

Placing Femoral Intramedullary Nails in Severely Bowed Femurs

Nirav H. Amin, MD; Rajit Chakravarty, MD; Andre Jakoi, MD; Douglas L. Cerynik, MD, MBA; Nader Toossi, MD; Susan P. Harding, MD

Abstract: The authors describe a novel technique of antero-grade femoral intramedullary nail fixation for hip fracture using the starting guide pin as a blocking screw. This cost-effective technique uses fluoroscopic radiography to ensure the guidewire is within the posterior aspect of the femur on a lateral view, thereby minimizing the risk of anterior cortical femoral fractures. [*Orthopedics*. 2014; 37(3):179-182.]

Hip fractures in the elderly are responsible for a large number of hospital admissions annually, and will continue to occur frequently as the population and life expectancy increase.^{1,2} In the United States, hip fractures account for more than 340,000 fractures per year and are associated with an estimated cost of \$2.9 billion annually. Incidence is expected to increase to more than 700,000 fractures annually by 2050.²⁻⁵ Considering the mor-

tality and morbidity associated with hip fractures, intramedullary nail fixation of hip fractures is increasingly favored.⁶

Intramedullary nailing is associated with shortened operative times and decreased blood loss and involves a minimally invasive technique compared with traditional fixation with a sliding compression hip screw and plate.^{3,7,8} However, intramedullary nail fixation is associated with peri- and postoperative complications, burdening

the health care system.⁷ Several studies and case reports have shown a significant incidence of intra- and postoperative femoral fractures associated with intramedullary nailing.^{7,8} Often, the tip of the nail can be seen resting against the anterior cortex, leading to a perforation of the distal anterior cortical surface and, over time, causing a periprosthetic fracture.^{1,8,9} Complications arising from the position of the nail can be related to the anterior migration of the nail during insertion secondary to osteoporosis and loss of adequate trabecular bone in the distal metaphysis, in elderly patients. The higher radius of curvature in the femoral bow of certain elderly patients predisposes the guidewire and/or reamer to approach cortical bone of the anterior cortex. In addition to the guidewire position, the design of the nail and the geometry of the bone are disproportionate. Earlier techniques of femoral intramedullary nailing that used a higher radius of curvature were more associated with this complication. Although newer implants

have addressed the geometry of the femoral bow in younger patients by using a lower radius of curvature, anterior femoral perforation continues to be a problem in the operating room.^{1,3,6-9}

The authors describe a novel technique for adjusting the position of the femoral nail guidewire before placing the intramedullary nail to prevent intra- and postoperative complications. Using the starting guide pin instead of a blocking screw improves positioning of the femoral nail while requiring fewer intraoperative materials, thereby shortening operative time and potentially reducing costs. The purpose of the guide pin is to prevent anterior perforations of the distal femur by positioning the nail along the posterior cortex.

MATERIALS AND METHODS

Fourteen femoral fractures were internally fixed using intramedullary nails and a blocking pin between 2010 and 2012 at the authors' urban, level 1 trauma center. Mechanisms of injury included 11 motor vehicle accidents and 3

The authors are from the Department of Orthopaedic Surgery, Drexel University College of Medicine, Philadelphia, Pennsylvania.

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Correspondence should be addressed to: Douglas L. Cerynik, MD, MBA, Department of Orthopaedic Surgery, Drexel University College of Medicine, 245 N 15th St, Philadelphia, PA 19102 (douglas.cerynik@drexelmed.edu).

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Figure 1: Preoperative anteroposterior radiograph showing the fracture.

falls from standing. Preoperative radiographic examination included anteroposterior and lateral radiographs of the hip and full-length femur radiographs to assess the anatomic bow of the femur. Inclusion criteria were a hip or femur fracture in which an anatomic bow resulted in the intraoperative decision to use a starting guide pin.

The senior author (S.P.H.), a fellowship-trained orthopedic trauma surgeon, performed all of the operations. The authors reviewed the intraoperative complications, such as a broken guidewire, a broken guide pin, issues related to femoral nail passage, and in-

traoperative fractures related to the guide pin. In addition, the authors retrospectively evaluated technique complications, such as infections (deep and/or superficial), periprosthetic fractures through the guide pin site, and nonunions related to the guide pin site. Patients were followed for up to 1 year.

SURGICAL TECHNIQUE

The operation was performed with the patient in a supine position after administration of general anesthesia. Reduction of the femur was achieved with manipulation of the distal fragment and the use of longitudinal traction



Figure 2: Photograph of bending the guidewire prior to insertion.

(**Figure 1**). With the patient's extremity in flexion and adduction, the starting point on the medial tip of the greater trochanter was found using the threaded guide pin. Errors in placement of the femoral nail starting pin can lead to increased risk of anterior perforation of the femoral cortex; therefore, it is critical that the starting point be confirmed by anteroposterior and lateral fluoroscopy. After confirmation of correct guide pin position by fluoroscopy, the opening reamer was used.

Following removal of the opening reamer and guide pin, a sharp bend was placed within and at the end of the guidewire to help steer the wire into the ideal position prior to reaming (**Figure 2**). Great care was taken while inserting the guidewire into the femur; monitoring via anteroposterior and lateral fluoroscopic radiography ensured that the guidewire was contained within the medullary canal. Once the guidewire had passed the fracture site, anteroposterior and lateral fluoroscopic radiographs of the knee were taken to ensure that the

guidewire was in the center of the femoral shaft in the medial-lateral plane as well as in the posterior aspect of the femur in the anteroposterior plane. The femur is divided into thirds on the anteroposterior plane, with the ideal position of the guidewire being in the posterior one-third on the fluoroscopic images. Often, however, difficulty was encountered in keeping the guide pin on the posterior cortex with severe bows in femurs with vacuous distal metaphyseal segments (**Figure 3**).

