CLINICAL APPROPRIATENESS GUIDELINES

ADVANCED IMAGING

Appropriate Use Criteria: Imaging of the Extremities

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Proprietary

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Table of Contents

Description and Application of the Guidelines

The AIM Clinical Appropriateness Guidelines (hereinafter "the AIM Clinical Appropriateness Guidelines" or the "Guidelines") are designed to assist providers in making the most appropriate treatment decision for a specific clinical condition for an individual. As used by AIM, the Guidelines establish objective and evidence-based criteria for medical necessity determinations where possible. In the process, multiple functions are accomplished:

- To establish criteria for when services are medically necessary
- To assist the practitioner as an educational tool
- To encourage standardization of medical practice patterns
- To curtail the performance of inappropriate and/or duplicate services
- To advocate for patient safety concerns
- To enhance the quality of health care
- To promote the most efficient and cost-effective use of services

The AIM guideline development process complies with applicable accreditation standards, including the requirement that the Guidelines be developed with involvement from appropriate providers with current clinical expertise relevant to the Guidelines under review and be based on the most up-to-date clinical principles and best practices. Relevant citations are included in the References section attached to each Guideline. AIM reviews all of its Guidelines at least annually.

AIM makes its Guidelines publicly available on its website twenty-four hours a day, seven days a week. Copies of the AIM Clinical Appropriateness Guidelines are also available upon oral or written request. Although the Guidelines are publicly-available, AIM considers the Guidelines to be important, proprietary information of AIM, which cannot be sold, assigned, leased, licensed, reproduced or distributed without the written consent of AIM.

AIM applies objective and evidence-based criteria, and takes individual circumstances and the local delivery system into account when determining the medical appropriateness of health care services. The AIM Guidelines are just guidelines for the provision of specialty health services. These criteria are designed to guide both providers and reviewers to the most appropriate services based on a patient's unique circumstances. In all cases, clinical judgment consistent with the standards of good medical practice should be used when applying the Guidelines. Guideline determinations are made based on the information provided at the time of the request. It is expected that medical necessity decisions may change as new information is provided or based on unique aspects of the patient's condition. The treating clinician has final authority and responsibility for treatment decisions regarding the care of the patient and for justifying and demonstrating the existence of medical necessity for the requested service. The Guidelines are not a substitute for the experience and judgment of a physician or other health care professionals. Any clinician seeking to apply or consult the Guidelines is expected to use independent medical judgment in the context of individual clinical circumstances to determine any patient's care or treatment.

The Guidelines do not address coverage, benefit or other plan specific issues. If requested by a health plan, AIM will review requests based on health plan medical policy/guidelines in lieu of the AIM Guidelines.

The Guidelines may also be used by the health plan or by AIM for purposes of provider education, or to review the medical necessity of services by any provider who has been notified of the need for medical necessity review, due to billing practices or claims that are not consistent with other providers in terms of frequency or some other manner.

Administrative Guidelines

Ordering of Multiple Studies

Requests for multiple imaging studies to evaluate a suspected or identified condition and requests for repeated imaging of the same anatomic area are subject to additional review to avoid unnecessary or inappropriate imaging.

Simultaneous Ordering of Multiple Studies

In many situations, ordering multiple imaging studies at the same time is not clinically appropriate because:

- Current literature and/or standards of medical practice support that one of the requested imaging studies is more appropriate in the clinical situation presented; or
- One of the imaging studies requested is more likely to improve patient outcomes based on current literature and/or standards of medical practice; or
- Appropriateness of additional imaging is dependent on the results of the lead study.

When multiple imaging studies are ordered, the request will often require a peer-to-peer conversation to understand the individual circumstances that support the medically necessity of performing all imaging studies simultaneously.

Examples of multiple imaging studies that may require a peer-to-peer conversation include:

- CT brain and CT sinus for headache
- MRI brain and MRA brain for headache
- MRI cervical spine and MRI shoulder for pain indications
- MRI lumbar spine and MRI hip for pain indications
- MRI or CT of multiple spine levels for pain or radicular indications
- MRI foot and MRI ankle for pain indications
- Bilateral exams, particularly comparison studies

There are certain clinical scenarios where simultaneous ordering of multiple imaging studies is consistent with current literature and/or standards of medical practice. These include:

- Oncologic imaging – Considerations include the type of malignancy and the point along the care continuum at which imaging is requested
- Conditions which span multiple anatomic regions – Examples include certain gastrointestinal indications or congenital spinal anomalies

Repeated Imaging

In general, repeated imaging of the same anatomic area should be limited to evaluation following an intervention, or when there is a change in clinical status such that imaging is required to determine next steps in management. At times, repeated imaging done with different techniques or contrast regimens may be necessary to clarify a finding seen on the original study.

Repeated imaging of the same anatomic area (with same or similar technology) may be subject to additional review in the following scenarios:

- Repeated imaging at the same facility due to motion artifact or other technical issues
- Repeated imaging requested at a different facility due to provider preference or quality concerns
- Repeated imaging of the same anatomic area (MRI or CT) based on persistent symptoms with no clinical change, treatment, or intervention since the previous study
- Repeated imaging of the same anatomical area by different providers for the same member over a short period of time

Pre-Test Requirements

Critical to any finding of clinical appropriateness under the guidelines for specific imaging exams is a determination that the following are true with respect to the imaging request:

- A clinical evaluation has been performed prior to the imaging request (which should include a complete history and physical exam and review of results from relevant laboratory studies, prior imaging and supplementary testing) to identify suspected or established diseases or conditions.
- **For suspected diseases or conditions:**
  - Based on the clinical evaluation, there is a reasonable likelihood of disease prior to imaging; and
  - Current literature and standards of medical practice support that the requested imaging study is the most appropriate method of narrowing the differential diagnosis generated through the clinical evaluation and can be reasonably expected to lead to a change in management of the patient; and
  - The imaging requested is reasonably expected to improve patient outcomes based on current literature and standards of medical practice.
- **For established diseases or conditions:**
  - Advanced imaging is needed to determine whether the extent or nature of the disease or condition has changed; and
  - Current literature and standards of medical practice support that the requested imaging study is the most appropriate method of determining this and can be reasonably expected to lead to a change in management of the patient; and
  - The imaging requested is reasonably expected to improve patient outcomes based on current literature and standards of medical practice.
- If these elements are not established with respect to a given request, the determination of appropriateness will most likely require a peer-to-peer conversation to understand the individual and unique facts that would supersede the pre-test requirements set forth above. During the peer-to-peer conversation, factors such as patient acuity and setting of service may also be taken into account.

History

Status	Date	Action
Reviewed and revised	07/26/2016	Independent Multispecialty Physician Panel review and revision
Created	03/30/2005	Original effective date

Imaging of the Extremities

General Information/Overview

Scope

These guidelines address advanced imaging of the extremities in both adult and pediatric populations. For interpretation of the Guidelines, and where not otherwise noted, "adult" refers to persons age 19 and older, and "pediatric" refers to persons age 18 and younger. Where separate indications exist, they are specified as **Adult** or **Pediatric**. Where not specified, indications and prerequisite information apply to persons of all ages.

See the Coding section for a list of modalities included in these guidelines.

Technology Considerations

In general, conventional radiographs should be obtained prior to advanced imaging. **Computed tomography (CT)** is often the preferred modality for evaluation of displaced fractures and subluxations, whereas stress fractures and some incomplete and non-displaced fractures may be better imaged with **magnetic resonance imaging (MRI)** or radionuclide bone scintigraphy. Tendons and ligamentous structures are better imaged using MRI. Use of contrast is at the discretion of both the ordering and imaging physicians. Implanted surgical hardware, including joint prostheses, may produce sufficient local artifact to preclude adequate imaging through the region containing hardware.

Disadvantages of CT include exposure to ionizing radiation and risks associated with infusion of iodinated contrast media, including allergic reactions or renal compromise. The presence of implantable devices such as pacemakers or defibrillators, a potential need for sedation in pediatric patients, and claustrophobia are the main limitations of MRI. Infusion of gadolinium may also confer an unacceptable risk in persons with advanced renal disease.

CT arthrography and **MR arthrography** are diagnostic tests performed by injecting contrast into the joint space prior to imaging. Injection is generally performed under fluoroscopic or ultrasound guidance. They are often preferable to standard CT or MRI for indications where visualization of the joint space integrity is needed.

