

## American College of Radiology ACR Appropriateness Criteria®

**Clinical Condition:** Nontraumatic Knee Pain

**Variant 1:** Child or adolescent: nonpatellofemoral symptoms. Mandatory minimal initial examination.

Radiologic Procedure	Rating	Comments	<a href="#">RRL*</a>
X-ray knee	9		☼
X-ray hip ipsilateral	1		☼ ☼ ☼
CT knee without contrast	1		☼ ☼
CT arthrography knee	1		☼ ☼
MRI knee without contrast	1		O
MR arthrography knee	1		O
US knee	1		O
Tc-99m bone scan lower extremity	1		☼ ☼ ☼
<b>Rating Scale:</b> 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			<b>*Relative Radiation Level</b>

**Variant 2:** Child or adult: patellofemoral (anterior) symptoms. Mandatory minimal initial examination.

Radiologic Procedure	Rating	Comments	<a href="#">RRL*</a>
X-ray knee	9		☼
X-ray hip ipsilateral	1		☼ ☼ ☼
CT knee without contrast	1		☼
CT arthrography knee	1		☼
MRI knee without contrast	1		O
MR arthrography knee	1		O
US knee	1		O
Tc-99m bone scan lower extremity	1		☼ ☼ ☼
<b>Rating Scale:</b> 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			<b>*Relative Radiation Level</b>

**Clinical Condition:****Nontraumatic Knee Pain****Variant 3:****Adult: nontrauma, nontumor, nonlocalized pain. Mandatory minimal initial examination.**

Radiologic Procedure	Rating	Comments	RRL*
X-ray knee	9		☼
X-ray hip ipsilateral	1		☼ ☼ ☼
CT knee without contrast	1		☼
CT arthrography knee	1		☼
MRI knee without contrast	1		○
MR arthrography knee	1		○
US knee	1		○
Tc-99m bone scan lower extremity	1		☼ ☼ ☼
<b>Rating Scale:</b> 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			<b>*Relative Radiation Level</b>

**Variant 4:****Child or adolescent: nonpatellofemoral symptoms. Initial knee radiographs nondiagnostic (demonstrate normal findings or a joint effusion).**

Radiologic Procedure	Rating	Comments	RRL*
MRI knee without contrast	9		○
X-ray hip ipsilateral	2	Indicated if there is clinical evidence or concern for hip pathology causing referred pain to the knee.	☼ ☼ ☼
CT knee without contrast	1		☼ ☼
CT arthrography knee	1		☼ ☼
MR arthrography knee	1		○
US knee	1		○
Tc-99m bone scan lower extremity	1		☼ ☼ ☼
<b>Rating Scale:</b> 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			<b>*Relative Radiation Level</b>

**Variant 5:****Child or adult: patellofemoral (anterior) symptoms. Initial knee radiographs nondiagnostic (demonstrate normal findings or a joint effusion).**

Radiologic Procedure	Rating	Comments	RRL*
MRI knee without contrast	9	If additional imaging is necessary and if internal derangement is suspected.	○
X-ray hip ipsilateral	1		☼ ☼ ☼
CT knee without contrast	1		☼
CT arthrography knee	1		☼
MR arthrography knee	1		○
US knee	1		○
Tc-99m bone scan lower extremity	1		☼ ☼ ☼
<b>Rating Scale:</b> 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			<b>*Relative Radiation Level</b>

**Clinical Condition:****Nontraumatic Knee Pain****Variant 6:**

**Adult: nontrauma, nontumor, nonlocalized pain. Initial knee radiographs nondiagnostic (demonstrate normal findings or a joint effusion).**

Radiologic Procedure	Rating	Comments	RRL*
MRI knee without contrast	9	If additional imaging is necessary and if internal derangement is suspected.	O
X-ray hip ipsilateral	1		☼ ☼ ☼
CT knee without contrast	1		☼
CT arthrography knee	1		☼
MR arthrography knee	1		O
US knee	1		O
Tc-99m bone scan lower extremity	1		☼ ☼ ☼
<b>Rating Scale:</b> 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			<b>*Relative Radiation Level</b>

**Variant 7:**

**Child or adolescent: nonpatellofemoral symptoms. Initial knee radiographs demonstrate osteochondral injuries (fracture/osteochondritis dissecans or a loose body).**

Radiologic Procedure	Rating	Comments	RRL*
MRI knee without contrast	9		O
MR arthrography knee	6		O
CT arthrography knee	5	If MRI cannot be done.	☼ ☼
X-ray hip ipsilateral	1		☼ ☼ ☼
CT knee without contrast	1		☼ ☼
US knee	1		O
Tc-99m bone scan lower extremity	1		☼ ☼ ☼
<b>Rating Scale:</b> 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			<b>*Relative Radiation Level</b>

**Variant 8:**

**Adult: patellofemoral (anterior) symptoms. Initial knee radiographs demonstrate degenerative joint disease and/or chondrocalcinosis.**

