American College of Radiology
ACR Appropriateness Criteria®
Chronic Knee Pain

Variant: 1 **Adult or child greater than or equal to 5 years of age. Chronic knee pain. Initial imaging.**

Procedure	Appropriateness Category	Relative Radiation Level
Radiography knee	Usually Appropriate	☢
US knee	Usually Not Appropriate	O
Radiography hip ipsilateral	Usually Not Appropriate	☢☢☢
Image-guided aspiration knee	Usually Not Appropriate	Varies
MR arthrography knee	Usually Not Appropriate	O
MRI knee without and with IV contrast	Usually Not Appropriate	O
MRI knee without IV contrast	Usually Not Appropriate	O
CT arthrography knee	Usually Not Appropriate	☢
CT knee with IV contrast	Usually Not Appropriate	☢
CT knee without and with IV contrast	Usually Not Appropriate	☢
CT knee without IV contrast	Usually Not Appropriate	☢
Bone scan knee	Usually Not Appropriate	☢☢☢

Variant: 2 **Adult or child greater than or equal to 5 years of age. Chronic knee pain. Initial knee radiograph negative or demonstrates joint effusion. Next imaging procedure.**

Procedure	Appropriateness Category	Relative Radiation Level
MRI knee without IV contrast	Usually Appropriate	O
US knee	May Be Appropriate (Disagreement)	O
Radiography hip ipsilateral	May Be Appropriate	☢☢☢
Radiography lumbar spine	May Be Appropriate	☢☢☢
Image-guided aspiration knee	May Be Appropriate	Varies
MR arthrography knee	May Be Appropriate	O
CT arthrography knee	May Be Appropriate	☢
CT knee without IV contrast	May Be Appropriate	☢
MRI knee without and with IV contrast	Usually Not Appropriate	O
CT knee with IV contrast	Usually Not Appropriate	☢
CT knee without and with IV contrast	Usually Not Appropriate	☢
Bone scan knee	Usually Not Appropriate	☢☢☢

Variant: 3 **Adult or child greater than or equal to 5 years of age. Chronic knee pain. Initial knee radiograph demonstrates osteochondritis dissecans (OCD), loose bodies, or history of cartilage or meniscal repair. Next imaging procedure.**

Procedure	Appropriateness Category	Relative Radiation Level
MRI knee without IV contrast	Usually Appropriate	O
MR arthrography knee	May Be Appropriate (Disagreement)	O
CT arthrography knee	May Be Appropriate	☢
CT knee without IV contrast	May Be Appropriate	☢

Procedure	Appropriateness Category	Relative Radiation Level
US knee	Usually Not Appropriate	O
Radiography hip ipsilateral	Usually Not Appropriate	☢☢☢
Image-guided aspiration knee	Usually Not Appropriate	Varies
MRI knee without and with IV contrast	Usually Not Appropriate	O
CT knee with IV contrast	Usually Not Appropriate	☢
CT knee without and with IV contrast	Usually Not Appropriate	☢
Bone scan knee	Usually Not Appropriate	☢☢☢

Variant: 4   Adult or child greater than or equal to 5 years of age. Chronic knee pain. Initial knee radiograph demonstrates degenerative changes or chondrocalcinosis. Next imaging procedure.

Procedure	Appropriateness Category	Relative Radiation Level
Image-guided aspiration knee	May Be Appropriate (Disagreement)	Varies
MRI knee without IV contrast	May Be Appropriate	O
CT knee without IV contrast	May Be Appropriate	☢
US knee	Usually Not Appropriate	O
Radiography hip ipsilateral	Usually Not Appropriate	☢☢☢
MR arthrography knee	Usually Not Appropriate	O
MRI knee without and with IV contrast	Usually Not Appropriate	O
CT arthrography knee	Usually Not Appropriate	☢
CT knee with IV contrast	Usually Not Appropriate	☢
CT knee without and with IV contrast	Usually Not Appropriate	☢
Bone scan knee	Usually Not Appropriate	☢☢☢

Variant: 5   Adult or child greater than or equal to 5 years of age. Chronic knee pain. Initial knee radiograph demonstrates signs of prior osseous injury (ie, Segond fracture, tibial spine avulsion, etc.). Next imaging procedure.

