

# Innovative Closed Reduction Technique in Intramedullary Nailing for Femoral Shaft Fracture Using Orthopedic Traction Table and the Impaction Principle

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## Abstract

## Original Research Article

**Background:** Based on simplicity, speed, low cost, and safety, the technique developed in the present work allows, thanks to the traction table, to obtain a stable reduction by impacting the fragments by distracting the distal fragment on a reduced fracture. **Material and methods:** This is a retrospective study of 18 patients treated for displaced femoral shaft fracture on an orthopedic traction table. The contribution of this technique was based on an assessment of operating time, reduction time, exposure to radiation, and the need for assistance or special devices. **Results:** All patients were successfully operated by our technique. There was no need to convert to an open reduction, which contributed to the minimization of intraoperative bleeding. The reduction time was  $10 \pm 3$  min, and the operative time was  $55 \pm 12$  min. Exposure to fluoroscopy was significantly reduced and the need for assistance during the operative procedure was also reduced. **Conclusion:** This technique is simple to perform and does not require any special device, providing an excellent surgical result in a short operative time.

**Keywords:** Femoral shaft fracture; orthopedic traction table; closed reduction; intramedullary nailing.

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## INTRODUCTION

Since its introduction by Kuntscher in 1939 [1], femoral intramedullary nailing remains the GOLD standard for femoral shaft fractures [2]. In fact, Kuntscher [1] insisted on percutaneous intramedullary nailing since it preserves the hematoma, avoids periosteal stripping, and reduces the risk of infection, all of which contribute to bone healing.

Since the fracture site is not exposed, the reduction represents a surgical challenge. Muscles covering the femur are strong and thick, making it difficult for the surgeon to correct the displacement in both frontal and sagittal planes, resulting in longer operative time and increased radiation exposure [4]. Several techniques have been suggested to facilitate closed reduction: the orthopedic table allows correction of length and rotation but does not correct alignment [5]; the percutaneous insertion of Steinman's pin [6,7] allows manipulation of the fragments using a joystick technique [8]; or even reduction using an external support device [9]. Due to the variability of fracture types, the technical set-ups and skills differences, reduction of closed femoral fractures remains a challenge for the surgeon in

the absence of a standard set of instruments for reduction [4].

We have developed a technique based on fragment impaction requiring only the orthopedic traction table and external maneuvers. This technique allows a reduction in a short time and limits the exposure to radiation. This technique also allows the closed intramedullary nailing to be performed without the use of specific instruments or the presence of multiple operating aids.

## MATERIAL AND METHODS

### • Study group:

18 patients were included in a retrospective study and were treated using closed intramedullary nailing on an orthopedic traction table from June 2021 to September 2022.

We included in our study:

1. Patients admitted for a displaced femoral shaft fracture with no additional fractures of the lower limb.
2. Patients aged >18 years.

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### 3. Fractures 32A and 32B according to the AO/OTA classification.

Exclusion criteria were open fractures, AO/OTA 32C fractures, and old fractures. Gender, mechanism of injury, patient's history, and affected side were not part of the selection criteria for our patients.

The technique was used by two surgeons. The average age of the patients was 41 years (range 20-55 years). The sex ratio was 2 (12 males and 6 females). Following the AO/OTA classification system, there were fourteen 32A cases and four 32B cases. The right side was affected in 8 cases and the left one in 10 cases.

