Diagnosis and Management Options of intertrochanteric femur fractures

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Abstract

Background: These patients typically present with a short and externally rotated lower extremity. Past medical and social history should be obtained to optimize perioperative management and to prepare for postoperative rehabilitative care. It is important to evaluate the skin (open versus closed fracture) and the neurovascular status. Evaluation of a range of motion is typically not possible due to pain. Many reports include other proximal femoral fractures making analysis difficult. Trochanteric fractures have been considered one group irrespective of the cause or group of patient: These can have a marked influence on outcome. Nonoperative treatment is rarely indicated and should only be considered for non-ambulatory patients and patients with a high risk of perioperative mortality or those pursuing comfort care measures. The outcomes of this method of treatment are poor due to an increased risk of pneumonia, urinary tract infection, decubiti, and deep vein thrombosis. Surgery is the mainstay of treatment for both displaced and nondisplaced intertrochanteric fractures. The primary reason for surgery is to allow the early mobilization of the patient, with partial weight-bearing restrictions depending on the stability of the reduction. The type of surgical treatment is based on the fracture pattern and its inherent stability, as the failure rate is highly correlated with the choice of implant and fracture pattern. Fractures with involvement of the lateral femoral wall are considered an indication for intramedullary nailing and would not be treated with a sliding hip screw. Unstable fracture patterns such as fractures with comminution of the posteromedial cortex, a thin lateral wall, displaced lesser trochanter fractures, subtrochanteric extension of the fracture and reverse obliquity fractures are also indications for intramedullary nailing

Keywords: intertrochanteric femur fractures

Introduction

These patients typically present with a short and externally rotated lower extremity. Past medical and social history should be obtained to optimize perioperative management and to prepare for postoperative rehabilitative care. It is important to evaluate the skin (open versus closed fracture) and the neurovascular status. Evaluation of a range of motion is typically not possible due to pain **(1)**.

Laboratory investigations:

Basic lab studies such as complete blood count, comprehensive metabolic panel, and coagulation studies should be obtained to recognize abnormalities that may need time to correct prior to surgical stabilization **(1)**.

Radiological investigations:

Plain radiographs are the initial films chosen to evaluate for these fractures. The recommended views include the anteroposterior (AP) pelvis, AP and cross-table lateral of the affected hip and full-length radiographs of the affected femur. Although the diagnosis can be made without pelvic films, pelvic radiographs are useful to assist in preoperative planning for restoration of the proper neck-shaft angle. Full-length radiographs of the femur are useful to assess for deformities of the femur shaft which could affect the placement of an intramedullary nail and evaluation of prior implants in the distal femur. CT and MRI are typically not indicated but can be used if radiographs are negative, although the physical exam is consistent with a fracture. MRI is indicated if there is an isolated greater trochanteric femur fracture and intertrochanteric extension is of concern. Additionally, a physician-assisted AP traction view of the injured hip can be helpful in further characterizing fracture morphology and feasibility of closed reduction or need for open reduction techniques **(2)**.

Treatment options

Many reports include other proximal femoral fractures making analysis difficult. Trochanteric fractures have been considered one group irrespective of the cause or group of patient: These can have a marked influence on outcome **(3)**.

Conservative management:

Nonoperative treatment is rarely indicated and should only be considered for non-ambulatory patients and patients with a high risk of perioperative mortality or those pursuing comfort care measures. The outcomes of this method of treatment are poor due to an increased risk of pneumonia, urinary tract infection, decubiti, and deep vein thrombosis **(4)**.

Parker et al. (5) prospectively studied a group of 103 consecutive patients with trochanteric fractures. Ten were treated conservatively, and 93 had operations. The overall failure rate of fixation was 12%, with a re-operation rate of 6% at one year. There were six (8%) failures of fixation for the 74 fractures treated with sliding hip screws. No method of fracture classification had any value in predicting the choice of treatment or the risk of fracture healing complications.

Traction:

Larger weights are required for skeletal traction than for intertrochanteric fractures due to the larger deforming forces involved. If the lesser trochanter remains attached to the proximal fragment, flexion can result. Hamilton-Russell traction can aid reduction by allowing flexion of the distal femur. Perkins traction maintains knee movement, and therefore may prevent quadriceps atrophy. Any adjustments should be made under radiographic control to allow satisfactory alignment on the anteroposterior and lateral views. One should aim for less than 58 of varus or valgus angulation, at least 25% opposition of the bone ends, and less than 1 cm of shortening. The leg is immobilized for 3 – 4 weeks and then gradually extended with abduction, if required, to prevent varus angulation. The status of the fracture is monitored with weekly radiographs. Traction is maintained until there are clinical and radiographic signs of union – usually at 8 – 12 weeks. Mobilization is then commenced, initially non-weight bearing. Mobilization may be aided by a cast brace with a pelvic band. A shoe raise on the opposite limb can help by shifting the centre of gravity over the affected side, thus removing the varus stress caused by load bearing. Results of conservative management have shown 50 – 60% satisfactory outcome **(6)**.