Procedure	Appropriateness Category	Relative Radiation Level
MRI knee without IV contrast	Usually Appropriate	O
CT arthrography knee	May Be Appropriate	☢
CT knee without IV contrast	May Be Appropriate	☢
US knee	Usually Not Appropriate	O
Radiography hip ipsilateral	Usually Not Appropriate	☢☢☢
Image-guided aspiration knee	Usually Not Appropriate	Varies
MR arthrography knee	Usually Not Appropriate	O
MRI knee without and with IV contrast	Usually Not Appropriate	O
CT knee with IV contrast	Usually Not Appropriate	☢
CT knee without and with IV contrast	Usually Not Appropriate	☢
Bone scan knee	Usually Not Appropriate	☢☢☢

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Summary of Literature Review

Introduction/Background

Chronic knee pain affects tens of millions of people in the United States annually, with the pain sometimes highly disabling and often negatively impacting the patient's quality of life. Chronic knee pain has numerous causes, and it can present with localized or diffuse symptoms. Osteoarthritis is the most common cause of chronic knee pain with the knee the most common lower extremity joint impacted by osteoarthritis [1].

Typically, radiography is the initial imaging study used to evaluate chronic pain in a native knee. When pain persists but the initial radiographs are normal or demonstrate a joint effusion, MRI is usually considered the next imaging study. However, the use of MRI may be premature and unnecessary in some patients, as it is estimated that approximately 20% of patients with chronic knee pain have had an MRI performed without recent (within the prior year) radiographs [2].

This document discusses 5 variants for imaging chronic pain in a native knee in patients ≥5 years of age. The variants discussed include: (1) initial examination; (2) initial radiograph is normal or demonstrates a joint effusion; (3) initial radiograph demonstrates osteochondritis dissecans (OCD), loose bodies or history of cartilage, or meniscal repair; (4) initial radiograph demonstrates osteoarthritis or chondrocalcinosis; and (5) initial radiograph demonstrates signs of prior (chronic) knee injury (ie, Segond fracture, tibial spine avulsion, etc).

To evaluate knee pain associated with other conditions, please refer to the following ACR Appropriateness Criteria® topic on: "Osteonecrosis of the Hip" [3] for osteonecrosis, "Acute Trauma to the Knee" for acute knee injuries [4], "Imaging After Total Knee Arthroplasty" for patients with total knee arthroplasty [5], "Soft-Tissue Masses" for a patient with a suspected soft-tissue mass [6], "Primary Bone Tumors" for a patient with a suspected or known bone tumor [7], and "Chronic Extremity Joint Pain-Suspected Inflammatory Arthritis" for patient with suspected arthritis or synovitis [8].

Special Imaging Considerations

Knee radiographs should include at least one frontal projection of one or both knees (anteroposterior, Rosenberg, or tunnel), a tangential patellar view, and a lateral view of the affected knee [2,9]. Standing radiographs more accurately reflect medial and lateral compartment cartilage loss than supine radiographs with the posteromedial and posterolateral joint compartments more accurately assessed using a weight-bearing flexion posteroanterior radiograph [9,10].

Discussion of Procedures by Variant

Variant 1: Adult or child greater than or equal to 5 years of age. Chronic knee pain. Initial imaging.

A. Radiography Knee

Radiographs should be the initial imaging study for chronic knee pain. In elderly patients, the most common source of chronic knee pain is osteoarthritis. Conventional radiographic diagnosis of osteoarthritis includes joint space narrowing, osteophytes, subchondral cysts, and subarticular sclerosis [11]. Articular cartilage is evaluated indirectly on radiographs by joint space narrowing and changes in the subchondral bone [10]. When a severe varus or valgus deformity is present, significant cartilage loss in the apparently "wider" compartment may not be evident [11,12]. Conversely, joint space narrowing may be caused by meniscal extrusion or degeneration rather than cartilage loss [11].

Chronic knee pain is associated with the radiographic demonstration of osteophytes with the development of a "bone-on-bone" appearance or complete joint space loss on subsequent radiographs indicating disease progression and potentially indicating the need for arthroplasty [11-13].

Variant 1: Adult or child greater than or equal to 5 years of age. Chronic knee pain. Initial imaging.

B. Radiography Hip

An ipsilateral hip radiograph is usually not indicated as a first imaging examination.

Variant 1: Adult or child greater than or equal to 5 years of age. Chronic knee pain. Initial imaging.

C. CT Knee

CT is usually not indicated as a first imaging examination.

Variant 1: Adult or child greater than or equal to 5 years of age. Chronic knee pain. Initial imaging.