#### Presentation of the technique with case demonstration (Figure1, A):

The patient is placed in a dorsal position, on an orthopedic traction table, with the affected limb in extension. First, traction is applied to the affected limb until the diastasis between the 2 fragments (proximal and distal) is 2-3cm (Figures 1B and 1C). When compared with the intact side, a rotational disorder is corrected if

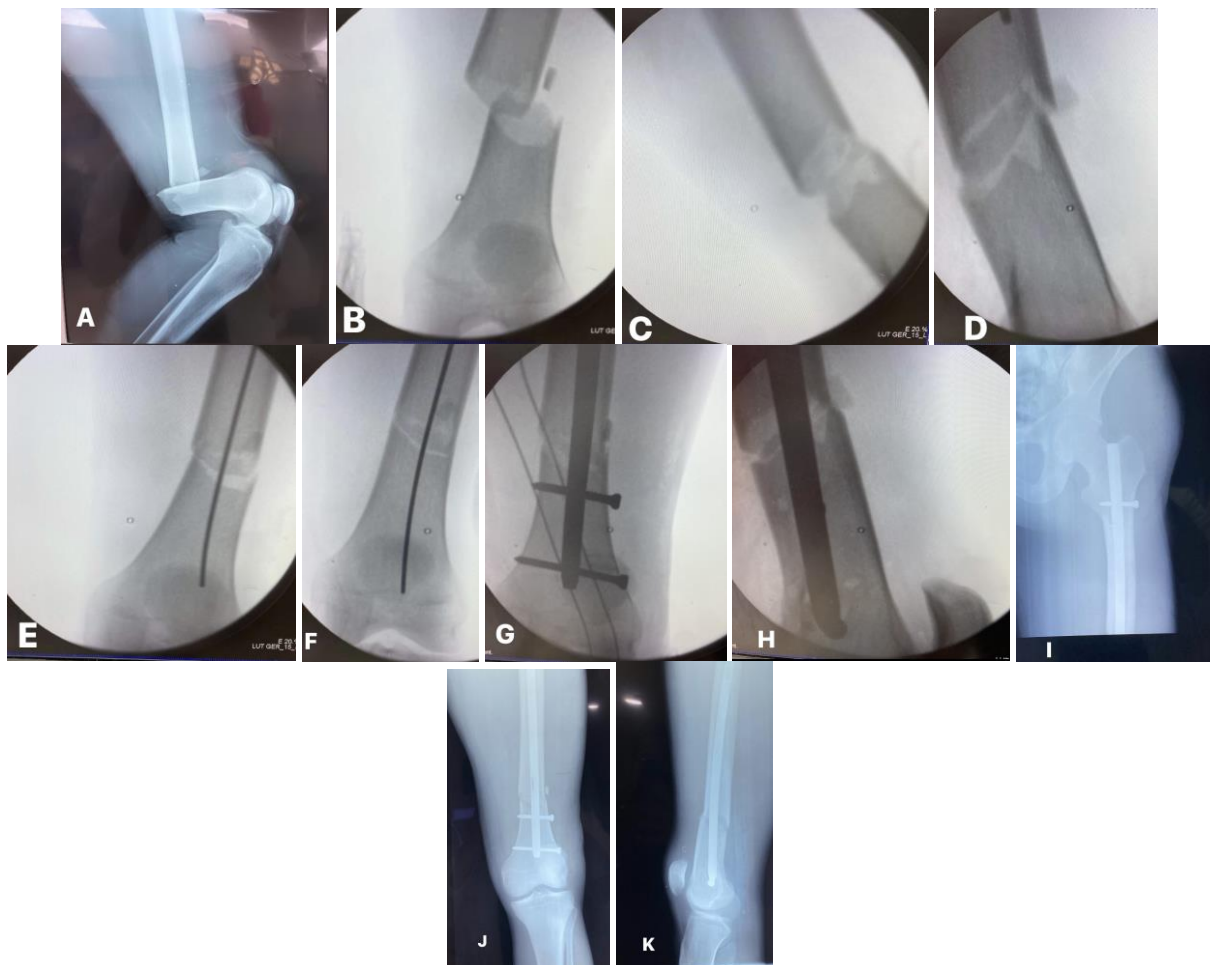
present and both fragments are aligned in the frontal and sagittal planes. Once alignment is verified by fluoroscopy, traction is released in a controlled manner until the distal fragment engages the proximal fragment (Figures 1D and 1E). If the fracture site is slightly angulated, a finger push (Figure 1F) is applied during reaming and nail insertion (Figure 1G and 1H). Once the reduction has been assessed and approved by C-arm, the remaining steps of the nailing procedure are performed.