Definitions

Phases of the care continuum are broadly defined as follows:

- **Screening** – testing in the absence of signs or symptoms of disease
- **Diagnosis** – testing based on a reasonable suspicion of a particular condition or disorder, usually due to the presence of signs or symptoms
- **Management** – testing to direct therapy of an established condition, which may include preoperative or postoperative imaging, or imaging performed to evaluate the response to nonsurgical intervention
- **Surveillance** – periodic assessment following completion of therapy, or for monitoring known disease that is stable or asymptomatic

Statistical terminology[1]

- **Confidence interval (CI) –** range of values which is likely to contain the cited statistic. For example, 92% sensitivity (95% CI, 89%-95%) means that, while the sensitivity was calculated at 92% on the current study, there is a 95% chance that, if a study were to be repeated, the sensitivity on the repeat study would be in the range of 89%-95%.

- **Diagnostic accuracy –** ability of a test to discriminate between the target condition and health. Diagnostic accuracy is quantified using sensitivity and specificity, predictive values, and likelihood ratios.
- **Hazard ratio –** odds that an individual in the group with the higher hazard reaches the outcome first. Hazard ratio is analogous to odds ratio and is reported most commonly in time-to-event analysis or survival analysis. A hazard ratio of 1 means that the hazard rates of the 2 groups are equivalent. A hazard ratio of greater than 1 or less than 1 means that there are differences in the hazard rates between the 2 groups.
- **Likelihood ratio –** ratio of an expected test result (positive or negative) in patients with the disease to an expected test result (positive or negative) in patients without the disease. Positive likelihood ratios, especially those greater than 10, help rule in a disease (i.e., they substantially raise the post-test probability of the disease, and hence make it very likely and the test very useful in identifying the disease). Negative likelihood ratios, especially those less than 0.1, help rule out a disease (i.e., they substantially decrease the post-test probability of disease, and hence make it very unlikely and the test very useful in excluding the disease).
- **Odds ratio –** odds that an outcome will occur given a particular exposure, compared to the odds of the outcome occurring in the absence of that exposure. An odds ratio of 1 means that the exposure does not affect the odds of the outcome. An odds ratio greater than 1 means that the exposure is associated with higher odds of the outcome. An odds ratio less than 1 means that the exposure is associated with lower odds of the outcome.
- **Predictive value –** likelihood that a given test result correlates with the presence or absence of disease. Positive predictive value is defined as the number of true positives divided by the number of test positives. Negative predictive value is defined as the number of true negatives divided by the number of test negative patients. Predictive value is dependent on the prevalence of the condition.
- **Pretest probability –** probability that a given patient has a disease prior to testing. May be divided into very low (less than 5%), low (less than 20%), moderate (20%-75%), and high (greater than 75%) although these numbers may vary by condition.
- **Relative risk –** probability of an outcome when an exposure is present relative to the probability of the outcome occurring when the exposure is absent. Relative risk is analogous to odds ratio; however, relative risk is calculated by using percentages instead of odds. A relative risk of 1 means that there is no difference in risk between the 2 groups. A relative risk of greater than 1 means that the outcome is more likely to happen in the exposed group compared to the control group. A relative risk less than 1 means that the outcome is less likely to happen in the exposed group compared to the control group.
- **Sensitivity –** conditional probability that the test is positive, given that the patient has the disease. Defined as the true positive rate (number of true positives divided by the number of patients with disease). Excellent or high sensitivity is usually greater than 90%.
- **Specificity –** conditional probability that the test is negative, given that the patient does not have the disease. Defined as the true negative rate (number of true negatives divided by the number of patients without the disease). Excellent or high specificity is usually greater than 90%.

General prerequisites for extremity imaging:

- **Conservative management** – a combination of strategies to reduce inflammation, alleviate pain, and improve function, including but not limited to the following:
  - Prescription strength anti-inflammatory medications and analgesics
  - Adjunctive medications such as nerve membrane stabilizers or muscle relaxants

- Physician-supervised therapeutic exercise program or physical therapy
- Manual therapy or spinal manipulation
- Alternative therapies such as acupuncture
- Appropriate management of underlying or associated cognitive, behavioral or addiction disorders

- **Clinical reevaluation** – In most cases, reevaluation should include a physical examination. Direct contact by other methods, such as by telephone or electronic messaging, may substitute for in-person evaluation when circumstances preclude an office visit.

Clinical Indications

The following section includes indications for which advanced imaging of the extremities is considered medically necessary, along with prerequisite information and supporting evidence where available. Indications, diagnoses, or imaging modalities not specifically addressed are considered not medically necessary.

It is recognized that imaging often detects abnormalities unrelated to the condition being evaluated. Such findings must be considered within the context of the clinical situation when determining whether additional imaging is required.

General prerequisites for extremity imaging include conservative management and clinical reevaluation, as defined above. Documentation of compliance with a plan of therapy that includes elements of conservative management may be required. Exceptions may be considered on a case-by-case basis.

Congenital and Developmental Conditions

Blount disease (Pediatric only)

Advanced imaging is considered medically necessary for preoperative evaluation when there is clinical concern for physeal bony bars and radiographs are nondiagnostic.

IMAGING STUDY

- CT or MRI lower extremity

Congenital anomalies of the lower extremity (Pediatric only)

Advanced imaging is considered medically necessary for diagnosis and management of **ANY** of the following conditions when radiographs are nondiagnostic or not sufficient to guide treatment:

- Acetabular dysplasia
- Congenital short femur associated with **ANY** of the following:
  - Achondroplasia
  - Mucopolysaccharidosis
  - Neurofibromatosis
  - Skeletal dysplasias
  - Spondyloepiphyseal dysplasia
- Proximal focal femoral deficiency

IMAGING STUDY

- CT or MRI lower extremity

Congenital anomalies of the upper extremity (Pediatric only)

Advanced imaging is considered medically necessary for diagnosis and management when radiographs are nondiagnostic or not sufficient to guide treatment.

IMAGING STUDY

- CT or MRI upper extremity (joint or non-joint)

Coxa vara (Pediatric only)

Advanced imaging is considered medically necessary in **ANY** of the following scenarios:

- Initial diagnosis following nondiagnostic radiograph
- Surgical planning
- Hip pain

IMAGING STUDY

- MRI lower extremity
- CT lower extremity when MRI contraindicated

Developmental dysplasia of the hip (Pediatric only)

Advanced imaging is considered medically necessary in **ANY** of the following scenarios:

- Initial diagnosis following nondiagnostic radiograph
- Surgical planning for complex dislocations
- Anticipated need for operative management based on failure to respond to bracing or late diagnosis
- Evaluation of suspected surgical complications including growth disturbance or avascular necrosis
- To determine adequacy of surgical reduction

IMAGING STUDY

- MRI lower extremity
- CT lower extremity when MRI contraindicated

Discoid meniscus (Pediatric only)

Advanced imaging is considered medically necessary when the results of imaging are essential to establish a diagnosis and/or direct management.

IMAGING STUDY

- MRI lower extremity
- CT lower extremity when MRI contraindicated

Tarsal coalition

Advanced imaging is considered medically necessary for diagnosis and management when radiographs are nondiagnostic or not sufficient to guide treatment.

IMAGING STUDY

- CT or MRI lower extremity

Rationale

Tarsal coalition refers to fusion—osseous, cartilaginous or fibrinous—of the tarsal bones, typically talocalcaneal or calcaneonavicular (90%)[1] and is an important cause of foot pain, especially in adolescents; it is responsible for foot pain in up to 13% of cases.[1] Radiographs are commonly the initial diagnostic imaging study[2, 3] and have reasonable sensitivity (~80%) and high specificity (~97%)[1, 2] for establishing the diagnosis of bony disease. Radiographs are also useful to exclude other causes of foot pain which can mimic the presentation of tarsal coalition, especially acutely. When radiographs are nondiagnostic or not sufficient to guide treatment, CT or MRI can be used to further delineate the extent of disease and to identify occult disease or associated abnormalities.[1]

Infection

Soft tissue infection

Advanced imaging is considered medically necessary in **ANY** of the following scenarios:

- Localization of known or suspected abscess, to direct surgical treatment
- Known or suspected fasciitis
- Other soft tissue infection not responsive to treatment

IMAGING STUDY

- CT or MRI upper extremity (joint or non-joint)
- CT or MRI lower extremity

Osteomyelitis

Advanced imaging is considered medically for diagnosis and management when radiographs are nondiagnostic or not sufficient to guide treatment.

IMAGING STUDY

- MRI upper extremity (joint or non-joint)
- MRI lower extremity
- CT upper or lower extremity when MRI contraindicated
- FDG-PET for chronic osteomyelitis

Rationale

Though radiographs often do not show abnormalities associated with osteomyelitis in the first two weeks of the infection, they can detect other pathologies that may contribute to the patient’s symptoms. The information provided by radiographs generally complements that provided by other modalities, so radiographs should be performed even when other imaging is planned.