D. CT Arthrography Knee

CT arthrography is usually not indicated as a first imaging examination.

Variant 1: Adult or child greater than or equal to 5 years of age. Chronic knee pain. Initial imaging.

E. MRI Knee

MRI is usually not indicated as a first imaging examination. To avoid unnecessary MRI, assessment of current radiographs (within the prior year) is required [2].

Variant 1: Adult or child greater than or equal to 5 years of age. Chronic knee pain. Initial imaging.

F. MR Arthrography Knee

MR arthrography is usually not indicated as a first imaging examination.

Variant 1: Adult or child greater than or equal to 5 years of age. Chronic knee pain. Initial imaging.

G. US Knee

Ultrasound (US) is usually not indicated as a first imaging examination.

Variant 1: Adult or child greater than or equal to 5 years of age. Chronic knee pain. Initial imaging.

H. Bone Scan Knee

Radionuclide bone scan is usually not indicated as a first imaging examination.

Variant 1: Adult or child greater than or equal to 5 years of age. Chronic knee pain. Initial imaging.
I. Image-Guided Aspiration Knee

Joint aspiration is usually not indicated as a first imaging examination.

Variant 2: Adult or child greater than or equal to 5 years of age. Chronic knee pain. Initial knee radiograph negative or demonstrates joint effusion. Next imaging procedure.

Variant 2: Adult or child greater than or equal to 5 years of age. Chronic knee pain. Initial knee radiograph negative or demonstrates joint effusion. Next imaging procedure.
A. Radiography Hip

In patients with chronic knee pain, referred pain from the hip must be considered, especially if the knee radiographs are unremarkable and there is clinical evidence or concern for hip pathology [14].

Variant 2: Adult or child greater than or equal to 5 years of age. Chronic knee pain. Initial knee radiograph negative or demonstrates joint effusion. Next imaging procedure.
B. Radiography Lumbar Spine

In patients with chronic knee pain, referred pain from the lower back must be considered, especially if the knee radiographs are unremarkable and there is clinical evidence or concern for lumbar spine pathology.

Variant 2: Adult or child greater than or equal to 5 years of age. Chronic knee pain. Initial knee radiograph negative or demonstrates joint effusion. Next imaging procedure.
C. CT Knee

CT without intravenous (IV) contrast may be indicated to evaluate the patellofemoral anatomy in the setting of chronic knee pain related to repetitive patellofemoral subluxation or maltracking [15]. CT can also be used to evaluate trochlear morphology and the tibial tubercle-trochlear groove distance. CT with IV contrast is usually not indicated when initial radiograph is negative or demonstrates a joint effusion.

CT without and with IV contrast is not routinely performed when initial radiographs are negative.

Variant 2: Adult or child greater than or equal to 5 years of age. Chronic knee pain. Initial knee radiograph negative or demonstrates joint effusion. Next imaging procedure.
D. CT Arthrography Knee

When an intra-articular abnormality is suspected, CT arthrography may be used instead of MRI to evaluate the menisci and articular cartilage [16].

Variant 2: Adult or child greater than or equal to 5 years of age. Chronic knee pain. Initial knee radiograph negative or demonstrates joint effusion. Next imaging procedure.
E. MRI Knee

When initial radiographs are normal or reveal a joint effusion but pain persists, the next indicated study is usually MRI without IV contrast, which is more sensitive than radiography [11].

MRI accurately depicts the extent of an effusion, presence of synovitis, and presence or rupture of a popliteal cyst [17]. Subchondral cysts, articular cartilage, and meniscal abnormalities are easily

detected on MRI [13,18,19]. However, meniscal tears are often incidental findings in older patients with the majority of people over 70 years of age having an asymptomatic meniscal tear, and the likelihood of a meniscal tear being present in either a painful or asymptomatic knee not significantly different in patients 45 to 55 years of age [20,21].

Bone marrow lesions (BML) are readily depicted on MRI as areas of increased edema-like signal in the subchondral bone. New or increasing BMLs are associated with increased knee pain, especially in males or patients with family history of osteoarthritis [22]. Conversely, decreasing BMLs are associated with reduced knee pain [23]. A systematic review of 22 articles concluded that both BMLs and synovitis/effusion may indicate the origin of knee pain in patients with osteoarthritis [24-26].

