

Appropriate Use of Imaging in Patients with Knee Pain

BY TONY JEANMENNE, MD

INTRODUCTION

The knee is a common source of pain in adult patients from acute traumatic, chronic overuse or other non-activity related etiologies. Choosing the appropriate diagnostic imaging assessment of the knee will provide a timely diagnosis that will guide proper treatment options.

Radiographs of the knees are commonly obtained first and are useful to diagnose fractures, joint effusions or osseous changes of arthrosis. Patients with classic clinical presentations and concordant radiographs may not need further imaging before treatment. However, radiographic findings such as effusion, avulsion fracture or unexpected osseous lesion may warrant further advanced diagnostic imaging assessment.

MRI without contrast is the overall most useful advanced imaging procedure for the majority of patients presenting with any kind of knee pain. **MRI without and with IV contrast** increases the sensitivity for synovitis, marrow replacing disease, infection and masses. Note, **MRI with contrast** is typically not recommended because it lacks the pre-contrast images that are used for comparison when assessing abnormal tissue enhancement. **MRI arthrography** of the knee is used in limited cases, often to help in the diagnosis of recurrent meniscal tearing after surgery, assessment of osteochondral lesions or loose bodies.

CT of the knee provides excellent osseous detail, but is limited in the assessment of connective and soft tissues pathology. **CT without contrast** is preferred to assess traumatic fractures prior to surgery or assess for subcutaneous gas. **CT arthrography** is preferred for the patient presenting for possible internal derangement of the knee and inability to undergo MRI. **CT angiography** is preferred in the setting of vascular injury. **CT of the knee with IV contrast** is of limited usefulness and is not generally recommended.

Ultrasound of the knee is used primarily for the assessment of peri-articular fluid collections, such as popliteal (Baker's) cyst, pre-patellar bursitis or vascular abnormalities, such as DVT. Assessment of internal knee structures, such as the cartilage, menisci and cruciate ligaments with ultrasound is generally not recommended.

Nuclear medicine studies of the knee may be useful in situations where the patient is unable to undergo MRI or the MRI findings are inconclusive. Consider use in patients presenting with suspected infection or loosening of hardware after arthroplasty.

INSIDE THIS ISSUE



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This material summarizes key elements of Appropriate Use Criteria (AUC) developed by the CDI Quality Institute's Provider Led Entity (PLE). The CDI Quality Institute PLE has been qualified by the Centers for Medicare and Medicaid Services to develop AUC to guide the ordering of advanced imaging studies. The entire AUC library is available at myCDI.com/PLE.

This edition of *The Consult* summarizes criteria developed by Dr. Jeanmenne and a panel of experts:

- Thomas Gilbert, MD, MPP; CDI Chief Clinical Officer and PLE Chair, Minneapolis, MN
- Robert Liddell, MD; musculoskeletal radiologist and PLE Vice Chair, Seattle, WA
- Edward Nelsen-Freund, MD; Assistant Professor of Orthopedic Surgery, Medical College of Wisconsin
- Brandon Messerli, DO; Evergreen Health sport and spine care physiatrist, Kirkland, WA
- David Strobel, MD; Pipe Trades Services MN family physician, Eagan, MN

Clinical decision support (CDS) is not intended to replace clinician judgment, but rather to provide information to assist care team members in managing the complex and expanding volume of biomedical and person-specific data needed to make timely, informed, and higher-quality decisions based on current clinical science (National Academy of Medicine, 2017).

CLINICAL SCENARIOS

The strength of recommendations for imaging is indicated as follows:

- Green = indicated
- Yellow = indicated in specific scenarios
- Orange = probably not indicated, with limited exceptions
- Red = not indicated

SCENARIO #1: IMAGING INDICATIONS

Knee pain with suspected structural derangement* after an acute injury:**	
● Green	MRI without IV contrast
● Yellow	CT arthrography in patients who cannot undergo MRI
● Yellow	CT without IV contrast in patients with suspected tibial plateau fracture and negative or indeterminate radiographs, or to characterize a fracture detected on radiographs
● Yellow	MR arthrography in patients with suspected recurrent injury after prior surgical repair (e.g., meniscal or osteochondral defect repair)
● Yellow	CT angiography or MR angiography to evaluate for suspected vascular injury in patients with multiple ligament injuries, or in patients with known or suspected dislocation
● Red	MRI without and with IV contrast, MRI with IV contrast, CT with IV contrast, CT without and with IV contrast, bone scan, SPECT, PET, PET/CT

* Signs and symptoms of structural derangement after an injury can include giving way, locking, catching, effusion, inability to bear weight, bone tenderness, loss of motion, and/or pathological laxity.

**Acute injury is defined as a discrete event resulting in excessive force on the knee, in contradistinction to overuse injuries that result from chronic repetitive injuries or insufficiency injuries that result from normal forces on structurally deficient bone.