Radiologic Procedure	Rating	Comments	RRL*
X-ray hip ipsilateral	1		☼ ☼ ☼
CT knee without contrast	1		☼
CT arthrography knee	1		☼
MRI knee without contrast	1		O
MR arthrography knee	1		O
US knee	1		O
Tc-99m bone scan lower extremity	1		☼ ☼ ☼
<b>Rating Scale:</b> 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			<b>*Relative Radiation Level</b>

**Clinical Condition:****Nontraumatic Knee Pain****Variant 9:**

**Adult: nontumor, nonlocalized pain. Initial knee radiographs demonstrate inflammatory, crystalline, or degenerative joint disease (uni- to tri-compartmental sclerosis, hypertrophic spurs, joint space narrowing, and/or subchondral cysts).**

Radiologic Procedure	Rating	Comments	RRL*
X-ray hip ipsilateral	1		☼ ☼ ☼
CT knee without contrast	1		☼
CT arthrography knee	1		☼
MRI knee without contrast	1	Consider for preoperative assessment.	O
MR arthrography knee	1		O
US knee	1		O
Tc-99m bone scan lower extremity	1		☼ ☼ ☼
<b>Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate</b>			<b>*Relative Radiation Level</b>

**Variant 10:**

**Adult: nontumor, nonlocalized pain. Initial knee radiographs demonstrate avascular necrosis.**

Radiologic Procedure	Rating	Comments	RRL*
MRI knee without contrast	7	If needed for therapy.	O
CT knee without contrast	1		☼
CT arthrography knee	1		☼
MR arthrography knee	1		O
US knee	1		O
Tc-99m bone scan lower extremity	1		☼ ☼ ☼
<b>Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate</b>			<b>*Relative Radiation Level</b>

**Variant 11:**

**Adult: nontumor, nonlocalized pain. Initial knee radiographs demonstrate evidence of internal derangement (eg, Segond fracture, deep lateral femoral notch sign).**

Radiologic Procedure	Rating	Comments	RRL*
MRI knee without contrast	9		O
CT arthrography knee	2	If MRI contraindicated.	☼
CT knee without contrast	1		☼
MR arthrography knee	1		O
US knee	1		O
Tc-99m bone scan lower extremity	1		☼ ☼ ☼
<b>Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate</b>			<b>*Relative Radiation Level</b>

## NONTRAUMATIC KNEE PAIN

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### **Summary of Literature Review**

Nontraumatic knee pain in children, adolescents, and adults includes localized complaints such as anterior (patellofemoral) pain and diffuse nonlocalized symptoms. The consensus of the committee is that the initial imaging study for nontraumatic knee pain are anteroposterior (AP) and lateral radiographs [1-3]. For patients with diffuse nonlocalized symptoms, a Merchant or axial view may be useful as part of the initial examination. In children with nontraumatic knee pain, referred pain from the hip must be considered and hip radiographs may need to be obtained if there is clinical evidence or clinical concern for hip pathology.

In elderly patients, the most common source of nontraumatic knee pain is osteoarthritis. Conventional radiographic diagnosis of degenerative joint disease (osteoarthritis) includes joint space narrowing, osteophytes, subchondral cysts, and sclerosis bordering the joint. Articular cartilage is evaluated indirectly on radiographs by joint space narrowing and changes in the subchondral bone [4]. Routine radiographs are insensitive for assessing articular cartilage in the early stages of osteoarthritis, while in advanced disease, joint space narrowing on radiographs is usually an accurate assessment of cartilage loss [5,6]. Standing radiographs have been reported to more accurately reflect medial and lateral joint compartment cartilage loss than supine radiographs; however, in the presence of a severe varus or valgus deformity, significant cartilage loss in the compartment that appears wide (due to the alignment deformity) may not be evident [7-9]. A weight-bearing

posteroanterior (PA) radiograph, obtained with knee flexion, has been reported to show the cartilage width of the posterior medial and lateral joint compartments more accurately than a standing view obtained with the knee extended [10]. The standing flexed view may be indicated in elderly patients with osteoarthritis when surgical intervention is being planned. Finally, one should bear in mind that a significant portion of the joint space narrowing may be due to meniscal extrusion or degeneration rather than hyaline cartilage loss in some patients [11]. Additional imaging studies are not indicated in patients for whom radiographs are diagnostic of degenerative joint disease unless treatment or surgery or both depend on additional findings such as internal knee derangement, or when symptoms are not explained by the radiographic findings (eg, stress fractures).

Other nontraumatic causes of knee pain in adult patients include internal knee derangement (meniscal and ligament tears), stress fracture, subchondral insufficiency fracture (known as spontaneous osteonecrosis), inflammatory arthritis, transient osteoporosis, and chronic regional pain syndrome. Chronic anterolateral knee pain may also result from patellar tendon–lateral femoral condyle friction syndrome or iliotibial band syndrome (friction syndrome), both of which can be confirmed or excluded by magnetic resonance imaging (MRI) [12].

