

CLINICAL PRESENTATION AND RADIOLOGY QUIZ QUESTION

A 61 year old woman presents with the acute onset of post-traumatic knee pain following stepping off of a ladder and twisting her knee upon impact. She had immediate knee pain and swelling at the time of the injury, and cannot bear weight on the knee. She has had no prior knee injury. On physical examination her right knee is swollen and there is tenderness over the anterior aspect of the tibial metaphysis. The patella is not tender. The dorsalis pedis and posterior tibial pulses are intact and the patient has normal sensation at and distal to the knee. She has good ankle flexor strength and good large toe extensor strength. Her vital signs are unremarkable.

Which of the following imaging studies is the initial examination of choice for evaluation of post-traumatic knee pain?

- (a) magnetic resonance (MR) imaging of the knee
- (b) plain film examination of the knee
- (c) nuclear medicine whole body bone scan
- (d) ultrasound (US) examination of the knee

RADIOLOGY QUIZ QUESTION, ANSWER, AND EXPLANATION

A 61 year old woman presents with the acute onset of post-traumatic knee pain following stepping off of a ladder and twisting her knee upon impact. She had immediate knee pain and swelling at the time of the injury, and cannot bear weight on the knee. She has had no prior knee injury. On physical examination her right knee is swollen and there is tenderness over the anterior aspect of the tibial metaphysis. The patella is not tender. The dorsalis pedis and posterior tibial pulses are intact and the patient has normal sensation at and distal to the knee. She has good ankle flexor strength and good great toe extensor strength. Her vital signs are unremarkable.

Which of the following imaging studies is the initial examination of choice for evaluation of post-traumatic knee pain?

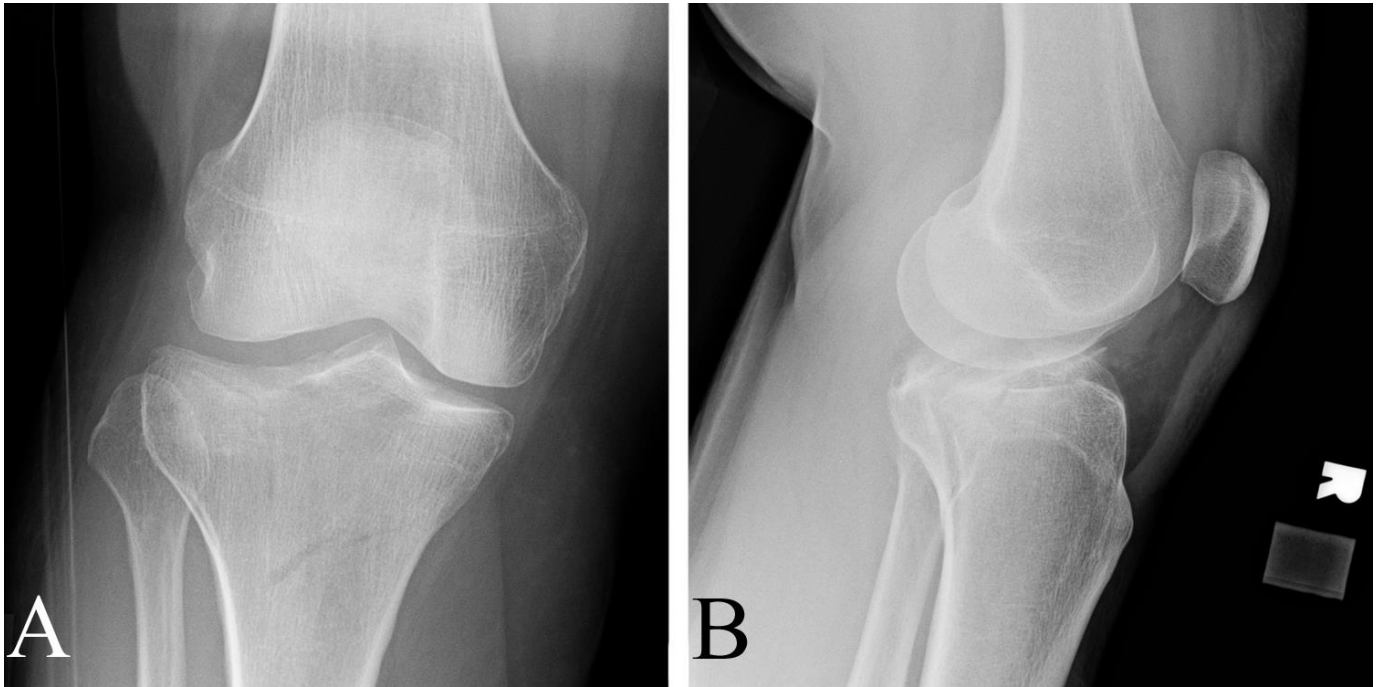
- (a) magnetic resonance (MR) imaging of the knee
- (b) plain film examination of the knee
- (c) nuclear medicine whole body bone scan
- (d) ultrasound (US) examination of the knee