SCENARIO #1: CLINICAL NOTES

- In the initial evaluation of a person with a knee injury and associated symptoms and signs, it is recommended that the practitioner obtain AP and lateral knee radiographs to identify fractures or dislocations requiring emergency care (Shea et al 2015 [AAOS]; consensus recommendation).
- The Ottawa Knee Rules (OKR) can guide the use of radiographs for excluding fracture in people with acute knee injury (Robb et al [NZMA] 2017; Grade A recommendation; (NICE 2016)).
- In adults with acute knee injury and positive findings for the OKR, radiographs are indicated in the presence of one or more of the OKR criteria (A level recommendation). If radiographs are negative but clinical signs are persistent, repeat films should be obtained 7-10 days after onset (Bussieres et al 2007).
- MRI is the gold standard for internal knee derangements such as meniscal and ligamentous injuries; however, many patients can be diagnosed without the need for this investigation. When there is an equivocal diagnosis, specialists may consider MRI to clarify the diagnosis and inform treatment decisions (Bussieres et al 2007; Robb et al [NZMA] 2007; Grade C recommendation).

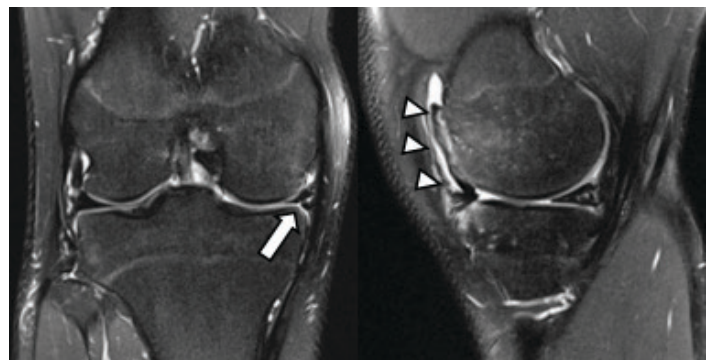
- In patients with suspected dislocation of the knee, vascular injury can be seen in about 30% of patients. Physical signs of vascular injury include the absence of pulses, an abnormal ankle brachial index (ABI), asymmetric pulses, ischemia, an increasing hematoma and a bruit/thrill (Tuite et al [ACR] 2015).

Scenario #1a: Acute Trauma



Coronal CT without contrast obtained for presurgical planning in a 59 year old patient with open fracture on radiographs. Multipart fracture includes an intra-articular impacted and comminuted fracture of the lateral tibial plateau (white arrow) Additional transverse fracture plane creates metadiaphyseal dissociation, in keeping with a Schatzker type VI fracture (green arrow). CT has excellent osseous detail to assess fracture fragments and will reveal subcutaneous gas from open fracture better than MRI (arrowhead).

Scenario #1b: Acute Pain After Injury



Coronal and Sagittal MRI without contrast obtained for knee pain and locking in a 19 year old patient with negative radiographs. There is a horizontal tear of the body of the medial meniscus (arrow). The meniscal tear creates a flap of meniscal tissue that is flipped anteriorly and superiorly (arrowheads).

SCENARIO #2: IMAGING INDICATIONS

Nontraumatic knee pain persisting after an appropriate trial of conservative care and no major abnormalities (e.g., fracture, AVN, tumor, or moderate or severe osteoarthritis) on radiographs:	
● Green	MRI without IV contrast
● Yellow	CT arthrography in patients who cannot undergo MRI
● Yellow	MR arthrography in patients with suspected recurrent injury after prior surgical repair (e.g., meniscal or osteochondral defect repair)
● Orange	CT without IV contrast, except when assessing patellofemoral morphology for surgical planning
● Red	MRI with IV contrast, MRI without and with IV contrast, CT with IV contrast, CT without and with IV contrast, bone scan, SPECT, PET, PET/CT

SCENARIO #2: CLINICAL NOTES

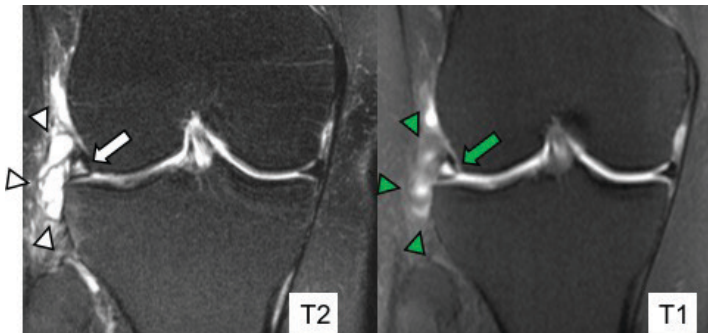
- Radiographs should be the initial imaging study for chronic knee pain (Fox et al [ACR] 2018) and should include AP 15° flexed weight-bearing, lateral and tangential patellar views (PLE expert panel consensus opinion).
- When the patient does not respond to a complete course of medical treatment, MRI should be performed to evaluate the menisci, the subchondral bone, the synovium, and, to a lesser extent, the cartilage (Beaufils et al 2009; professional agreement).
- Metal reduction technique should be used in patients with metallic instrumentation and knee arthroplasties (PLE expert panel consensus opinion).