When initial radiographs are nondiagnostic (normal findings or a joint effusion) and knee symptoms are suspicious for an internal derangement, the next indicated study is an MRI examination [13]. MRI is also indicated when the patient has persistent knee pain and normal radiographs. MRI is more sensitive than radiography and provides more specific information compared with radionuclide bone scan [14,15]. MRI of nontraumatic knee pain may document a joint effusion, communicating synovial cysts, proliferative changes of the synovial membrane, osteophytes, subchondral cysts, articular cartilage loss, meniscal and/or ligamentous tears and/or degeneration, bone marrow edema, fractures, and osteonecrosis [14-16]. A secondary MRI finding with a high sensitivity for internal derangement is an AP joint fluid measurement of greater than 10 mm in the lateral suprapatellar pouch [17].

MRI is useful to identify a subchondral insufficiency fracture as the initial injury from which localized osteonecrosis may result and which was otherwise identified as spontaneous osteonecrosis [18]. MRI can also detect osteonecrosis of the medial femoral condyle or of the medial tibial plateau associated with tibial stress fracture [19].

A suprapatellar joint effusion is readily detected on a lateral radiograph of the knee; however, the extent of a joint effusion, the presence of a communicating synovial (popliteal) cyst, or synovial proliferation is readily identified on MRI [16,18-24]. Subchondral cysts are easily detected on MRI because of its tomographic

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The American College of Radiology seeks and encourages collaboration with other organizations on the development of the ACR Appropriateness Criteria through society representation on expert panels. Participation by representatives from collaborating societies on the expert panel does not necessarily imply society endorsement of the final document.

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quality, multiplaner imaging capability, and superb sensitivity to fluid- and fat-containing tissues [15,16,25]. Cartilage pathology, both articular and meniscal, can be evaluated directly on MRI, and demonstration depends on the location of the abnormality and the pulse sequences used [26-30].

Magnetic resonance arthrography (MRA) performed with an intra-articular injection of dilute gadolinium solution [31,32] or with an intravenous injection [33] of gadolinium contrast to improve cartilage evaluation has been investigated, but noncontrast MRI has been reported accurate for cartilage abnormalities [26]. Patellofemoral cartilage loss has been reported to be closely associated with chronic knee pain symptoms [34].

Transient osteoporosis is characterized by self-limited pain and radiographically demonstrable osteopenia. The osteopenia typically develops within eight weeks after the onset of pain. Spontaneous osteonecrosis of the medial femoral condyle, most often found in middle-aged and elderly females, may have normal radiographs for months, followed by subchondral collapse, fragmentation of the articular cartilage, and progressive osteoarthritis [35-37]. Bone marrow edema seen on MRI occurs in association with, or independent of, transient osteoporosis or osteonecrosis, and also in association with stress fractures; MRI is highly sensitive for detecting these abnormalities [36]. In adult patients with conventional radiograph diagnosis of an osteochondral injury such as osteochondritis dissecans or osteonecrosis, an MRI examination may be indicated if an additional injury is suspected clinically or when it is necessary to determine the status of the articular cartilage over the area of abnormality. In the child or adolescent with radiographic evidence of osteochondritis dissecans, an MRI is indicated to determine the best method of treatment [38-40]. Finally, MRI is not indicated to confirm a stress fracture that is evident on the radiographic study.

In patients with radiographic evidence of inflammatory arthritis of the knee, the consensus of the panel is that a knee MRI is usually not indicated for preoperative differentiation of pannus from effusion or for evaluation of erosion [24]. An aspiration for crystals may be indicated; however, the use of medical imaging (such as fluoroscopic guidance, ultrasound guidance, or arthrographic confirmation) is usually not necessary.

When an intra-articular abnormality is suspected in a patient with claustrophobia, with a large body habitus, or who cannot for some reason tolerate an MRI examination, or when there is contraindication to an MRI, a CT arthrogram may be used instead of the MRI to evaluate the cruciate ligaments, menisci, and articular cartilage [41,42].

### Summary

- The mandatory initial imaging examination for nontraumatic knee pain is AP and lateral radiography.

- In patients with anterior patellofemoral knee pain, an axial view should be included in the initial radiographic study.
- An MRI examination for nontraumatic knee pain is indicated when the pain is persistent and conventional radiographs are nondiagnostic or when additional information is necessary before instituting treatment or surgical intervention.
- An MRI is not indicated before a physical examination or routine conventional radiographs, or when there is diagnostic radiographic evidence of severe degenerative joint diseases, inflammatory arthritis, stress fracture, osteonecrosis, or reflex sympathetic dystrophy, for which additional imaging is not going to alter the treatment plan.

### 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, both because of 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 to 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 (eg, region of the body exposed to ionizing radiation, the imaging guidance that is used). The RRLs for these examinations are designated as NS (not specified).		

## Supporting Document(s)

- [ACR Appropriateness Criteria® Overview](#)
- [Procedure Contrast Information](#)
- [Evidence Table](#)

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The ACR Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those examinations generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the FDA have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.