

Easily Missed Fractures in the Lower Extremity



Joseph S. Yu, MD

KEYWORDS

• Trauma • Hip • Femur • Knee • Ankle • Fractures • Injury • Ligaments

KEY POINTS

- A systematic approach is useful when evaluating radiographs of patients with acute trauma to their lower extremity.
- Recalling high-risk areas in the hip, knee, and ankle allows the radiologist to quickly evaluate key locations in each projection for findings that are frequently subtle and may be evident in only 1 view.
- The technique is simple and sufficiently comprehensive to maximize fracture detection.
- However, the key to success is meticulous attention to detail and remembering to not overlook regions that frequently hide fractures.

HIP

The hip joint is a stable spheroidal joint composed of the femoral head and the cup-shaped acetabulum. The capsule that encloses the joint attaches to the rim of the acetabulum and the femoral neck. Within the joint, the fibrocartilaginous labrum deepens the socket by adding to the surface area by 10% to 15% and is integral to both function and stability.¹ Three capsular condensations, the iliofemoral, pubofemoral, and ischiofemoral ligaments, also contribute to joint stability.

The hip joint is frequently injured in trauma. Dislocations are relatively common in high-energy trauma and tend to occur in younger people.² These dislocations are associated with a high incidence of cartilaginous and osteochondral lesions. Femoral neck fractures are important injuries in the elderly population but may be difficult to detect owing to arthritis, obesity, osteoporosis, or external rotation of the leg.

Radiographic Evaluation

A recurring scenario in the emergency department is hip pain after falling or motor vehicle collision. Evaluation of the hip joint starts with adequate radiographs that include an anteroposterior (AP)

pelvic radiograph with accompanying AP and frog leg views of the hip.

Assessment includes close scrutiny for symmetry of the femoral heads and joint spaces, integrity of the acetabular arc and radiographic pelvic “teardrop,” and continuity of 4 critical osseous landmarks. The osseous landmarks are the iliopectineal line, ilioischial line, anterior acetabular rim line, and posterior acetabular rim line. These reference lines allow inspection of the quadrilateral plate, the anterior and posterior columns, and the acetabular walls. Shenton line, which is drawn along the superior margin of the obturator ring and laterally along the medial cortex of the femoral neck, is helpful in identifying dislocations.

Even with careful inspection, the incidence of radiographically occult hip fractures ranges from 4% to 9% in patients presenting with pain after trauma.^{3,4} In these situations, MRI is the most appropriate follow-up imaging study owing to its exquisite sensitivity to edema in the bone marrow (**Fig. 1**). The reported sensitivity and specificity of MRI for occult fractures is 100%.^{5,6}

Acetabular fractures

Fractures of the acetabulum are often complex, and the Judet-Letournel classification is useful when reporting findings.^{7,8} By carefully evaluating

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Department of Radiology, The Ohio State University Wexner Medical Center, 395 West 12th Avenue, Suite 481, Columbus, OH 43210, USA

E-mail address: Joseph.yu@osumc.edu

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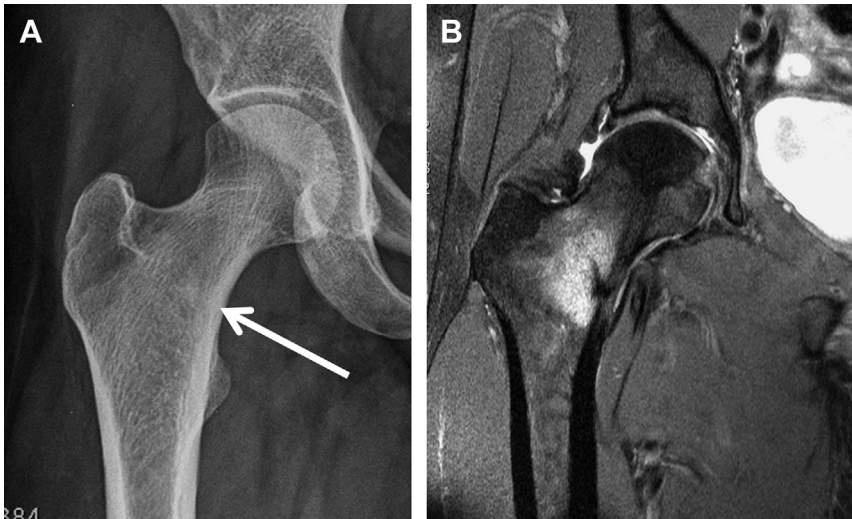


Fig. 1. Occult femur stress fracture in distance runner. (A) Radiograph of the hip shows no obvious fracture but there is a faint linear area of sclerosis at the base of the neck medially (*arrow*). (B) Coronal short tau inversion recovery (STIR) magnetic resonance image shows a unicortical linear low-signal-intensity abnormality on the compressive side of the femoral neck surrounded by intensely bright marrow edema.

the osseous landmarks and pelvic symmetry, most acetabular fractures may be easily identified and appropriately classified.

The most common type of fracture of the acetabulum is a posterior acetabular wall fracture, which comprises nearly one-fourth of fractures in this joint, and it is usually produced by a posterior hip dislocation. Unlike the shoulder, nearly 85% of dislocations of the hip are directed posteriorly, occurring with hip flexion so that the head of the femur is driven toward the back of the acetabulum.²

Visualizing the fracture may be quite subtle owing to overlapping osseous structures. Disruption of the posterior rim line is characteristic of a posterior wall fracture (**Fig. 2**).⁹ The fracture may involve the posterior acetabular rim and/or a portion of the retroacetabular surface. Oblique (Judet) views are optimal for diagnosis, but when there are large or numerous fragments, computed tomography (CT) is preferred for comprehensive evaluation for instability.¹⁰

Pubic fractures

Pubic bone fractures typically are associated with other fractures in the pelvis. Fractures in the rami may be subtle, particularly in patients with osteoporosis who have sustained trauma (**Fig. 3**). Meticulous attention to cortical disruption and changes in bone density is required.

Long-distance runners are susceptible to stress fractures of the pubic arch usually in the inferior ramus near the symphysis pubis.¹¹ Because these fractures are nondisplaced, they are easy to overlook.

Pediatric considerations

Avulsion injuries that involve the ossification centers in skeletally immature patients constitute an important group of injuries that affect the muscular, tendinous, and ligamentous attachments about the hip joint (**Fig. 4**).¹² These injuries frequently occur as a manifestation of strong muscular contractions during athletic events. In the hip, important areas to consider include the ischium (hamstring), pubis (adductors), and anterior inferior iliac spine (rectus femoris) (**Fig. 5**).

Femoral head fractures

Femoral head fractures most commonly are associated with hip dislocations. The incidence of femoral head fractures is about 7% in patients with posterior dislocation and ranges from 10% to 68% in patients with anterior dislocation.^{13,14}

Note that fractures may be the result of either a shearing injury or a direct impaction. Both types of fractures may be extremely subtle. CT is advocated not only to confirm the diagnosis and identify other fractures but also to assess the presence of intra-articular fragments (**Fig. 6**).

Proximal femoral fracture

Fractures of the femoral neck are generally a condition of elderly people.¹⁵ Subcapital fractures are most common, but these may be difficult to detect when the femur is externally rotated or there is significant osteophyte formation from arthritis. Obesity and osteopenia may further compromise an already challenging hip radiograph, so meticulous inspection is required.

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