The Field Expedient Extremity Tower (FEET)

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Abstract

The field expedient extremity tower (FEET) is a versatile multipurpose radiolucent lower extremity positioner, which can be constructed from readily available external fixator parts and employed as an intraoperative aid for a variety of lower extremity cases. Examples include intramedullary nailing of the tibia, retrograde nailing of the femur, open or percutaneous plating of the distal femur and proximal tibia as well as skin grafting and wound debridements involving the posterior thigh, leg, and foot. In addition, it allows surgeons in austere environments to perform a wide variety of cases employing modern orthopedic techniques with this dual purpose liquid asset which can readily be broken down and reused as an external fixator if needed.

There is an ever-increasing need for disaster preparedness in response to natural catastrophes such as the recent events in Haiti.[1,2] Certain challenges exist in this environment to include logistics, supplies, sterility, and many others.[3-5] However, once the operative team is established in an austere environment, many additional obstacles and surgical challenges present for even routine orthopedic surgical cases.[4]

When performing external fixation, plating, or intramedullary nailing of lower extremity long bone fractures for instance, we have the luxury of using radiolucent triangles, limb positioners, traction tables, or other intraoperative aids to simplify the surgical technique and assist with fracture reduction. While equipment like this is standard in the developed world, it is often not available in an austere or underdeveloped world. In addition, it can take up substantial space and may be excluded from the packing list for a deploying surgical team. The surgeon must adapt to these limitations and create innovative ways to accomplish the same goal with the equipment and personnel at hand.

In this article, we present a novel technique to build an intraoperative aid from commonly available external fixator components that mimics a radiolucent triangle or leg holder that can be used in a variety of cases, such as intramedullary nailing of the tibia, retrograde nailing of the femur, open or percutaneous plating of the distal femur and proximal tibia fractures as well as skin grafting and wound debridements involving the posterior thigh, leg, and plantar foot wounds.

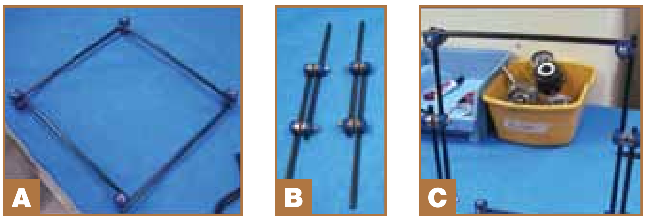
Technique for Assembly and Use

Components Required

First, an inventory of the appropriate parts is made (**Figure 1**). In the example shown, the Hoffmann II External Fixation

Figure 1. An inventory of the parts required for setup of the FEET is made, including 16 rod-to-rod coupling devices, and 11 carbon fiber rods (8x300 mm).

Figure 2. The base is assembled utilizing 4 rods and 4 rod-to-rod coupling devices (A). The adjustable uprights are then added (B) and connected with as crossbar (C).



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System (Stryker Osteosynthesis, Mahwah, New Jersey) components were used, but this technique can be applied to any external fixator system, depending on the instrumentation/components that are available in the austere environment. The inclusion of an external fixation device is a nearly universal requirement for orthopedic surgical teams tasked with deployment into wartime or disaster relief situations. The reusable and utilitarian components used to construct the FEET serves a dual purpose, which is a marked advantage when packing space and weight are limited.

Total instrumentation needed to create the FEET includes the following: 16 rod-to-rod coupling devices (4920-1-010; Stryker), 11 carbon fiber rods (8x300 mm; 5029-8-830; Stryker), and 1 wrench (**Figure 1**). Variations can be made based on need and components available, but the basic tenets for construction are outlined below.

Assembly of the FEET

Assemble the base utilizing 4 rods and 4 rod-to-rod coupling devices assembled with the flat side of the rod-to-rod coupling device towards the table (**Figure 2A**). Assemble the adjustable uprights using 2 pairs of rods and 2 rod-to-rod coupling devices connecting each pair as shown (**Figure 2B**). Connect the 2 adjustable uprights with a crossbar (**Figure 2C**).

Connect the uprights to the base using 2 additional rod-to-rod coupling devices (**Figure 3A**). Add the oblique supports to the "static" upright, which has already been connected to the base (**Figure 3B**).

Pad the portion that will be supporting the extremity, either the crossbar of the adjustable upright or one of the sides of the base, depending on how the FEET is to be used (**Figure 4A**). The 3 clamps connected to the oblique support can be loosened and the construct adjusted to meet the needs of the case. In addition, the 2 clamps connected to the adjustable uprights can also be loosened to raise or lower the height of the crossbar (**Figure 4B, 4C**).

