

Femoral Head Fractures: A Critical But Frequently Missed Injury

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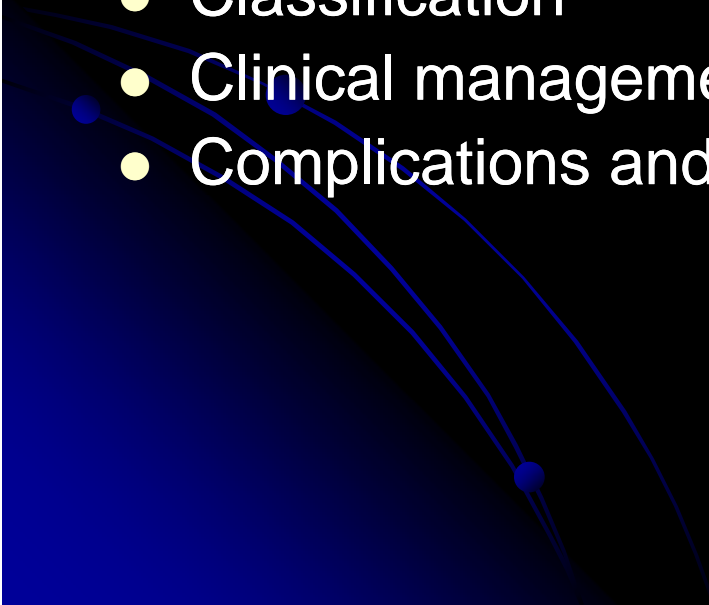
Background

Femoral head fractures:

- A complication of approximately 5-15% of posterior femoral head dislocations, however the incidence is on the rise.³
- Often go undiagnosed with potentially devastating consequences
- Rapid and accurate assessment of the severity of the injury is necessary to allow recognition of patients in need of urgent orthopedic care.

Objectives

Review:

- Pathophysiology
 - Anatomy
 - Diagnosis
 - Classification
 - Clinical management based on fracture type
 - Complications and patient outcomes
- 

Introduction to Femoral Head Fractures

Mechanism of injury:

- Motor vehicle collision
- Hip in flexion and internal rotation, resulting in posterior dislocation of the hip.
- Posterior dislocation variably results in:
 - Fracture of the posterior wall of the acetabulum
 - Femoral head fractures
 - Cartilaginous or ligamentous injuries.

Vascular Supply of the Femoral Head

- ~ 90% of vascular supply via an intracapsular plexus surrounding the femoral neck. Supply originates from two branches of the femoral artery:
 - Medial circumflex artery
 - Lateral circumflex artery
- ~ 10% is supplied via the **foveal artery**, which runs through the ligamentum teres.
- Therefore, femoral neck fracture resulting in injury to the intracapsular plexus is far more likely to result in avascular necrosis of the femoral head than avulsion of the ligamentum teres.

Methods of Diagnosis

Plain film radiography:

- Posterior hip dislocation may be obvious, but small femoral head fractures may be obscured by overlying structures.
- Orthogonal views are often helpful.

CT:

- Gold standard for diagnosis of femoral head fractures.
- 3D CT also allows for an accurate anatomic depiction of the femoral head, and is helpful for orthopedic planning.

MRI:

- infrequently used in the trauma setting, but often used for follow up of patients undergoing expectant management.

Types of Femoral Head Fractures

Compression type:

- Analogous to a Hillsach's injury
- Results from impaction of the femoral head upon the acetabulum.