Subchondral insufficiency fractures, now recognized as the underlying cause of what was previously termed spontaneous osteonecrosis of the knee, most commonly involve the medial femoral condyle in middle-aged to elderly females. MRI can identify subchondral insufficiency fractures earlier than radiographs with radiographs often initially normal [27]. Radiographs may later reveal articular surface fragmentation, subchondral collapse, and progressive osteoarthritis sometimes requiring total knee arthroplasty [27]. Even when a subchondral insufficiency fracture is diagnosed on a conventional radiograph, MRI may be indicated if an additional injury is suspected clinically. MRI can also detect tibial stress fractures as discussed in the ACR Appropriateness Criteria® topic on "Stress (Fatigue/Insufficiency) Fracture, Including Sacrum, Excluding Other Vertebrae" [28].

Some patients with normal knee radiographs and anterior knee pain have abnormal cartilage on 3 T MRI using quantitative imaging [29]. In particular, patients 45 to 55 years of age with knee pain but normal radiographs exhibited elevated T2 mapping values on 3 T MRI [20].

Patellofemoral cartilage loss is also associated with chronic knee pain, with active knee pain correlated with BMLs [30,31]. Similar to CT, MRI can calculate various anatomic measurements associated with patellofemoral subluxation/dislocation and lateral patellofemoral friction syndrome [32-34]. Bone marrow edema in the classic location for patellofemoral dislocation/relocation injuries is also identified by MRI [15]. MRI may also differentiate patients with more severe patellofemoral osteoarthritis who may not benefit from supervised exercise therapy from patients with medial or lateral knee compartment arthritis who might benefit [35].

Other etiologies of chronic anterolateral knee pain diagnosed on MRI include patellar tendinopathy, various fat pad impingement syndromes, Hoffa's disease, deep infrapatellar bursitis, iliotibial band syndrome, adhesive capsulitis, medial plicae, discoid meniscus, tumors, ganglion cysts, pigmented villonodular synovitis, osteophytes, and osteonecrosis [15,19,36-45].

MRI without and with IV contrast is not usually indicated when initial radiograph is negative or demonstrates a joint effusion. However, contrast-enhanced images may be more accurate in diagnosing other causes of chronic knee pain, such as Hoffa's disease, deep infrapatellar bursitis, patellofemoral friction syndrome, and adhesive capsulitis [15]. In particular, enhancing synovitis thicker than 2 mm in Hoffa's fat is correlated with peripatellar pain [46]. Contrast-enhanced MRI is also useful in quantifying the degree of synovitis and in evaluating conditions such as pigmented villonodular synovitis [17,42,47,48].

Variant 2: Adult or child greater than or equal to 5 years of age. Chronic knee pain. Initial knee radiograph negative or demonstrates joint effusion. Next imaging procedure.
F. MR Arthrography Knee

MR arthrography performed with an intra-articular injection of dilute gadolinium solution is typically not indicated as a second examination but rather reserved for patients with known prior meniscal surgery, chondral and osteochondral lesions, and suspected loose bodies [10].

Variant 2: Adult or child greater than or equal to 5 years of age. Chronic knee pain. Initial knee radiograph negative or demonstrates joint effusion. Next imaging procedure.
G. US Knee

US is not often useful as a screening test or a comprehensive examination. It may be appropriate to confirm a suspected effusion and to guide a potential aspiration [10]. US is as accurate in diagnosing a popliteal cyst and detecting cyst rupture when compared to MRI [10]. US is also useful in evaluating medial plicae and following patients with iliotibial band syndrome [17,44].

More recently, shear wave elastography has been used to evaluate female patients with patellofemoral pain by demonstrating reduced contraction ratio in the vastus medialis oblique but not the vastus lateralis muscles [49]. Finally, US can diagnose a cyst and determine the vascularity of a mass [37].

Variant 2: Adult or child greater than or equal to 5 years of age. Chronic knee pain. Initial knee radiograph negative or demonstrates joint effusion. Next imaging procedure.
H. Bone Scan Knee

Radionuclide bone scan is usually not indicated when initial radiograph is negative or demonstrates a joint effusion.

Variant 2: Adult or child greater than or equal to 5 years of age. Chronic knee pain. Initial knee radiograph negative or demonstrates joint effusion. Next imaging procedure.
I. Image-Guided Aspiration Knee

If an aspiration for crystals or atypical/low-grade chronic infection is indicated, it can be facilitated by US or fluoroscopy [10].

