Roundtable Discussion

The Operative Management of Pertrochanteric Femur Fractures

Moderators: John Scolaro, MD & Samir Mehta, MD

Participants

Milton L "Chip" Routt, Jr, MD (MLR): Dr. Routt was a medical student at the University of Texas School of Medicine and an orthopaedic resident at Vanderbilt University. After completion of residency, Dr. Routt was an orthopaedic trauma fellow at Harborview Medical Center where he subsequently remained as a faculty member. He is currently Professor of Orthopaedic Surgery at the University of Washington Harborview Medical Center. His accolades include the Howard Rosen Award as well as the Jack McDaniel Traveling Fellow. In addition, he has received the teaching award from the University of Washington Department of Orthopaedic Surgery numerous times. Dr. Routt has an interest in pelvic & acetabular surgery as well as fractures of the proximal femur. He has authored numerous publications on the management of patients with these traumatic injuries

.

Adam J. Starr, MD (AJS): Dr. Starr attended the University of Virginia for his Bachelor of Arts and the University of Texas Southwestern for his Doctor of Medicine. His internship in general surgery was performed at Parkland Memorial Hospital in Dallas, Texas. His orthopaedic surgery residency and fellowship in Orthopaedic trauma were completed back at Univ. of Texas Southwestern under Dr. Robert Bucholz and Dr. Charles Reinert, respectively. He is currently an associate professor of orthopaedic surgery at UT Southwestern. Dr. Starr has published over 30 peer-reviewed articles, written or contributed to over ten textbook chapters and presented at both national and international meetings. He has an interest in pelvic and acetabular injuries, fractures of the lower extremity, and principles of care in the orthopaedic trauma patient. Dr. Starr has also developed the Starr frame, which is used to reduce markedly displaced pelvic ring fractures.

Introduction

Pertrochanteric femur fractures are fractures that involve the trochanteric region of the femur and are extracapsular. They are also referred to as "intertrochanteric femur fractures with subtrochanteric extension", "reverse obliquity intertrochanteric femur fractures", "unstable intertrochanteric femur fractures," or "subtrochanteric femur fractures." The fracture pattern is exiting the lateral femoral cortex distal to the vastus ridge, differentiating this fracture from elementary or traditional intertrochanteric femur fractures. Because of this unique fracture pattern, pertrochanteric fractures of the femur are recognized as biomechanically different from standard intertrochanteric fractures. This fracture pattern is becoming more common, accounting for about 8% to 10% of all

intertrochanteric and subtrochanteric fractures.

Pertrochanteric fractures of the intertrochanteric region of the femur are challenging to treat. As such, multiple fixation constructs have been suggested, utilized, and evaluated. Possible fixation constructs include compression hip screws, intramedullary hip screws, trochanteric intramedullary nails, cephalomedullary antegrade intramedullary nails, 95° plates, and pre-contoured proximal fixed angle plates. The operative management of this unique anatomic and mechanical fracture is discussed in our roundtable below.

Figure 1. The two plain films identify the major fracture lines. Both films were taken while manual traction was applied to the injured limb. Manual traction films reveal separation of the fracture fragments, while the computed tomography axial images reveal the specific fracture details. Traction films and CT imaging facilitate a more complete preoperative plan. Associated soft tissue injuries such as degloving injuries are also confirmed on the CT scan.

Q: Do you see a role for CT imaging in pertrochanteric femur fractures to define the fracture? Is there anything potentially seen on CT that would change your surgical plan?

MLR: Yes, CT scans provide further detailing of the fracture. This information is typically available on the abdominal CT scan. Numerous fracture specifics exist that alter or tailor the surgical plan.

AJS: The presence of a fracture line entering the piriformis fossa isn't a big deal. Better knowledge of the fracture anatomy may help you avoid loss of reduction while reaming or placing the nail.

Q: What is your preferred fixation device for pertrochanteric femur fractures?

MLR: For most adult patients who can tolerate a surgical procedure, I'd prefer an angled blade plate.

AJS: My preference for subtrochanteric and pertrochanteric fractures is a cephalomedullary nail.

