

Using an External Fixation “Kickstand” to Prevent Soft-Tissue Complications and Facilitate Wound Management in Traumatized Extremities

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ABSTRACT

External fixation represents an extremely effective and versatile means of treating severe musculoskeletal injuries of both upper and lower extremities, particularly in austere environments.

A relatively simple modification of standard external fixation techniques can facilitate the care of complex soft-tissue wounds and prevent unnecessary wound complications. Additional carbon bars can be attached to the primary construct to create a “kickstand” that can effectively support the extremity and eliminate the risk for pressure ulcers.

This kickstand modification, which also allows improved access for wound care and dressing changes, has proved to be an effective adjunct in the treatment of high-energy extremity trauma.

Treating a severely traumatized extremity can be a challenge for orthopedic surgeons. Both the skeletal injury and the compromised soft-tissue envelope must be addressed. In an austere environment such as a military field hospital in a combat zone, the challenge can be even greater.^{1,2}

In this type of environment, the surgeon’s armamentarium is extremely limited. Sophisticated internal fixa-

II. Data were collected for all these patients. More than 250 of these cases involved severely traumatized extremities. The most common mechanism of injury was a high-velocity gunshot wound or explosive (98%); 95% of open fractures were grade III-B. The most common treatment modality was external fixation (81%).

The soft-tissue compromise associated with these injuries was often severe, frequently requiring pro-

“This simple technique...is effective in both preventing and reconstructing soft-tissue complications.”

tion devices (eg, plates, screws, intramedullary nails) are seldom available, and external fixation becomes the treatment of choice.^{1,2} In addition, the usual treatment adjuncts (eg, trapeze beds, air mattresses, Bohler-Braun frames) are unavailable, increasing the risk for wound complication and decubitus ulceration.

Here we describe a simple external fixation “kickstand” modification that can be used in an austere environment to facilitate wound management and prevent pressure ulceration.

MATERIALS AND METHODS

Between July 2004 and July 2005, the 115th Field Hospital based at Fort Polk, Louisiana, provided orthopedic surgical care for 672 detainees in support of Operation Iraqi Freedom

longed treatment with a vacuum-assisted closure device before definitive coverage with skin graft or muscle flap. In addition, many patients had concomitantly sustained other significant injuries, the treatment of which required prolonged time in bed. After 4 patients being treated with external fixation developed full-thickness decubitus heel ulcers as a result of their immobility, a kickstand technique was introduced and used on 14 consecutive patients with III-B open fractures.

Technique

The Hoffman II external fixator device (Stryker Howmedica, Mahwah, NJ) was used at the field hospital, but the kickstand technique is amenable to any external fixation system. The tech-

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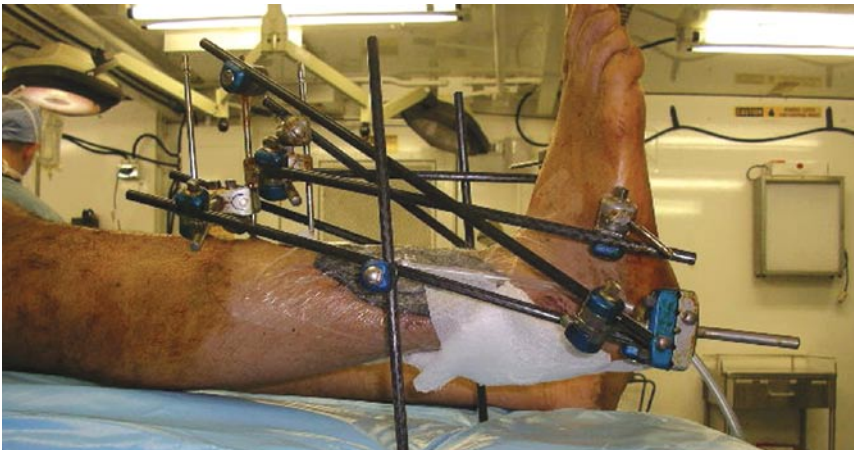


Figure 1. Comminuted, open III-B distal tibia fracture (caused by high-velocity gunshot wound sustained during combat) is stabilized with spanning external fixation. Two additional carbon fiber rods are incorporated into the construct to form a kickstand. The carbon bars extend vertically to elevate the heel several inches off the bed and prevent decubitus ulceration.



Figure 2. Stability of the kickstand construct can be increased by attaching a horizontal carbon-fiber rod to the vertical rods to prevent unnecessary torque on the half-pins.



Figure 3. Full-thickness decubitus heel ulcer in a 25-year-old male Iraqi detainee. The ulcer developed during treatment of an ipsilateral left III-B tibia fracture with spanning external fixation and a contralateral transtibial amputation. The patient's mobility was significantly hindered by the external fixator and his multiple injuries.

nique is simple. Pins are predrilled and placed by hand in fracture-appropriate locations, the fracture is reduced, and the primary external fixation construct is secured. Bar-to-bar clamps are used to attach additional carbon fiber rods on either side of the main external fixation construct, extending toward the surface of the bed. The bars are positioned so that the affected limb is effectively elevated several inches from the bed surface (Figure 1). An additional carbon rod may be placed transversely, also held with bar-to-bar clamps, to add stability to the kickstand (Figure 2). The amount of elevation can be varied according to the situation but should be adequate to prevent ulceration and facilitate dressing changes. In virtually all cases, the external fixator served as definitive fracture fixation and was maintained for approximately 3 months. The frame was well supported, even by the simple beds available in the combat zone. There were no complications related to kickstand or frame.