Waddell (7) found 908 –908 traction superior to that with a Thomas splint. **Bajaj et al. (8)** found superior results with Hamilton-Russell traction compared to fixed and balanced traction.

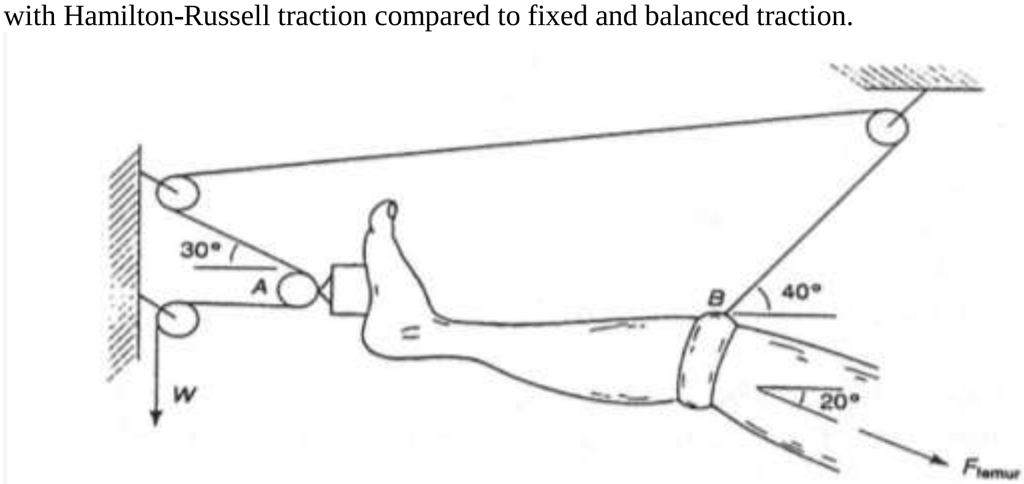

Figure (1): Russell's traction rig used to apply an axial tensile force to a fractured femur for immobilization. Assume weight of tibia and foot = 9.2 lb

1. What magnitude weight W must be suspended from the free end of the cable to maintain the leg in static equilibrium?

2. Compute the average tensile force applied to the thigh under these conditions.

Conservative management avoids the considerable problems posed by failure of fixation. However, it has its own drawbacks. Shortening and angulation are relatively frequent. It also necessitates prolonged bed rest, which has many associated problems, especially in the elderly. All patients should have some form of thromboembolic prophylaxis **(9)**.

Cast bracing:

Only one report on this form of management has been found in the English language. Fifteen patients were managed by 908–908 traction followed by bracing with a hinged knee single leg hip spica. All fractures united, and this modality of management was recommended for open fractures and in patients unsuitable for operative intervention **(10)**.

Operative management:

Surgery is the mainstay of treatment for both displaced and nondisplaced intertrochanteric fractures. The primary reason for surgery is to allow the early mobilization of the patient, with partial weight-bearing restrictions depending on the stability of the reduction. The type of surgical treatment is based on the fracture pattern and its inherent stability, as the failure rate is highly correlated with the choice of implant and fracture pattern. Fractures with involvement of the lateral femoral wall are considered an indication for intramedullary nailing and would not be treated with a sliding hip screw. Unstable fracture patterns such as fractures with comminution of the posteromedial cortex, a thin lateral wall, displaced lesser trochanter fractures, subtrochanteric extension of the fracture and reverse obliquity fractures are also indications for intramedullary nailing **(1)**.

Operative management of these fractures is considered urgent, not emergent. This allows the many comorbidities with which patients often present to be optimized preoperatively, to reduce morbidity and mortality. Most of these fractures are treated operatively with either a sliding hip screw or intramedullary hip screw, although arthroplasty is a rare option **(1)**.

A wide variety of implants have been used to manage these fractures. These can be broadly divided into intramedullary and extramedullary devices. The theoretical advantage of intramedullary devices is the reduced lever arm working against the device, as they are closer to the weight-bearing axis of the femur. There are few direct clinical comparisons between intramedullary and extramedullary devices. Those that exist are often of poor quality. The dynamic hip screw (DHS) produced a more rigid fixation than intramedullary devices, but interlocking nails in a cadaver study could withstand higher loads **(11)**.

