

# ACR Appropriateness Criteria® Chronic Ankle Pain: Update 2025

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## Abstract

Chronic ankle pain is common and can be caused by a variety of osseous or soft tissue abnormalities, either alone or in combination. Common etiologies of chronic ankle pain include osteoarthritis, impingement, osteochondral lesion, tarsal coalition, instability, or a chronic sequela of ligament or tendon injury. This document summarizes the current evidence for the appropriate use of specific imaging modalities for each of these clinical scenarios.

The American College of Radiology Appropriateness Criteria are evidence-based guidelines for specific clinical conditions that are reviewed annually by a multidisciplinary expert panel. The guideline development and revision process support the systematic analysis of the medical literature from peer reviewed journals. Established methodology principles such as Grading of Recommendations Assessment, Development, and Evaluation or GRADE are adapted to evaluate the evidence. The RAND/UCLA Appropriateness Method User Manual provides the methodology to determine the appropriateness of imaging and treatment procedures for specific clinical scenarios. In those instances where peer reviewed literature is lacking or equivocal, experts may be the primary evidentiary source available to formulate a recommendation.

**Key Words:** Appropriateness Criteria, Appropriate Use Criteria, AUC, ankle, chronic pain, imaging, osteoarthritis, osteochondral lesion, tarsal coalition

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**Disclaimer:** 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.

**Variant 1.** Adult. Chronic ankle pain. Initial imaging.

| Procedure                              | Appropriateness Category | Relative Radiation Level |
|----------------------------------------|--------------------------|--------------------------|
| Radiography ankle                      | Usually Appropriate      | ☢                        |
| US ankle                               | Usually Not Appropriate  | ○                        |
| MRI ankle without and with IV contrast | Usually Not Appropriate  | ○                        |
| MRI ankle without IV contrast          | Usually Not Appropriate  | ○                        |
| CT ankle with IV contrast              | Usually Not Appropriate  | ☢                        |
| CT ankle without and with IV contrast  | Usually Not Appropriate  | ☢                        |
| CT ankle without IV contrast           | Usually Not Appropriate  | ☢                        |
| Bone scan ankle                        | Usually Not Appropriate  | ☢☢☢                      |

**Variant 2.** Adult. Chronic ankle pain. Suspected osteoarthritis or early impingement. Radiographs performed. Next imaging study.

| Procedure                              | Appropriateness Category | Relative Radiation Level |
|----------------------------------------|--------------------------|--------------------------|
| MRI ankle without IV contrast          | Usually Appropriate      | ○                        |
| CT ankle without IV contrast           | Usually Appropriate      | ☢                        |
| US ankle                               | Usually Not Appropriate  | ○                        |
| MR arthrography ankle                  | Usually Not Appropriate  | ○                        |
| MRI ankle without and with IV contrast | Usually Not Appropriate  | ○                        |
| CT ankle with IV contrast              | Usually Not Appropriate  | ☢                        |
| CT ankle without and with IV contrast  | Usually Not Appropriate  | ☢                        |
| CT arthrography ankle                  | Usually Not Appropriate  | ☢                        |
| Bone scan ankle                        | Usually Not Appropriate  | ☢☢☢                      |

**Variant 3.** Adult. Chronic ankle pain. Suspected osteochondral lesion. Radiographs performed. Next imaging study.

| Procedure                              | Appropriateness Category | Relative Radiation Level |
|----------------------------------------|--------------------------|--------------------------|
| MRI ankle without IV contrast          | Usually Appropriate      | ○                        |
| CT ankle without IV contrast           | Usually Appropriate      | ☢                        |
| CT arthrography ankle                  | May Be Appropriate       | ☢                        |
| US ankle                               | Usually Not Appropriate  | ○                        |
| MR arthrography ankle                  | Usually Not Appropriate  | ○                        |
| MRI ankle without and with IV contrast | Usually Not Appropriate  | ○                        |
| CT ankle with IV contrast              | Usually Not Appropriate  | ☢                        |
| CT ankle without and with IV contrast  | Usually Not Appropriate  | ☢                        |
| Bone scan ankle                        | Usually Not Appropriate  | ☢☢☢                      |