Variant 3: Adult or child greater than or equal to 5 years of age. Chronic knee pain. Initial knee radiograph demonstrates osteochondritis dissecans (OCD), loose bodies, or history of cartilage or meniscal repair. Next imaging procedure.

Variant 3: Adult or child greater than or equal to 5 years of age. Chronic knee pain. Initial knee radiograph demonstrates osteochondritis dissecans (OCD), loose bodies, or history of cartilage or meniscal repair. Next imaging procedure.
A. Radiography Hip

An ipsilateral hip radiograph is usually not indicated to evaluate patients with osteochondritis dissecans (OCD), loose bodies, or history of cartilage repair.

Variant 3: Adult or child greater than or equal to 5 years of age. Chronic knee pain. Initial knee radiograph demonstrates osteochondritis dissecans (OCD), loose bodies, or history of cartilage or meniscal repair. Next imaging procedure.
B. CT Knee

CT without IV contrast may be indicated to evaluate patients with OCD or a history of cartilage repair, especially to confirm loose bodies or when MRI is not definitive.

CT with IV contrast is not usually indicated to evaluate patients with OCD, loose bodies, or history of cartilage repair.

CT without and with IV contrast is not usually indicated to evaluate patients with OCD, loose bodies, or history of cartilage repair.

Variant 3: Adult or child greater than or equal to 5 years of age. Chronic knee pain. Initial knee radiograph demonstrates osteochondritis dissecans (OCD), loose bodies, or history of cartilage or meniscal repair. Next imaging procedure.
C. CT Arthrography Knee

CT arthrography may be used instead of MRI to evaluate the menisci, articular cartilage, and the presence of loose bodies [16].

Variant 3: Adult or child greater than or equal to 5 years of age. Chronic knee pain. Initial knee radiograph demonstrates osteochondritis dissecans (OCD), loose bodies, or history of cartilage or meniscal repair. Next imaging procedure.
D. MRI Knee

In patients with OCD or subchondral insufficiency fracture on radiographs, MRI without IV contrast may be indicated if an additional injury is suspected clinically or to clarify the status of the overlying articular cartilage [41]. A hyperintense rim or cysts at the osteochondral fragment periphery on MRI are less specific for OCD fragment instability in children compared to adults; however, MRI is still useful to determine the best method of treatment [41,50]. Following cartilage repair, MRI can grade the repair site and even guide the retrograde drilling of the OCD lesion [51-54].

MRI with and without IV contrast is not usually indicated to evaluate patients with OCD, loose bodies, or history of cartilage repair because of the usual larger volume of joint fluid, the lesser degree of synovial invagination, and the longer time required to achieve steady state gadolinium in the joint compared to the shoulder [16].

Variant 3: Adult or child greater than or equal to 5 years of age. Chronic knee pain. Initial knee radiograph demonstrates osteochondritis dissecans (OCD), loose bodies, or history of cartilage or meniscal repair. Next imaging procedure.
E. MR Arthrography Knee

MR arthrography is typically reserved for patients with known prior meniscal surgery, chondral and osteochondral lesions, prior cartilage repair procedures, or suspected loose bodies [10,16].

Variant 3: Adult or child greater than or equal to 5 years of age. Chronic knee pain. Initial knee radiograph demonstrates osteochondritis dissecans (OCD), loose bodies, or history of cartilage or meniscal repair. Next imaging procedure.
F. US Knee

US is not often useful as a screening test or a comprehensive examination. It may be appropriate to localize suspected loose bodies, especially if the loose bodies might be within a popliteal cyst, lateral recess, or suprapatellar recess.

Variant 3: Adult or child greater than or equal to 5 years of age. Chronic knee pain. Initial knee radiograph demonstrates osteochondritis dissecans (OCD), loose bodies, or history of cartilage or meniscal repair. Next imaging procedure.

G. Bone Scan Knee

Radionuclide bone scan is usually not indicated to evaluate patients with OCD, loose bodies, or history of cartilage repair.

Variant 3: Adult or child greater than or equal to 5 years of age. Chronic knee pain. Initial knee radiograph demonstrates osteochondritis dissecans (OCD), loose bodies, or history of cartilage or meniscal repair. Next imaging procedure.
H. Image-Guided Aspiration Knee

Joint aspiration is usually not indicated to evaluate patients with OCD, loose bodies, or history of cartilage repair.

Variant 4: Adult or child greater than or equal to 5 years of age. Chronic knee pain. Initial knee radiograph demonstrates degenerative changes or chondrocalcinosis. Next imaging procedure.

