Conversion of Cephalomedullary Nail Fixation to Hip Arthroplasty: Technical Points and Pitfalls

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Abstract

Cephalomedullary nail fixation is used to treat proximal femur fractures. Some of these internal fixation constructs fail secondary to hardware failure, fracture malunion or nonunion, or the interval development of degenerative arthritis. Converting one of these constructs to a hip arthroplasty is technically more demanding and has a higher complication rate compared with routine primary total hip replacement.

In this article, we review tips, techniques, and potential pitfalls for converting cephalomedullary nail fixation to hip arthroplasty—knowledge that orthopedic surgeons can use to minimize intraoperative and postoperative complications.

Proximal femur fractures have a substantial impact on health care. Extracapsular intertrochanteric and subtrochanteric fractures account for more than half of these fractures and are usually fixed with a cephalomedullary nail or a hip screw and side plate.[1]

Intertrochanteric fractures are characterized as stable or unstable. Unstable fractures are reverse obliquity fractures, intertrochanteric fractures with subtrochanteric extension, and fractures with loss of the posteromedial calcar.[2] The literature suggests that these fractures are appropriately treated with cephalomedullary nails.

For stable intertrochanteric fractures, however, the most appropriate type of fixation is controversial.[3] Cephalomedullary nails increasingly are being used to treat stable intertrochanteric fractures.[4] According to their proponents, these implants facilitate shorter operative and recovery times, less blood loss, and improved biomechanical load bearing. Other investigators have found no clinical differences between sliding hip screws and cephalomedullary nails except for the nails' higher cost.[5] Despite the lack of clear and compelling evidence that cephalomedullary nails minimize complications and improve clinical outcomes, their use is still prevalent.

In some instances, these internal fixation constructs need to be revised. These scenarios usually arise secondary to fracture nonunion, hardware failure or cutout, femoral head avascular necrosis, or development of degenerative hip arthritis. Several authors have described conversion of failed internal fixation constructs to hip arthroplasties.[6-9] The studies reliably and reproducibly demonstrated less pain and improved function using hip arthroplasty as a salvage procedure.

Data regarding conversion of cephalomedullary nails to hip arthroplasty are scarce. More recently, investigators have reported that hip arthroplasty performed in the setting of a prior cephalomedullary nail is a more complex operation with a higher potential for intraoperative and postoperative complications compared to routine primary total hip replacement.[10-12]

Some of the cephalomedullary nails used to treat hip fractures will eventually require conversion to hip arthroplasty as a salvage procedure for the reasons indicated. In this article, we review technical tips and provide a framework for approaching these complex cases.

Intraoperative Considerations and Special Equipment

- Radiolucent table
- Appropriate extraction instruments (implant-specific slap hammers, screwdrivers)
- Universal nail extractor set
- High-speed burr
- Osteotomes
- Backup acetabular implants
- Cemented or cementless (distal metaphyseal- or diaphyseal-engaging) stems
- Backup proximal femur replacement

Tips and Techniques

- Position lateral on a radiolucent table. C-arm fluoroscopy should be available.
- Remove any distal screws for long nails; for shorter nails, distal screws may be removed through the proximal incision.