Scenario #2a: Chronic Non-traumatic Knee Pain



Coronal CT arthrography obtained for chronic knee pain over 1 year in a 67-year-old patient with unremarkable radiographs. There is a complete radial-oriented tear of the posterior horn at the posterior root ligament of the medial meniscus (arrow). Note, CT arthrography performed in this patient with a pacemaker, who is unable to undergo MRI.

Scenario #2b: Chronic Knee Pain after Surgery



MR Arthrography with Coronal T2 & T1 sequences assessing recurrent pain and locking after lateral partial meniscectomy 4 months earlier. **T2-weighted MR** image shows fluid signal within the body of the lateral meniscus (white arrow) and a 25mm parameniscal cyst (white arrowheads). Post-operative blunting of the apex, but no definite tear on the surface appreciated. **T1-weighted MR** image confirms recurrent tearing of the meniscus with intra-articular contrast extravasating through the meniscus (green arrow) and partially filling the parameniscal cyst (green arrowheads).
Images courtesy of Thomas Sullivan, MD.

Coronal and Sagittal MRI without contrast obtained for chronic knee pain over 3 years in a 56 year old patient with moderate to severe medial joint space narrowing on radiographs. There is a complete radial oriented tear of the posterior horn of the medial meniscus (arrow) with peripheral displacement of the body, impressing on the MCL (arrowhead). There is advanced osteoarthritis in the medial compartment with subchondral marrow edema and early cystic change, compatible with stress from meniscal and cartilage failure (green arrows).

SCENARIO #3: IMAGING INDICATIONS

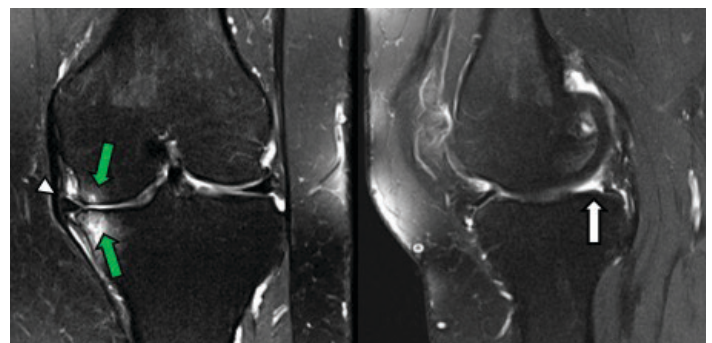
Nontraumatic (chronic) knee pain with moderate to severe osteoarthritis on initial radiographs:	
●	* (see below)
●	MRI without IV contrast in patients with new-onset severe pain, mechanical symptoms, a significant change in symptoms, or pain which is disproportionate to findings on repeat radiography
●	CT arthrography if the patient is unable to undergo MRI and there is new-onset severe pain, mechanical symptoms, a significant change in symptoms, or pain which is disproportionate to findings on repeat radiography
●	MR arthrography in patients with suspected recurrent injury after prior surgical repair (e.g., meniscal or osteochondral defect repair) and new-onset severe pain, mechanical symptoms, a significant change in symptoms, or pain which is disproportionate to findings on repeat radiograph
●	MRI without IV contrast for surgical planning in patients considering patellofemoral arthroplasty or chondroplasty
●	CT arthrography for surgical planning in patients who are considering partial knee arthroplasty or chondroplasty and who are unable to undergo MRI
●	MR arthrography for surgical planning in patients with previous meniscal repair and/or ACL reconstruction who are considering partial knee arthroplasty or chondroplasty
●	MRI without and with IV contrast, MRI with IV contrast, CT with IV contrast, CT without IV contrast, CT without and with IV contrast, bone scan, SPECT, PET, PET/CT

* Advanced imaging is not recommended for the routine diagnosis, management or follow-up of osteoarthritis of the knee.

SCENARIO #3: CLINICAL NOTES

- Radiography (both knees, weightbearing semiflexed PA view, plus a lateral and tangential patellar view) is the current “gold standard” for morphological assessment of knee osteoarthritis. Classical features are focal joint space narrowing, osteophyte, subchondral bone sclerosis and subchondral “cysts” (Zhang et al [EULAR] 2010; level Ib-IIb evidence; strength of recommendation: 83; Fox et al [ACR] 2018).
- Additional radiographic views (45° oblique views) may be useful if signs and symptoms do not correlate with standard views (Bussieres et al 2007).
- Using the amount of joint space narrowing as a guide for the amount of osteoarthritis can help to both rule in and rule out the presence of severe osteoarthritis (Duncan et al 2015).

