Placing Femoral Intramedullary Nails in Severely Bowed Femurs

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Abstract: The authors describe a novel technique of anterograde 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. 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. Considering the mortality and morbidity associated with hip fractures, intramedullary nail fixation of hip fractures is increasingly favored.

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. However, intramedullary nail fixation is associated with peri- and postoperative complications, burdening the health care system. Several studies and case reports have shown a significant incidence of intra- and postoperative femoral fractures associated with intramedullary nailing. 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. 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.

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...
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 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 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,
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 as-
sistance.

**DISCUSSION**

As the number of hip fractures rises, the role of intramedull-
ary nail fixation will become more paramount.8,10,11 However,
with the increased use of intramedullary nails, the asso-
ciated 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
posteriorly with an intramedullary nail also means
that supplementary blocking screws are not needed, po-
tentially saving the costs of the blocking screws, sterile
trays, and time in the operat-
ing room. Hoeksema12 and
Koska et al13 have stressed the
importance of identifying pur-
chasing practices and innova-
tive 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 limi-
tations. Owing to the transient
nature of the patient popula-
tion, length of follow-up was
approximately 1 year. Patients’n
preoperative functional activ-
ity levels were unavailable.

**CONCLUSION**

The placement of the start-
ing guide pin in the distal fe-
mur offers surgeons an adju-
vant tool in avoiding anterior
cortical breaching by narrow-
ing the medullary canal. Al-
though this study was small,
it demonstrates an effective
method to guide intramedul-
ary fixation posteriorly with
femur fracture fixation that
may also be cost-effective.

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