ISSN: 3033-358X

Case Report

Journal of Orthopedics and Physiotherapy

Management of an Ipsilateral Intertrochanteric Fracture in a Below-Knee Amputee: A Case Report Highlighting a Novel Modification of the Inverted Boot Technique

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Received: April 01, 2026; **Accepted:** April 10, 2026; **Published:** April 17, 2026

ABSTRACT

Managing intertrochanteric (IT) fractures in below-knee (BK) amputees is challenging, as standard fracture table techniques rely on an intact foot for traction. The inverted boot technique provides a non-invasive alternative, but its success depends on the residual limb length. We present a case of a 62-year-old woman with a left BK amputation and IT fracture. The standard inverted boot method was unsuccessful due to her short stump. The team modified the setup by angling the fracture table's traction arm to 90°, enabling secure traction and successful fixation with a proximal femoral nail (PFN). At 12 weeks, the patient was fully weight-bearing with radiographic healing. This cost-free, simple modification broadens the applicability of the inverted boot technique in amputees with short stumps.

Introduction

Hip fractures are increasing in an aging population, while the prevalence of limb amputations is also rising. By 2030, over 3.5 million Americans are expected to live with limb loss [1]. Consequently, more surgeons will encounter proximal femoral fractures in amputated limbs.

Standard IT fracture fixation involves positioning the patient on a fracture table and applying traction through a boot attached to the foot. In amputees, this method is impractical due to the absence of a distal anchoring point. Alternative strategies are broadly classified as non-invasive (e.g. skin traction, inverted boot) or invasive (e.g. skeletal traction using Steinmann pins or wires) [1,2]. Each carries advantages and limitations, with no established gold standard.

This report describes a BK amputee with an IT fracture managed with PFN using a modified inverted boot method, addressing a previously undocumented limitation in cases with short residual limbs.

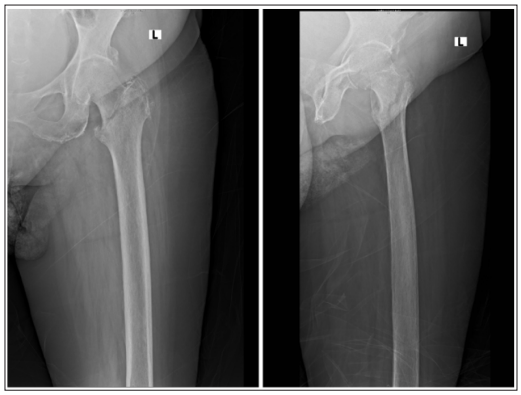
Case Presentation

Patient History

A 62-year-old woman with a left BK amputation, poorly controlled diabetes, and hypertension presented after a fall at home while using her prosthesis and crutch. She had a history of peripheral vascular disease and prior amputations. Due to her comorbidities, minimizing soft tissue disruption was a priority.

Clinical and Radiographic Findings

Examination revealed external rotation and shortening of the left lower limb with tenderness over the proximal femur. Radiographs confirmed an AO 31A2 left IT fracture and an AO 23A2 left distal radius fracture (Figure 1).



Citation: Gowtham Krishna Y, Reuben Cedric Nappoly, Paulson Varghese. Management of an Ipsilateral Intertrochanteric Fracture in a Below-Knee Amputee: A Case Report Highlighting a Novel Modification of the Inverted Boot Technique. J Ortho Physio. 2026. 4(2): 1-3. DOI: doi.org/10.61440/JOP.2026.v4.54

Figure 1: Clinical and Radiographic Findings

Surgical Management

Following glucose stabilization, the patient underwent closed reduction and internal fixation of the IT fracture with a short PFN, followed by K-wire fixation of the distal radius fracture.

The uninjured leg was placed in a stirrup, and the left BK stump was padded. The knee was flexed to 90°, and the stump was secured in an inverted boot using adhesive tape. However, the short residual limb was insufficient to reach the standard traction mechanism, making it impossible to apply longitudinal traction.

Novel Modification

To overcome this, the main traction arm of the fracture table was angled to 90° relative to the table, effectively reducing the distance required for attachment (Figure 2). This adjustment allowed the boot to connect securely to the traction mechanism [3].

With traction and internal rotation, fluoroscopy confirmed anatomical reduction. PFN fixation was completed, followed by wrist stabilization. Both procedures were minimally invasive [4].

Figure 2: Novel Modification

Outcome

The patient mobilized with full weight-bearing on postoperative day 2 using her prosthesis and a walker (Figure 4). At 12 weeks, she was independently ambulant, with radiographs showing union of both fractures and satisfactory implant positioning (Figure 3).

Figure 3

Figure 4

Discussion

IT fractures in amputees present unique technical challenges due to difficulty in applying intraoperative traction. Solutions include:

Non-invasive Methods

- **Skin Traction:** Anjum and McNicholas described adhesive skin traction, though it offers limited rotational control [1].
- **Inverted Boot:** Allows both traction and rotation by securing the stump in a flexed knee position. However, it requires a stump length of at least 12 cm and adequate flexion for boot fitment [1].

Invasive Methods

- **Skeletal Traction:** Involves inserting Steinmann pins or wires into the distal femur or tibial remnant. Provides strong traction but risks pin-site infection, especially in osteoporotic or infected stumps [2,5].
- **Ring Fixators or Distractors:** Offer stable fixation but are resource-intensive, technically demanding, and increase soft tissue morbidity [6].

Our Modification

This report highlights a previously unreported issue failure of the inverted boot method due to short stump length. By angling the traction arm to 90°, the surgeon can bridge the gap and achieve secure connection, avoiding the need for invasive skeletal traction. This simple manoeuvre broadens the inverted boot's applicability and is particularly useful in resource-limited or infection-prone settings.

Conclusion

Treating IT fractures in BK amputees is complex when the residual stump is too short for traction equipment. Our modification angling the traction arm to 90° is a cost-free, practical solution that enables effective traction, avoids invasive techniques, and improves intraoperative control. It expands the scope of the inverted boot technique and enhances patient safety in a vulnerable population.

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