Radiographs are the appropriate initial imaging study in osteomyelitis because they can demonstrate findings suggestive of the diagnosis, but can also exclude or provide information to suggest other diagnoses. The sensitivity of radiography is reportedly 43%-75% and the specificity is 75%-83%. Abnormal radiographs are helpful, but the diagnosis cannot be excluded on the basis of negative radiographs. The sensitivity and specificity of CT are not well established, but the sensitivity is known to be lower than that of MRI. For this reason, the utility of CT is limited to specific situations. For example, CT can be used to detect bony sequestra, and has an important role in determining operative therapy.[4]

Overall, CT has a limited role in the diagnosis of osteomyelitis, and should be used only when imaging is being done to assess the extent of bone destruction, to direct a biopsy, or when MRI is contraindicated. For early detection of osteomyelitis, MRI is superior to other imaging modalities. The sensitivity and specificity for MRI are 78%-90% and 60%-90%, respectively. This compares to sensitivity and specificity of 67% and 50% for CT, and 14%-54% and 68%-70% for radiography.[5]

The American College of Radiology Appropriateness Criteria rate radiographs as "usually appropriate" for initial evaluation of suspected osteomyelitis. CT, MRI, and ultrasound are all rated as "usually not appropriate" regardless of whether the studies are performed with IV contrast. For evaluation of suspected osteomyelitis following radiographs, MRI without and with IV contrast is preferred, with a comment that radiographs and MRI are both indicated and complementary. MRI without contrast is generally appropriate if contrast is contraindicated, and CT with IV contrast is generally appropriate if MRI is contraindicated.[6]

Septic arthritis

ADULT

Advanced imaging is considered medically necessary in **EITHER** of the following scenarios:

- Diagnosis of septic arthritis when **ANY** of the following risk factors are present:
  - Underlying joint disease
  - Joint prosthesis
  - IV drug abuse
  - Diabetes
  - Presence of cutaneous ulcers
- Preoperative planning for established septic arthritis

PEDIATRIC

Advanced imaging is considered medically necessary in **ANY** of the following scenarios:

- Initial diagnosis
- To evaluate for associated osteomyelitis or cartilage involvement
- Presurgical planning

IMAGING STUDY

- MRI lower extremity
- MRI upper extremity (joint)
- MRI upper extremity (non-joint) when there is concern for spread of infection into the adjacent soft tissue not visualized on MRI joint
- CT upper or lower extremity when MRI contraindicated

Rationale

The diagnosis of septic arthritis is established by joint aspiration and culture of the synovial fluid. Initial evaluation for septic joint should include radiography (to outline anatomic detail, evaluate for radiodense foreign bodies or soft-tissue gas, and exclude alternate diagnoses such as fracture, degenerative changes, or tumor).[6,7] Additional imaging with CT or MRI may be utilized for further evaluation in children, high-risk adults, and for preoperative planning for confirmed septic arthritis. In children, MRI may also be useful to evaluate for associated osteomyelitis or cartilage involvement. The American College of Radiology recommends MRI to further clarify and stage conditions diagnosed clinically and/or suggested by other imaging modalities, including, but not limited to, the following: inflammatory, infectious, neuropathic, degenerative, crystal-induced, or post-traumatic arthritis.[8] Compared to other advanced imaging modalities, MRI is generally preferred for septic arthritis for its ability to assess soft tissue infection, osteomyelitis, and abscess.[6,7] MRI is highly sensitive for the diagnosis of septic arthritis, although it still lacks specificity as it cannot reliably distinguish inflamed from infected joints.[9] MRI is as sensitive as and more specific than bone scintigraphy in the diagnosis of osteomyelitis.[5] CT may be utilized when MRI is contraindicated.

Inflammatory Conditions

Bursitis

Applies to shoulder indications only.

Advanced imaging is considered medically necessary for evaluation of acute shoulder pain in adults and acute or chronic shoulder pain in pediatric patients following initial radiographs when imaging is required to establish the diagnosis and the patient is a candidate for corticosteroid or anesthetic injection.

IMAGING STUDY

- MRI upper extremity joint
- CT upper extremity for pediatric patients only

Rationale

For suspected bursitis, initial imaging evaluation should be with radiographs, including anterior, posterior, axillary, and outlet views .[11]

Capitellar osteochondritis

Advanced imaging is considered medically necessary when the results of imaging are essential to establish a diagnosis and/or direct management.

IMAGING STUDY

- MRI upper extremity joint
- CT may be utilized when MRI contraindicated

Epicondylitis

Advanced imaging is considered medically necessary when **BOTH** of the following criteria are met:

- Radiographs are nondiagnostic
- There has been no substantial improvement following a trial of conservative treatment

Note: Epicondylitis is generally considered a clinical diagnosis and imaging usually does not change management. Specialist evaluation should be strongly considered prior to advanced imaging.

IMAGING STUDY

- MRI upper extremity joint
- CT may be utilized when MRI contraindicated

Juvenile idiopathic arthritis (Pediatric only)

Also see juvenile idiopathic arthritis in Spine Imaging guidelines.

Advanced imaging of the extremity is considered medically necessary for management of established juvenile idiopathic arthritis when radiographs are insufficient to determine appropriate course of therapy, particularly intra-articular therapy.

IMAGING STUDY

- MRI upper extremity joint
- MRI lower extremity
- CT when MRI contraindicated or expected to be nondiagnostic

Rationale

Juvenile idiopathic arthritis (JIA), the most common rheumatic disease of children and adolescents, is an umbrella term that encompasses all forms of arthritis that begin before age 16, persist for more than 6 weeks, and are of unknown etiology. Examples of JIA include oligoarthritis, polyarthritis, systemic arthritis, psoriatic arthritis, and enthesis-related arthritis. JIA is the most common childhood rheumatic entity with a prevalence of 0.6 to 1.9 in 1000 children.[12]

JIA is primarily a clinical diagnosis. General practitioners should base diagnosis of JIA (and differential diagnosis) primarily on history and clinical examination, with strong suspicion of JIA indicated by pain and swelling of single or multiple joints, persistent or worsening loss of function, fever of at least 10 days with unknown cause (often associated with transient erythematous rash), decreased range of motion, and joint warmth or effusion.[13]

Laboratory assessment with appropriate tests can assist in increasing diagnostic certainty, excluding differential diagnoses, and predicting patients likely to progress to erosive disease. Base investigations usually include erythrocyte sedimentation rate or C-reactive protein and full blood count, with consideration given to rheumatoid factor, antinuclear antibody, and human leukocyte antigen B27.[13]

When there is clinical diagnostic doubt, conventional radiographs (CR), ultrasound, or MRI can be used to improve the certainty of a diagnosis of JIA above clinical features alone.[14] MRI is the most sensitive noninvasive imaging modality to evaluate for inflammation of the joints, tendons, and entheses, and is the only modality that can depict bone marrow edema. Currently, MRI with contrast is the most sensitive tool for determining active synovitis.[12]

When the imaging modalities were directly compared, MRI and ultrasound detected more joint damage than CR, but primarily at the hip (MRI vs CR detection rate, mean [range] 1.54-fold [1.08–2.0-fold]; ultrasound vs CR detection rate, mean 2.29-fold), and at the wrist (MRI vs CR detection rate, 1.36-fold [1.0–2.0-fold]).[14]

Imaging studies help identify children with a high likelihood of early erosive joint damage, providing an opportunity to implement aggressive therapy at an early stage in an attempt to reduce morbidity.[12]

Myositis

Advanced imaging is considered medically necessary in **EITHER** of the following scenarios:

- Localization for biopsy
- Monitor response to therapy

IMAGING STUDY

- MRI upper extremity non-joint
- MRI lower extremity
- CT may be utilized when MRI contraindicated

Plantar fasciitis

Advanced imaging is considered medically necessary in the following scenario:

- Preoperative evaluation following a failure of 6 months of physician-supervised conservative treatment

IMAGING STUDY

- MRI lower extremity
- CT may be utilized when MRI contraindicated

Tenosynovitis – long head of biceps

Advanced imaging is considered medically necessary in the following scenario:

- Evaluation of acute shoulder pain following initial radiographs when imaging is required to establish the diagnosis and the patient is a candidate for corticosteroid or anesthetic injection

IMAGING STUDY

- MRI upper extremity joint

- CT may be utilized when MRI contraindicated

Trauma

Fracture

Note: Sites at high risk for fracture include femoral neck/proximal femur, tibia (anterior/lateral), great toe sesamoid, patella, scaphoid, lunate, talus, navicular, and metatarsal base (second to fifth digits).