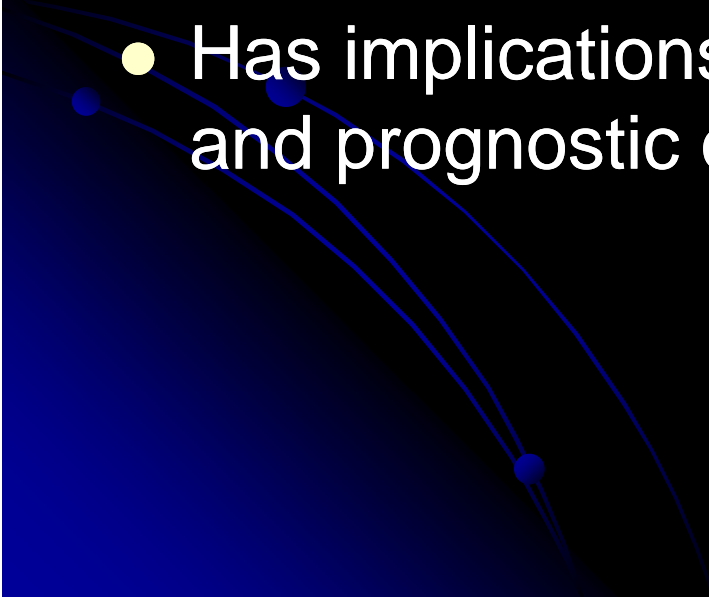
Types of Femoral Head Fractures



Avulsion/ shearing injury

- Typically an oblique fracture through the femoral head
- Often displaced

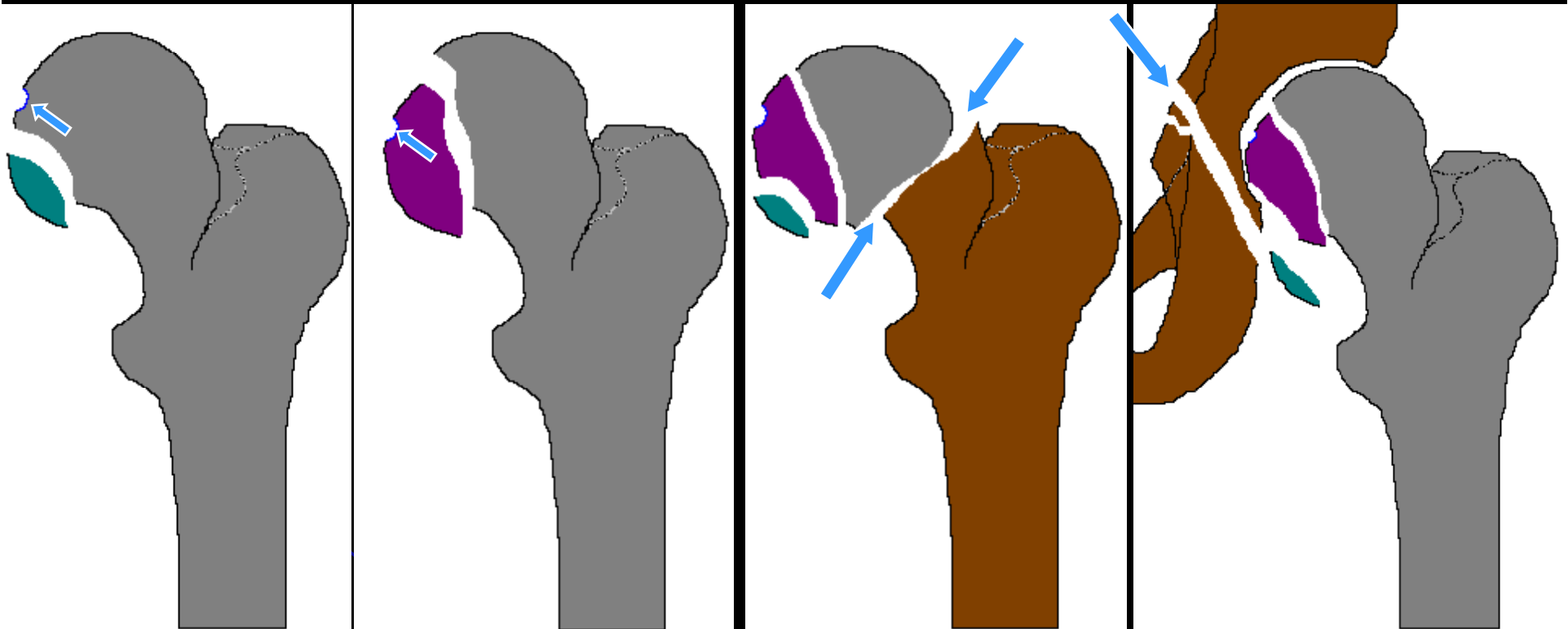
The Pipkin Classification

- Originally proposed by Pipkin in 1957¹
 - The most widely used femoral head classification system in the surgical literature
 - Categorizes femoral head fractures into four types, increasing in order of severity
 - Has implications both for surgical management and prognostic outcome
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The Pipkin Classification

- **Type I:** fracture of the *non-weightbearing* portion of the femoral head only, inferior to the fovea
- **Type II:** fracture of the *weightbearing* portion of the femoral head, superior to or involving the fovea
- **Type III:** fracture of the femoral head, with associated fracture of the femoral *neck*
- **Type IV:** Type I or II, with associated fracture of the *acetabulum*.