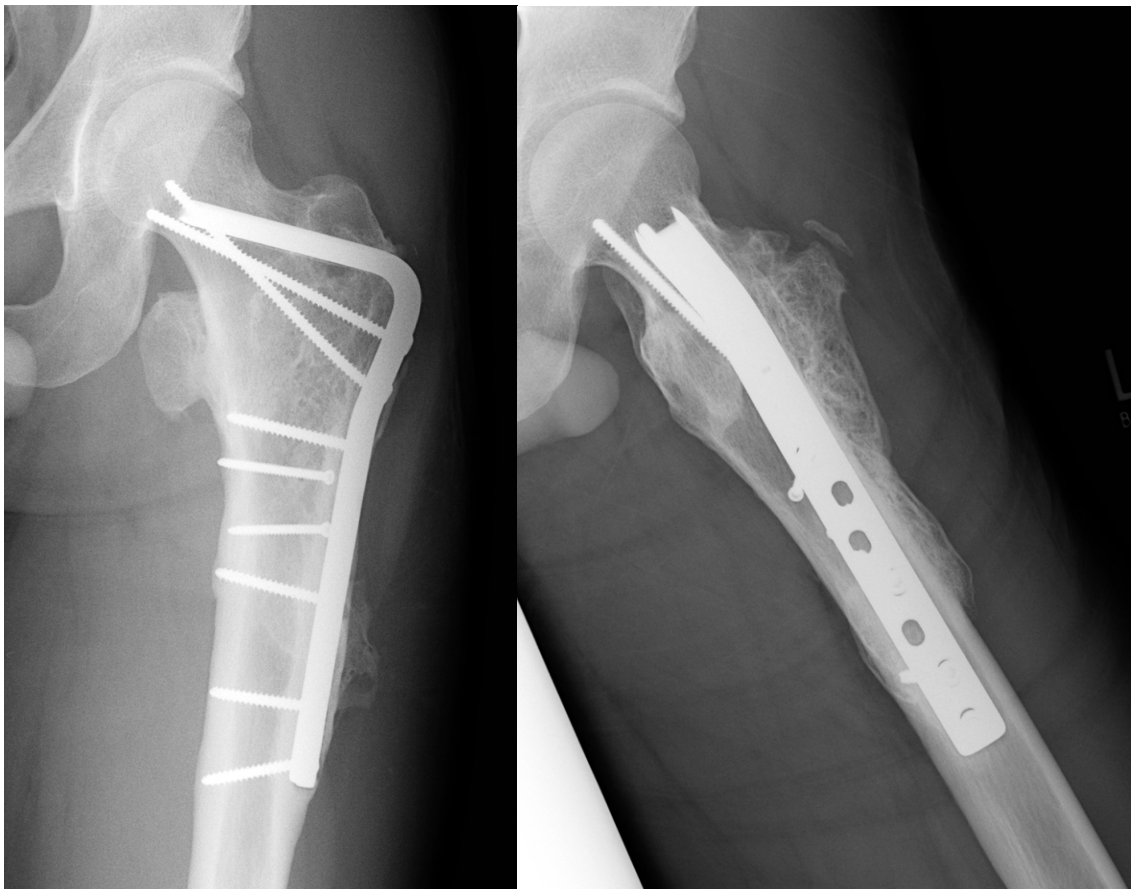


Figure 2. These radiographs demonstrate a healed and remodeled left pertrochanteric femur fracture 2 years after open reduction and internal fixation using an angled blade plate. He was asymptomatic with symmetrical ranges of hip and knee motions.

Q: Pertrochanteric fractures of the proximal femur are subject to deforming forces which make reduction notoriously difficult. What surgical techniques do you utilize to reduce these types of fractures?

MLR: I open the fracture site surgically, then clean the exposed cancellous fracture fragment surfaces, and then use appropriate clamps to manipulate and maintain the reduction.

AJS: I use lateral position, skeletal traction, and percutaneous reduction aids such as a ball-spike pusher, joker, etc. to obtain reduction.