ADULT

Advanced imaging is considered medically necessary in **ANY** of the following scenarios:

- Detection of occult fracture following initial nondiagnostic radiographs at high-risk sites noted above.
- To define the extent of an acute fracture and position of fracture fragments
- To assess fracture healing for delayed union or nonunion when radiographs are inconclusive

PEDIATRIC

Advanced imaging is considered medically necessary in **ANY** of the following scenarios:

- Detection of occult fracture following initial nondiagnostic radiographs
- To assess fracture healing for delayed union or nonunion when radiographs are inconclusive
- Preoperative evaluation when radiographs do not provide adequate information to direct treatment in **ANY** of the following situations:
  - To define the extent of an acute fracture
  - Intra-articular fracture
  - Physeal bar
  - Salter-Harris fracture

IMAGING STUDY

- CT or MRI upper extremity joint or non-joint
- CT or MRI lower extremity

Note: MRI is preferred for suspected occult or stress fractures of high-risk sites noted above.

Rationale

Though MRI is often more sensitive than radiography in detecting occult fractures, radiography remains the initial study of choice for clinically suspected fractures with good specificity (greater than 88%) but limited sensitivity (less than 56%).[15,16] CT is often the preferred modality for evaluation of displaced fractures and subluxations, whereas stress fractures and some incomplete and non-displaced fractures may be better imaged with MRI or radionuclide bone scintigraphy.

While many types of stress fractures are diagnosed clinically and managed conservatively,[17] high-risk fracture sites are susceptible to nonunion.[18,19] Early diagnosis is important, as these fractures may require prolonged immobilization or surgical intervention.[18] Advanced imaging, preferably MRI, is indicated when radiographs are nondiagnostic to support this management change.

SUSPECTED SCAPHOID FRACTURE

For initial evaluation of suspected scaphoid fracture, radiographs (via the finding of a fat pad sign) have a sensitivity of 82% (95% CI 77%-86%) and specificity of 72% (95% CI 68%-75%). The pretest probability of scaphoid fracture when radiographs do not demonstrate a fracture but the history and physical examination are consistent with the diagnosis is 25%. Regarding follow-up imaging after negative radiographs, CT has a sensitivity of 83% (95% CI 75%-89%) and specificity of 97% (95% CI 94%-99%). The diagnostic accuracy of MRI is superior to CT, with 96% sensitivity (95% CI 92%-99%) and 98% specificity (95% CI 96%-99%).[20]

SUSPECTED HIP FRACTURE WITH NEGATIVE OR INCONCLUSIVE RADIOGRAPHS

Stress or fragility fractures, especially those of the subcapital hip, may progress to complete fractures. Subcapital hip fractures are often complicated by avascular necrosis unless surgically treated; as such, accurate detection is important. Clinically, these fractures most commonly present with hip pain after trauma, and the patient may be unable to bear weight. When radiographs are negative or indeterminate, MRI is sensitive and specific for diagnosis and is better able to diagnose soft tissue causes of hip pain that may mimic fracture; these may include musculotendinitis and bursal abnormalities.[21]

There is consensus among multiple high-quality evidence-based guidelines that advanced imaging (most commonly MRI) is indicated in patients with suspected stress of fragility fracture when initial and or follow-up radiography is negative. MRI has a high diagnostic yield in this patient population—especially for elderly patients—and establishing the diagnosis frequently changes management.

CHOICE OF IMAGING STUDY

Moderate evidence supports MRI as the advanced imaging modality of choice for diagnosis of presumed hip fracture not apparent on initial radiographs.[21] For suspected hip fracture, MR imaging is the imaging study of choice when there is doubt regarding the diagnosis. If MR is not available or not feasible, a radioisotope bone scan or repeat plain radiographs (after a delay of 24-48 hours) should be performed.[22]

A 2016 systematic review of imaging modalities in lower extremity stress fractures found greater sensitivity for MRI (68%-99%) than CT (32%-38%) and comparable but wide-ranging specificities (4%-97% for MRI, 88%-98% for CT). In assessing the data, the authors conclude that “MRI was identified as the most sensitive and specific imaging test for diagnosing stress fractures of the lower extremity.”[15] Highlighting the superior sensitivity of MRI, a recent retrospective study of 44 patients found that MRI changed management in up to 61% of cases following inconclusive radiographs and CT.[23]

Patellar dislocation – transient (Pediatric only)

Advanced imaging is considered medically necessary when the results of imaging are essential to establish a diagnosis and/or direct management.

IMAGING STUDY

- CT lower extremity

Patellar sleeve avulsion (Pediatric only)

Advanced imaging is considered medically necessary when the results of imaging are essential to establish a diagnosis and/or direct management.

IMAGING STUDY

- MRI lower extremity
- CT when MRI contraindicated

Trauma complications (Pediatric only)

Advanced imaging is considered medically necessary to evaluate **ANY** of the following:

- Chondrolysis
- Intra-articular bodies
- Premature growth plate closure

IMAGING STUDY

- CT or MRI lower extremity

Traumatic injuries – acute/not otherwise specified

See pain indications or ligament/tendon derangements for subacute or chronic injuries.

Advanced imaging is considered medically necessary when radiographs are nondiagnostic or not sufficient to establish a diagnosis and/or direct management.

IMAGING STUDY

- CT or MRI upper or lower extremity

Rationale

For evaluation of musculoskeletal trauma, radiologists judge radiographs to be “essential” or “very important” for use in the interpretation of MRI. When advanced imaging is warranted, having radiographs available at the time of advanced imaging allows the radiologist to more appropriately protocol the study, as well as to determine which study will best assess the clinical and radiographic concerns.[16]

Tumor/Neoplasm

See Oncologic Imaging guidelines for management of an established tumor.

Brachial plexus mass

Advanced imaging is considered medically necessary when the results of imaging are essential to establish a diagnosis and/or direct management.

IMAGING STUDY

- MRI upper extremity (non-joint)
- CT upper extremity when MRI contraindicated

Morton’s neuroma

Advanced imaging is considered medically necessary when physical examination or ultrasound is nondiagnostic and imaging is required to direct treatment.

IMAGING STUDY

- MRI lower extremity
- CT may be utilized when MRI contraindicated

Osteochondroma or exostosis (Pediatric only)

Advanced imaging is considered medically necessary for diagnosis in symptomatic patients or periodic surveillance for malignant degeneration.

IMAGING STUDY

- CT upper extremity or lower extremity
- MRI upper extremity or lower extremity

Osteoid osteoma (Pediatric only)

Advanced imaging is considered medically necessary for diagnosis and management when radiographs are nondiagnostic or not sufficient to guide treatment.

IMAGING STUDY

- CT or MRI lower extremity

Pigmented villonodular synovitis

Advanced imaging is considered medically necessary when the results of imaging are essential to establish a diagnosis and/or direct management.

IMAGING STUDY

- MRI upper extremity joint
- MRI lower extremity
- MR or CT arthrogram
- CT upper extremity or lower extremity when MRI contraindicated

Rationale

Pigmented villonodular synovitis exists in both diffuse and localized forms. Radiographic findings are nonspecific, and radiographs may be normal in up to approximately 20% of cases. In localized disease, a soft tissue mass may be evident. In diffuse disease, there may be a joint effusion as well as erosive changes. Radiographic changes including osteopenia, joint space narrowing, and degenerative changes may less commonly be present. CT arthrography and MR arthrography reveal synovial thickening with nodular projections into the joint.[57]

The extent of disease is better demonstrated with MR arthrography than with CT arthrography. However, CT is ideal for demonstrating bony erosion and subchondral cystic change. The CT appearance of pigmented villonodular synovitis is less well described than its appearance on MR arthrography. Because the clinical and radiographic findings, particularly in diffuse disease, are nonspecific, MR is typically the study chosen as a follow up to radiography.[57]

Posterior knee mass (Adult only)

Advanced imaging is considered medically necessary for diagnosis of a palpable posterior knee mass following nondiagnostic radiograph and ultrasound.

IMAGING STUDY

- MRI lower extremity
- CT may be utilized when MRI contraindicated

Rationale

The initial evaluation for suspected popliteal (Baker's) cyst should include an ultrasound and plain radiographs. Plain radiography provides limited information about the popliteal cyst, but may provide additional information on joint and bone abnormalities such as loose bodies in the cyst or the general findings of osteoarthritis and inflammatory arthritis. Ultrasound, however, is preferred and considered invaluable for evaluation of a Baker's cyst as it is readily available, noninvasive, involves no exposure to radiation, and allows assessment of the cyst including size, extent, and relation to surrounding tissue. In the clinical scenario where plain radiograph and ultrasound are nondiagnostic for a Baker's cyst, an MRI may be useful. As ultrasound is not sensitive for intra-articular lesions, an MRI can confirm the cystic, unilocular nature of a benign popliteal cyst, evaluate its relationship to anatomic structures in the joint and surrounding tissue, and delineate associated intra-articular pathologies.[24] Primary indications for MRI of the knee include but are not limited to diagnosis, exclusion, and grading of suspected synovial-based disorders (synovitis, bursitis, symptomatic plicae, and popliteal cysts).[8] CT imaging is generally not indicated.