The Pipkin Classification



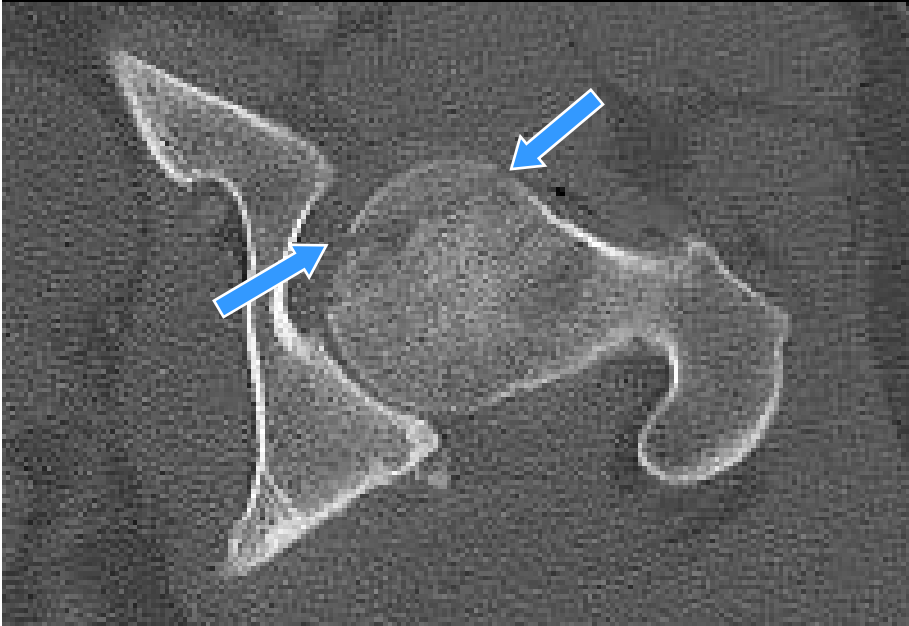
Type I

Type II

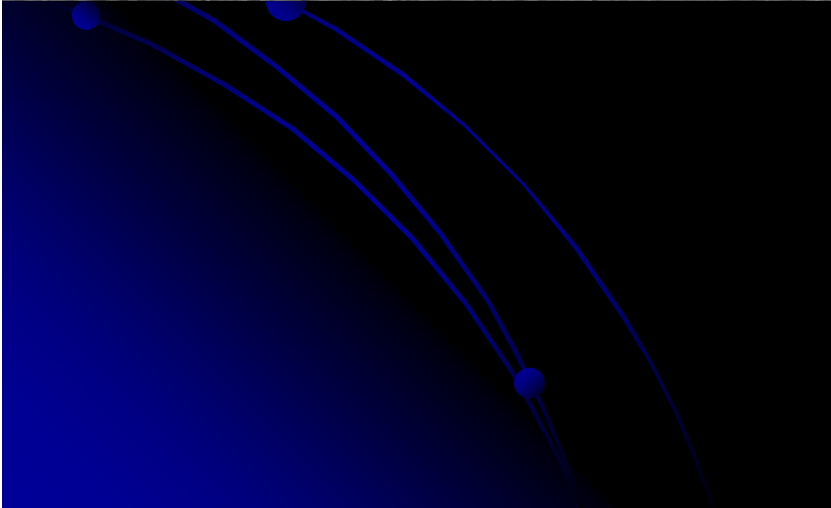
Type III

Type IV

The Pipkin Classification



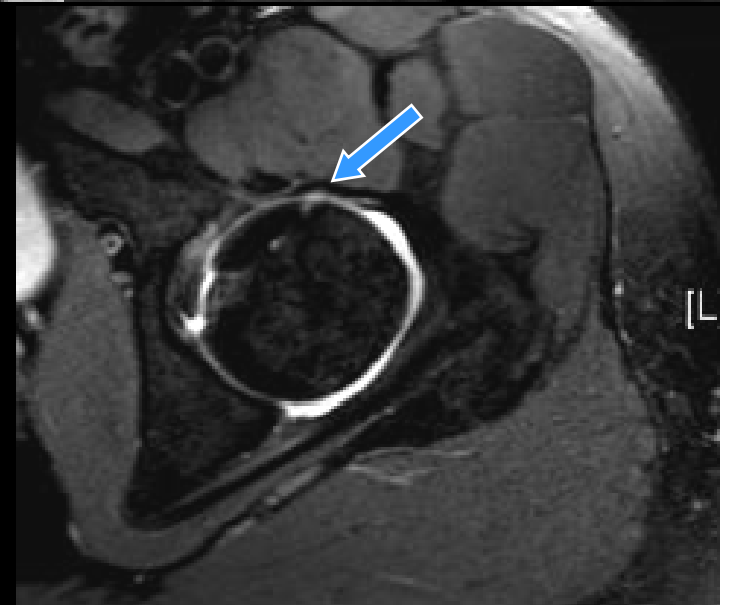
Type 1: involvement of non- weightbearing portion of the femoral head caudad to the fovea



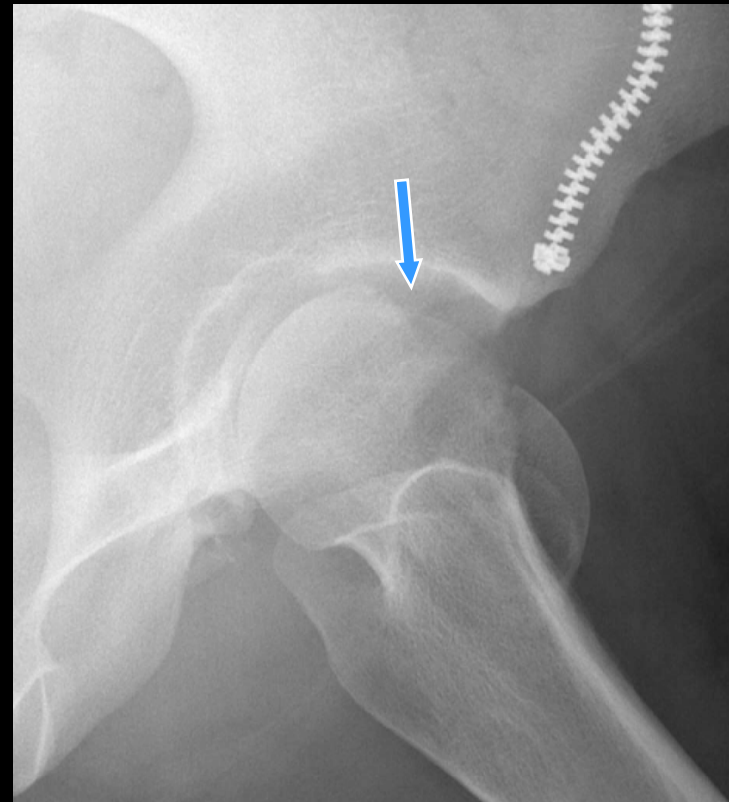
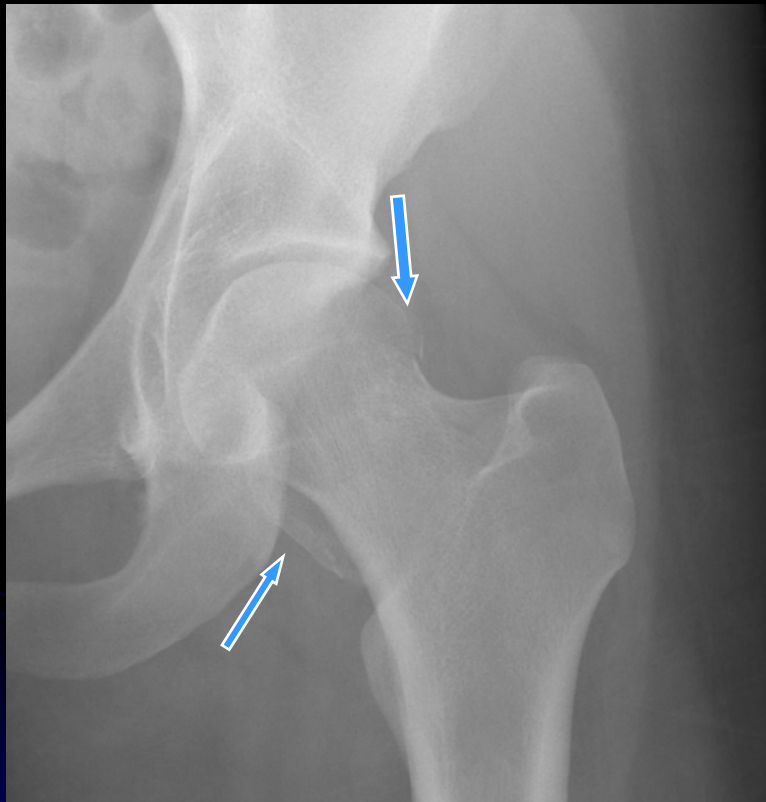
Pipkin Type I



Minimally displaced femoral head fracture extending just caudad to the fovea.



Pipkin Type II

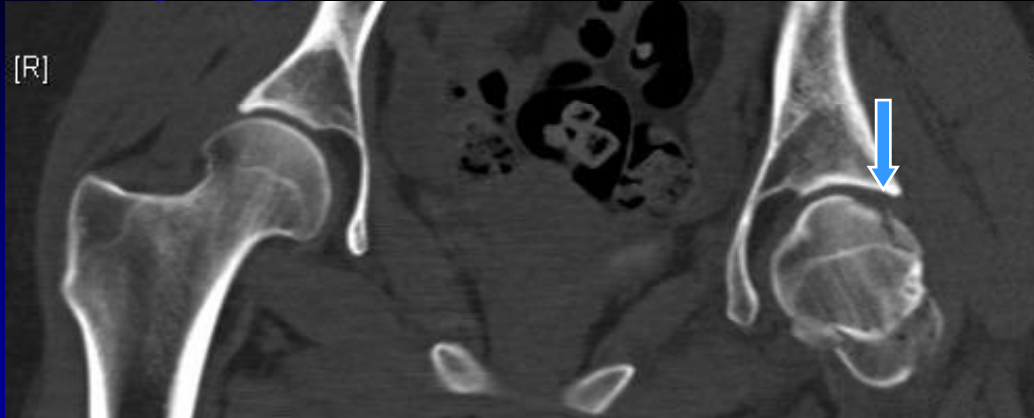


- Femoral head fracture extends **cranial to the fovea**, involving the weight-bearing surface of the joint
- Orthogonal images may be helpful in evaluating the full extent of injury