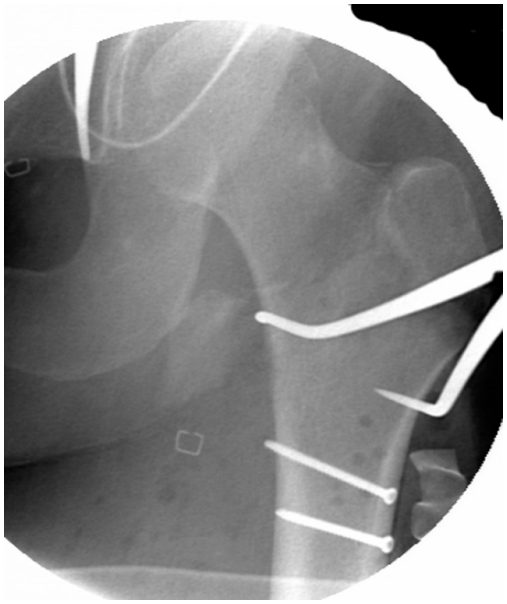


Figure 3. Here reduction clamps and interfragmentary lag screws are applied so that the fragments' soft tissue attachments are spared

.

Q: *Have you ever used provisional fixation intra-operatively to reduce the fracture before definitive fixation? If so, please explain.*

MLR: Yes. Clamps, Kirschner wires, cerclage wires or sutures, and manipulative pins are all useful. A "universal manipulator" or external fixation device is also useful. I've also used Küntscher medullary manipulative technique to offset the proximal muscular deforming forces. Here, a small diameter hollow nail is inserted into the proximal femur after its medullary preparation is accomplished. The hollow medullary nail is used to reduce the proximal fragment and then pass the medullary guide pin into the distal fragment. It's an old technique but still useful when the surgeon is trying to use a medullary device and closed techniques.

AJS: No.

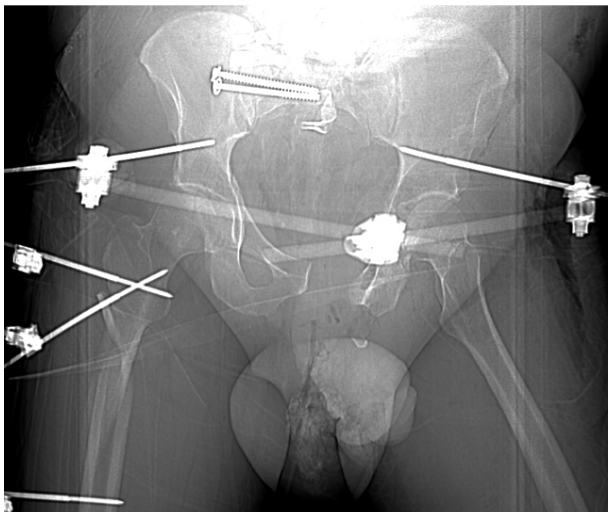


Figure 4. This patient had numerous injuries including an open unstable pelvic ring disruption and a closed proximal femur fracture. The femur fracture was initially stabilized using external fixation.

Q: *Do you consider the use of bone graft or bone graft substitutes in the management in pertrochanteric fractures when the fracture is exposed for reduction or is highly comminuted?*

MLR: Not initially. If significant osseous defects result from ballistic/blast injuries, open fractures, or trauma-related fragment soft tissue stripping, then antibiotic laced spacers are applied. Bone grafting is subsequently performed if needed and as indicated

AJS: No. Use a nail and a closed technique – they always heal.

Q: *If you decide to use an IM nail for a pertrochanteric femur facture, do you use a piriformis or greater trochanteric entry point for your device and why? Do you feel there is a difference between the two techniques?*

MLR: That answer depends on the medullary device's design. Yes, the implant's specific design dictates the appropriate starting site. Mis-position of the insertion site can cause deformity as the medullary device is applied. For example, a proximal femoral varus deformity results if the surgeon applies a "piriformis" style straight medullary nail through a greater trochanteric insertion site. The insertion site and proximal femoral medullary preparation with reamers must be specific to the selected device's design. Some surgeons also believe that reaming and implant insertion using a greater trochanteric nail insertion site injures the proximal femoral muscular insertions along the greater trochanter.
AJS: Either works fine. We studied this question and found no difference. The reference is:

Starr AJ, Hay MT, et al. *Cephalomedullary nails in the treatment of high-energy proximal femur fractures in young patients: a prospective, randomized comparison of trochanteric versus piriformis fossa entry portal.* J Orthop Trauma. 2006 Apr;20(4):240-6.

