Antegrade Femoral Nailing in Acetabular Fractures Requiring a Kocher-Langenbeck Approach

JULIUS A. BISHOP, MD; WILLIAM W. CROSS III, MD; JAMES C. KRIEG, MD; M.L. CHIP ROUTT JR, MD

Ipsilateral displaced acetabular and femoral shaft fractures represent a dilemma for orthopedic surgeons because antegrade femoral nailing may complicate a Kocher-Langenbeck acetabular exposure. The goals of this study were to review the results of ipsilateral femoral and acetabular fractures treated with antegrade femoral nailing and a Kocher-Langenbeck approach and to evaluate the assertion that this treatment strategy is associated with increased morbidity. This was a retrospective cohort study at a regional Level I trauma center.

Sixteen patients with a femoral fracture treated with antegrade nailing and an ipsilateral acetabular fracture treated with a Kocher-Langenbeck approach were identified. One patient died as a result of his injuries, and 2 were not available for long-term follow-up. One had a deep infection requiring irrigation, debridement, and intravenous antibiotics. One patient developed a hematoma requiring irrigation and debridement. At final follow-up, 2 patients had no heterotopic ossification about the hip, 4 had Brooker class I heterotopic ossification, 3 had Brooker class II heterotopic ossification, 2 had Brooker class III heterotopic ossification, and 2 patients had Brooker class IV heterotopic ossification requiring excision. Ipsilateral femoral and acetabular fractures represent a rare and severe injury constellation. Antegrade nailing of the femur with ipsilateral Kocher-Langenbeck exposure for fixation of the acetabulum was not associated with excessive rates of wound-healing complications, but the incidence of heterotopic ossification was increased.

The authors are from the Department of Orthopaedic Surgery (JAB), Stanford University School of Medicine, Palo Alto, California; the Division of Orthopedic Trauma Surgery (WWC), Mayo Clinic, Rochester, Minnesota; the Department of Orthopaedic Surgery (JCK), Jefferson University Hospitals, Philadelphia, Pennsylvania; and the Department of Orthopaedic Surgery (MLCR), University of Texas Medical School at Houston, Houston, Texas.

The authors have no relevant financial relationships to disclose.

Correspondence should be addressed to: Julius A. Bishop, MD, Department of Orthopaedic Surgery, Stanford University School of Medicine, 450 Broadway St, Redwood City, CA 94063 (jabishop@stanford.edu).

doi: 10.3928/01477447-20130821-18
Psilateral fractures of the femur and acetabulum represent a severe combination of injuries for which optimal management remains uncertain.\textsuperscript{1,6} When confronted with this constellation of fractures, most surgeons advocate stabilizing the femur fracture first and then treating the acetabulum either in the same setting or as a delayed procedure.\textsuperscript{3,5} Although reamed antegrade nailing is the preferred treatment for fractures of the femoral shaft and is evolving into the treatment of choice for many peritrochanteric fractures, an ipsilateral acetabular fracture, particularly one for which a Kocher-Langenbeck approach is anticipated, is considered by some to be a relative contraindication.\textsuperscript{3,5,6}

Antegrade femoral nailing has several important advantages over other treatment strategies. It is a versatile technique that can be performed in the supine, lateral, or prone position through a piriformis or trochanteric entry portal.\textsuperscript{2,4} With the development of percutaneous insertion techniques, surgical wounds are minimized and can be incorporated into the Kocher-Langenbeck incision, if necessary.\textsuperscript{9} Cephalomedullary fixation can be used to treat complex proximal femur fractures, whereas multiplanar distal interlocking can be used to stabilize distal fractures.\textsuperscript{10} Although retrograde nailing has been advocated as a preferable alternative for ipsilateral acetabular fractures, this technique has distinct disadvantages. It must be performed in the supine position, violates the knee joint, and cannot be used to treat some proximal femoral lesions. Plate fixation is another alternative for femoral shaft fixation but requires a more extensive exposure, adversely impacting the Kocher-Langenbeck approach and increasing operative time and the potential for blood loss.

Although some surgeons caution against antegrade femoral nailing below an acetabular fracture requiring a Kocher-Langenbeck approach, the authors do not consider antegrade nailing to be contraindicated under these circumstances at their Level I trauma center.\textsuperscript{3,5,6} The surgical technique and results of such a treatment protocol have not been previously reported in the literature.