The initial imaging study in patients with high velocity trauma of the knee is a plain films examination. In patients with low velocity trauma, the Ottawa criteria apply. Patients that do not meet any of the Ottawa criteria do not require imaging. The Ottawa criteria include age greater than 55 years, tenderness at the head of the fibula, isolated tenderness of the patella, inability to flex the knee to 90 degrees, and inability to bear weight both immediately and in the emergency room for at least four steps. The patient was greater than 55 years of age and could not bear weight for four steps, and therefore should be evaluated with plain films; thus, (b) is correct.

MR imaging of the knee (a) may be helpful for evaluation of the knee and may allow diagnosis of a variety of traumatic and non-traumatic knee abnormalities (including radiographically occult fractures, anterior and posterior cruciate ligament tears, meniscal tears, arthritis, and bone and soft tissue tumors). However, MR of the knee is typically performed only *after* plain film examination of the knee in the setting of acute knee trauma, and (a) is incorrect. A nuclear medicine bone scan (c) may be helpful in excluding areas of increased radiotracer indicating increased bone turnover such as might be seen in radiographically occult post-traumatic fracture, stress fracture, or complex regional pain syndrome. However, as in the case with MR imaging, nuclear medicine is typically performed only *after* plain film examination of the knee, and (b) is incorrect. US examination of the knee (d) is not widely used in the setting of acute trauma with suspected fractures or fracture/dislocations, and (d) is incorrect.

IMAGING STUDY AND QUESTIONS

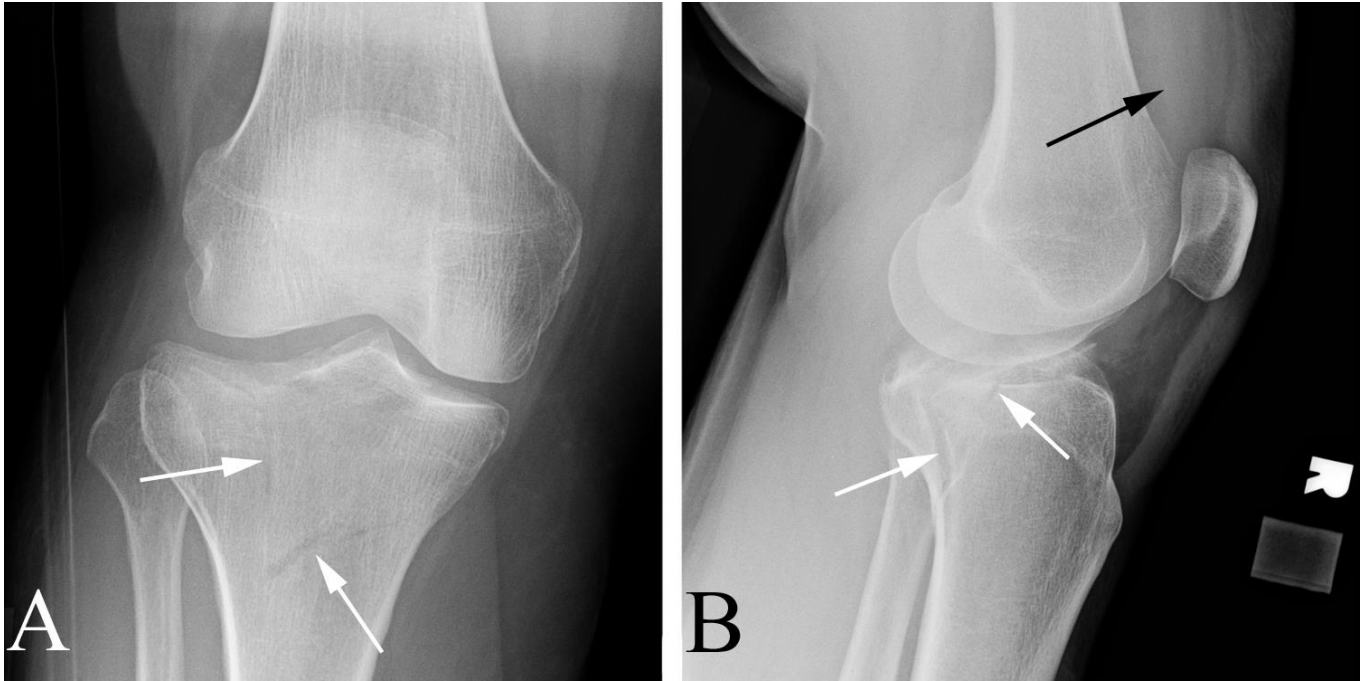
An imaging study was performed:



Imaging questions:

- 1) What type of study is shown?
- 2) Are there any abnormalities?
- 3) What is the most likely diagnosis?
- 4) What is the next step in management?

IMAGING STUDY QUESTIONS AND ANSWER

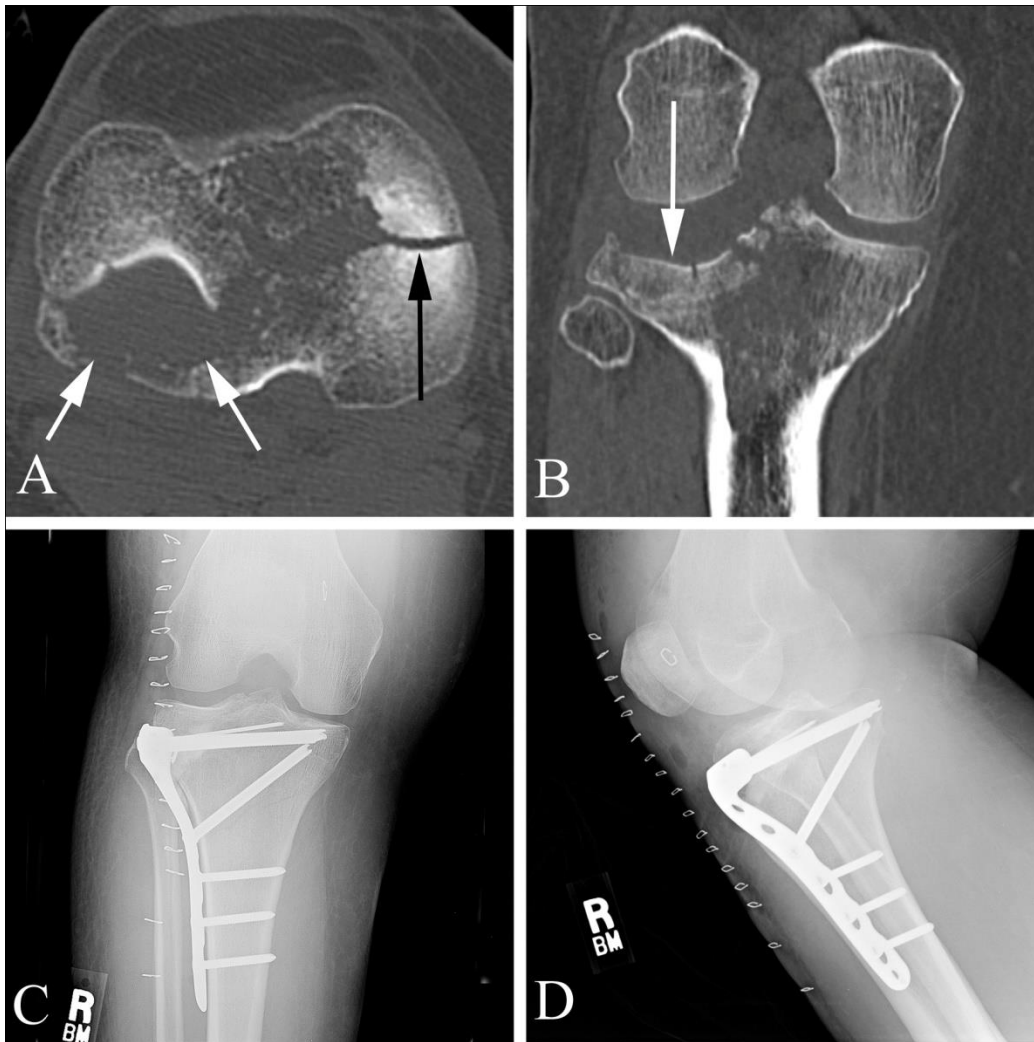


Imaging questions:

- 1) What type of study is shown? An anteroposterior (A) and lateral (B) plain film examination of the knee.
- 2) Are there any abnormalities? Yes. There is a fracture of the proximal tibia (white arrows in A and B). There is an accompanying joint effusion (black arrow in B). The exact extent of the fracture is somewhat difficult to evaluate as the fracture is not widely displaced and the fracture lines are not all parallel to the direction of the X-ray beam.
- 3) What is the most likely diagnosis? Proximal tibial fracture.
- 4) What is the next step in management? Referral to an orthopedic surgeon.

PATIENT DISPOSITION, DIAGNOSIS, AND FOLLOW-UP

The patient was referred to an orthopedic surgeon, and subsequently underwent computed tomography (CT) of the knee (see below figure). The CT examination demonstrated that the fracture not only involved the lateral tibial plateau, but also extended to the medial aspect of the proximal tibia. In addition, there was a significant segment of the posterior lateral tibial plateau that was inferiorly displaced. The orthopedic surgeon elected for open reduction internal fixation to reduce the displacement of the articular surface and to allow earlier recovery than would be possible with closed reduction and external fixation.



61 year old woman with a comminuted intra-articular proximal tibial fracture who underwent open reduction internal fixation. A. Axial computed tomograph (CT) of the proximal tibia shows that the fracture line extends through the medial tibial plateau (black arrow) and that a significant segment of the posterior tibial plateau is depressed out of the plane of section (white arrows). B. Coronal CT study through the posterior tibial plateau shows depression of the posterior aspect of the lateral tibial plateau (white arrow). C. Anteroposterior radiograph shows hardware in the proximal tibia and restoration of anatomic alignment and position. D. Lateral plain film following surgery documents hardware placement.