Q: With regard to IM nailing, how many distal locking screws do you use?

MLR: This depends on the fracture extent and the diaphyseal fill of the selected medullary device. If the fracture is confined to the proximal femur and the nail fills the diaphyseal endosteal contact region well, then one distal locking screw is used. If the medullary device poorly fills the diaphysis or the fracture extends beyond the mid-shaft, then more that one distal locking screw is chosen.

AJS: I usually use just one distal locking screw

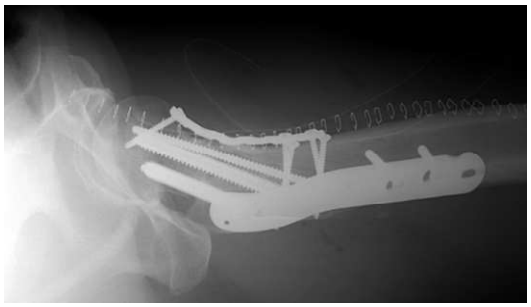
Q: What is your routine post-operative protocol for such fractures?

MLR: Initially, range of motion and gravity resistance exercises are performed and then progressed. Loading of the injured lower extremity is protected as the patient uses either crutches or a walker. "Weight of limb" weight bearing restrictions are progressed over the subsequent 2-3 months after surgery.
AJS: Flat-foot weight bearing for 12 weeks.

Q: Is there any role for 135-degree compression plates in the management of subtrochanteric femur fractures?

MLR: If you are referring to pseudo-"fixed angle" compression plates using "locking screw" technology, maybe. The proximal femoral pseudo-"fixed angle locking" compression plates seem to have sufficient function in early clinical experiences for pertrochanteric femur fractures. If you are referring to a 135 (or similar) degree dynamic hip screw (DHS) or some variant "sliding hip screw," then I would say no. The implant's sliding screw design allows for guided compression in the proximal fracture. This usually results in fracture impaction with often dramatic and unwanted shortening until either the lag screw's thread base contacts the side plate's barrel tip or cortical surfaces "bottom out" on one another. In either situation, the resultant deformity is unwanted.
AJS: Not in my hands.

Q: Would you change your management in a young (<50) patient with a comminuted pertrochanteric fracture? How so?



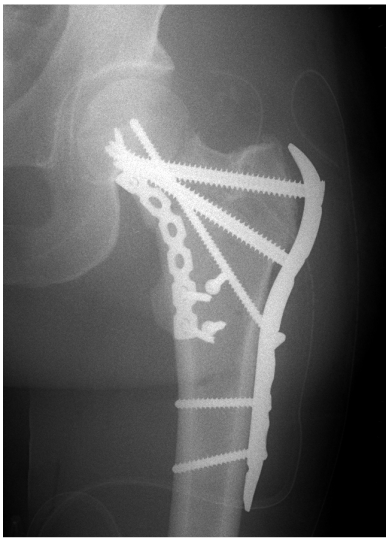


Figure 5. A proximal femoral "locking" plate was used along with an anterior contoured reconstruction plate to successfully treat this closed comminuted pertrochanteric femur fracture

MLR: Yes but it is very important to not under-size implants in children. The preoperative planning should determine the appropriate sized implant for the individual patient. The selected plate should fit the lateral femur. In some patients, a 3.5mm plate is needed while in others the 4.5mm narrow DC plate is indicated. The surgeon should use fluoroscopy during screw insertion to avoid drilling and iatrogenic injury of the proximal femoral physis. Similarly if a medullary device is selected, the surgeon must remember the hip capsule's peripheral extent during insertion site selection, reaming, nail placement, and locking screw application, thereby avoiding damage to the lateral epiphyseal artery. To further protect this critical blood supply, screws and other implants should not be placed into the cranial and posterior quadrant of the femoral neck. Spica casting can also be used to support the fixation devices particularly in smaller children.