Soft tissue mass – not otherwise specified

ADULT

Advanced imaging is considered medically necessary in **ANY** of the following scenarios:

- Evaluation of a palpable mass following nondiagnostic radiograph
- Soft tissue evaluation when prominent calcifications are seen on radiograph
- Spontaneous soft tissue hemorrhage with or without palpable mass
- Surveillance of a soft tissue mass identified on prior imaging without pathologic tissue confirmation

PEDIATRIC

Advanced imaging is considered medically necessary when the results of imaging are essential to establish a diagnosis and/or direct management.

IMAGING STUDY

- MRI joint/non-joint or CT upper extremity
- MRI or CT lower extremity

Rationale

Among patients presenting for primary care evaluation of a soft tissue mass, a benign cause is found in 95% of cases.[25] Radiographic findings are often nonspecific. However, there are some radiographic findings that are characteristic of certain masses. Examples include phleboliths, which are suggestive of hemangiomas, as well as trabecular bone adjacent to a soft tissue mass, which—when combined with a history of trauma—suggests myositis ossificans. The radiographic findings may help direct next steps in evaluation of the mass, such as a clinical situation where the most appropriate next study is CT. For most soft tissue masses, MRI is the more appropriate follow-up study.[26]

Ligament and Tendon Derangement

Note: MRI is preferable to CT for evaluation of internal derangements of tendinous, ligamentous, and cartilaginous structures. Except where noted, CT should be limited to situations where there is a contraindication to MRI.

Adhesive capsulitis (Adult only)

Advanced imaging is considered medically necessary when **BOTH** of the following criteria are met:

- Acute shoulder pain with nondiagnostic radiographs
- A minimum of 6 consecutive weeks of physician-supervised conservative treatment for the current episode of pain has been completed, with lack of substantial improvement on clinical reevaluation

IMAGING STUDY

- MRI upper extremity (joint)
- CT upper extremity

Rationale

There is no agreement on the imaging features of adhesive capsulitis. A single high-quality evidence-based guideline suggests that imaging is not initially indicated but that MRI may be considered prior to manipulation.[10]

Labral tear – hip

Advanced imaging is considered medically necessary when the results of imaging are essential to establish a diagnosis and/or direct management.

IMAGING STUDY

- MRI lower extremity
- MR or CT arthrogram

Rationale

Consensus among high-quality evidence-based guidelines is that imaging may be indicated when radiographs are negative or equivocal. Recommendations about choice of imaging study are inconsistent.

- MR arthrography or CT arthrography is appropriate in patients with chronic hip pain when a labral tear is suspected and radiographs are negative, equivocal, or nondiagnostic.[27]
- MRI is useful in detecting musculotendinous pathology such as iliopsoas tendinopathy. Although MRI is not used widely to detect intra-articular injury, some investigators report high accuracy (89%-95%) in detecting labral tears. Currently, the most common imaging procedure used to confirm the diagnosis of intra-articular pathology, such as labral tears or chondral lesions, is MR arthrography.[28]

- A systematic review of 29 studies (13 MRI [10 @ 1.5T], 16 MR arthrography [13 @ 1.5T]) assessing the diagnostic accuracy of MRI or MR arthrography for labral tear in 872 patients found that both conventional MRI and MR arthrography provide acceptable ability in detecting acetabular labral tears in adults. The sensitivity of MR arthrography was greater than conventional MRI in detecting an acetabular labral tear when one was present, but conventional MRI had a higher specificity than MR arthrography in detecting a negative result when no labral tear was evident. The authors conclude that "both MRI and MR arthrography may be useful adjuncts in the diagnosis of acetabular labral tears in adults, but MR arthrography appears to be superior to conventional MRI based on the current evidence."[29]

Labral tear – shoulder

Suspected glenohumeral instability/labral tear based on **EITHER** of the following:

- Recurrent anterior shoulder dislocation
- First-time dislocation in a young patient at high risk for recurrence

Suspected superior labrum anterior posterior (SLAP) tear in **ANY** of the following scenarios:

- Acute trauma in persons under age 45
- Acute traumatic event with evidence of suprascapular nerve entrapment
- Lack of improvement or worsening of symptoms following at least 4 weeks of conservative therapy

Management of labral tear

- Preoperative imaging when labral tear has been diagnosed by a modality other than MRI, or more than one year has elapsed since MRI was performed for this diagnosis
- Postoperative evaluation when at least 3 months have elapsed since surgical repair and there has been no clinical improvement

IMAGING STUDY

- MR or CT arthrogram
- MRI upper extremity joint
- CT may be considered when MRI is contraindicated

Rationale

In general, MR arthrogram is more accurate than MRI in diagnosing and excluding labral tears. CT and MR arthrogram have comparable diagnostic accuracy in evaluation of superior labral anterior to posterior (SLAP) tears, Bankart lesions, and humeral head/Hill-Sachs fractures. CT arthrogram may have slightly better diagnostic accuracy for glenoid rim fractures and anterior labral periosteal sleeve avulsion fractures. In the absence of intra-articular contrast, CT should only be performed for this indication when there is a contraindication to MRI.

In a meta-analysis comparing MR arthrogram (N=2013) to MRI (N=1498) in patients with suspected SLAP tears, MR arthrogram was superior to MRI in the detection of SLAP lesions. MR arthrogram had higher sensitivity (87% vs 76%), specificity (92% vs 87%), positive likelihood ratio (10.28 vs 5.89), and negative likelihood ratio (0.14 vs 0.28) than MRI.[30]

A 2012 meta-analysis by Smith et al. reviewed 4574 patients and 4667 shoulders in patients presenting with suspected labral tear and clinical signs and/or symptoms of shoulder instability. MRI had a sensitivity of 76% (95% CI, 72%-80%) and specificity of 87% (95% CI, 84%-90%), while MR arthrogram had a sensitivity of 88% (95% CI, 86%-90%) and specificity of 93% (95% CI, 92%-95%) in the evaluation of all labral tears. For evaluation of anterior labral tears, MRI (sensitivity 92% [95% CI, 88%-96%], specificity 98% [95% CI, 98%-99%]) was more accurate than MR arthrogram (sensitivity 84%, [95% CI, 79%-89%], specificity 93% [95% CI, 90%-95%]). No significant difference was found between MRI and MR arthrogram in the detection of posterior or superior labral tears. For SLAP tears, MR arthrogram showed slightly higher diagnostic accuracy (sensitivity 83% [95% CI, 79%-87%], specificity 93% [95% CI, 90%-96%]) than MRI (sensitivity 79% [95% CI, 75%-93%], specificity 87% [95% CI, 83%-91%]).[31]

Though MR arthrogram is considered the reference standard for shoulder imaging, CT arthrography could also provide a valuable preoperative assessment, given its excellent spatial resolution, multiplanar capacity, and high-contrast resolution.[32]

In nontraumatic cases, there is agreement that imaging is not initially indicated prior to 4 weeks of conservative care. Clinical tests such as O'Brien, Neer, and Yergason tests are used to diagnose labral lesions. Since most SLAP tears are associated with other pathology, the provider should identify other shoulder conditions, if any, and follow appropriate surgical indications. Indications for surgical treatment of SLAP tears are not standardized and remain somewhat controversial. Expert opinion, including the American Academy of Orthopedic Surgeons, recommends initial conservative care for SLAP tears. In general, conservative management should last a minimum of 6 to 12 weeks. Early surgery should be considered only when there is evidence of symptomatic suprascapular nerve compression.[33]

Besides the typical history of repetitive dislocation episodes, the diagnosis of chronic anterior instability of the shoulder is usually confirmed by imaging. Conventional radiographs and CT scans can provide useful information about bone status, but so far, MR arthrography represents the gold standard for prearthroscopy evaluation.[34]

Ligament tear – knee

Advanced imaging is considered medically necessary in **ANY** of the following scenarios:

- Patient has completed a minimum of 4 consecutive weeks of physician supervised conservative treatment for the current episode and has not shown substantial improvement on clinical reevaluation
- Postoperative evaluation following a ligament or tendon repair when there are new symptoms
- Preoperative evaluation

  Note: Positive findings of any of these tests—anterior or posterior drawer test, Lachman test, medial or lateral stress test, or pivot shift test—may indicate the need for intervention.

