Amputated Lower Limb Fixation to the Fracture Table

Axel Gamulin, MD; Mazda Farshad, MD, MPH

Abstract: Fractures of the proximal and diaphyseal femur are frequently internally fixed using a fracture table with fracture reduction obtained by traction and adequate rotation exerted on the slightly abducted extremity. Although rare, these fractures may occur on an amputated limb. If so, standard use of a fracture table is not possible. To address this situation, the authors describe a simple novel technique allowing rigid fixation of the amputated limb to the traction device of the fracture table that provides accurate control of reduction in all planes. [Orthopedics. 2015; 38(11):679-682.]
traction device of the fracture table or (3) fitting the boot of the traction device to the knee of the amputated patient in an inverted fashion, or tying it to the prosthetic foot of the patient. Another alternative is to perform the surgery without a mechanical traction device, especially when the fracture is undisplaced. These approaches are difficult to use in the operating room, as reduction forces are transmitted to the fracture in a suboptimal way.

A simple novel technique allowing rigid fixation of the amputated limb to the traction device of the fracture table for accurate control of the fracture in all planes is described here.

**Materials and Methods**

An 88-year-old male patient with below-knee amputation (BKA) fitted with a prosthetic device on the left side presented to the emergency department with a Vancouver type C periprosthetic femoral shaft fracture on the same side. He had undergone total hip arthroplasty and an open trochanteric fixation for a displaced intertrochanteric femoral fracture associated with symptomatic hip osteoarthrosis 4 years earlier. The patient was mobile and independent before the recent traumatic event. It was decided to treat the periprosthetic fracture by internal plate fixation.

**Surgical Technique**

After general endotracheal anesthesia and intravenous administration of cefuroxime, the patient was positioned on a fracture table fitted with a well-padded perineal post (TruSystem 7500; Trumpf, Ditzingen, Germany). The unaffected limb was flexed to 90° and abducted at the level of the hip, then placed on a dedicated leg support to maintain this position for easy access of the image intensifier. The affected limb was first placed on a flat radiolucent support, and a supracondylar femoral Steinmann pin (Medeco-ch, Duillier, Switzerland) was inserted in a standard fashion, using stab incisions under sterile conditions and fluoroscopic control. The pin was then coupled to a Hoffmann II external fixator construct using standard Hoffmann II pin to rod couplings (Stryker, Selzach, Switzerland). Subsequently, the external fixator construct was fixed to the traction device of the fracture table by inserting and clamping connecting rods into the fixation apparatus that is usually dedicated to the attachment of the boot. Depending on the model and manufacturer of the fracture table, provided accessories such as clamps and extension rails can be used to rigidly fix the connecting rods into the traction device of the fracture table.
necting the Steinmann pin to the traction device.

Surgery was then performed after proper preparation and draping. A modified posterolateral approach (performing a lateral rather than posterolateral skin incision) along the lateral intermuscular septum was used. The previous plate and screw construct was removed. The fracture site was exposed for improving the reduction and then fixed using a 4.5/5.0-mm variable angle locking compression plate and cerclage wires (Synthes, Oberdorf, Switzerland). After fluoroscopic control of the fracture reduction and fixation, copious irrigation was performed and the wound was closed. Staples were used for skin closure. The external fixator construct was disconnected from the fracture table traction device and dismantled. The Steinmann pin was removed and its skin incisions were closed with staples. Non-adhesive sterile dressing was applied. No drains were used. On operating room discharge, the remaining lower extremity was well perfused and popliteal pulse was present. Postoperative radiographs showed adequate fracture reduction and fixation (Figure 6).

RESULTS

Accurate fracture reduction was obtained and maintained until internal fixation completion using this technique. Rotation was precisely controlled through the rigid fixation of the amputated limb to the traction device. There was no pullout of the Steinmann pin even though the bone was radiographically osteopenic. Surgical scars healed uneventfully; there was no postoperative infection, and the scars related to the insertion of the Steinmann pin did not prevent the patient from comfortably using his BKA prosthetic device. The fracture healed after 4 months, and the patient was able to bear full weight on the affected side.

DISCUSSION

Few reports exist regarding the management of proximal or diaphyseal femoral fractures in patients with ipsilateral above-knee amputation or BKA. The main drawback of the previously described closed reduction techniques is their poor ability to control either rotation or traction force (or both) applied on the amputated limb to obtain and maintain adequate fracture reduction until definitive internal fixation is performed. This is mainly due to an insufficiently rigid link between the amputation stump and the traction device of the fracture table: (1) using a rope between the skeletal pin and the traction device may have a good effect on the amount and direction of traction (abduction/adduction), but does not provide stable rotational control due to the inherent twisting property of the rope; (2) a skin traction-like setup provides little rotational control and may be easily unraveled if a significant amount of traction is applied; (3) fitting the boot of the traction device to the knee of the amputated limb or tying it to the prosthetic foot of the patient leads to suboptimal transmission of reduction forces; and (4) manual fracture reduction poorly controls both traction force and rotation. The major advantage of the technique described here is the ability to provide a rotational and traction force control that is similar to the standard use of a fracture table in a nonamputated patient. The Steinmann pin and external fixator construct is sufficiently rigid, well anchored into the bone of the amputation stump, and strongly clamped into the traction device of the fracture table to avoid inadequate rotational control or insufficient traction force.
The application of a Steinmann pin into the bone of an amputated limb carries the theoretical risk of (1) injury to the soft tissues of the stump, (2) infection, and (3) pullout in the case of osteopenic bone. Some authors have emphasized the risk of soft tissue injuries to the inherently fragile stump, especially by describing chronic skin scar discom comfort and pain in an area that has to comply with high compressive and shearing forces related to the use of a prosthetic device.\(^\text{18,19}\) In this case, and in other cases reported by other authors, such a complication did not occur, probably because the Steinmann pin was inserted using minimally invasive stab incisions.\(^\text{9-11}\) The scars related to the insertion of the Steinmann pin did not prevent the patient from comfortably using his BKA prosthetic device.

Pin tract infections are a well-described complication.\(^\text{20,21}\) No infection occurred in the case presented here. The Steinmann pin was inserted under surgical sterile conditions, away from the knee joint, and left in place for no more than the duration of the procedure, thus minimizing the risk of a subsequent infection.\(^\text{21,22}\) Pullout of the Steinmann pin may occur in osteopenic or osteoporotic bone of the amputated stumps (disuse atrophy).\(^\text{8-10,12-14}\) The current authors did not encounter this complication. However, it is plausible to perform fluoroscopic control of the supracondylar Steinmann pin during traction and rotation to the affected limb.

Although the technique described here has been used in a patient with ipsilateral BKA, it could theoretically also be used in patients with above-knee amputation. However, the remaining femur should have enough length to accommodate for the selected implant to be used for fixation.

**CONCLUSION**

When compared with previously published techniques, this simple novel technique of rigid supracondylar pin fixation of the amputated limb to the fracture table via an external fixator is an efficient way to obtain a precise multiplanar reduction control of a proximal or diaphyseal femoral fracture in patients with ipsilateral BKA and potentially also with ipsilateral above-knee amputation.

**REFERENCES**