**MATERIALS AND METHODS**

This investigation was performed at Harborview Medical Center/University of Washington, Seattle, Washington. After approval from the institutional review board, review of the orthopedic trauma database at the regional Level I trauma center between January 1999 and December 2010 identified 16 patients treated for an Orthopaedic Trauma Association (OTA) 31A, 31B, 32A, 32B, or 32C femoral fracture and an ipsilateral OTA 62A, 62B, or 62C acetabular fracture using an antegrade femoral nail and a Kocher-Langenbeck approach.\textsuperscript{11} Five additional patients were treated with retrograde femoral nails for fractures below acetabular fractures requiring a Kocher-Langenbeck approach and were not included in the study group.

**SURGICAL TECHNIQUE**

Femoral nailing precedes acetabular fracture fixation in almost all circumstances. If the surgeon treating the femur fracture does not plan to treat the acetabulum, the acetabular surgeon should be involved early in the decision to place an antegrade nail. It is the authors’ preference to place the patient supine on a radiolucent table with a rolled blanket placed under the ipsilateral sacrum and lumbar spine to elevate the affected hip approximately 20°. The patient’s pelvis is positioned so that the ipsilateral buttock overhangs the edge of the table to optimize starting point access, and the entire limb is steriley prepared and draped in the surgical field. The surgical technique for supine antegrade femoral nailing without a fracture table has been previously described in the literature.\textsuperscript{12}

A minimally invasive femoral nailing technique helps to ensure that the subsequent Kocher-Langenbeck incision is not adversely affected. A guidewire is placed percutaneously into the appropriate starting point at either the piriformis fossa or trochanteric entry site and is followed by a corresponding skin and fascial incision only large enough to admit the requisite reamers and subsequent medullary nail. Establishing an appropriate starting point for the intramedullary nail can be complicated in the setting of an unreduced posterior hip dislocation or by medial displacement of the proximal femur due to the acetabular fracture. When establishing the femoral starting point is difficult, the surgeon must remain mindful of the planned Kocher-Langenbeck incision before making a larger incision and performing a more invasive approach to the proximal femur. A percutaneously placed Schanz pin in the proximal femoral segment can be used in these circumstances to manipulate the hip while the starting point is established. A standard reamed, locked intramedullary nailing is then performed. At the conclusion of the procedure, care is taken to debride any residual reamings from the abductor musculature. The hip must also be scrutinized radiographically to ensure that it is reduced. If definitive acetabular fracture surgery is to be delayed, fine-wire distal femoral traction adjacent to the nail is used as needed to maintain reduction.

If the patient’s overall medical status is appropriate and a surgeon with the required expertise in acetabular fracture surgery is available, acetabular fracture fixation can proceed under the same anesthetic. If these criteria are not met, acetabular surgery can be performed as a staged procedure. Either way, it is the authors’ practice to perform a Kocher-Langenbeck approach in the prone position on a radiolucent table. The leg is again left free and a standard sterile prep and drape undertaken. The femoral nail insertion wound can almost always be avoided because the stab incisions required for proximal interlocking can be incorporated into the vertical limb of the Kocher-Langenbeck approach if necessary with no ill effect. Acetabular fracture exposure, reduction, and fixation...
can be performed routinely according to surgeon preference. At the conclusion of the procedure, it is important to perform an aggressive excision of nonviable muscle from the posterior hip to minimize heterotopic ossification formation.\textsuperscript{13}

Postoperatively, patients are treated with perioperative antibiotics, low-molecular-weight-heparin, and pneumatic compression devices for deep venous thrombosis prophylaxis and are kept toe-touch weight bearing on the involved side. The authors do not routinely use indomethacin or radiation therapy for heterotopic ossification prophylaxis.

**Results**

Mean patient age was 40 years (range, 14-76 years). Fifteen (94\%) patients were men and 1 (6\%) was a woman. Average follow-up was 12.6 months (range, 0-84 months). Eight (50\%) patients had hip dislocations associated with their acetabular fractures. The fracture patterns as classified by both the OTA\textsuperscript{11} and Judet and Letournel\textsuperscript{14} are summarized in the Table.