Scenario #3: Chronic Non-traumatic Knee Pain with Advanced Osteoarthritis



SCENARIO #4: IMAGING INDICATIONS

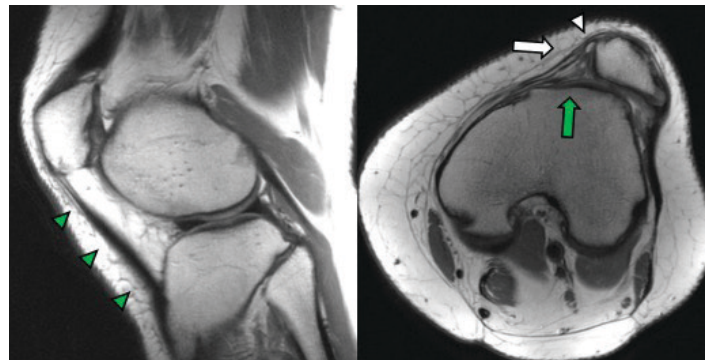
Patellofemoral (anterior knee) pain unresponsive to conservative management with non-diagnostic radiographs:	
●	MRI without IV contrast
●	CT arthrography in patients who cannot undergo MRI
●	CT abdomen with IV contrast after 48 hours to assess the severity of disease, to guide management, or for follow-up
●	CT without IV contrast*
●	MR arthrography in patients with suspected recurrent injury after prior surgical repair (e.g., meniscal or osteochondral defect repair)
●	MRI without and with IV contrast, MRI with IV contrast, CT with IV contrast, CT without and with IV contrast, bone scan, SPECT, PET, PET/CT

* CT without contrast may be indicated in patients with anterior knee pain to evaluate patellofemoral anatomy or morphology

SCENARIO #4: CLINICAL NOTES

- Clinical features of anterior knee pain include insidious onset, aggravated with steps/incline/rising from chair, stiffness with rest or gliding, pseudolocking or giving way, tender patellar facets, positive apprehension tests, crepitation, and abnormal Q angle (Bussieres et al 2007).
- MRI without IV contrast may be indicated when radiographs demonstrate a small osseous fragment along the medial patellar margin or if there is a clinical concern for prior or chronic patellar dislocation-relocation. MRI can assess the integrity of the medial patellofemoral ligament and medial patellar retinaculum, define the extent of cartilage injury, and identify loose bodies (Fox et al [ACR] 2018).
- Since MRI is more accurate than physical examination in identifying severe grades of chondromalacia patellae, it may be an appropriate screening tool prior to arthroscopy (Fox et al [ACR] 2018).
- CT without IV contrast may be indicated to evaluate the patellofemoral anatomy in knee pain related to repetitive patellofemoral subluxation or maltracking. It can also be used to evaluate trochlear morphology and the tibial tubercle-trochlear groove distance (Fox et al [ACR] 2018).
- CT arthrography may be used instead of MRI when an intra-articular abnormality is suspected to evaluate the menisci and articular cartilage (Fox et al [ACR] 2018).
- MR arthrography knee may be reserved for patients with known prior meniscal surgery, chondral and osteochondral lesions, and suspected loose bodies (Fox et al [ACR] 2018).

Scenario #4: Patellofemoral Knee Pain



Sagittal and Axial MRI without contrast obtained for anterior knee pain and instability in a 22-year-old patient. Radiographs (and axial MRI) show a small ossific fragment on the medial margin of the patella (arrowhead). MRI findings compatible with altered patellar tracking: lateral patellar subluxation and tilting (white arrow), patella alta with elongated patellar tendon (green arrowheads), and shallow trochlear groove/trochlear dysplasia (green arrow).

SCENARIO #5: IMAGING INDICATIONS

Patellofemoral (anterior knee) pain with patellofemoral osteoarthritis on radiographs:	
●	* (see below)
●	MRI without IV contrast for surgical planning in patients considering patellofemoral arthroplasty or chondroplasty
●	CT arthrography for surgical planning in patients considering patellofemoral arthroplasty or chondroplasty who are unable to undergo MRI
●	CT without IV contrast**
●	MR arthrography in patients with suspected recurrent injury after prior surgical repair (e.g., meniscal or osteochondral defect repair) for surgical planning in patients considering patellofemoral arthroplasty or chondroplasty
●	MRI without and with IV contrast, MRI with IV contrast, CT without and with IV contrast, CT with IV contrast, bone scan, SPECT, PET, PET/CT

*Advanced imaging is not recommended for the routine diagnosis, management, or follow-up of osteoarthritis of the knee

**CT without contrast may be indicated in patients with anterior knee pain to evaluate patellofemoral anatomy or morphology

SCENARIO #5: CLINICAL NOTES

- MRI or CT arthrography may be useful in patients being considered for patellofemoral arthroplasty or chondroplasty in order to assess for degenerative changes and/or meniscal pathology in the medial and lateral tibiofemoral compartments (PLE expert panel consensus opinion).