Pipkin Type II



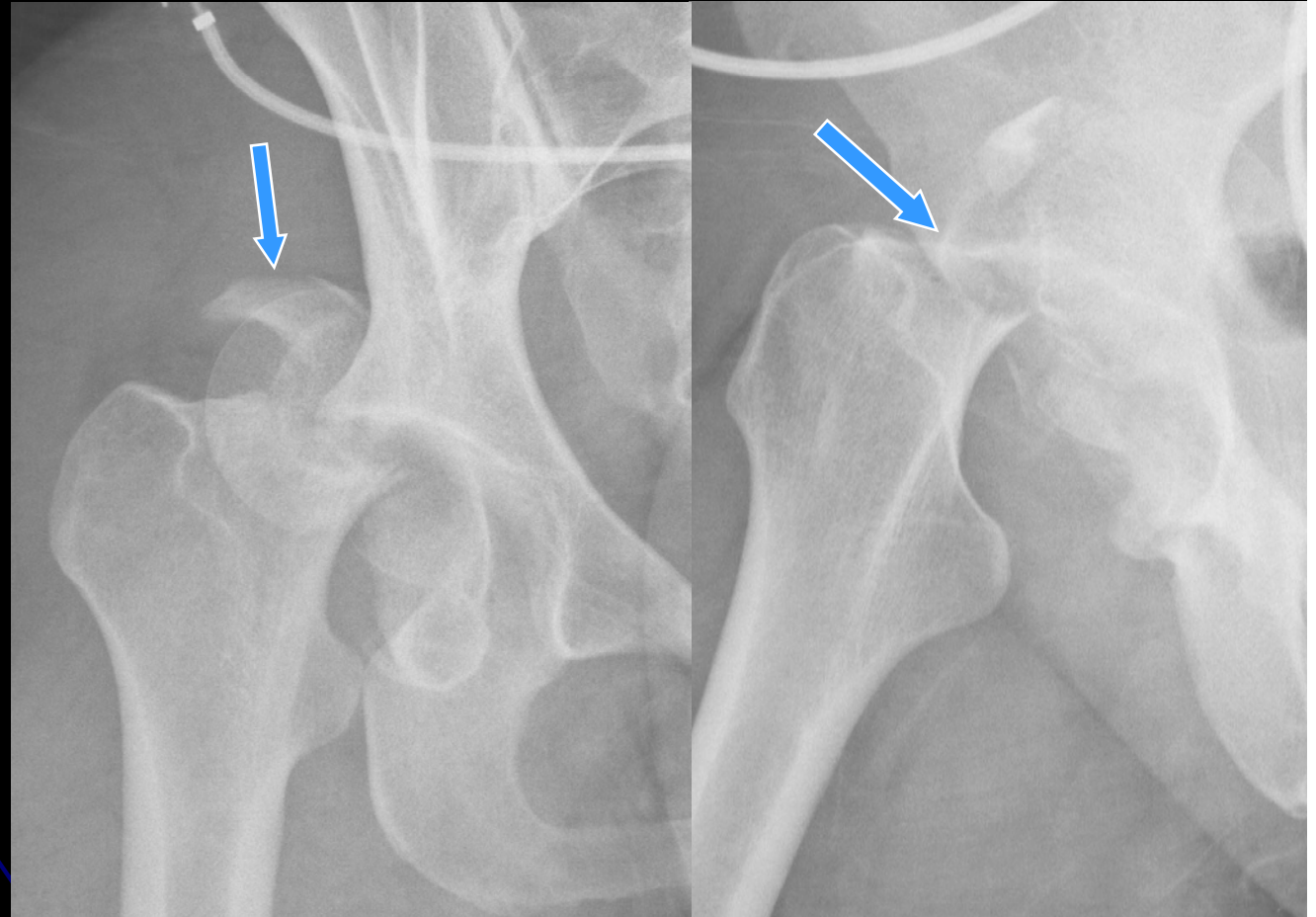
An anterior femoral head fracture extends cranial to the fovea (to the weight-bearing surface).