IMAGING STUDY

- MRI lower extremity

Meniscal tear/injury

Advanced imaging is considered medically necessary in **EITHER** of the following scenarios:

- Patient has completed a minimum of 4 consecutive weeks of physician supervised conservative treatment for the current episode and has not shown substantial improvement on clinical reevaluation
- Preoperative evaluation in **ANY** of the following scenarios:
  - Positive McMurray test with minimal knee flexion
  - Symptoms of locking, inability to bear weight, or fully extend the knee
  - Pain and swelling occurring immediately after an acute injury
  - A severe twisting injury after which activity could not be resumed
  - Concomitant anterior cruciate ligament tear

IMAGING STUDY

- MRI lower extemity

Rationale

In patients with nontraumatic knee pain without initial radiographic evidence of underlying pathology, consensus among multiple high-quality evidence-based guidelines suggests that a period of conservative care is indicated in patients prior to advanced imaging.[35,36] In patients without gross instability or prior surgery, studies have shown no difference in patient-centered outcomes (short or long term pain, quality of life, functional limitations) for patients with knee pain and suspected internal derangement who receive MRI at the time of initial primary care consultation versus delayed MRI after conservative care and orthopedic referral.[37] In patients who have failed conservative treatment, or when history or physical findings are suggestive of injury whereby surgical treatment is planned, an MRI is the most appropriate imaging study.[38] Strong evidence suggests that MRI can provide confirmation of injury and assist in identifying concomitant knee pathology such as other ligament, meniscal, or articular cartilage injury.[39]

The use of CT for evaluation of internal knee pathology has been looked at prospectively in 2 separate trials. Heffernan et al. found that multidetector CT imaging had very high sensitivity and specificity for anterior cruciate ligament (ACL) tears (87.5%-100%, with a specificity of 100%); however, CT had low sensitivity for other soft tissue injuries of the knee.[40] In a second prospective study, the overall accuracy rates for diagnosing a meniscal tear were 82%-88% with MR arthrography and 74%-76% with CT arthrography. The authors concluded that CT arthrography was moderately accurate in the diagnosis of meniscal tears and can be used as an alternative procedure when MR arthrography cannot be completed.[41] An older retrospective study confirmed that multidetector CT can detect an intact ACL and posterior cruciate ligament with good specificity, accuracy, and negative predictive value, but assessment of torn ligaments is unreliable.[42] In general, spiral CT arthrography is an alternative for assessing internal derangements of the knee when MRI is unavailable or contraindicated.[35]

MRI is considered the gold standard for detection of internal derangement of the knee. A meta-analysis of 13 studies with 1197 patients assessed the evidence for the diagnostic efficacy of 3T MRI for meniscal and ACL injuries in the knee using arthroscopy as the reference standard. For medial meniscal injuries, mean sensitivity of 3T MRI was 0.94 (95% CI, 0.91-0.96) and mean specificity was 0.79 (95% CI, 0.75- 0.83). For detection of lateral meniscal injuries, 3T MRI had a mean sensitivity of 0.81 (95% CI, 0.75-0.85) and a mean specificity of 0.87 (95% CI, 0.84-0.89). Finally, for ACL injuries, 3T MRI had a mean sensitivity of 0.92 (95% CI, 0.83-0.96) and a mean specificity of 0.99 (95% CI, 0.96-1.00).[43] A 2016 systematic review and meta-analysis of 21 prospective studies with 1339 patients to determine the diagnostic accuracy of MRI and ultrasound in the diagnosis of ACL, medial meniscus and lateral meniscus tears in people with suspected ACL and/or meniscal tears. The results showed that a positive finding on MRI doubles the probability of an ACL tear across all clinical settings from 35.7% (95% CI, 25.9%-45.5%) to 85.8% (95% CI, 82.0%-90.0%). The estimated sensitivity and specificity of MRI were 87% (95% CI, 77%-94%) and 93% (95% CI, 91%-96%) for ACL tears, 89% (95% CI, 83%-94%) and 88% (95% CI, 82%-93%) for medial meniscal tears, and 78% (95% CI, 66%-87%) and 95% (95% CI, 91%-97%) for lateral meniscal tears. The sensitivity of MRI for lateral meniscal tears was lower than for ACL and medial meniscal tears but the specificity was higher.[44]

Rotator cuff tear (Adult only)

Suspected acute rotator cuff tear when **ALL** of the following are present:

- At least 1 positive sign to support the diagnosis of rotator cuff tear has been demonstrated
- Radiographs or ultrasound are nondiagnostic
- Lack of improvement following an initial trial of conservative therapy including 4 weeks of physical therapy

  Note: Conservative therapy is not required when there is clinical evidence of a full thickness tear including of the following:

  - *Traumatic injury*
  - *Positive drop arm test*
  - *Significant motor weakness or sensory changes in the affected limb*
  - *Decreased radial pulse*
  - *Plateau or worsening of symptoms during therapy*
  - *Two or more signs of instability: Yergason's test, Speed's biceps tendon test, O'Brien's test, or compression-rotation test*

Suspected chronic rotator cuff tear when **ALL** of the following are present:

- Radiographs or ultrasound are nondiagnostic
- At least 1 positive sign to support the diagnosis of rotator cuff tear has been demonstrated
- Symptoms have persisted for more than 3 months despite optimal medical management

Management of rotator cuff tear following repair in **EITHER** of the following scenarios:

- Suspicion of recurrent rotator cuff tear
- Suspected postsurgical complication

IMAGING STUDY

- CT arthrography
- MRI upper extremity joint
- MR arthrogram

Rationale

Rotator cuff tears usually occur as a result of trauma, and are rare in the young (age < 35 years) but common in older people, in whom the trauma may be minimal, and tears may be asymptomatic. Radiography is a useful initial screening modality for acute shoulder pain of all causes[45] and is recommended as the initial imaging modality by multiple high-quality evidence-based and practice based guidelines.[10,11]

There is consensus among multiple high-quality evidence-based guidelines that imaging is generally not indicated for suspected atraumatic rotator cuff tear unless the patient has failed a 4 to 6 week course of conservative care or has red flags/high risk features. Imaging is not indicated in patients with full or limited movement and nontraumatic shoulder pain of less than 4 weeks duration.[10] MRI or ultrasound may be considered when shoulder pain is refractory to 4 to 6 weeks of an appropriate shoulder rehabilitation program and the diagnosis has not been identified through clinical exam.[11] In the absence of red flag symptoms, X-rays and imaging are not indicated in the first 4 to 5 weeks for an injured worker presenting with suspected rotator cuff syndrome.[46]

High-risk features, for which early intervention confers a better prognosis, include infection, neoplasm, high-impact trauma, and specific clinical features suggestive of a full-thickness rotator cuff tear.[33,47]

According to Handoll et al., imaging is not indicated for shoulder pain in the primary care setting unless there is a suspicion of serious pathology. Imaging and surgical intervention should only be considered after conservative treatment has failed.[48]

The American Academy of Orthopaedic Surgeons 2010 guideline for the management of rotator cuff problems indicates that in the absence of a full thickness tear, it is appropriate to treat patients with exercise and/or nonsteroidal anti-inflammatory medications.[49] This recommendation was based on multiple high-quality studies showing statistically significant benefits in function and reduction in symptoms with both forms of conservative treatment.

CHOICE OF IMAGING STUDY

There is consensus among multiple high-quality evidence-based guidelines that MRI, MR arthrogram, and ultrasound are all accurate in the assessment of full thickness rotator cuff tears. All three modalities are more accurate in identifying full thickness tears than partial thickness tears. CT arthrography and MR arthrography have comparable diagnostic accuracy in the evaluation of full thickness rotator cuff tears. MR arthrogram is accurate in detecting rotator cuff lesions such as partial articular supraspinatus tendon avulsions and concealed interstitial delaminations.[10,11]

A 2013 meta-analysis by Lenza et al. extracted data from 20 prospective studies (1147 shoulders) in patients with shoulder pain being considered for surgery. The authors found no statistically significant difference between MRI, MR arthrogram, and ultrasound in the diagnostic accuracy for the detection of full thickness tears (P = .07), partial thickness tears (P = 1.0), or any tear (P = 0.13). For full thickness tears, MRI (7 studies, 368 shoulders) had a sensitivity of 94% (95% CI, 85%-98%). The positive and negative likelihood ratios were 13 (95% CI, 6-29) and 0.06 (95% CI, 0.02-0.23). The authors concluded that there was no evidence to suggest differences in the sensitivities and specificities of MRI and ultrasound for detecting any rotator cuff tears or partial thickness tears. The authors also found no evidence to suggest differences in the sensitivities and specificities of MRI, MR arthrogram, and ultrasound for detecting full thickness tears.[50]

A 2015 meta-analysis by Roy et al. found no statistically significant difference in the sensitivity or specificity of MRI, MR arthrogram, and ultrasound in the detection of rotator cuff tears. For ultrasound, based on 25 studies and 2774 shoulders, the sensitivity was 91% and specificity was 86%. For MRI, based on 21 studies and 1575 shoulders, sensitivity and specificity were both 90%. For MR arthrogram, based on 14 studies and 979 shoulders, the sensitivity and specificity were both 90%.[47]

Tendon injuries-foot and ankle

Advanced imaging is considered medically necessary when **BOTH** of the following criteria are met:

- Radiographs are nondiagnostic (Adult only)
- Patient has completed a course of physician supervised conservative treatment for the current episode and has not shown substantial improvement on clinical reevaluation

IMAGING STUDY

- MRI lower extremity

Tendon rupture – biceps or triceps

Advanced imaging is considered medically necessary when the results of imaging are essential to establish a diagnosis and/or direct management.