To address the position of the guide pin, the senior surgeon (S.P.H.) has developed a novel method using the starting guide pin as a blocking screw. Using fluoroscopic imaging, a lateral image of the distal femur is obtained with the patella parallel to the floor and the femoral condyles showing no double density. A small, percutaneous incision is followed by blunt dissection in line with the anterior distal femur to position the guidewire toward the posterior femoral condyles. The starting guide pin is inserted from lateral to medial, in the sagittal plane, in a unicortical fashion,



Figure 3: Intraoperative lateral fluoroscopic image of the guidewire during initial insertion.



Figure 4: Intraoperative anteroposterior fluoroscopic image of a distal blocking pin with guidewire after complete insertion.

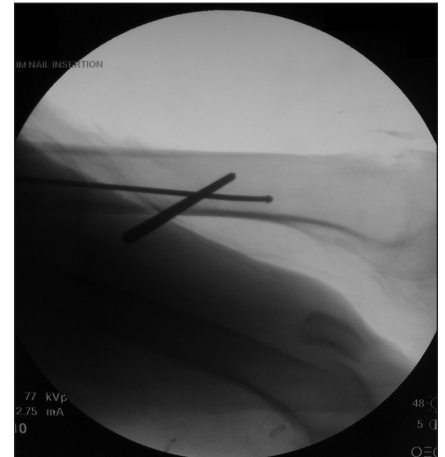


Figure 5: Intraoperative lateral fluoroscopic image of a distal blocking pin causing the guidewire to be directed posteriorly.

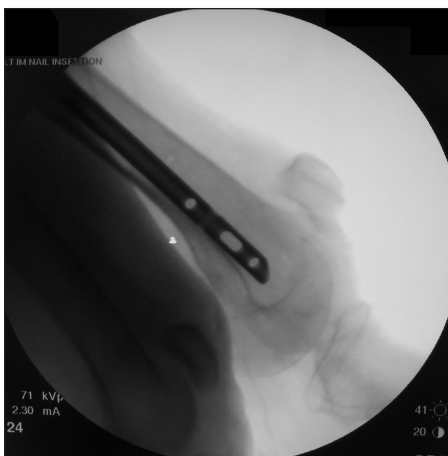


Figure 6: Intraoperative lateral fluoroscopic image of the femoral nail demonstrating acceptable anteroposterior positioning.



Figure 7: Intraoperative anteroposterior fluoroscopic image of the femoral nail after distal interlocking screw placement.



Figure 8: Postoperative lateral radiograph demonstrating the anteroposterior position of the nail.

into the posterior one-third of the femur, redirecting the guidewire into a posterior direction (**Figures 4-5**). Following this maneuver, the ball-tip guidewire is advanced past the starting guidewire. The starting guide pin is left unicortical at the most distal site along the femur, allowing the reamers to pass over the guidewire in the posterior aspect of the femur. Also, the guidewire is turned 180° once the arc of the wire

is contained in the posterior aspect of the distal femur. This allows the reaming to pass over the guidewire along the posterior aspect of the femur during the passage of the reamers. The femoral nail is inserted over the guidewire, with the guide pin orienting the nail in a posterior direction in the distal femur. The nail must be passed prior to removing the starting guide pin to avoid shifting the nail anteriorly during insertion.

Care is taken to ensure that the nail is guided gently past the guide pin and that the pin or wire does not break. The guide pin must not be used to correct starting entry point malposition on the greater trochanter or as an aid to fracture reduction. A compression screw and end cap followed by proximal interlocking screws are consecutively placed through the nail. Before the distal interlocking screws are placed, however,

fluoroscopic images are obtained to verify the posterior positioning of the intramedullary nail in the femur (**Figures 6-7**). Final radiographic images are obtained in the postoperative care unit (**Figure 8**).

RESULTS

None of the 14 patients experienced intraoperative complications related to the guide pin placement. No postoperative complications, including

deep and/or superficial infections, stress fractures, or peri-prosthetic fractures, were seen at the guide pin sites within a 1-year follow-up period. All patients were able to ambulate on the injured extremity within 1 year postoperatively, with or without additional walking assistance.

DISCUSSION

As the number of hip fractures rises, the role of intramedullary nail fixation will become more paramount.^{8,10,11} However, with the increased use of intramedullary nails, the associated complications cannot be overstated.³ Anterior cortical perforation of the femur and subsequent femur fractures are devastating complications and can be avoided with proper intraoperative technique. The authors have developed a novel technique of anterograde femoral intramedullary nail fixation minimizing the risk of anterior cortical femoral fractures using fluoroscopic radiography to ensure that the guidewire is within the posterior aspect of the femur on a lateral view. The guide pin location is able to confirm correct posterior positioning of the femoral in-

tramedullary nail and to avoid intra- and postoperative complications associated with anterior cortical femoral fractures.

Use of the guide pin to direct placement of the intramedullary nail also means that supplementary blocking screws are not needed, potentially saving the costs of the blocking screws, sterile trays, and time in the operating room. Hoeksema¹² and Koska et al¹³ have stressed the importance of identifying purchasing practices and innovative approaches in patient care that do not burden hospital systems or endanger patients. With the authors' technique using the opening guide pin, femoral intramedullary nails can be placed accurately, risks of anterior cortical perforation decreased, and costs reduced.

This study has several limitations. Owing to the transient nature of the patient population, length of follow-up was approximately 1 year. Patients' preoperative functional activity levels were unavailable.

CONCLUSION

The placement of the starting guide pin in the distal femur offers surgeons an adju-

vant tool in avoiding anterior cortical breaching by narrowing the medullary canal. Although this study was small, it demonstrates an effective method to guide intramedullary fixation posteriorly with femur fracture fixation that may also be cost-effective.

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