Iranian Journal of Orthopaedic Surgery
Vol. 24, No. 1 (Serial No. 92) Winter 2025, p. 40-43

Management of Concurrent Femoral Shaft Fractures and Amputations Around the Knee

(Report of 2 Cases)

Abstract
Concurrent femoral shaft fractures and lower limb amputations around the knee are rare but complex injuries, often resulting from high-energy trauma. This report reviews the challenges and treatment strategies for such cases, focusing on innovative fracture table positioning and fixation methods in transfemoral, through-knee, and transtibial amputations. We present two novel cases: a 29-year-old man with an above-knee amputation and midshaft femoral fracture treated with delayed intramedullary nailing after external fixation, and a 40-year-old man with a through-knee amputation and open midshaft femoral fracture managed with external fixation, skin grafting, and subsequent plate fixation. Key challenges include patient instability, soft tissue defects, osteoporotic bone, and positioning without distal anchors. Techniques such as Schanz pins, Kirschner wires, inverted boots, and skin traction facilitate the reduction. The review underscores the need for staged approaches and standardized protocols to optimize outcome in such rare scenarios.
Keywords: Femoral shaft fractures, amputations around the knee, case report

Accepted: 40 days before printing

Davood Dehghani Ashkezari, MD[1], Saied Besharaty, MD[2], Seyed Hossein Saeed-Banadaky, MD[1], Milad Gholizadeh, MD[3]

1. Trauma Research Center, Shahid Sadoughi University of Medical Sciences, Yazd, Iran
2. Department of Orthopedic Surgery, Shahid Sadoughi University of Medical Sciences, Yazd, Iran
3. Department of Orthopedic Surgery, Trauma Research Center, Shahid Sadoughi University of Medical Sciences, Yazd, Iran

Corresponding Author:
Milad Gholizadeh, MD
Email address:
Miladghz15255@gmail.com

Introduction

Lower extremity amputations are significant global health concerns, often stemming from vascular disease, diabetes, or high-energy trauma, and pose unique challenges when complicated by concurrent or subsequent femoral fractures. A systematic review by Moxey et al. estimated the global incidence of lower extremity amputations to range from 46.1 to 9600 per 10^5 in diabetic populations and 5.8 to 31 per 10^5 in the general population, highlighting substantial variability influenced by socioeconomic factors, ethnicity, and access to preventive care.[1]

In amputated limbs, femoral fractures are relatively rare, occurring in less than 3% of cases, but they are particularly underreported for shaft fractures, which can arise from altered biomechanics, osteoporosis due to disuse, or traumatic events.[2] High-energy mechanisms, such as road traffic collisions or crush injuries, frequently lead to concurrent femoral fractures and amputations around the knee, complicating management due to multisystem trauma, soft tissue compromise, and the need for staged interventions.[3] These cases require innovative approaches to fracture table positioning, stable fixation in often osteoporotic bone, and prosthetic-compatible rehabilitation to restore mobility. While the literature predominantly focuses on proximal femoral fractures in amputees, with techniques like dynamic hip screws (DHS), proximal femoral nail anti-rotation (PFNA), or arthroplasty described for intertrochanteric or neck fractures, femoral shaft fractures have received less attention. This review synthesizes case reports and studies on fixation strategies across transfemoral, through-knee, and transtibial amputation levels, emphasizing challenges in reduction and fixation.

We also present two cases of concurrent midshaft femoral fractures with amputations around the knee—one treated with delayed intramedullary nailing after above-knee amputation and the other with plating following through-knee amputation—illustrating practical application of staged management in high-energy trauma scenarios leading to amputation.