IMAGING STUDY

- MRI upper extremity joint

Tendon rupture – foot and ankle

Advanced imaging is considered medically necessary in the following scenario:

- Preoperative evaluation and **ANY** of the following:
  - Severe muscle weakness from the involved tendon
  - Nondiagnostic X-ray for bone avulsion
  - Nondiagnostic ultrasound evaluation

IMAGING STUDY

- MRI lower extremity

Triangular fibrocartilage complex tear

Advanced imaging is considered medically necessary when the results of imaging are essential to establish a diagnosis and/or direct management.

IMAGING STUDY

- MRI upper extremity joint
- CT or MR arthrogram

Rationale

In comparing CT arthrography and MRI (without arthrography), dorsal segment tears were only detected with CT arthrography. For palmar tears, the sensitivity and specificity of CT arthrography were 100% and 77%, respectively, compared to 60% sensitivity and 77% specificity for MRI. For central segment tears, the sensitivity and specificity of CT arthrography were 86% and 50%, respectively, compared to 79% sensitivity and 25% specificity for MRI. In addition, inter-observer agreement was better for CT arthrography (k = 0.37-0.78) compared to MRI (k = -0.33–0.10).[51]

MRI is preferable to CT for evaluation of internal derangements of the joints and related tendinous, ligamentous, and cartilaginous structures. However, both MR arthrography and CT arthrography are appropriate. In the absence of arthrography, CT should only be used for this indication when there is a contraindication to MRI.

Ulnar collateral ligament tear (elbow or thumb)

Ulnar collateral ligament tear at the thumb is also known as gamekeeper's thumb

Advanced imaging is considered medically necessary when the results of imaging are essential to establish a diagnosis and/or direct management.

IMAGING STUDY

- MRI upper extremity joint

Ligament and tendon injuries not listed elsewhere

Advanced imaging is considered medically necessary in the following scenario:

- The diagnosis is supported by the history and physical exam and there has been no substantial improvement on clinical reevaluation following a trial of conservative management

IMAGING STUDY

- MRI upper extremity joint

Miscellaneous Joint Conditions

Avascular necrosis

Advanced imaging is considered medically necessary for diagnosis and management when radiographs are nondiagnostic or not sufficient to guide treatment.

IMAGING STUDY

- CT or MRI upper extremity joint
- CT or MRI lower extremity

Rationale

Avascular necrosis or osteonecrosis is a form of ischemic bone necrosis due to vascular insufficiency. In 60%-75% of cases, avascular necrosis is associated with sickle cell disease, steroid use, alcoholism, chemoradiation, or metabolic bone disease.[35] Accurate grading is important for treatment as more advanced stages tend to require surgical intervention whereas medical treatments are favored in earlier stages. When initial radiographs demonstrate avascular necrosis and additional information is needed to guide treatment, MRI without IV contrast is usually appropriate.[38] Consensus among high-quality evidence-based guidelines also suggests that additional MRI imaging for avascular necrosis is also indicated in high-risk patients when radiographs are normal or inconclusive. Bone scan or CT may be substituted when MRI is not available.[35]

Few studies have directly compared the accuracy of MRI and CT in the diagnosis of avascular necrosis, and most of these studies focus on the hip. Those findings are likely applicable to other joints as the disease process is similar. While consensus favors MRI, and MRI has the added benefit of not using ionizing radiation, CT may be more sensitive in detecting subchondral fractures than MRI (MRI had a relative sensitivity of 38% compared to CT for subchondral fracture detection).[52]

Chondromalacia patella

Advanced imaging is considered medically necessary when **BOTH** of the following criteria are met:

- Radiographs are nondiagnostic
- Patient has completed a minimum of 4 consecutive weeks of physician-supervised conservative treatment for the current episode and has not shown substantial improvement on clinical reevaluation

IMAGING STUDY

- MRI lower extremity
- CT may be utilized when MRI contraindicated

Hemarthrosis

Advanced imaging is considered medically necessary following arthrocentesis (except where contraindicated) when imaging is required to guide management.

IMAGING STUDY

- CT or MRI upper extremity joint
- CT or MRI lower extremity

Rationale

Both CT and MRI may be useful in the evaluation of hemarthrosis. In the setting of trauma, CT may be useful to detect an underlying fracture. Both of these modalities can be useful in evaluating the extent of hemophilic pseudotumor. To evaluate changes of hemophilic arthropathy in early stages of the disease, when treatment may be most beneficial, MRI is preferable.[53]

Intra-articular loose body

Advanced imaging is considered medically necessary for diagnosis and management when radiographs are nondiagnostic or not sufficient to guide treatment.

IMAGING STUDY

- CT or MRI upper extremity joint
- CT or MRI lower extremity
- CT or MR arthrogram

Rationale

Both CT arthrography and MRI showed excellent sensitivity (92%-100%) but lower specificity (15%-77%) for detecting posteriorly located loose bodies in the elbow. Neither MRI nor CT arthrography showed adequate sensitivity (46%-91%) or specificity (13%-73%) for evaluating anterior loose bodies. Overall, the sensitivity (80%-100%) and specificity (20%-70%) of MRI and CT arthrography were similar to those of radiography, which had a sensitivity of 84% and specificity of 71%.[54]

In both primary and secondary synovial chondromatosis, radiographs reveal multiple intraarticular calcifications. They tend to be more numerous and more uniform in size, shape, and distribution in primary synovial chondromatosis. CT is the optimal modality to characterize these loose bodies. The appearance of the loose bodies is more variable on MRI, with differences depending on the degree of calcification. However, MRI delineates the extent of disease well.[55]

Legg-Calve-Perthes disease (Pediatric only)

Refers to osteonecrosis of bony epiphysis in femoral heads, usually in patients age 4 to 10

Advanced imaging is considered medically necessary for diagnosis and management when radiographs are nondiagnostic or not sufficient to guide treatment.

IMAGING STUDY

- MRI lower extremity
- CT lower extremity when MRI contraindicated

Lipohemarthrosis (Pediatric only)

Advanced imaging is considered medically when the results of imaging are essential to establish a diagnosis and/or direct management.

IMAGING STUDY

- MRI lower extremity
- CT lower extremity when MRI contraindicated

Osteochondral lesion (including osteochondritis dissecans)

Advanced imaging is considered medically necessary when the results of imaging are essential to establish a diagnosis and/or direct management.

IMAGING STUDY

- MRI upper extremity joint
- MRI lower extremity
- MR or CT arthrogram
- CT upper extremity or lower extremity when MRI contraindicated

Rationale

MR arthrography is reportedly more accurate than standard MRI, both for the detection of loose bodies and for determining the stability of osteochondral lesions. When direct arthrography is done, a lesion is considered to be unstable if there is insinuation of contrast between the lesion and its parent bone.[56]

Slipped capital femoral epiphysis (Pediatric only)

Note: Atraumatic fracture through the physeal plate is typically seen in overweight teenagers

Advanced imaging is considered medically necessary for diagnosis and management when radiographs are nondiagnostic or not sufficient to guide treatment.

IMAGING STUDY

- MRI lower extremity
- CT lower extremity when MRI contraindicated

Neurogenic Conditions

Brachial plexopathy

Advanced imaging is considered medically necessary when the results of imaging are essential to establish a diagnosis and/or direct management.

IMAGING STUDY

- MRI upper extremity non-joint
- CT upper extremity when MRI contraindicated

Entrapment neuropathy

Advanced imaging is considered medically necessary when **ALL** of the following criteria are met:

- The diagnosis is confirmed by electromyography
- A trial of conservative therapy has been provided
- Imaging is required to direct treatment

IMAGING STUDY

- MRI upper extremity joint
- CT upper extremity when MRI contraindicated

Neuropathic osteoarthropathy (Charcot joint) (Adult only)

Advanced imaging is considered medically necessary for diagnosis and management when radiographs are nondiagnostic or not sufficient to guide treatment.