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- Incorporate an old incision whenever possible but do not allow an old incision to compromise a standard or extended hip approach. Use a posterior or lateral approach based on surgeon discretion and preference. Trochanteric slide osteotomies may be used, especially if the trochanteric fragment is already nonunited.
- Be prepared to release the gluteus maximus tendon, if necessary, to mobilize the femur. The skeletal anatomy will be altered secondary to nonunion or malunion of multiple fracture fragments.
- Dislocate the hip before removing the nail. If the blade or screw has not cut out the femoral head entirely, this step will facilitate femoral head dislocation and removal. In addition, performing dislocation before hardware removal may reduce the risk for a stress riser fracture through empty screw holes in cases in which dislocation may be difficult because of stiffness or deformity.
- Identify the entry point of the nail. Inspect the gluteus medius/minimus for any damage incurred during index implant insertion. The surgeon may have to dissect and release through or medial to the abductor insertion. Use a high-speed burr along the medial edge of the trochanter, if necessary. Heterotopic bone may interfere with exposure and should be removed. Dissecting around the trochanteric fragment to identify the nail may also compromise abductor integrity.
- Ensure that the proximal portion of the nail is entirely exposed to avoid fracture during removal. Once the top of the nail is exposed, first unlock the derotational set screw through the nail entry hole.
- Then remove the helical blade or lag screw from the lateral cortex. A high-speed burr may be needed to identify the screw or blade if there is overgrowth. The vastus lateralis may need to be incised. Ideally, the screw or blade will be prominent secondary to fracture fragment collapse and hardware backout.
- Once the blade or lag screw has been removed, use an extractor to impact the nail out from the canal. If the implant-specific instrumentation is not available, use a universal extraction device. Theoretically, the extraction device should be threaded into the nail before lag screw/blade removal in order to prevent spinning of the nail within the femur.
- Ensure that there is enough clearance around the trochanter so that the nail does not cause an inadvertent trochanteric fracture during stem extraction. The trochanteric fragment may already be compromised from fracture nonunion, hardware failure, bone loss from previous implant insertion, or surgical exposure.
- Inspect the acetabulum for any chondral damage from screw cutout. If the cartilage is intact, resurfacing depends on surgeon preference and patient selection. If the cartilage is damaged, expose the acetabulum and resurface with an acetabular component. If the patient is low-demand and chondral damage is minimal, it is not inappropriate to proceed with hemiarthroplasty if there are concerns about the potential for hip instability and dislocation.
- Inspect the remaining proximal femur. The trochanteric fracture fragment is often free-floating. Inspect the medial calcar for bone quality and fragment union/healing. The proximal femur may be in multiple pieces, and the lesser trochanter may be separated from the calcar. Identify the distal femoral canal through the nonunited or malunited proximal fracture fragments.
- At surgeon discretion, choose a cementless or cemented implant. Stem length should be based on distal fixation and bypass of screws and stress risers, if feasible. If the proximal intertrochanteric fragment does not accommodate passing a stem into the distal fragment, use a high-speed burr to widen the canal or perform a sliding trochanteric osteotomy. Often, bone quality is poor, and a construct that allows immediate mobilization and weight-bearing is preferred, given that many of these patients are elderly.
- For cemented implants, choose a calcar-replacing stem if there is significant medial bone loss (**Figures 1A, 1B**). The surgeon may also build up the medial calcar with cement if bone loss is not too severe.
- For cementless implants, use a primary or revision stem (surgeon preference), if bone quality permits. If proximal

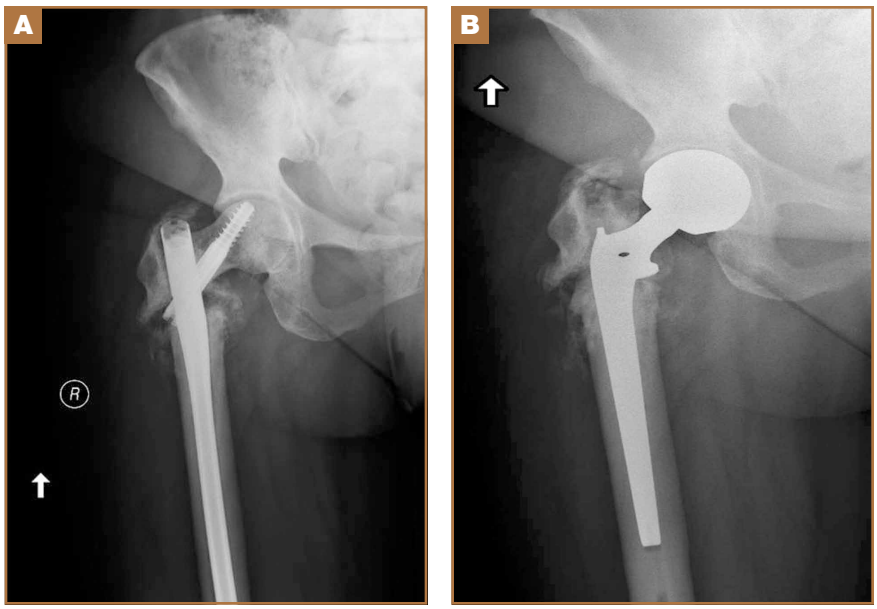

Figure 1. (A) Preoperative anteroposterior (AP) radiograph of a hip with a pathologic subtrochanteric fracture from metastatic carcinoma. Initially fixed with cephalomedullary nail, the fracture shows nonunion and hardware cutout. (B) Postoperative AP radiograph shows revision to a cemented calcar-replacing hemiarthroplasty.