#### • Postoperative management:

All our patients benefited from medical treatment for pain, thromboprophylaxis for 14 days, and antibiotic prophylaxis for 48 hours.

The day after surgery, patients were positioned upright without support, with assisted passive movements on the affected limb.

Two orthogonal radiographic views were performed immediately after surgery (Figures 1I, 1J, and 1K) and at each follow-up.



**Figure 1: A** The fracture involved the lower third of the femoral shaft. Traction creates a diastasis between the fragments in the frontal plane B and sagittal plane C, allowing alignment to be achieved by external maneuvers. D and E Once alignment has been achieved, traction is released to allow the two fragments to mesh, which is the basis for stable reduction. F If angulation persists, a finger push would be sufficient. G and H the reduction remained stable after nail insertion and locking. I, J, and K the control radiograph showed excellent alignment

## RESULTS

All fractures were reduced with no need for exposure of the fracture site. The reduction time was 10±3min. The operative time was 55±12min with minimal use of image intensification. 13 patients required no further manipulation during the procedure and 5 patients had slight angulation corrected by finger push.

Postoperatively, all patients had excellent alignment with no vascular or nerve damage from the initial traction. No complications were observed.

## DISCUSSION

Femoral fractures are common orthopedic injuries. They occur most frequently among young adults following high-energy trauma [10]. Intramedullary nailing is currently the surgical treatment of choice, with the advantage of a high rate of bone healing and a low rate of complications. The presence of strong muscles surrounding the femur [13], makes the task of closed reduction difficult. The use of several invasive or non-invasive devices and the need for multiple assistants during the procedure are necessary. Several studies have focused on closed-reduction techniques. The use of Schanz wires as a joystick" was studied by Georgiadis and al [7]. The unicortical introduction of Schanz pins allows fragment manipulation and alignment, but with a theoretical risk of neurovascular injury, infection, and quadriceps contracture. Shezar and al [9] have described an external support device that allows a reduction in the sagittal plane. The residual displacement requires a decreased adduction, which may complicate access to the insertion point, especially in corpulent or obese subjects. Gao and al [14] have designed a reduction frame but suggest that their device still needs to be improved. They reported an opening of the reduction frame in a patient with muscle swelling. Moreover, the reduction and operative times were 6-45min and 60-120min respectively, which is much longer than our study as well as other studies using specific devices. Shui and al [4] suggested the use of hemostatic forceps using the lever arm. Given the complexity of closed reduction, many authors continue to rely on open reduction and internal osteosynthesis [15].

In our group of patients, the results were excellent, with a reduction time of 10±3min and an operating time of 55±12min, which was significantly shorter than other reduction techniques reported in other studies. Also, this technique reduces the number of assistants needed and the use of a specific instrument. We suggest that this technique can be used for simple displaced shaft fractures or fractures with a third fragment. 32C fractures of the AO/OTA were not studied because of the comminution that could prevent stable impaction of the fragments, which is essential for our technique. Patients operated on using retrograde nailing

were excluded since our technique uses the traction table. The limited sample size is also a limitation of this study.

In conclusion, our technique enables a stable reduction with no need for a specific instrument or device with reduced operative time. The need for multiple assistants during the surgical procedure is not necessary. Radiation exposure is also reduced.

### Ethics approval and consent to participate

Ethical approval was not sought. Written consent was obtained from the patients.

### Availability of data and materials

The datasets used and analysed during the study are available from the corresponding author.

### Declaration of conflicting interest

The authors declare that there is no conflict of interest.

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### Authors contributions

YB has conceived and developed the technique. YB has collected the data. All authors Have read and approved the final manuscript.

### Abbreviations

AO/OTA: AO Foundation/Orthopaedic Trauma Association.

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