The most common internal fixation device used is the sliding screw-plate device. This implant consists of a large lag screw placed in the center of the femoral neck and head and a side plate along the lateral femur. The screw-plate interface angle is variable and depends on the anatomy of the patient and the fracture **(12)**.

Indications for the sliding hip screw include stable fracture patterns with an intact lateral wall. When used for the appropriate fracture pattern, this treatment affords outcomes similar to intramedullary nailing. The advantages of the dynamic hip screw are that they allow for dynamic interfragmentary compression and are low cost compared to intramedullary devices **(1)**.

Figure (2): Radiograph (anteroposterior view) of an intertrochanteric fracture treated by way of internal fixation with a lag screw and side plate **(12)**.

It Was used extramedullary fixation in 45 of 60 patients treated operatively. These patients had slightly better results especially in Seinsheimer grade V fractures. The results for grade III fractures were less satisfactory. Thus, they recommended intramedullary devices for more distal fractures and pathological fractures.

Intramedullary nailing can be used to treat a broader range of intertrochanteric fractures, including the more unstable patterns such as reverse obliquity pattern. One proposed advantage of the intramedullary hip screw is its minimally invasive approach which minimizes blood loss. Although there are is no data suggesting that an intramedullary hip screw is more effective than a sliding hip screw in treating stable fracture patterns, it is becoming more and more commonly used by young surgeons. The choice for short or long intramedullary implants is debatable in these fractures **(1)**.

Although repair of an intertrochanteric fracture is often referred to as *open reduction with internal fixation* (ORIF), the term *closed reduction with internal fixation* (CRIF) may be more accurate. The patient rests in a supine position on a fracture table that allows the affected leg to be placed in traction. The fracture is anatomically reduced by longitudinal traction and rotation of the leg. An incision is made, and after the bone is exposed, the lag screw is placed into the center of the femoral neck and head with fluoroscopic guidance **(12)**.

Optimally, the end of the lag screw should be placed in close proximity to the apex of the femoral head so that the sum of the distances between the end of the screw and the apex of the femoral head in the AP and lateral views is less than 20 to 25 mm. By doing this, the occurrence of the complication known as “cut out” of the lag screw from the femoral head can be almost completely prevented. The next step is placement of the sliding side plate device, which is fixed to the shaft of the femur by using cortical screws **(13)**.

CRIF of intertrochanteric fractures may allow for immediate weight bearing. Depending on the stability of the fracture and its fixation, touchdown weight bearing or partial weight bearing is usually recommended for 4 to 6 weeks after the surgical procedure. When signs of healing are apparent and fracture collapse has diminished, weight-bearing status is usually increased. Long-term problems after these fractures are healed include malrotation, abductor muscle biomechanical abnormalities, pain (owing to the hardware), and shortening of the leg at the fracture site (because of collapse) **(12)**.

Arthroplasty is typically not indicated as primary management and is reserved for severely comminuted fractures, patients with a history of degenerative arthritis, salvage of internal fixation, and osteoporotic bone that is unlikely to hold internal fixation **(1)**.

Postoperatrive and rehabilitation care:

The postoperative protocol consists of weight-bearing as tolerated, chemical VTE prophylaxis for up to 6 weeks, and progressive physical therapy beginning in the immediate postoperative period **(14)**.

Proximal femoral nail fixation

Biomechanically, compared to a laterally fixed side-plate, an intramedullary device (the gamma nail) decreases the bending force of the hip joint on implants by 25 to 30%. This has advantages especially in elderly patients, in whom the primary treatment goal is immediate full–weight-bearing mobilisation. Good reduction of the fracture, and optimal positioning and length of the hip pin and lag screws are crucial for the PFN procedure and reported to yield excellent outcomes. Lateral slide may occur more often in patients with a PFN than a gamma nail, because of impaction of the fracture, rather than migration of the screws, assuming that anchorage of the lag screws in the femoral head for PFN and that of the gamma nail are similar. Restriction of the sliding mechanism of the gamma nail caused by the more rigid femoral neck screw-nail assembly may initiate cut-out or penetration of the joint **(15)**.

The gamma nail fixation is recommended for pertrochanteric fractures, but serious complications such as cut-out of lag screws have been reported in 8 to 15% of cases. The proximal femoral nail (PFN) has an additional anti-rotational screw (hip pin) placed in the femoral neck to avoid rotation of the cervicocephalic fragments during weight bearing. Proximal femoral nail (PFN) devised by AO/ASIF group has proven to be a stable implant in peritrochanteric, intertrochanteric or subtrochanteric femoral fractures **(16)**.