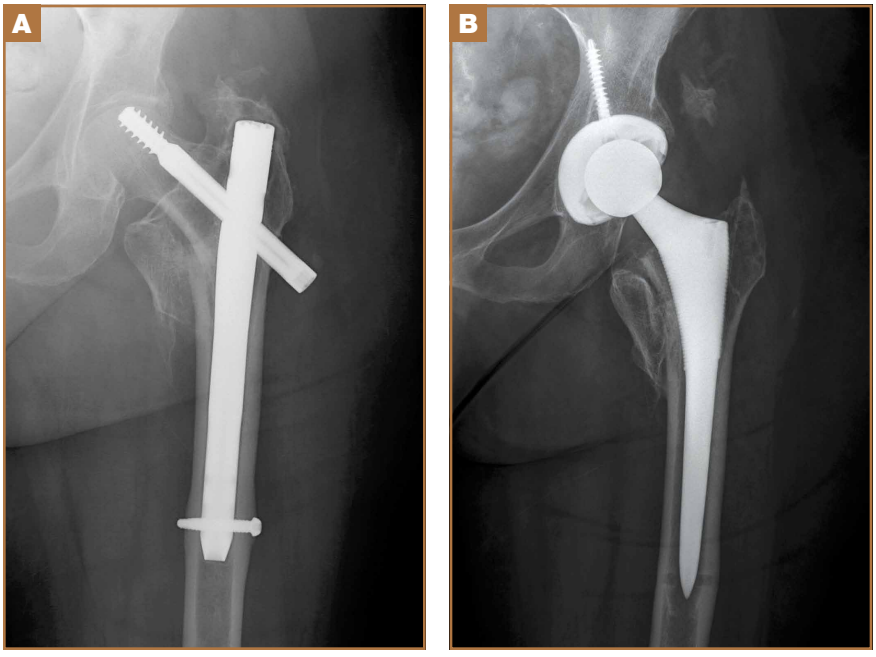

Figure 2. (A) Preoperative anteroposterior (AP) radiograph of a hip demonstrating fracture malunion with shortening, varus angulation, and trochanteric overgrowth over the proximal end of the rod. (B) Postoperative AP radiograph of the hip after removal of the intramedullary rod and conversion to an uncemented total hip replacement. Trochanteric fragment superior and lateral to the acetabulum avulsed off the trochanter, leaving the patient with abductor weakness and cane dependence.

fracture fragments are united, and the proximal femoral anatomy is not distorted, a metaphyseal-fitting stem may be used. If the proximal femoral metaphysis does not permit appropriate fixation, then a longer, diaphyseal-engaging stem should be used. The goal is to achieve diaphyseal fixation distal to the proximal femoral bone. Use of cerclage cabling before canal reaming or broaching and stem insertion may prevent initiation and propagation of iatrogenic femur fractures.

- When bone loss is substantial, a proximal femoral replacement should be kept available as a salvage option.
- The surgeon may need to address abductor tendon damage or trochanteric fragment nonunion before closure. Our approach to tendon repair varies according to abductor integrity. Usually, side-to-side repair is attempted first, if the tissues allow. If there is a good tendinous portion, however, sutures passed through drill holes in bone can provide a more secure reattachment. Furthermore, trochanteric claw plates and adjunctive wires have successfully been used in the setting of trochanteric fracture and nonunion.[13,14]

Discussion

Conversion of a cephalomedullary nail to a total hip arthroplasty is a technically demanding and complex procedure with the potential for prolonged operative times with increased blood loss. Surgical dissection and exposure must be extensive in order to identify hardware and mobilize the femur to permit safe removal of the implant. The skeletal anatomy is often distorted secondary to fracture nonunion or malunion.

Furthermore, the risk for damage to the abductor mechanism is high. The trochanteric fragment is already compromised in the setting of hardware failure or fracture nonunion (**Figures 2A, 2B**). The gluteus medius/minimus damage incurred during implant insertion is further compounded by the dissection required to extract the nail. Nail extraction then reveals the profound bone loss previously masked by hardware.

Bercik and colleagues[10] compared the outcomes of conversion arthroplasty of hip screw and side plates versus cephalomedullary nails. They reported that hip arthroplasty in the setting of a prior cephalomedullary nail was a technically more challenging procedure. Operative time, blood loss, and length of hospital stay were increased in comparisons with conversions for screw/plate constructs.

Exaltacion and colleagues[11] examined 20 cases of failed intramedullary fixation constructs for hip fractures converted to hip arthroplasty. They reported an average operative time of 166 minutes and an average blood loss of 621 mL. Forty-five percent of the patients developed nonunion of the greater trochanteric fragment.

More recently, Pui and colleagues[12] conducted a multicenter study on the complication rates of hip arthroplasty in the setting of prior side plates versus nails. The complication rate was significantly higher for converted cephalomedullary nails (41.9%) than for converted side plates (11.7%).

As cephalomedullary nail fixation is increasingly being used for stable intertrochanteric fractures, surgeons should be aware of the challenges and complications of using hip arthroplasty as a salvage procedure.

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