Above-Knee (Transfemoral) Amputation with Femoral Fracture:

Transfemoral amputation (TFA) result into short stump, complicating fracture table positioning. Nannaparaju et al.[4] reported serial femoral fractures in TFA stumps, treated with dynamic hip screw (DHS) for a proximal fracture and open reduction with a combined dynamic compression plate for a distal fracture, using locking screws and bone grafting to address poor bone quality. Takeba et al.[3] managed a trochanteric fracture post-TFA using a Kirschner wire at the distal stump, connected to the traction table, with manual rotation control for intramedullary nailing. Perumal et al.[5] used bipolar hemiarthroplasty with Schanz pins just proximal to the TFA stump for a femoral neck fracture, ensuring version control. Patnaik et al.[6] performed minimally invasive total hip replacement (THR) for post-traumatic arthritis in a TFA patient, achieving early rehabilitation. Freitas et al.[7] treated a femoral neck fracture with percutaneous screw fixation, using a Schanz pin as a joystick for reduction under fluoroscopy. Davarinos et al.[8] applied skin traction for a non-displaced intertrochanteric fracture, and Aqil et al.[9] used radiolucent thigh support for DHS fixation in bilateral TFAs.

Through-Knee Amputation with Femoral Fracture:

Through-knee amputations preserve femoral condyles, complicating proximal fixation. Wolinsky et al. recommend skeletal pin traction for reduction.[10] Amanatullah et al noted faster progression to total hip arthroplasty (THA) in through-knee amputees (mean 6.4 years) versus above-knee amputees (15.6 years) due to increased hip stress.[11] Arango et al. used bipolar hemiarthroplasty for a femoral neck fracture, achieving stability in short bone stock.[12]

Below-Knee (Transtibial) Amputation with Femoral Fracture:

Transtibial amputations (TTAs) lack foot anchors, complicating traction application. Lee et al.[13] used modified fracture tables with inverted boots and skin traction for intertrochanteric fractures, achieving union with nailing in six months. Ochi et al.[14] managed a TTA with an intertrochanteric fracture using an inverted traction boot for short femoral nail fixation, enabling full weight-bearing. Mitrasinovic et al. treated bilateral diaphyseal femoral fractures in a TTA patient with Steinmann pins and Bohler stirrup for external fixation, followed by nailing.[2]

Two case reports on delayed fixation of femoral shaft fractures with amputations around the knee:

This study was approved by the ethics committee, and informed consent was obtained from the patients.

Case 1: A 29-year-old man sustained a crush injury to the left lower limb and a concurrent femoral shaft fracture due to trauma from agricultural equipment, ultimately requiring an above-knee amputation. Initially, amputation was performed, and an external fixator was applied for the femoral fracture due to the patient's clinical condition. After hemodynamic stabilization and treatment, the patient was discharged. Two months later, once the amputation stump had healed, the external fixator was removed, and the fracture was fixed with an intramedullary nail (Fig. 1).

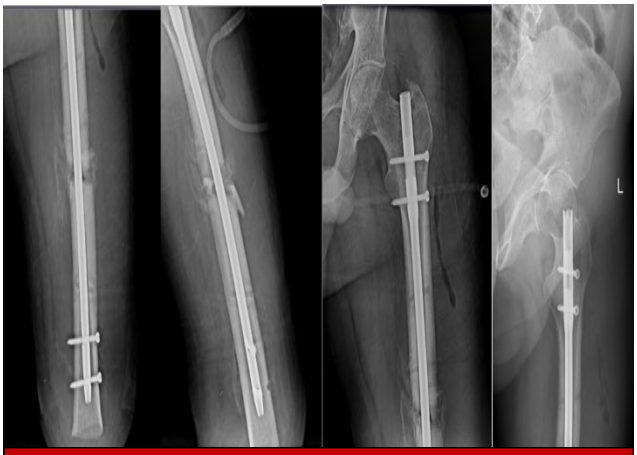

Figure 1: Radiograph of midshaft femoral fracture post-nailing

Case 2: A 40-year-old man suffered a crush injury to the lower limb and an open midshaft femoral fracture from a car-pedestrian accident, leading to a through-knee amputation. Due to the severe crush injury and significant soft tissue defect, there was a risk of requiring an above-knee amputation. However, an external fixator was initially applied to stabilize the fracture, given the open nature and the patient's clinical condition. After soft tissue preparation for grafting, a skin graft was performed, preserving part of the patient's limb. Following partial recovery and graft healing at two months, the external fixator was

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removed, and the fracture was fixed with open reduction and plate fixation (Fig. 2).