Method of fixation:

Reduction was achieved by closed manipulation and traction under anaesthesia. The fracture site was exposed only if reduction by closed means was not successful. The fixation used an intramedullary nail (10–11 mm in diameter), a lag screw (90–105 mm in length), and a hip pin (10–15 mm shorter than the lag screw). The lag screw was inserted near the subchondral femoral head. The intramedullary nail was interlocked distally with one or 2 screws. Prophylactic intravenous antibiotics were administered. Patients were allowed to mobilise on postoperative day 2, and weight-bearing walking was initiated on day 3 or 4 as tolerated. To measure the influence of lag screw placement on migration, the femoral head was divided into 9 sectors by drawing 2 parallel lines on the anteroposterior (AP) radiograph to divide superior and inferior parts and 2 parallel lines on the lateral radiograph to divide anterior and posterior parts. The position of the lag screw tip within the femoral head was then measured. The lateral slide of the lag screw after fracture consolidation was measured by comparing the immediate postoperative and final AP radiographs **(17)**.

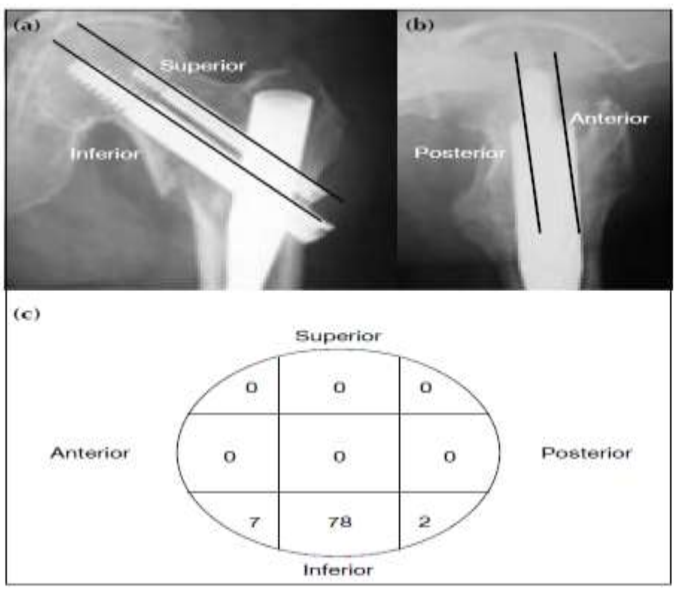

Figure (3): The femoral head is divided into 9 sectors by drawing 2 parallel lines on the **(a)** anteroposterior radiograph to divide superior and inferior parts and 2 parallel lines on the **(b)** lateral radiograph to divide anterior and posterior parts. **(c)** All of the lag screws are inserted in the inferior part of the femoral head.

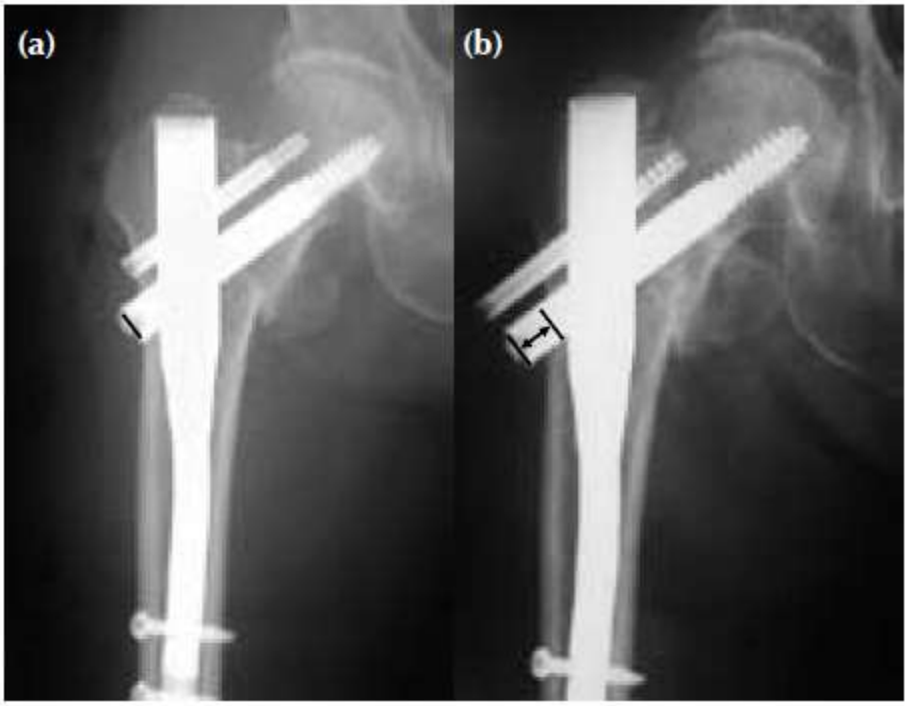

Figure (4): Measurement of lateral slide of the lag screw by comparing **(a)** immediate postoperative and **(b)** final anteroposterior radiographs

An 82-year-old woman with an A2 fracture had a 22-mm lateral slide of the lag screw at postoperative week 3. She changed to partial weight bearing and had bone united at month 4 without any cut-out of the lag screw and could walk with a stick **(17)**.