Variant 4: Adult or child greater than or equal to 5 years of age. Chronic knee pain. Initial knee radiograph demonstrates degenerative changes or chondrocalcinosis. Next imaging procedure.
A. Radiography Hip

An ipsilateral hip radiograph is usually not indicated to evaluate patients with osteoarthritis or chondrocalcinosis.

Variant 4: Adult or child greater than or equal to 5 years of age. Chronic knee pain. Initial knee radiograph demonstrates degenerative changes or chondrocalcinosis. Next imaging procedure.
B. CT Knee

Dual-energy CT without IV contrast may be indicated if gout or mixed crystal disease is a consideration. Otherwise, CT is not commonly used as a diagnostic test to evaluate patients with osteoarthritis or chondrocalcinosis. Limited CT without IV contrast can be used for surgical planning.

Variant 4: Adult or child greater than or equal to 5 years of age. Chronic knee pain. Initial knee radiograph demonstrates degenerative changes or chondrocalcinosis. Next imaging procedure.
C. CT Arthrography Knee

CT arthrography is not commonly utilized as a second test in patients with arthritis even though CT is the most accurate method for evaluating cartilage abnormalities extending to the articular surface that is due to the high spatial resolution between the contrast and the cartilage [11].

Variant 4: Adult or child greater than or equal to 5 years of age. Chronic knee pain. Initial knee radiograph demonstrates degenerative changes or chondrocalcinosis. Next imaging procedure.
D. MRI Knee

MRI without IV contrast is not usually indicated in patients for whom radiographs are diagnostic of osteoarthritis unless symptoms are not explained by the radiographic findings (eg, stress fractures) or the appropriate treatment option requires additional imaging [11,19].

Given the increased sensitivity of MRI for osteoarthritis, MRI may be indicated when more accurate or serial cartilage measurements are desired [10,55,56]. In patients >70 years of age, a higher

correlation with the "abnormal" knee being painful is present when structural abnormalities are unilateral on either radiographs or MRI. Since bilateral structural abnormalities can be present with primarily unilateral symptoms, the ability to discriminate painful from nonpainful knees is limited [57]. This persists even when using the MRI presence of synovitis or effusion and/or a Kellgren and Lawrence score of ≥2; findings were reported to be the best discriminators between painful and asymptomatic knees [19].

Patellofemoral cartilage loss is closely associated with chronic knee pain with active knee pain correlated with BMLs [56]. 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 [58].

MRI with and without IV contrast is indicated when performing semiquantitative assessment of knee osteoarthritis using various scoring systems to include cartilage, synovitis, ligaments, BMLs, and menisci [18]. In obese patients with osteoarthritis on contrast-enhanced images, increased perfusion in Hoffa's fat is associated with more severe anterior knee pain [59].

Variant 4: Adult or child greater than or equal to 5 years of age. Chronic knee pain. Initial knee radiograph demonstrates degenerative changes or chondrocalcinosis. Next imaging procedure.
E. MR Arthrography Knee

MR arthrography is usually not indicated to evaluate patients with osteoarthritis or chondrocalcinosis.

Variant 4: Adult or child greater than or equal to 5 years of age. Chronic knee pain. Initial knee radiograph demonstrates degenerative changes or chondrocalcinosis. Next imaging procedure.
F. US Knee

US is not often useful as a screening test or a comprehensive examination. US can detect synovial pathology, effusions, and cortical erosive changes [11]. Power Doppler US can demonstrate increased synovial blood flow that is associated with knee pain and can demonstrate reduced blood flow, which correlates with reduced knee pain following joint injections [60]. US can also demonstrate meniscal extrusion, a finding that suggests an underlying meniscal tear, and, on occasion, chondrocalcinosis and peripheral meniscal tears [11].

Variant 4: Adult or child greater than or equal to 5 years of age. Chronic knee pain. Initial knee radiograph demonstrates degenerative changes or chondrocalcinosis. Next imaging procedure.
G. Bone Scan Knee

Radionuclide bone scan is usually not indicated to evaluate patients with chronic knee pain given the low specificity and decreased anatomic resolution compared to CT or MRI [11]. However, it may help distinguish between bone and soft-tissue origins for pain as well as localize pain to one or more joints [11].