Three (19\%) patients presented with sciatic nerve palsies as a result of their injuries. Three (19\%) had open femoral shaft fractures, all of which were Gustilo type IIIA.\textsuperscript{15} Three (19\%) patients had both injuries definitively treated in a single procedure, whereas 13 (81\%) patients underwent staged treatment, initially undergoing antegrade reamed locked femoral nailing followed by acetabular fracture fixation under a separate anesthetic. Mean time from injury to femoral nailing was 1.2 days (range, 0-6 days), and mean time from injury to open reduction and internal fixation of the acetabulum was 4.5 days (range, 0-14 days).

A total of 10 surgeons performed the femoral nailings, and 3 surgeons (J.C.K., M.L.C.R.) performed the acetabular fracture fixation. The same surgeon performed both surgeries in 6 (38\%) cases. Eleven (69\%) nails were inserted through a piriformis starting point and 5 (31\%) through a trochanteric starting point. All nails were placed using a percutaneous technique, and nail insertion incisions were not incorporated into the Kocher-Langenbeck wound in any case. Eleven (69\%) patients had evidence of femoral medullary reaming debris in their abductor musculature on postoperative computed tomography scan. Radiation therapy for heterotopic ossification prophylaxis was not used.

One (8\%) patient died and 2 (15\%) had follow-up at outside institutions and were therefore unavailable for long-term follow-up. Of the remaining patients, 1 (8\%) developed a Kocher-Langenbeck wound deep infection requiring irrigation and

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>T, PW</td>
<td>62A1.2, 62B1.2</td>
<td>32A3.2</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>2</td>
<td>T, PW</td>
<td>62A1.3, 62B1.3</td>
<td>31B2.3, 32B3.2</td>
<td>NA</td>
<td>Posterior</td>
</tr>
<tr>
<td>3</td>
<td>BC</td>
<td>62C3.2</td>
<td>32A2.1</td>
<td>NA</td>
<td>Posterior</td>
</tr>
<tr>
<td>4</td>
<td>PC, PW</td>
<td>62A2.3</td>
<td>31A2.2</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>5</td>
<td>PC</td>
<td>62A2.2</td>
<td>32A2.3</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>6</td>
<td>T</td>
<td>62B1.2</td>
<td>32B2.3</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>7</td>
<td>T, PW</td>
<td>62A1.3, 62B1.3</td>
<td>32C1.1</td>
<td>3A</td>
<td>Posterior</td>
</tr>
<tr>
<td>8</td>
<td>T, PW</td>
<td>62A1.3, 62B1.3</td>
<td>31A3.3, 32A3.3</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>9</td>
<td>PW</td>
<td>62A1.2</td>
<td>32A3.3</td>
<td>3A</td>
<td>Posterior</td>
</tr>
<tr>
<td>10</td>
<td>T, PW</td>
<td>62A, 62B1.3</td>
<td>32B2.2</td>
<td>NA</td>
<td>Medial</td>
</tr>
<tr>
<td>11</td>
<td>T, PW</td>
<td>62A1.1, 62B1.2</td>
<td>32A2.2</td>
<td>NA</td>
<td>Posterior</td>
</tr>
<tr>
<td>12</td>
<td>T, PW</td>
<td>62A1.3, 62B1.3</td>
<td>32B3.2</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>13</td>
<td>T-type</td>
<td>62B2.2</td>
<td>32A3.2</td>
<td>NA</td>
<td>Posteromedial</td>
</tr>
<tr>
<td>14</td>
<td>T, PW</td>
<td>62A1.3, 62B1.2</td>
<td>32C3.2</td>
<td>NA</td>
<td>None</td>
</tr>
<tr>
<td>15</td>
<td>T</td>
<td>62B1.3</td>
<td>32B1.1</td>
<td>NA</td>
<td>Medial</td>
</tr>
<tr>
<td>16</td>
<td>T, PW</td>
<td>62A, 62B</td>
<td>32C3.1</td>
<td>3A</td>
<td>NA\textsuperscript{b}</td>
</tr>
</tbody>
</table>

**Abbreviations:** BC, both columns; NA, not available; OTA, Orthopaedic Trauma Association; PC, posterior column; PW, posterior wall; T, transverse.

\textsuperscript{a}Gustilo classification for the acetabulum is not applicable because all acetabular fractures were closed.

\textsuperscript{b}Injury radiograph unavailable.
debridement along with intravenous antibiotics. Another developed a Kocher-Langenbeck wound hematoma in the setting of therapeutically dosed low-molecular-weight-heparin and required evacuation. At final follow-up, 2 (15%) patients had no heterotopic ossification about the hip, 4 (31%) had Brooker class I heterotopic ossification, 3 (23%) had Brooker class II, 2 (15%) had Brooker class III, and 2 (15%) had Brooker class IV requiring resection. Neither the severity nor location of the heterotopic bone formation correlated with the hip abductor medullary reaming material noted on the postoperative computed tomography scans.