AJS: Would use a smaller diameter pedi nail and NOT cross the distal femur physis.

Q: In a patient who previously had a femoral neck fracture (or SCFE) fixed with retained cannuluted screws, how would you approach a new ipsilateral subtrochanteric fracture?

MLR: This would depend on the patient's age, body habitus, the amount of time since the prior operation(s), prior wound problems, resultant scarring, the amount of residual osseous deformity, the number-location-condition of the prior implants, among other critical details needed for planning.

AJS: Take out the old screws if they were in the way and use a cephalomedullary nail.

Q: Recent literature has cited a correlation between pertrochanteric insufficiency fractures and patients taking alendronate. Would this type of pathologic fracture change your surgical management or post operative protocol?

MLR: Perhaps.

AJS: No. I'd still use a nail and I would manage it the same way post-op.

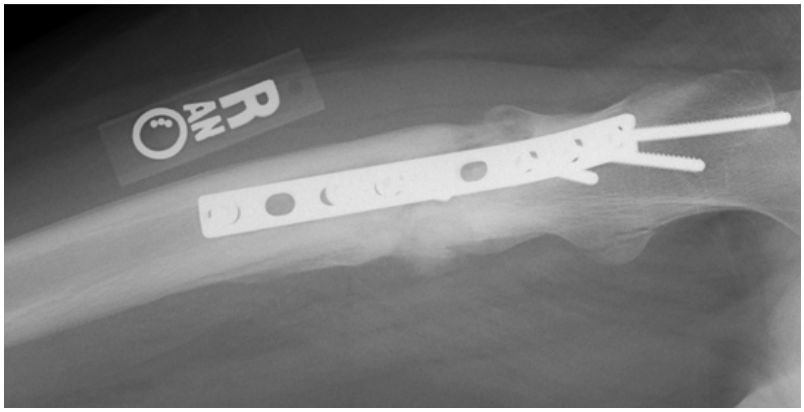


Figure 6. This 12 years 5 months male sustained numerous injuries after a motorcycle crash. His closed displaced proximal femur fracture was treated with open reduction and internal fixation using a 3.5mm dynamic compression plate and lag screw. The proximal screws were inserted using fluoroscopic guidance and placed anteriorly and caudally to avoid physeal and lateral epiphyseal artery injury. This implant was under-sized and also too short for his femur. The distal fragment fixation is insufficient. A larger and longer balanced plate likely would have avoided his delayed union.

Q: In your opinion, does fixation device have an effect on nonunion rates? What do you feel are the keys to avoiding a malunion or nonunion in a fixed pertrochanteric femur fracture?

MLR: Not the device itself, but perhaps the techniques associated with their applications. For example a poor reduction, a mis-applied implant, insufficient fixation due to implant size-length-attachment sites, and excess surgical soft tissue stripping are all factors related to higher nonunion rates. In order for bone to heal the following are required:

1. A healthy host human.
2. Sufficient bone quality.
3. A well aligned and stable reduction
4. A sufficiently preserved local soft tissue envelope.
5. Secure, smart, balanced fixation.

AJS: Key to avoiding malunion is to learn how to reduce them. They are tough to reduce sometimes, especially in young patients. The key to avoiding non-union is to use a nail instead of a plate. Nails placed using closed techniques have very high union rates.

Q: What errors do you identify most commonly in the treatment, and surgical management, of pertrochanteric femur fractures?

MLR:

1. Poor reduction.
2. Poor implant selection.
3. Poor implant application.
4. Poor surgical technique and detailing.
5. Insufficient patient compliance.

AJS: Failure to correct the flexion deformity on the proximal fragment. People tend to nail them with the hip flexed and the nail goes out the back of the proximal piece.

The editors would like to thank Dr. Routt for the radiographs used in this article.