After its use, the uprights can be removed from the base and oblique support (**Figure 5A**). The oblique supports can be folded down, and the uprights placed on top of the base (**Figure 5B, 5C**). The FEET can then be sterilized with the wrench for future use (**Figure 5D**).

Clinical Application

The FEET was successfully used in the treatment of over 50 extremity fractures and wound debridements during Operation Iraqi Freedom in 2006 (n = 40) and during a medical readiness mission in Tegucigalpa, Honduras in 2011 (n = 11). The adjustable nature of the construct permitted various intraoperative applications such as use as an indirect fracture reduction aid for external fixator application, plating, intramedullary nailing, skin grafting, and simple leg elevation while debriding posterior leg wounds. There were no postoperative neurological or vascular injuries associated with use of the FEET. Furthermore, there were no technical or mechanical failures with the FEET or its component parts,

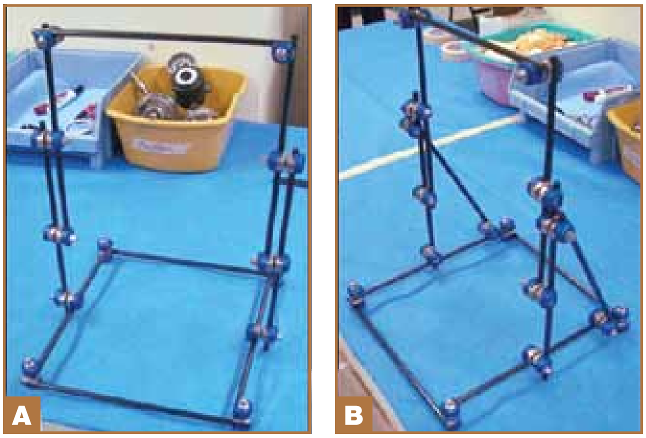

Figure 3. The uprights are then connected to the base using 2 additional rod-to-rod coupling device (A) and oblique supports are added (B).

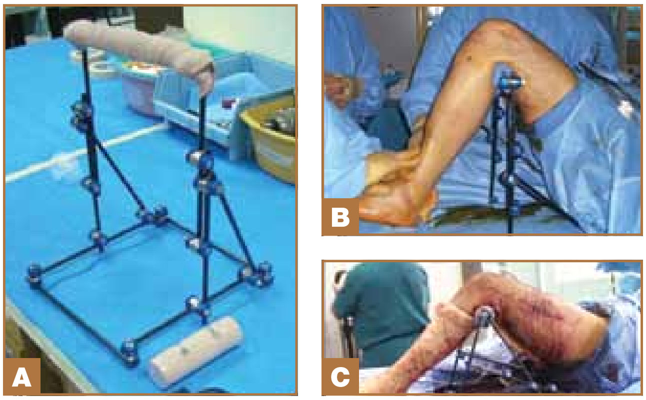

Figure 4. The bar supporting the patient (A), which is dependent on how the FEET is to be used (B, C).

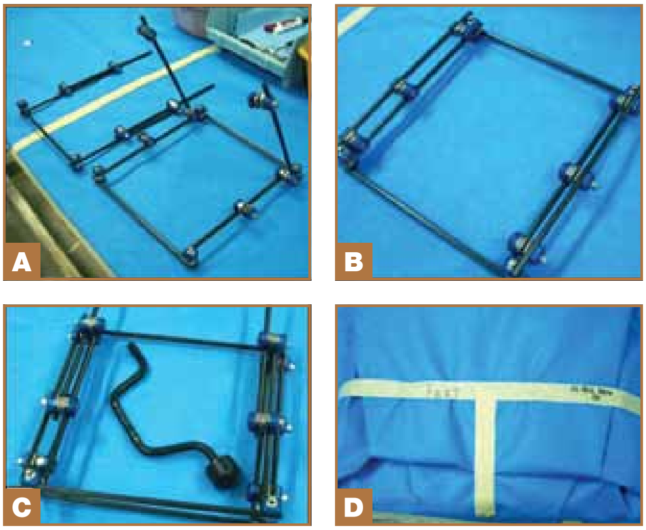

Figure 5. After use, the uprights can be removed from the base and oblique support (A). The oblique supports can then be folded down, the uprights on top of the base (B, C) and wrapped for sterilization (D).

despite its repeated use and resterilization. With minimal training, the operating room technicians and nurses were able to proficiently assemble and break down the FEET in a reproducible manner.

In summary, the FEET is a versatile, multipurpose, radiolucent, lower extremity positioner, which can be constructed from readily available external fixator parts and employed for a wide variety of uses. In addition, it allows surgeons in an austere environment to perform a wide variety of cases employing modern orthopedic techniques with this dual purpose liquid asset which can readily be broken down and reused if needed.

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