**DISCUSSION**

Ipsilateral fractures of the femur and acetabulum are uncommon, and the optimal treatment strategy has not been established. Although antegrade femoral nailing is the best surgical tactic for many femur fractures, some authors caution against this approach when an ipsilateral Kocher-Langenbeck approach for acetabular fracture treatment is anticipated. Concerns have been raised over the potential for increased risk of wound complications and heterotopic bone formation. These assertions come without supportive data from the peer-reviewed literature.

The results of the current study indicate that antegrade femoral nailing can be performed in the setting of an ipsilateral acetabular fracture requiring a posterior approach with an acceptably low incidence of wound-related complications. One patient treated in this fashion developed an infection requiring irrigation and debridement followed by intravenous antibiotics, yielding an 8% infection rate. This rate is comparable with published infection rates after isolated acetabular fracture surgery. Another patient developed a hematoma that required irrigation and debridement, but this was in the setting of therapeutically dosed low-
molecular-weight heparin. In the majority of cases, femoral nailing will be performed prior to acetabular open reduction and internal fixation, and with the evolution of contemporary percutaneous nailing techniques, the skin incisions required for nail insertion are rarely relevant to the subsequent Kocher-Langenbeck approach.

The formation of heterotopic ossification about the hip can be problematic after isolated acetabular surgery or femoral nailing alone.\textsuperscript{5,10-27} Antegrade nailing of the femoral shaft has been associated with a 10% incidence of Brooker class III or IV heterotopic ossification, whereas the incidence of clinically significant heterotopic ossification after acetabular fracture surgery is cited between 7% and 14%.\textsuperscript{5,18-27} As might be expected, the patients in the current study were at risk of heterotopic ossification formation (Figure). Eleven (85%) patients had evidence of heterotopic ossification formation at final radiographic follow-up, but only 2 (15%) were Brooker class IV and symptomatic enough to require additional surgery. Formal functional outcomes measures were not available in this cohort, but both patients with Brooker class III heterotopic ossification also reported hip pain, stiffness, and functional limitations, although additional surgery was not required.

The authors’ primary approach to minimizing heterotopic ossification involves careful debridement of the commonly present residual reamings in the abductor musculature after femoral nailing and aggressive excision of nonviable muscle from the posterior hip.\textsuperscript{12} The incidence of heterotopic ossification in this patient population was notably higher than in a previous series of isolated acetabular fractures from the authors’ institution treated through a Kocher-Langenbeck approach, suggesting that supplemental heterotopic ossification prophylaxis in the form of indomethacin or radiation may be warranted in this patient population.\textsuperscript{12}

The authors also indentified a high incidence of both open femoral shaft fractures and traumatic sciatic nerve palsies in this patient population. These associated injuries have been observed previously in the orthopedic literature and are likely related to the extreme energy transfer required to produce such an injury constellation.\textsuperscript{1,15} Clinicians must be particularly vigilant in examining and documenting the status of the soft tissue envelope as well as sciatic nerve function in this patient population.

This study has several important limitations. It was retrospective in nature, and functional outcome scores were not obtained. As is common in many studies involving trauma patients, long-term follow-up was not available for all patients. However, follow-up was sufficient to detect acute postoperative complications. In addition, all of the patients in this series had their femoral nailing performed at the authors’ institution by fellowship-trained orthopedic trauma surgeons using small incisions and after consultation with an acetabular fracture surgeon. Femoral nails inserted through larger incisions, by less experienced surgeons, or without discussion with an acetabular surgeon may have more adverse effects on a subsequent Kocher-Langenbeck approach.

**CONCLUSION**

Ipsilateral fractures of the femur and acetabulum treated with antegrade nailing and a Kocher-Langenbeck approach did not demonstrate an increased risk of wound complications, and, although heterotopic bone formation was common, it was not clinically significant in most patients. Based on the authors’ experience, the presence of an ipsilateral acetabular fracture requiring a Kocher-Langenbeck approach is not a contraindication to antegrade femoral nailing. Additional measures to prevent heterotopic ossification formation may be warranted in some cases.

**REFERENCES**