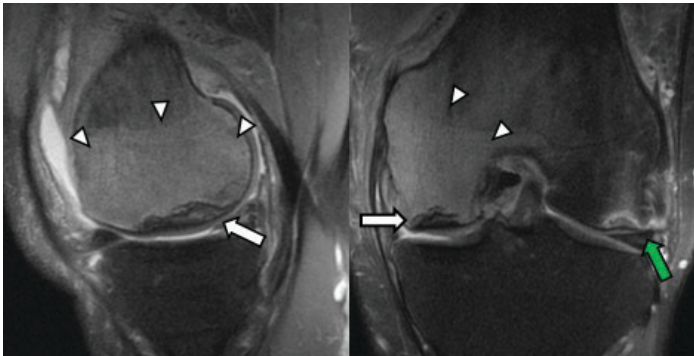
SCENARIO #6: IMAGING INDICATIONS

Clinical or radiological suspicion for avascular necrosis (osteonecrosis):	
●	MRI without IV contrast
●	MRI with IV contrast after prior MRI without IV contrast reporting indeterminate findings of AVN
●	CT without IV contrast in patients who are unable to undergo MRI
●	Bone scan/SPECT when MRI is contraindicated or expected to be non-diagnostic
●	MRI without and with IV contrast, MR arthrography, CT with IV contrast, CT without and with IV contrast, CT arthrography, PET, PET/CT

SCENARIO #6: CLINICAL NOTES

- Avascular necrosis, or osteonecrosis, is a form of ischemic bone necrosis due to vascular insufficiency. It is often (60-75% of the time) associated with antecedent risk factors such as sickle cell disease, steroid use, alcoholism, or metabolic bone disease (Bussieres et al 2007).
- Radiographs should be the initial imaging study for chronic knee pain (Fox et al [ACR] 2018).

Scenario #6: Suspected Avascular Necrosis



Sagittal and Coronal MRI without contrast obtained for burning medial knee pain in a 62-year-old patient. Patient has findings of acute avascular necrosis beneath the central articulating surface of the medial femoral condyle. Serpentine lines of subchondral sclerosis (white arrows) are surrounded by bone marrow edema (arrowheads). Incidental finding of chronic avascular necrosis in the central/lateral aspects of the lateral femoral condyle (green arrow) demonstrating the typical chronic AVN changes with only minimal surrounding edema.

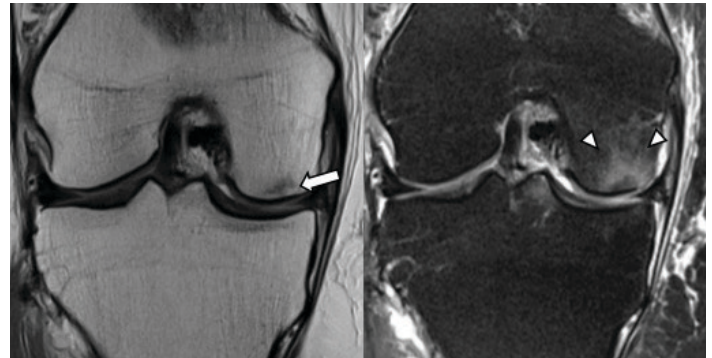
SCENARIO #7: IMAGING INDICATIONS

Suspected stress or insufficiency reaction/fracture and negative or indeterminate radiographs:	
●	MRI without IV contrast
●	Bone scan/SPECT in patients with equivocal MRI, or for patients who are unable to undergo MRI
●	CT without IV contrast for diagnosis in patients with equivocal MRI findings, with increased uptake on bone scan if the patient is unable to undergo MRI, or to evaluate healing in patients with a known fracture
●	MRI with IV contrast, MRI without and with IV contrast, MR arthrography, CT with IV contrast, CT without and with IV contrast, CT arthrography, PET, PET/CT

SCENARIO #7: CLINICAL NOTES

- Stress fractures occur in two varieties: 1) fatigue fractures resulting from repetitive submaximal stress on normal bone, resulting in a region of accelerated bone remodeling, and 2) insufficiency fractures due to normal activity on bones that are deficient in microstructure and/or mineralization (Bencardino et al [ACR] 2017).
- For suspected stress (fatigue or insufficiency) fracture, the ACR recommends radiography as the first imaging study (Bencardino et al [ACR] 2017).
- MRI can identify subchondral insufficiency fractures earlier than radiographs with radiographs often initially normal (Fox et al [ACR] 2018).

Scenario #7: Suspected Stress Fracture with Negative Radiologists



Coronal PD and T2FS MRI without contrast assessing progressive medial knee pain in a 70-year-old patient that recently started physical therapy for a prior back injury. Knee radiographs were normal. Patient has findings of an acute small subchondral stress type fracture (arrow) beneath the central articulating surface of the medial femoral condyle. There is surrounding mild bone marrow edema (arrowheads). No depression of the subchondral bone plate and the overlying cartilage is intact.

