be associated with malunion and pin track infection.[13] Therefore, unless bone transport is required due to bone loss (Fig. 2 A, E, and F), internal fixation is preferred (Fig. 1B). Internal fixation with an intramedullary nail or compression plate is ideally performed immediately before flap application, after the tissues have been cleaned of the contaminants and infection is under control. A delay between

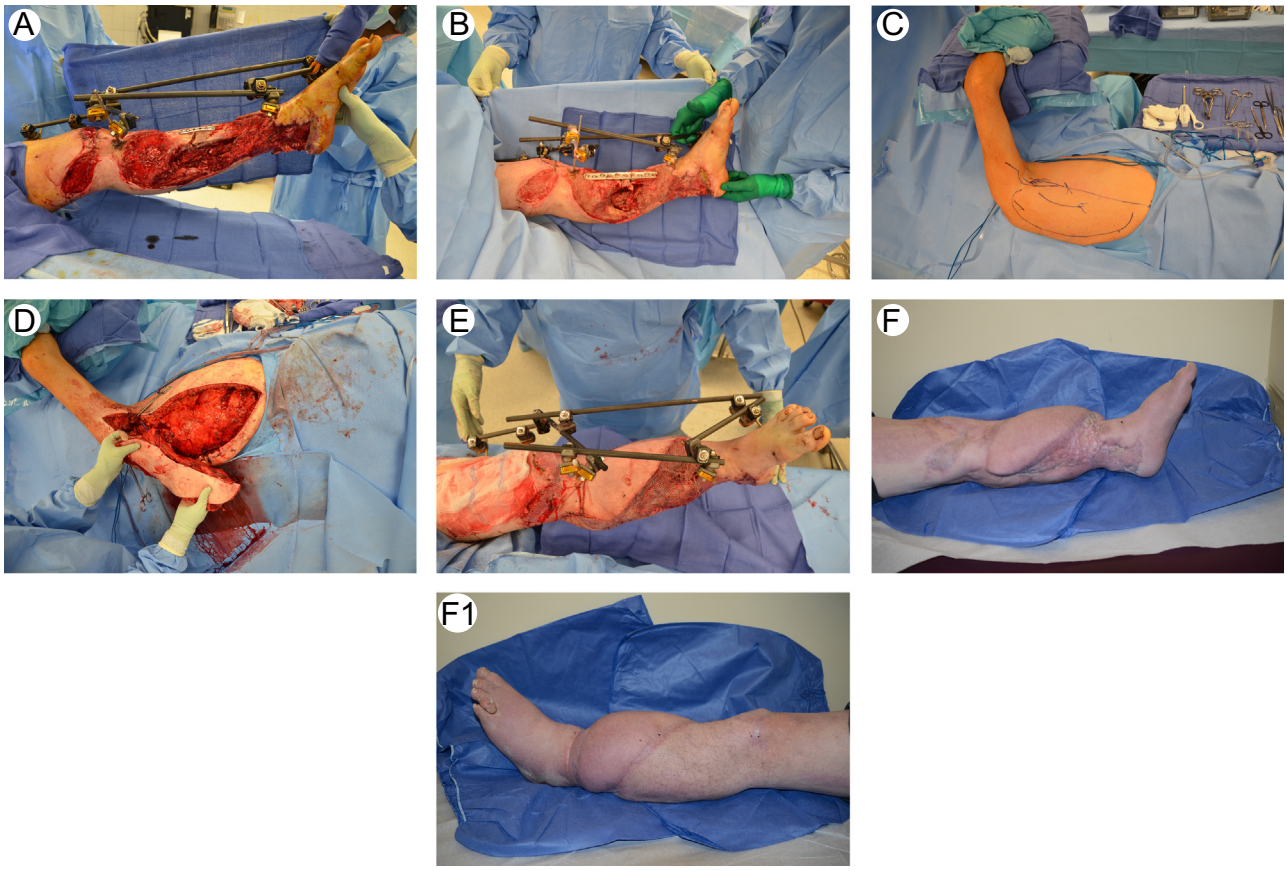

Figure 1 Deglovement injury with large bone exposure managed with latissimus dorsi musculofasciocutaneous flap. (A) Soft tissue defect after application of external fixator. (B) Fixation with plate after removal of devitalized bone and shortening. (C) Patient positioning and flap design. (D) Latissimus dorsi musculofasciocutaneous flap elevated and tethered only by its pedicle. (E) After flap inset and application of split-thickness skin graft. (F) Final result (bone fixation done by Dr J.T. Watson and Dr D. Kuldjanov).