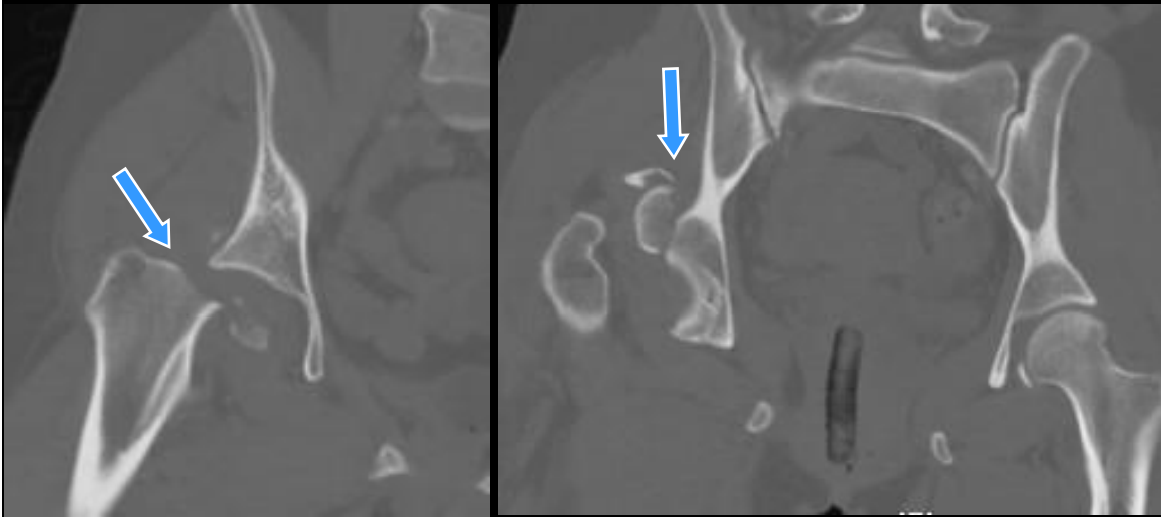
CT in the same patient

Pipkin Type III

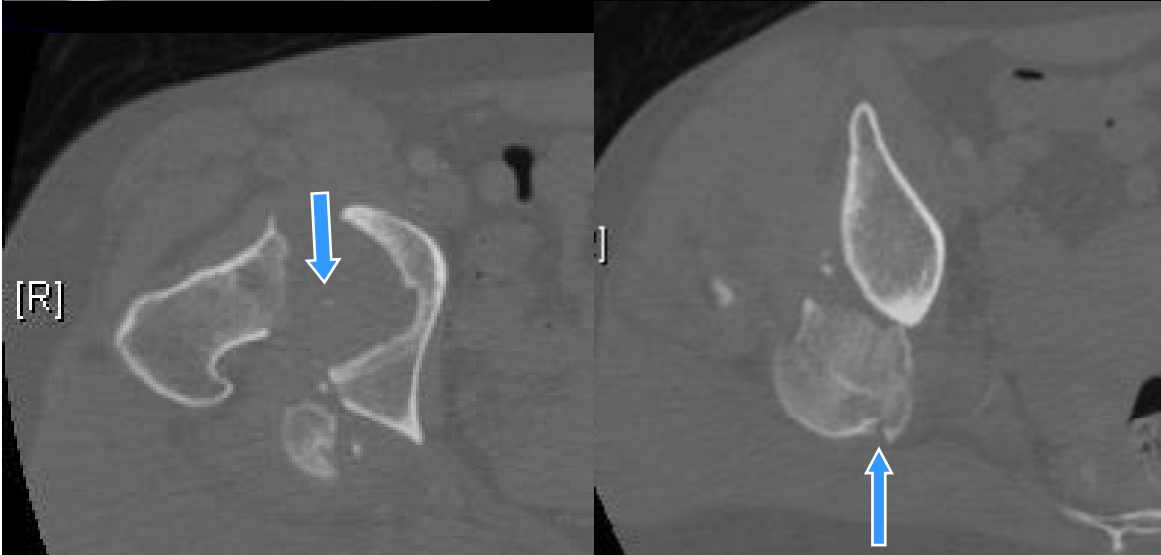
Type III injuries involve fractures of the femoral head *and* neck.



Pipkin Type III

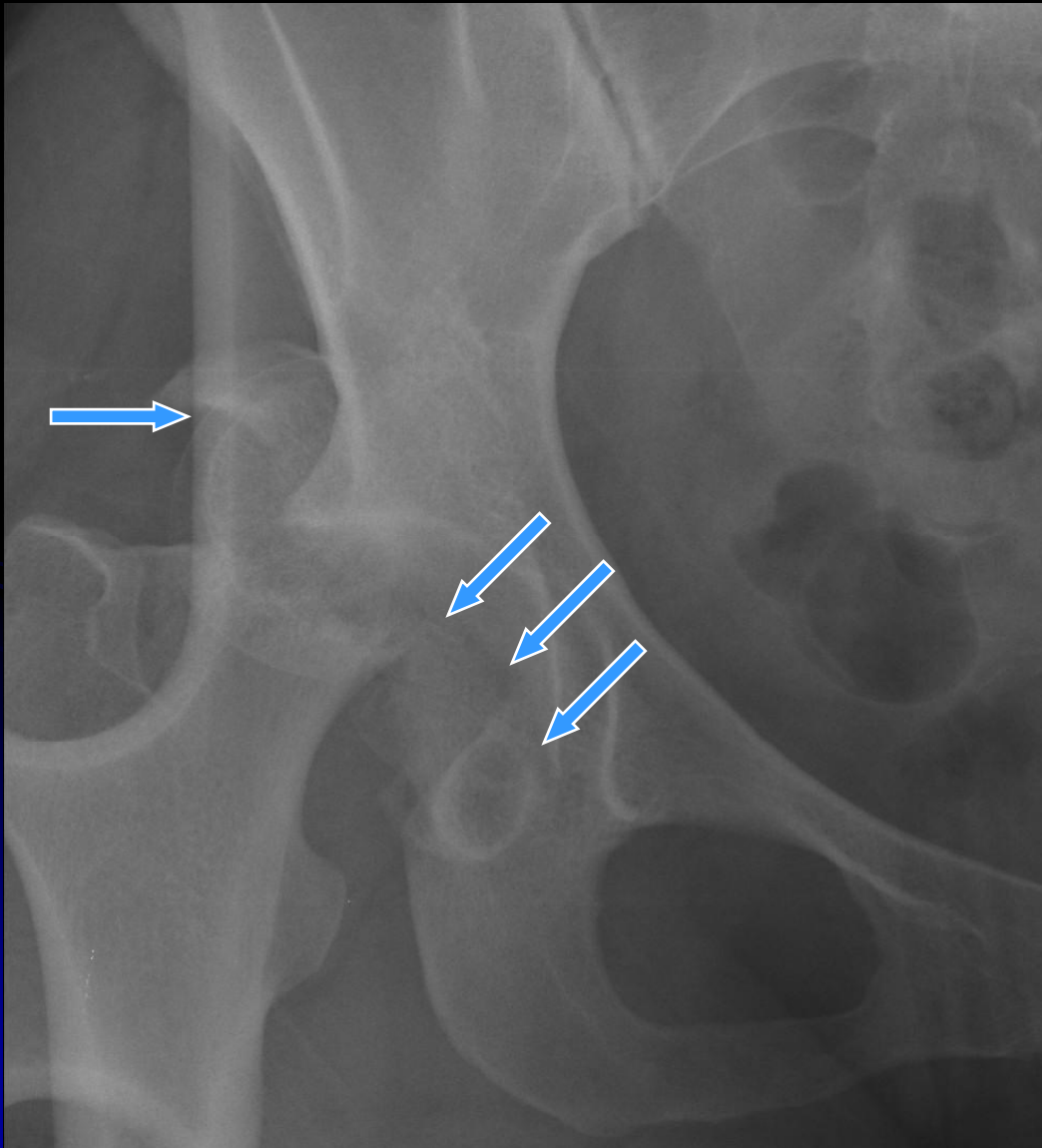


Fractures of the femoral head *and* neck make this a Pipkin Type III injury.



Intra-articular fragments are present within the joint.