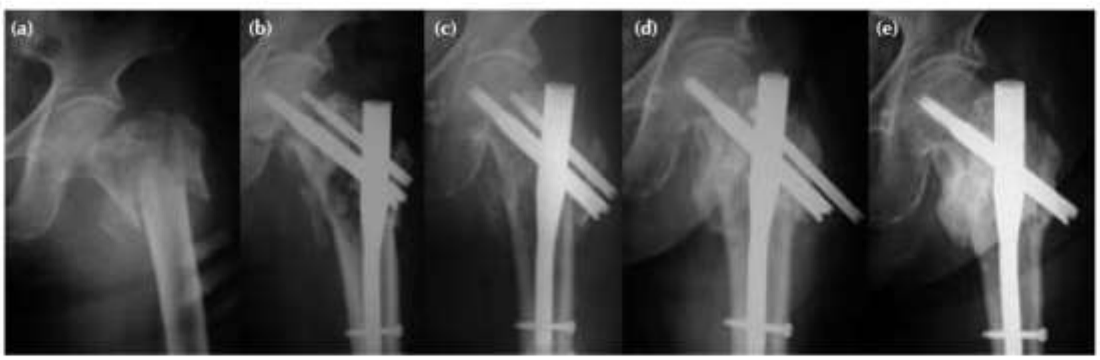

Figure (22): Radiographs of an 82-year-old woman with an A2 fracture showing a 22-mm lateral slide of the lag screw: **(a)** preoperation, **(b)** immediate, **(c)** 3-week, **(d)** one-year, and **(e)** 2-year postoperation

Results:

Operating time and blood loss are both less in patients undergoing PFN as opposed to gamma nail procedures, because reaming is not necessary. The PFN is fixed with 2 screws; the larger (lag) screw is designed to carry most of the load, and the smaller screw (the hip pin) is to provide rotational stability. If the hip pin is longer than the lag screw, vertical forces would increase on the hip pin and start to induce cutout, a knife effect or Z-effect. This might force the hip pin to migrate into the joint and the lag screw to slide laterally. The cut-out rate with a PFN is reportedly 0.6 to 8% **(18)**.

Although complication rates remain low, cut-out of either screw is a serious complication, which can lead to revision surgery and related morbidity. When the hip pin was 10 mm shorter than the lag screw, the percentage of the total load carried by the hip pin ranged from 8 to 39% (mean, 21%); no cut-out of the femoral head and no unacceptable implant or fracture displacement were observed. Unstable A2 fractures should be initially reduced to a slightly valgus position during PFN surgery, because the neck-shaft angle would decrease during the first 6 postoperative weeks. The lag screw should be inserted into the femoral head as deeply as noted in the AP view, and centrally in the lateral view. The tip of the lag screw should always be inferior to the centre of the femoral head **(19)**.

Haynes et al. (20) have shown that the superomedial quadrant of the femoral head is the weakest part for the implant, and therefore proper positioning of the screw is emphasised. Cutout is usually resulted from poor positioning of the proximal screw in the femoral head, particularly in the osteoporotic bone.

Morihara et al. (17) reported outcomes of 87 consecutive patients treated with a PFN for trochanteric femoral fractures and suggested that a PFN is useful for the treatment of all types of trochanteric femoral fractures. **Bhakat and Bandyopadhayay (21)** have found that PFN is much superior to DHS in management of fracture intertrochanteric femur.

Gunaki et al. (22) assessed role of proximal femoral nail in management of intertrochanteric femur fracture. They found that proximal femoral nail is a good minimally invasive stable fixation option with minimal soft tissue handling for unstable intertrochanteric fractures. Patients treated by proximal femoral nailing showed good functional outcome.

Mehta et al. (23) found out the functional outcome of patients with intertrochanteric fractures treated by PFN. They concluded that PFN is an excellent technique for management of intertrochanteric fractures. It is associated with excellent outcome in majority of the cases and is associated with minimal complications.

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