SCENARIO #8: IMAGING INDICATIONS

Clinical or radiological suspicion for septic arthritis, osteomyelitis and/or periarticular abscess:*	
●	MRI without IV contrast or MRI without and with IV contrast
●	CT with or without IV contrast to evaluate for soft tissue gas or for a soft tissue foreign body
●	CT with or without IV contrast to evaluate patients with known or suspected chronic osteomyelitis
●	CT with or without IV contrast to evaluate patients who are unable to undergo MRI
●	Bone scan/SPECT or three-phase bone scan for suspected osteomyelitis for patients who are unable to undergo MRI or for whom MRI is indeterminate or non-diagnostic
●	MRI with IV contrast, MR arthrography, CT without and with IV contrast, CT arthrography, PET, PET/CT

* This guideline does not address the evaluation of suspected infection in patients with knee prostheses

SCENARIO #8: CLINICAL NOTES

Clinical Diagnosis

- Patients with a short history of a hot, swollen, and tender joint(s) with restriction of movement should be regarded as having septic arthritis until proven otherwise (Coakley et al 2006; B recommendation).
- In patients with a suspected joint infection, the white blood cell count, erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) should be measured (Coakley et al 2006; B recommendation).
- In patients with new knee pain and a new joint effusion or swelling following an injection procedure in the knee, the white blood cell count, erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) should be measured (PLE expert panel consensus opinion).

Imaging

- Radiographs are the recommended first study in patients with suspected osteomyelitis, septic arthritis or soft-tissue infection. They are well suited for the detection of radiodense foreign bodies (Beaman et al [ACR] 2017).
- Although often not diagnostic in acute osteomyelitis, [radiographs] provide anatomic evaluation of the affected site, depict changes of chronic osteomyelitis, can reveal gas or foreign bodies, and can suggest alternative diagnoses such as neuropathic arthropathy, fracture, or tumor, which influence subsequent imaging selection and interpretation (Beaman et al [ACR] 2017).
- Magnetic resonance imaging (MRI) is the modality of choice for suspected bone and extremity soft-tissue infections. MRI has a very high negative predictive value for excluding osteomyelitis; a normal marrow signal reliably excludes infection (Beaman et al [ACR] 2017). The absence of a joint effusion and synovial hyperplasia effectively excludes septic arthritis (PLE expert panel consensus opinion).
- CT is particularly sensitive to soft-tissue gas (that can signal necrotizing fasciitis) and foreign bodies. CT in fact is superior to MRI for the diagnosis of sequestra, foreign bodies and gas (Beaman et al [ACR] 2017).
- Nuclear medicine examinations may be useful in cases where MRI is contraindicated, infection is multifocal, or when the infection is associated with orthopedic hardware or chronic bone alterations from trauma or surgery (Beaman et al [ACR] 2017).
- Skeletal scintigraphy is highly sensitive but lacks specificity. Bone scans can become positive as early as one–two days after the onset of clinical symptoms. A 3- or 4-phase bone scan aids in distinguishing cellulitis from osteomyelitis. The addition of single-photon emission CT (SPECT) or SPECT/CT improves the accuracy of radionuclide scintigraphy, facilitating the differentiation between bone and soft-tissue infection (Beaman et al [ACR] 2017).
- Currently, there is no evidence supporting a role for FDG-PET in the evaluation of septic arthritis since FDG also accumulates in inflammatory arthritis (Beaman et al [ACR] 2017).

Aspiration

- In patients with suspected joint infection, joint aspiration is recommended for diagnosis. Ultrasound can be used to confirm the presence of a joint effusion. Fluoroscopy or ultrasound may be used to guide diagnostic joint aspirations (Beaman et al [ACR] 2017; PLE expert panel consensus opinion).

SCENARIO #9: IMAGING INDICATIONS

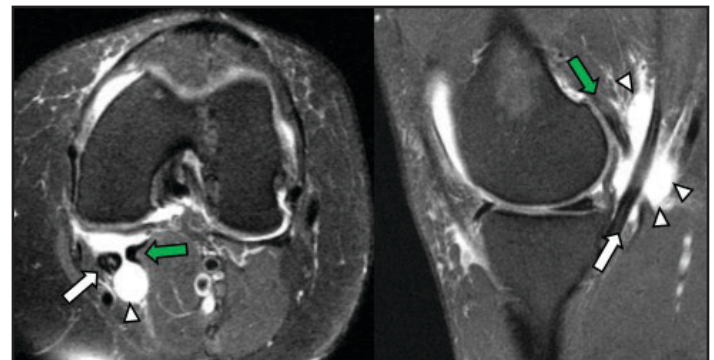
Baker's (popliteal) cyst with or without abnormalities on radiographs:	
●	* (see below)
●	MRI without IV contrast to evaluate for associated intraarticular pathology
●	CT arthrography to evaluate for associated intraarticular pathology for patients who are unable to undergo MRI
●	MRI arthrography to evaluate for associated intraarticular pathology in patients with suspected recurrent injury after prior surgical repair (e.g., meniscal or osteochondral defect repair)
●	MRI without and with IV contrast, MRI with IV contrast, CT without and with IV contrast, CT with IV contrast, PET, PET/CT, SPECT, bone scan