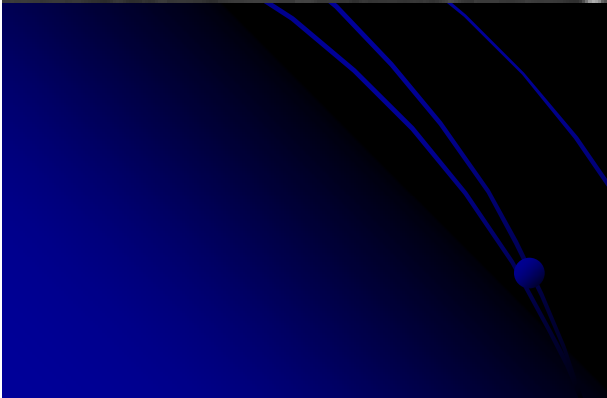
Pipkin Type IV



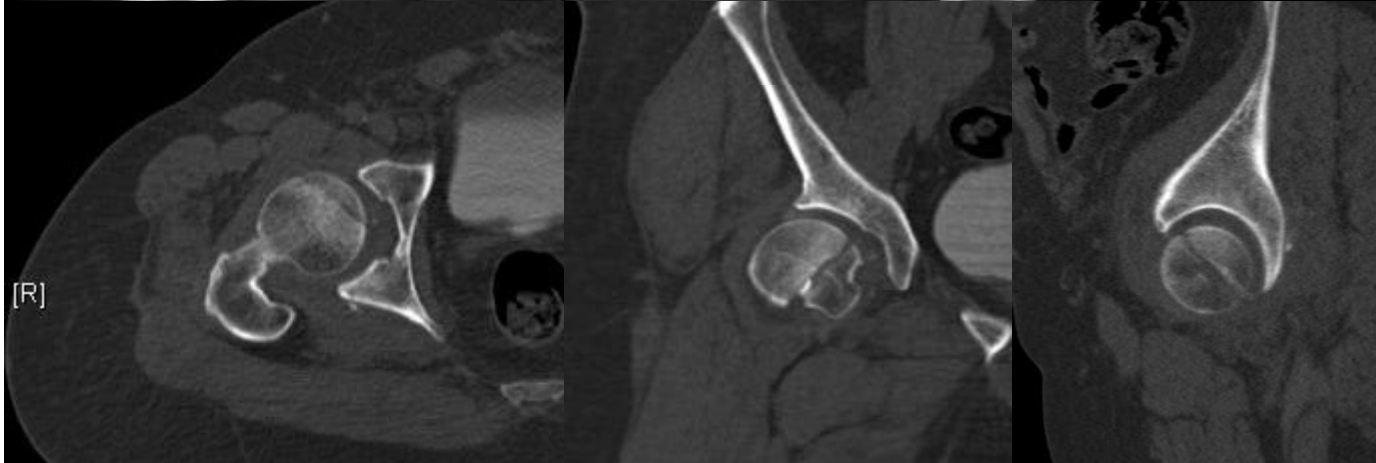
Type I or Type II injuries to the femoral head, with associated acetabular injuries, are classified Type IV

Pipkin Type IV

Extensive fractures of the acetabulum, along with an avulsion of the femoral head, make this a Pipkin Type IV injury

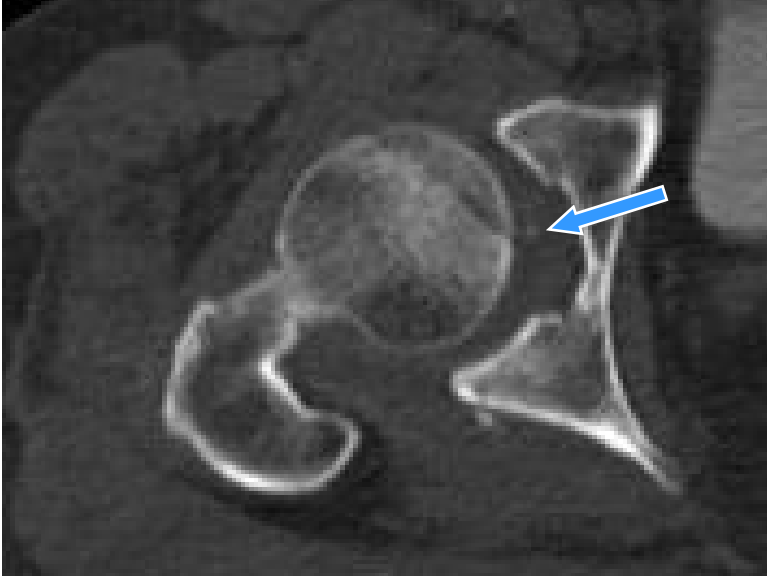
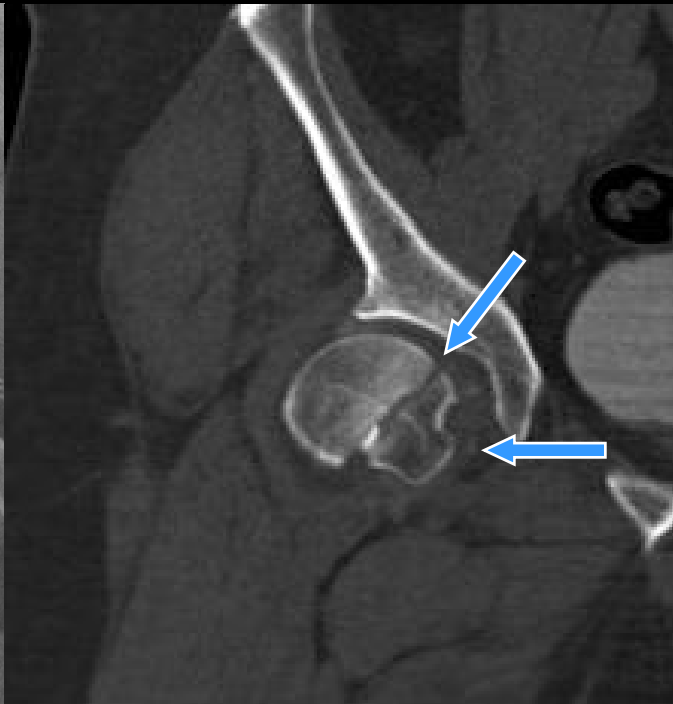
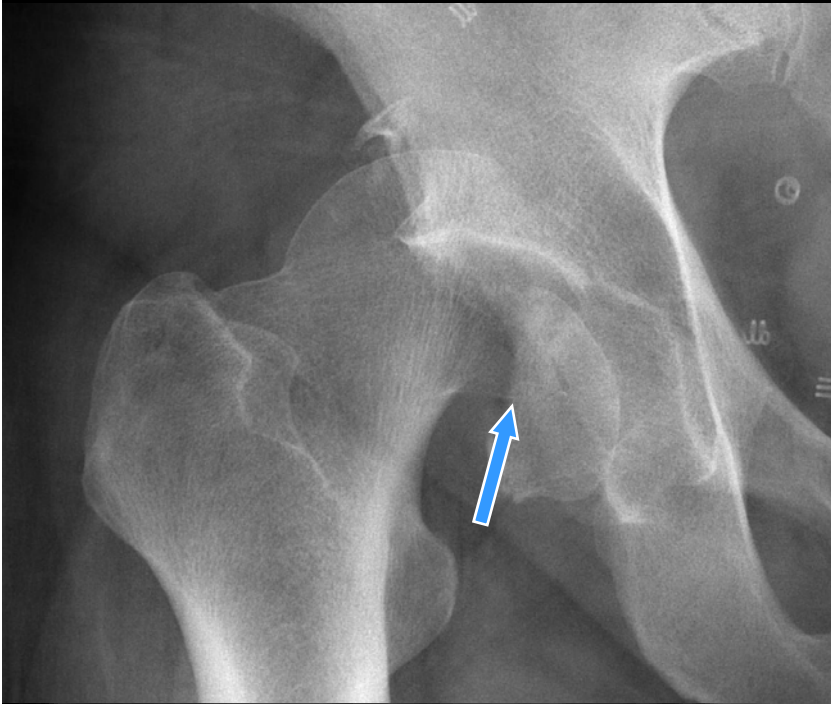