SUMMARY

Presenting symptoms: The patient presented with acute knee pain following trauma. The main considerations are fracture and soft tissue injury. In the case of fracture, the nature of the fracture is also critical to patient management. Minimally displaced avulsion fractures often do not require operative treatment, whereas comminuted, displaced fractures, especially those involving the articular surface, may require open reduction and internal fixation to achieve optimal results.

Imaging work-up: For low-velocity knee injuries, plain films are usually *not* necessary. However, if the patient meets any of the five criteria listed in the Ottawa rules (age greater than 55, tenderness at the head of the fibula, isolated tenderness of the patella, inability to flex the knee to 90 degrees, and inability to bear weight both immediately and in the emergency room for at least four steps) then plain films should be obtained. This patient was greater than 55 and could not bear weight, so plain films were obtained. The decision to order a CT study to further evaluate fracture fragment configuration after plain films demonstrate an obvious fracture is generally left to the treating orthopedic surgeon.

Establishing the diagnosis: When plain films or CT demonstrates definite fracture lucency they are diagnostic.

Take-home message: Plain films are not necessary in patients with low-velocity knee trauma if the patient does not meet any of the Ottawa criteria. Whether further imaging beyond plain films is necessary, and whether further imaging should be performed with CT or MR, depends on the findings on the plain film examination and on the clinical circumstances.

FURTHER READING

Stiell IG, Greenberg GH, Wells GA et al. Derivation of a decision rule for the use of radiography in acute knee injuries. *Ann Emerg Med* 1995;26:405-413.

Renfrew DL. Single joint pain. Chapter 14 in *Symptom Based Radiology*, Symptom Based Radiology Publishing, Sturgeon Bay, WI, 2010, available for no charge at www.symptombasedradiology.com.