Variant 4: Adult or child greater than or equal to 5 years of age. Chronic knee pain. Initial knee radiograph demonstrates degenerative changes or chondrocalcinosis. Next imaging procedure.
H. Image-Guided Aspiration Knee

If an effusion is present, US- or fluoroscopically guided joint aspiration can be performed for

synovial fluid analysis if there is concern for crystal disease or infection. Corticosteroid injections can also be performed as they may result in a 1 to 2 week reduction in synovitis on MRI in two-thirds of patients. MRI also demonstrates a subsequent increase in the synovial volume in approximately 70% of patients that develop recurrent pain [61].

Variant 5: Adult or child greater than or equal to 5 years of age. Chronic knee pain. Initial knee radiograph demonstrates signs of prior osseous injury (ie, Segond fracture, tibial spine avulsion, etc.). Next imaging procedure.

When associated with acute injury, recommendations are covered in the ACR Appropriateness Criteria® topic on "[Acute Trauma to the Knee](#)" [4].

Variant 5: Adult or child greater than or equal to 5 years of age. Chronic knee pain. Initial knee radiograph demonstrates signs of prior osseous injury (ie, Segond fracture, tibial spine avulsion, etc.). Next imaging procedure.
A. Radiography Hip

An ipsilateral hip radiograph is usually not indicated to evaluate patients with signs of prior (chronic) osseous knee injury.

Variant 5: Adult or child greater than or equal to 5 years of age. Chronic knee pain. Initial knee radiograph demonstrates signs of prior osseous injury (ie, Segond fracture, tibial spine avulsion, etc.). Next imaging procedure.
B. CT Knee

CT without IV contrast may be indicated to evaluate the patellofemoral anatomy in the setting of chronic knee pain related to repetitive patellofemoral subluxation, which can be suggested by a small osseous fragment along the medial patellar margin on axial knee radiographs [15]. CT knee without IV contrast may also be useful to confirm a prior osseous injury.

CT with IV contrast is not usually indicated to evaluate patients with signs of prior (chronic) osseous knee injury.

CT without and with IV contrast is not usually indicated to evaluate patients with signs of prior (chronic) osseous knee injury.

Variant 5: Adult or child greater than or equal to 5 years of age. Chronic knee pain. Initial knee radiograph demonstrates signs of prior osseous injury (ie, Segond fracture, tibial spine avulsion, etc.). Next imaging procedure.
C. CT Arthrography Knee

CT arthrography may be used to evaluate the menisci, articular cartilage, and the presence of loose bodies with reported sensitivities and specificities ranging from 86% to 100% [16,62-64].

Variant 5: Adult or child greater than or equal to 5 years of age. Chronic knee pain. Initial knee radiograph demonstrates signs of prior osseous injury (ie, Segond fracture, tibial spine avulsion, etc.). Next imaging procedure.
D. MRI Knee

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 [41]. MRI is useful for evaluating Osgood-Schlatter or Sinding-Larsen-Johansson syndrome [41]. If the

radiograph suggests prior anterior cruciate ligament injury, MRI can effectively evaluate the menisci, but evaluation for associated cartilage lesions is less useful [65].

MRI without and with IV contrast is not usually indicated to evaluate patients with signs of prior (chronic) osseous knee injury.

Variant 5: Adult or child greater than or equal to 5 years of age. Chronic knee pain. Initial knee radiograph demonstrates signs of prior osseous injury (ie, Segond fracture, tibial spine avulsion, etc.). Next imaging procedure.
E. MR Arthrography Knee

MR arthrography is usually not indicated to evaluate patients with signs of prior (chronic) osseous knee injury.

Variant 5: Adult or child greater than or equal to 5 years of age. Chronic knee pain. Initial knee radiograph demonstrates signs of prior osseous injury (ie, Segond fracture, tibial spine avulsion, etc.). Next imaging procedure.
F. US Knee

US is usually not indicated to evaluate patients with signs of prior (chronic) osseous knee injury.

Variant 5: Adult or child greater than or equal to 5 years of age. Chronic knee pain. Initial knee radiograph demonstrates signs of prior osseous injury (ie, Segond fracture, tibial spine avulsion, etc.). Next imaging procedure.
G. Bone Scan Knee

Radionuclide bone scan is usually not indicated to evaluate patients with signs of prior (chronic) osseous knee injury.

Variant 5: Adult or child greater than or equal to 5 years of age. Chronic knee pain. Initial knee radiograph demonstrates signs of prior osseous injury (ie, Segond fracture, tibial spine avulsion, etc.). Next imaging procedure.
H. Image-Guided Aspiration Knee

Joint aspiration is usually not indicated to evaluate patients with signs of prior (chronic) osseous knee injury.