Ready to Take a Case?



56 year old male status post MVC. What Pipkin classification would you give? What does the surgeon need to know?

Solution



Initial radiograph and post-reduction CT images demonstrate a Pipkin Type II femoral head fracture that extends superior to the fovea. Tiny intra-articular fragments are present.

Initial Management

- Full trauma evaluation
- Immediate closed reduction of the dislocated hip (within 6 hours) to reduce the risk of avascular necrosis of the femoral head.²
- Inform the clinician of associated femoral neck fracture, as this is considered a contraindication to closed reduction! ^{2,3}

Management: Pipkin Type I



Often managed non-operatively, with limited weight-bearing followed by physical therapy.

Indications for non-operative management include:

- Fracture fragment <2mm displaced following reduction
- No intra-articular free fragments precluding successful reduction
- Stable hip joint

Management: Pipkin Type II

- In the past were managed nonoperatively, with poor outcomes.⁵
- Operative management is now the rule.^{2, 3}
- Significant debate remains as to whether the free fragment should be *fixated* or *excised*.

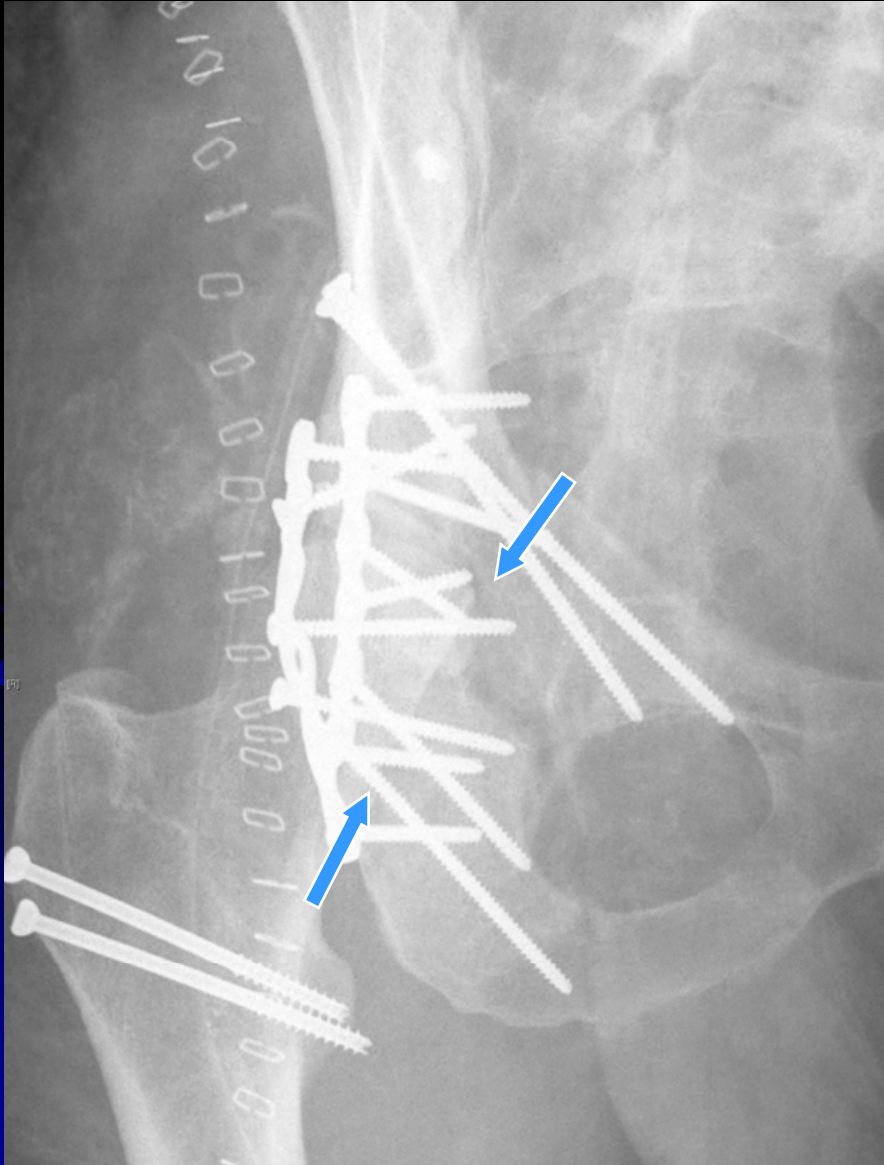


Management: Pipkin Type III



- Involve fractures of the femoral neck → increased risk of femoral head AVN.
- Immediate surgical reduction of the femoral neck fracture.
- Management of the femoral head fracture based on Type I or Type II involvement.
- Severe cases or cases involving AVN may require total joint replacement.