IMAGING STUDY

- CT or MRI upper extremity joint
- CT or MRI lower extremity

Rationale

The early radiographic findings are similar to those of osteoarthritis. In more advanced disease, additional changes include subluxation, subchondral bone loss or fragmentation, sclerosis, osteophytosis, and intraarticular bone fragments.[58]

The decision to perform CT or MRI is dependent upon the specific clinical concerns. For evaluation of subluxation and cortical or subcortical bone, CT may be preferable. If there is concern for underlying infection, MRI may be preferred.

Tarsal tunnel

Advanced imaging is considered medically necessary in the following scenario:

- Following confirmation by electromyography and nerve conduction study, when patient fails to show substantial improvement following 4 weeks of physician-supervised conservative therapy

IMAGING STUDY

- MRI lower extremity
- CT lower extremity when MRI contraindicated

Pain, unspecified

Applies to conditions not otherwise referenced in the Extremity guidelines

Non-specific hip pain (Pediatric only)

Advanced imaging is considered medically necessary in **EITHER** of the following scenarios:

- Evaluation of a limp in patients under 5 years of age, following nondiagnostic radiographs and ultrasound
- In patients age 5 or older, following nondiagnostic radiographs and a lack of significant improvement following trial of conservative therapy

IMAGING STUDY

- MRI lower extremity
- CT lower extremity when MRI contraindicated

Persistent lower extremity pain

Excludes knee joint.

Advanced imaging is considered medically necessary when **BOTH** of the following criteria are met:

- Radiographs are nondiagnostic
- Patient has completed a course of physician supervised conservative treatment for the current episode and has not shown substantial improvement on clinical reevaluation

IMAGING STUDY

- MRI lower extremity
- CT lower extremity when MRI contraindicated

Upper extremity pain, unspecified

Advanced imaging is considered medically necessary when **ALL** of the following requirements are met:

- Focused history and physical exam have not provided a likely diagnosis
- Radiographs have been performed and are not sufficient to establish a diagnosis
- There has been no substantial improvement on clinical reevaluation following a 6-week trial of conservative management.

Note: This requirement may be waived when significant objective muscle weakness across a joint has been demonstrated.

IMAGING STUDY

- CT or MRI upper extremity joint or non-joint

Rationale

A focused history and physical may lead to a diagnosis in about 70% of cases. When imaging is needed, radiographs are the first-line modality and should include postero-anterior and lateral views. If the diagnosis remains in doubt after radiography, further imaging is indicated. The appropriate study depends upon the primary clinical concerns, among advanced imaging modalities, CT can evaluate for fractures and articular subluxations that are radiographically occult, and MRI is preferred for evaluation of soft tissue injuries.[59]

Perioperative Imaging, unspecified

Perioperative Imaging, unspecified

Includes conditions not otherwise referenced in the Extremity guidelines.

Advanced imaging is considered medically necessary when imaging is required to guide management.

Exclusion: This indication does not apply to preoperative evaluation for primary total knee arthroplasty for osteoarthritis.

IMAGING STUDY

- CT or MRI dependent on scenario

Rationale

Studies evaluating patient-specific instrumentation have found limited evidence for improved mechanical alignment relative to conventional total knee replacement. A large systematic review of 8 randomized control trials and 8 cohort studies concluded that patient-specific instrumentation does not improve the accuracy of alignment of the components in total knee replacement compared with conventional instrumentation.[60] A separate systematic review looked at 2739 knees and found more misalignment in the patient-specific instrumentation group than in the conventional total knee replacement group and no difference in rotational alignment.[61]

Exclusions

The following indications generally do not require advanced imaging.

Limb malalignment, preoperative

Radiographs or CT scanogram are usually sufficient.

Note: CT scanogram (without cross-sectional imaging) is not part of AIM review.

Osgood-Schlatter

Clinical diagnosis occasionally suggested by radiography.

Osteoarthritis

Osteoarthritis is a clinical diagnosis, and imaging is not required in patients with typical presentation of osteoarthritis. In adults over age 40 with usage-related knee pain, only short-lived morning stiffness, functional limitation, and one or more typical examination findings (crepitus, restricted movement, bony enlargement), a confident diagnosis of knee osteoarthritis can be made without a radiographic examination. If imaging is needed, conventional (plain) radiography should be used before other modalities.[62,63] Radiographs (anterior and posterior, lateral, and intercondylar views with additional 45-degree oblique views if signs and symptoms do not correlate with standard views) are usually indicated if symptoms are unrelieved by 4 weeks of conservative care.[35] Consistent recommendations among high-quality evidence-based guidelines suggest that when imaging is required, weight-bearing radiography is sufficient to evaluate clinically significant osteoarthritis.[35,63] Individual radiographic features including joint space narrowing, osteophytes, Kellgren and Lawrence score, subchondral bone sclerosis, and subchondral cysts have individual probability of radiographic detection of knee osteoarthritis of 24%-32%. However, a composite of joint space narrowing, osteophyte, sclerosis, and cysts increases the probability from 24% up to 89%.[64] In addition, radiographic scores for evaluating osteoarthritis such as KS, OARSI, JSN are highly correlated with osteoarthritis seen on MRI.[65] Radiographs can also serve to exclude mimics of osteoarthritis including fracture, osteonecrosis, and malignancy.[63] In a 2015 systematic review that included 6 studies and 970 patients, the authors concluded that standing knee radiographs, especially the 45-degree flexion PA view, are sensitive for detecting severe osteoarthritis of the tibiofemoral joint (6% to 86%).[66] MRI is more sensitive for bone marrow edema, but the significance of marrow edema in the context of osteoarthritis management is uncertain. These lesions may reflect increased water, blood, or other fluid inside bone and may contribute to the causal pathway of pain, but should be considered incidental findings and should not be used to determine a final diagnosis or make decisions regarding surgery.[67]

Surgical treatment for osteoarthritis is usually total knee arthroplasty and radiography is used in the selection process.[63] A literature review by the U.S. Department of Veterans Affairs did not demonstrate any evidence of improved outcomes in osteoarthritis patients who underwent an MRI as part of their evaluation. Some studies have shown utility of MRI for identifying articular cartilage degeneration. However, given the heterogeneity of utilized MRI sequences and findings, as well as the lack of studies evaluating MRI for monitoring disease progression, the utility of MRI for guiding diagnosis and treatment is not currently supported.[63]

Patellar tendinitis

Clinical diagnosis.

Sinding-Larsen-Johansson

Clinical diagnosis suggested by radiography.

Transient (toxic) synovitis

Self-limiting condition. Ultrasound may help to confirm the presence of a joint effusion.

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Codes

The following codes may be applicable to extremity imaging and may not be all inclusive.

CPT

73200	CT upper extremity, without contrast
73201	CT upper extremity, with contrast
73202	CT upper extremity, without contrast, followed by re-imaging with contrast
73218	MRI upper extremity non-joint, without contrast
73219	MRI upper extremity non-joint, with contrast
73220	MRI upper extremity non-joint, without contrast, followed by re-imaging with contrast
73221	MRI upper extremity any joint, without contrast
73222	MRI upper extremity any joint, with contrast
73223	MRI upper extremity any joint, without contrast, followed by re-imaging with contrast
73700	CT lower extremity, without contrast
73701	CT lower extremity, with contrast
73702	CT lower extremity, without contrast, followed by re-imaging with contrast
73718	MRI lower extremity non-joint, without contrast
73719	MRI lower extremity non-joint, with contrast
73720	MRI lower extremity non-joint, without contrast, followed by re-imaging with contrast
73721	MRI lower extremity any joint, without contrast
73722	MRI lower extremity any joint, with contrast
73723	MRI lower extremity any joint, without contrast, followed by re-imaging with contrast
78811	PET imaging, limited area
78812	PET imaging, skull to mid-thigh
78813	PET imaging, whole body
78814	PET imaging, with concurrently acquired CT for attenuation correction and anatomic localization; limited area
78815	PET imaging, with concurrently acquired CT for attenuation correction and anatomic localization; skull base to mid-thigh
78816	PET imaging, with concurrently acquired CT for attenuation correction and anatomic localization; whole body

HCPCS

None

ICD-10 Diagnosis

Refer to the ICD-10 CM manual

History

Status	Date	Action
Restructured	01/01/2019	Advanced Imaging guidelines redesigned and reorganized to a condition-based structure
Reviewed	09/22/2017	Last Independent Multispecialty Physician Panel review
Revised	07/16/2016	Independent Multispecialty Physician Panel revision
Created	03/30/2005	Original effective date