DISCUSSION

External fixation has been demonstrated to provide an effective and versatile means of treating severe extremity trauma.³⁻⁶ Particularly in a combat environment, where supplies are limited and wounds are often severe and contaminated, external fixation is extremely useful.^{1,2} However, the result of using external fixation is relative immobility, which may make a patient susceptible to decubitus ulceration. For several reasons, this is particularly true in a combat zone. In place of sophisticated hospital beds are simple, poorly padded cots and gurneys with hard, sharp edges, and overhead suspension bars are seldom available. Often, severe concomitant injuries hinder the patient's ability to change position and transfer. The sheer number of casualties makes it difficult for nursing staff to monitor adequately for skin breakdown. And the language barrier between staff and foreign detainees further makes implementing preventive measures difficult. In addition, in an austere environment (vs a civilian setting), duration of external fixation

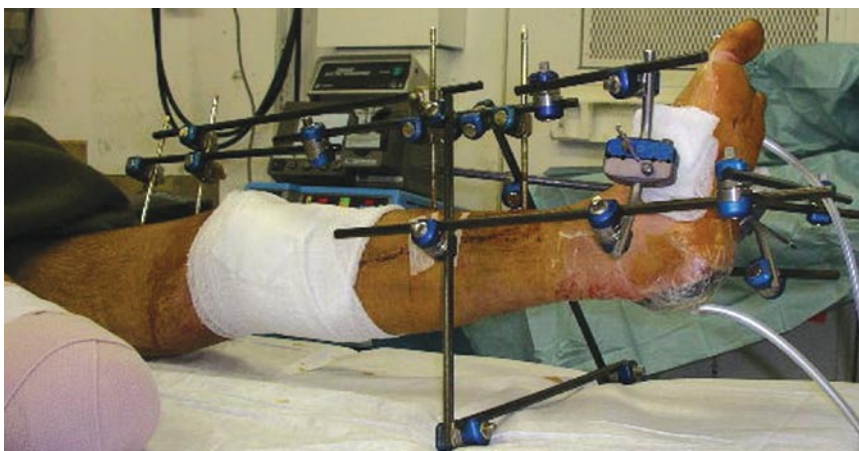


Figure 4. A kickstand was added to the spanning external fixation construct to remove pressure from the ulcer and to facilitate soft-tissue reconstruction using a vacuum-assisted wound dressing followed by split-thickness skin grafting.

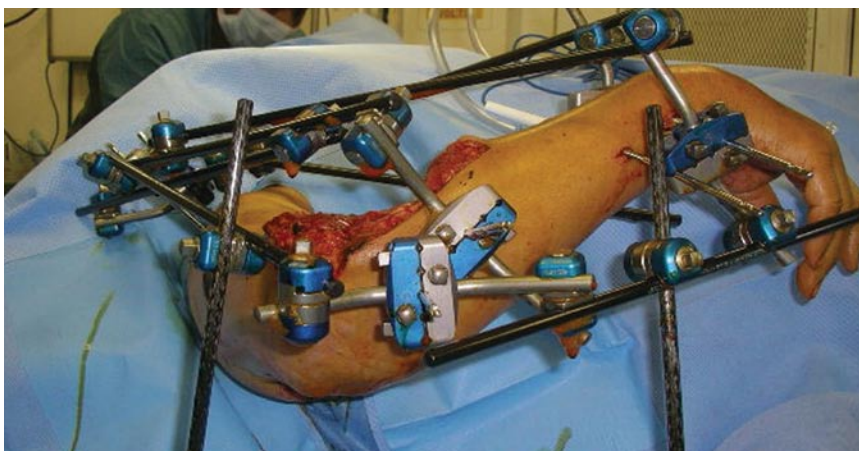


Figure 5. A 50-year-old Iraqi woman sustained open III-B humerus and radius fractures from a high-velocity gunshot wound. A spanning external fixator was applied. A kickstand was incorporated to facilitate wound care. The kickstand provided optimal surgical positioning of the limb for repeat débridements and vacuum dressing changes.

is significantly longer, increasing the risk for decubitus ulceration.^{2,6} Each of these factors may contribute to unnecessary wound complications and decubitus ulcers (Figure 3).

The kickstand modification is a simple technique that effectively eliminates the risk for decubitus ulceration using readily available equipment. Although there is clearly less need for this technique outside the combat environment, the kickstand has proved extremely useful even when heel breakdown occurs or is at risk in the civilian trauma setting. This technique also facilitates application of vacuum dressings and ultimately skin grafts or muscle flaps (Figures 3, 4). The concept of using modified external fixa-

tion to elevate the limb and facilitate soft-tissue reconstruction is not entirely new. Similar constructs have been used to protect free-tissue grafts applied during reconstruction of heel defects.⁷⁻¹¹ As in these reports, we have found the kickstand technique to be simpler and more reliable and effective than other modalities, such as prone position, pillows, and splints.

The kickstand technique has also proved particularly useful in the upper extremity. High-velocity gunshot wounds to the upper extremity often result in severe skeletal and soft-tissue injuries requiring extensive reconstruction.^{4,5} The kickstand technique simplifies limb positioning while the patient is in bed, provides

elevation to decrease edema, and allows easy access for wound and dressing care without painful manipulation of the arm (Figure 5). To our knowledge, our report is the first to describe application of the kickstand technique to the upper extremity.

Conclusions

This report extends the indications for the kickstand technique to include all extremity injuries, upper and lower, treated with external fixation that are at risk for pressure ulceration or require complex concomitant wound care. This simple technique can be performed even in austere environments and is effective in both preventing and reconstructing soft-tissue complications.

AUTHORS' DISCLOSURE STATEMENT

The authors report no actual or potential conflict of interest in relation to this article.

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