Materials & Methods

Concurrent femoral shaft fractures and lower limb amputations are rare but clinically demanding, particularly in high-energy trauma scenarios where multisystem injuries, such as those reported in road traffic collisions or crush mechanisms, lead to simultaneous fractures at various levels in femur and amputations around the knee.[2]

Patients frequently present with hemodynamic instability, necessitating initial orthopedic damage control through external fixation to stabilize fractures, manage open wounds, and facilitate soft tissue reconstruction, as demonstrated in polytrauma cases where delayed definitive fixation reduces complication risks.[3]

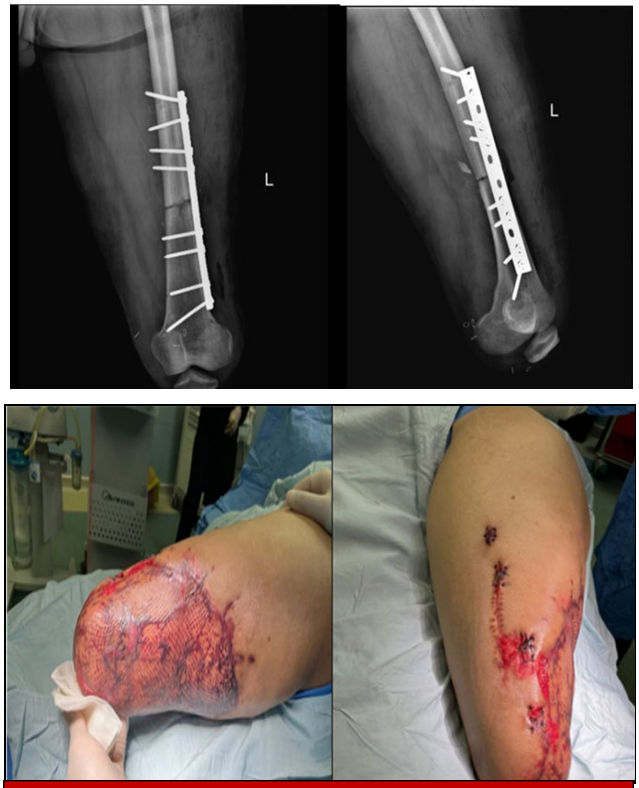

Figure 2: Photograph and radiograph of midshaft femoral fracture post-plating

Soft tissue injuries exacerbate challenges, complicating debridement, wound closure, and subsequent definitive treatment, often requiring skin grafts or flaps, which delay internal fixation and increase the infection rates in often osteoporotic bones, commonly observed in amputees population.[5]

Positioning for surgery is particularly challenging due to the length of the stump and the absence of distal anchors. The literature describes adaptations, such as inverted boots for transtibial amputations, Schanz pins for version control in transfemoral cases, Kirschner wires for traction in short stumps, and skin traction for non- displaced fractures, which enable fluoroscopic-guided reduction on fracture tables.

Conclusion

For proximal femoral fractures the options include DHS for stable and PFNA for unstable intertrochanteric fractures, and arthroplasty (hemi or total) in elderly or arthritic patients for early ambulation. Femoral shaft fracture management is complex, and therefore, plating is favored for distal fractures, which may be risking nonunion in contaminated wounds. Femoral nailing offers biomechanical advantages in midshaft cases, yet carries risks of femoral neck fractures during insertion in osteoporotic bone and would complicate reduction without the use of standard traction. Staged approaches, as in our cases, with initial external fixation followed by nailing or plating after stump healing, mitigate these issues, but standardized protocols are essential to optimize outcomes, reduce reoperation rates, and enhance prosthetic rehabilitation in these rare presentations.

Conflict of interest

The authors declare no conflict of interest.

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