Management: Pipkin Type IV



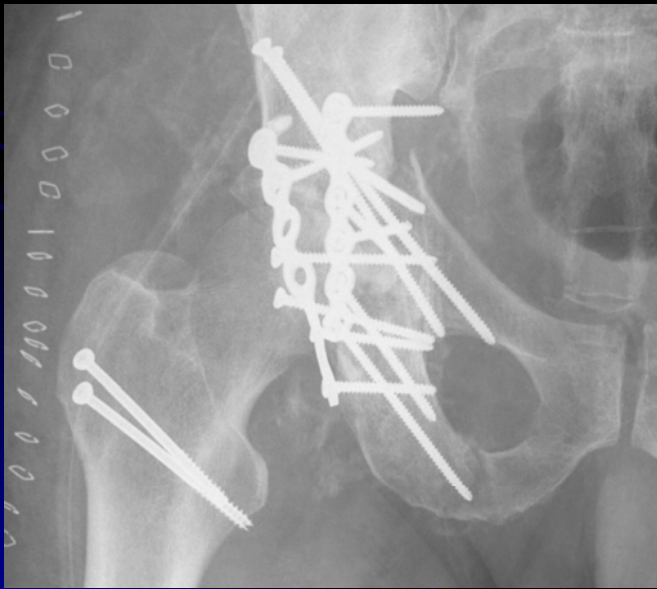
Extensive injury to the acetabulum will be surgically reduced.

Femoral head fracture repaired concurrently, as dictated by criteria for Type I or Type II injury.

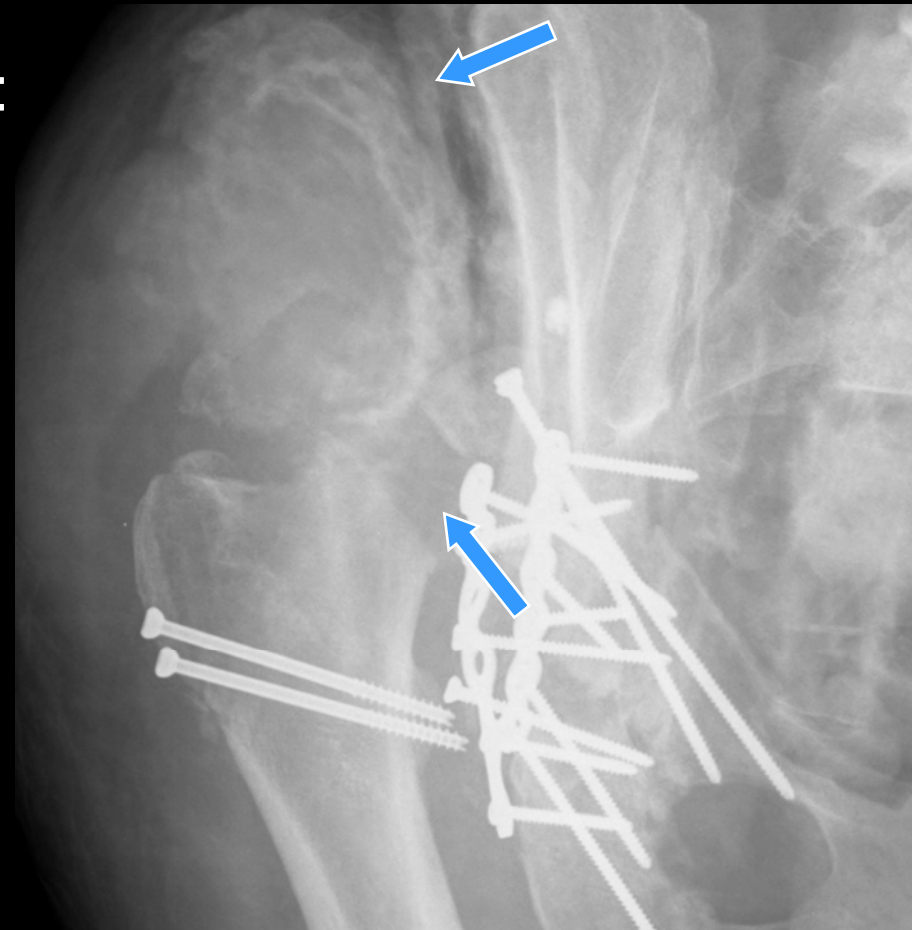
Long term results of Pipkin Type IV injuries are less favorable.

Complications increase in frequency and severity from Pipkin Type I → IV, and include:

- Post-traumatic osteoarthritis
- Sciatic nerve injury
- Avascular necrosis of the femoral head
- Heterotopic ossification



Initial post-operative radiograph



Follow up radiograph 3 weeks later. AVN of the femoral head has resulted in surgical resection, and there is increasing heterotopic ossification.

Review of Management and Outcome by Type

	Type 1	Type 2	Type 3	Type 4
Management* 2,3	Nonsurgical	Fixation or excision of major fragment	Surgical fixation of femoral neck fracture, femoral head fracture managed as per Type 1-2	Surgical fixation of acetabular fractures, femoral head fracture managed as per Type 1-2
Outcome ⁴	Good: 75% Fair: 25%	Good: 78% Fair: 22%	Good: 50% Fair: 50%	Good: 57% Fair: 7% Poor: 36%

*In all cases, small, free intra-articular fragments will be excised.
Outcome data adapted from Marchetti et al⁴

Management Controversies

- Management controversies remain, as to whether:
 - An anterior or posterior surgical approach is preferable
 - Fragment excision or fixation should be performed
- Posterior approach: higher risk of AVN of the femoral head, presumed to be because the medial circumflex artery anastomoses posteriorly⁶
- Anterior approach: increased risk of myositis ossificans, without increased risk of AVN.⁷

What the Physician Needs to Know

- Type of injury to the femoral head: does it extend *cranial to the fovea*?
- Is the fragment significantly *displaced*?
- Is there a *femoral neck* fracture?
- Are there *acetabular* fractures?
- Are there *intra-articular* fragments?



Summary

Femoral head fractures:

- Are commonly missed, with potentially devastating consequences.
- Should be actively sought in every patient presenting with posterior hip dislocation.
- Morbidity increases from Pipkin Type I-IV.
- Appropriate classification allows for rapid and appropriate patient triage.

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