* Ultrasound is recommended for the initial evaluation of a suspected popliteal cyst

SCENARIO #9: CLINICAL NOTES

- Therapeutic aspiration and injection of the cyst with steroid and anesthetic can be done under ultrasound guidance (Bussieres et al 2007; PLE expert panel consensus opinion).
- Advanced imaging should be considered to evaluate patients with atypical popliteal cysts (PLE expert panel consensus opinion):
 - **Typical Popliteal Cysts** should localize to the semimembranosus-medial gastrocnemius space or should extend deep to the semimembranosus tendon or MCL.
 - **Ganglion Cysts** should arise from the joint capsule, cruciate ligaments or periarticular tendons.
 - **Meniscal Cysts** should arise from or be contiguous with the meniscocapsular attachment.
 - **Cysts (masses) with solid components** and cysts that do not meet these criteria should be evaluated for possible malignancy (e.g., monophasic synovial cell sarcoma, peripheral nerve sheath tumors, cystic metastases or myxomatous tumors) which can mimic a benign cyst.

Scenario #9: Baker's Cyst



Axial and Sagittal MRI without contrast assessing posterior knee pain in a 39-year-old female. MRI demonstrates a moderately sized popliteal cyst (arrowheads) between the distal semimembranosus tendon (white arrow) and the proximal medial gastrocnemius tendon (green arrow). The location is compatible with a classic Baker's cyst. Patient did not have other reasons for posterior knee pain. *Patient underwent an ultrasound-guided therapeutic aspiration with injection of steroid and anesthetic resulting in 90% relief of her knee pain.

Summary: Appropriate Use of Imaging in Patients with Knee Pain

● = indicated, ● = indicated in specific scenarios, ● = probably not indicated, with limited exceptions, and ● = not indicated

SCENARIO #1: IMAGING INDICATIONS

Knee pain with suspected structural derangement* after an acute injury**:	
●	MRI without IV contrast
●	CT arthrography in patients who cannot undergo MRI
●	CT without IV contrast in patients with suspected tibial plateau fracture and negative or indeterminate radiographs, or to characterize a fracture detected on radiographs
●	MR arthrography in patients with suspected recurrent injury after prior surgical repair (e.g., meniscal or osteochondral defect repair)
●	CT angiography or MR angiography to evaluate for suspected vascular injury in patients with multiple ligament injuries, or in patients with known or suspected dislocation
●	MRI without and with IV contrast, MRI with IV contrast, CT with IV contrast, CT without and with IV contrast, bone scan, SPECT, PET, PET/CT

* Signs and symptoms of structural derangement after an injury can include giving way, locking, catching, effusion, inability to bear weight, bone tenderness, loss of motion, and/or pathological laxity.

**Acute injury is defined as a discrete event resulting in excessive force on the knee, in contradistinction to overuse injuries that result from chronic repetitive injuries or insufficiency injuries that result from normal forces on structurally deficient bone.

SCENARIO #2: IMAGING INDICATIONS

Nontraumatic knee pain persisting after an appropriate trial of conservative care and no major abnormalities (e.g., fracture, AVN, tumor, or moderate or severe osteoarthritis) on radiographs:	
●	MRI without IV contrast
●	CT arthrography in patients who cannot undergo MRI
●	MR arthrography in patients with suspected recurrent injury after prior surgical repair (e.g., meniscal or osteochondral defect repair)
●	CT without IV contrast, except when assessing patellofemoral morphology for surgical planning
●	MRI with IV contrast, MRI without and with IV contrast, CT with IV contrast, CT without and with IV contrast, bone scan, SPECT, PET, PET/CT

SCENARIO #3: IMAGING INDICATIONS

Nontraumatic (chronic) knee pain with moderate to severe osteoarthritis on initial radiographs:	
●	* (see below)
●	MRI without IV contrast in patients with new-onset severe pain, mechanical symptoms, a significant change in symptoms, or pain which is disproportionate to findings on repeat radiography
●	CT arthrography if the patient is unable to undergo MRI and there is new-onset severe pain, mechanical symptoms, a significant change in symptoms, or pain which is disproportionate to findings on repeat radiography
●	MR arthrography in patients with suspected recurrent injury after prior surgical repair (e.g., meniscal or osteochondral defect repair) and new-onset severe pain, mechanical symptoms, a significant change in symptoms, or pain which is disproportionate to findings on repeat radiograph
●	MRI without IV contrast for surgical planning in patients considering patellofemoral arthroplasty or chondroplasty
●	CT arthrography for surgical planning in patients who are considering partial knee arthroplasty or chondroplasty and who are unable to undergo MRI
●	MR arthrography for surgical planning in patients with previous meniscal repair and/or ACL reconstruction who are considering partial knee arthroplasty or chondroplasty
●	MRI without and with IV contrast, MRI with IV contrast, CT with IV contrast, CT without IV contrast, CT without and with IV contrast, bone scan, SPECT, PET, PET/CT

* Advanced imaging is not recommended for the routine diagnosis, management or follow-up of osteoarthritis of the knee.