Summary of Highlights

- **Variant 1:** Radiographs of the knee are usually appropriate for the initial imaging of chronic knee pain in patients greater than or equal to 5 years of age.
- **Variant 2:** MRI knee without IV contrast is usually appropriate in patients greater than or equal to 5 years of age with chronic knee pain when initial knee radiographs are normal or demonstrate a joint effusion.
- **Variant 3:** MRI knee without IV contrast is usually appropriate in patients greater than or equal to 5 years of age with chronic knee pain when initial knee radiographs demonstrate OCD, loose bodies, or history of cartilage or meniscal repair.
- **Variant 4:** (1) MRI knee without IV contrast or (2) knee aspiration or (3) CT knee without IV contrast may be appropriate in patients greater than or equal to 5 years of age with chronic knee pain when initial radiographs demonstrate degenerative changes or chondrocalcinosis. While MRI knee without IV contrast may be appropriate more often, knee aspiration and CT knee without IV contrast may be appropriate in specific instances detailed in the narrative.

On occasion, these examinations may complement each other with more than one being appropriate.

- **Variant 5:** MRI knee without IV contrast is usually appropriate in patients greater than or equal to 5 years of age with chronic knee pain when initial radiographs demonstrates signs of prior osseous injury (ie, Segond fracture, tibial spine avulsion, etc).

Supporting Documents

The evidence table, literature search, and appendix for this topic are available at https://acsearch.acr.org/list. The appendix includes the strength of evidence assessment and the final rating round tabulations for each recommendation.

For additional information on the Appropriateness Criteria methodology and other supporting documents, please go to the ACR website at https://www.acr.org/Clinical-Resources/Clinical-Tools-and-Reference/Appropriateness-Criteria.

Appropriateness Category Names and Definitions

Appropriateness Category Name	Appropriateness Rating	Appropriateness Category Definition
Usually Appropriate	7, 8, or 9	The imaging procedure or treatment is indicated in the specified clinical scenarios at a favorable risk-benefit ratio for patients.
May Be Appropriate	4, 5, or 6	The imaging procedure or treatment may be indicated in the specified clinical scenarios as an alternative to imaging procedures or treatments with a more favorable risk-benefit ratio, or the risk-benefit ratio for patients is equivocal.
May Be Appropriate (Disagreement)	5	The individual ratings are too dispersed from the panel median. The different label provides transparency regarding the panel's recommendation. "May be appropriate" is the rating category and a rating of 5 is assigned.
Usually Not Appropriate	1, 2, or 3	The imaging procedure or treatment is unlikely to be indicated in the specified clinical scenarios, or the risk-benefit ratio for patients is likely to be unfavorable.

Relative Radiation Level Information

Potential adverse health effects associated with radiation exposure are an important factor to consider when selecting the appropriate imaging procedure. Because there is a wide range of radiation exposures associated with different diagnostic procedures, a relative radiation level (RRL) indication has been included for each imaging examination. The RRLs are based on effective dose, which is a radiation dose quantity that is used to estimate population total radiation risk associated with an imaging procedure. Patients in the pediatric age group are at inherently higher risk from exposure, because of both organ sensitivity and longer life expectancy (relevant to the long latency that appears to accompany radiation exposure). For these reasons, the RRL dose estimate ranges for pediatric examinations are lower as

compared with those specified for adults (see Table below). Additional information regarding radiation dose assessment for imaging examinations can be found in the ACR Appropriateness Criteria® [Radiation Dose Assessment Introduction](#) document.

Relative Radiation Level Designations

Relative Radiation Level*	Adult Effective Dose Estimate Range	Pediatric Effective Dose Estimate Range
O	0 mSv	0 mSv
☢	<0.1 mSv	<0.03 mSv
☢☢	0.1-1 mSv	0.03-0.3 mSv
☢☢☢	1-10 mSv	0.3-3 mSv
☢☢☢☢	10-30 mSv	3-10 mSv
☢☢☢☢☢	30-100 mSv	10-30 mSv

*RRL assignments for some of the examinations cannot be made, because the actual patient doses in these procedures vary as a function of a number of factors (e.g., region of the body exposed to ionizing radiation, the imaging guidance that is used). The RRLs for these examinations are designated as "Varies."

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