SCENARIO #4: IMAGING INDICATIONS

Patellofemoral (anterior knee) pain unresponsive to conservative management with non-diagnostic radiographs:	
●	MRI without IV contrast
●	CT arthrography in patients who cannot undergo MRI
●	CT abdomen with IV contrast after 48 hours to assess the severity of disease, to guide management, or for follow-up
●	CT without IV contrast*
●	MR arthrography in patients with suspected recurrent injury after prior surgical repair (e.g., meniscal or osteochondral defect repair)
●	MRI without and with IV contrast, MRI with IV contrast, CT with IV contrast, CT without and with IV contrast, bone scan, SPECT, PET, PET/CT

* CT without contrast may be indicated in patients with anterior knee pain to evaluate patellofemoral anatomy or morphology

Summary: Appropriate Use of Imaging in Patients with Knee Pain

● = indicated, ● = indicated in specific scenarios, ● = probably not indicated, with limited exceptions, and ● = not indicated

SCENARIO #5: IMAGING INDICATIONS

Patellofemoral (anterior knee) pain with patellofemoral osteoarthritis on radiographs:	
●	* (see below)
●	MRI without IV contrast for surgical planning in patients considering patellofemoral arthroplasty or chondroplasty
●	CT arthrography for surgical planning in patients considering patellofemoral arthroplasty or chondroplasty who are unable to undergo MRI
●	CT without IV contrast**
●	MR arthrography in patients with suspected recurrent injury after prior surgical repair (e.g., meniscal or osteochondral defect repair) for surgical planning in patients considering patellofemoral arthroplasty or chondroplasty
●	MRI without and with IV contrast, MRI with IV contrast, CT without and with IV contrast, CT with IV contrast, bone scan, SPECT, PET, PET/CT

*Advanced imaging is not recommended for the routine diagnosis, management, or follow-up of osteoarthritis of the knee

**CT without contrast may be indicated in patients with anterior knee pain to evaluate patellofemoral anatomy or morphology

SCENARIO #6: IMAGING INDICATIONS

Clinical or radiological suspicion for avascular necrosis (osteonecrosis):	
●	MRI without IV contrast
●	MRI with IV contrast after prior MRI without IV contrast reporting indeterminate findings of AVN
●	CT without IV contrast in patients who are unable to undergo MRI
●	Bone scan/SPECT when MRI is contraindicated or expected to be non-diagnostic
●	MRI without and with IV contrast, MR arthrography, CT with IV contrast, CT without and with IV contrast, CT arthrography, PET, PET/CT

SCENARIO #7: IMAGING INDICATIONS

Suspected stress or insufficiency reaction/fracture and negative or indeterminate radiographs:	
●	MRI without IV contrast
●	Bone scan/SPECT in patients with equivocal MRI, or for patients who are unable to undergo MRI
●	CT without IV contrast for diagnosis in patients with equivocal MRI findings, with increased uptake on bone scan if the patient is unable to undergo MRI, or to evaluate healing in patients with a known fracture
●	MRI with IV contrast, MRI without and with IV contrast, MR arthrography, CT with IV contrast, CT without and with IV contrast, CT arthrography, PET, PET/CT

SCENARIO #8: IMAGING INDICATIONS

Clinical or radiological suspicion for septic arthritis, osteomyelitis and/or periarticular abscess*:	
●	MRI without IV contrast or MRI without and with IV contrast
●	CT with or without IV contrast to evaluate for soft tissue gas or for a soft tissue foreign body
●	CT with or without IV contrast to evaluate patients with known or suspected chronic osteomyelitis
●	CT with or without IV contrast to evaluate patients who are unable to undergo MRI
●	Bone scan/SPECT or three-phase bone scan for suspected osteomyelitis for patients who are unable to undergo MRI or for whom MRI is indeterminate or non-diagnostic
●	MRI with IV contrast, MR arthrography, CT without and with IV contrast, CT arthrography, PET, PET/CT

* This guideline does not address the evaluation of suspected infection in patients with knee prostheses

SCENARIO #9: IMAGING INDICATIONS

Baker's (popliteal) cyst with or without abnormalities on radiographs:	
●	* (see below)
●	MRI without IV contrast to evaluate for associated intraarticular pathology
●	CT arthrography to evaluate for associated intraarticular pathology for patients who are unable to undergo MRI
●	MRI arthrography to evaluate for associated intraarticular pathology in patients with suspected recurrent injury after prior surgical repair (e.g., meniscal or osteochondral defect repair)
●	MRI without and with IV contrast, MRI with IV contrast, CT without and with IV contrast, CT with IV contrast, CT with IV contrast, PET, PET/CT, SPECT, bone scan

* Ultrasound is recommended for the initial evaluation of a suspected popliteal cyst

Examples provided throughout this document are common situations. Consider consultation with your local radiologist to determine what procedure would best suit you and your patient's unique needs for diagnostic imaging assessment of the knee.

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