**Variant 4.** Adult. Chronic ankle pain. Suspected tarsal coalition. Radiographs performed. Next imaging study.

| Procedure                              | Appropriateness Category | Relative Radiation Level |
|----------------------------------------|--------------------------|--------------------------|
| MRI ankle without IV contrast          | Usually Appropriate      | ○                        |
| CT ankle without IV contrast           | Usually Appropriate      | ⦿                        |
| US ankle                               | Usually Not Appropriate  | ○                        |
| MR arthrography ankle                  | Usually Not Appropriate  | ○                        |
| MRI ankle without and with IV contrast | Usually Not Appropriate  | ○                        |
| CT ankle with IV contrast              | Usually Not Appropriate  | ⦿                        |
| CT ankle without and with IV contrast  | Usually Not Appropriate  | ⦿                        |
| CT arthrography ankle                  | Usually Not Appropriate  | ⦿                        |
| Bone scan ankle                        | Usually Not Appropriate  | ⦿⦿⦿                      |

**Variant 5.** Adult. Chronic ankle pain. Suspected instability or ligamentous injury. Radiographs performed. Next imaging study.

| Procedure                              | Appropriateness Category | Relative Radiation Level |
|----------------------------------------|--------------------------|--------------------------|
| MRI ankle without IV contrast          | Usually Appropriate      | ○                        |
| US ankle                               | May Be Appropriate       | ○                        |
| Radiography ankle stress views         | May Be Appropriate       | ⦿                        |
| MR arthrography ankle                  | Usually Not Appropriate  | ○                        |
| MRI ankle without and with IV contrast | Usually Not Appropriate  | ○                        |
| CT ankle with IV contrast              | Usually Not Appropriate  | ⦿                        |
| CT ankle without and with IV contrast  | Usually Not Appropriate  | ⦿                        |
| CT ankle without IV contrast           | Usually Not Appropriate  | ⦿                        |
| CT arthrography ankle                  | Usually Not Appropriate  | ⦿                        |
| Bone scan ankle                        | Usually Not Appropriate  | ⦿⦿⦿                      |

**Variant 6.** Adult. Chronic ankle pain. Suspected tendon pathology. Radiographs performed. Next imaging study.

| Procedure                              | Appropriateness Category | Relative Radiation Level |
|----------------------------------------|--------------------------|--------------------------|
| US ankle                               | Usually Appropriate      | ○                        |
| MRI ankle without IV contrast          | Usually Appropriate      | ○                        |
| MR arthrography ankle                  | Usually Not Appropriate  | ○                        |
| MRI ankle without and with IV contrast | Usually Not Appropriate  | ○                        |
| CT ankle with IV contrast              | Usually Not Appropriate  | ⦿                        |
| CT ankle without and with IV contrast  | Usually Not Appropriate  | ⦿                        |
| CT ankle without IV contrast           | Usually Not Appropriate  | ⦿                        |
| CT arthrography ankle                  | Usually Not Appropriate  | ⦿                        |
| Bone scan ankle                        | Usually Not Appropriate  | ⦿⦿⦿                      |

**Table 1.** Appropriateness category names and definitions

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

**Table 2.** Relative radiation level designations

| RRL   | Adult Effective Dose Estimate Range (mSv) | Pediatric Effective Dose Estimate Range (mSv) |
|-------|-------------------------------------------|-----------------------------------------------|
| 0     | 0                                         | 0                                             |
| ☢     | <0.1                                      | <0.03                                         |
| ☢☢    | 0.1-1                                     | 0.03-0.3                                      |
| ☢☢☢   | 1-10                                      | 0.3-3                                         |
| ☢☢☢☢  | 10-30                                     | 3-10                                          |
| ☢☢☢☢☢ | 30-100                                    | 10-30                                         |

Note: Relative radiation level (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 "varies."

## SUMMARY OF LITERATURE REVIEW

### Introduction/Background

Ankle pain is common and considered chronic when symptoms persist for >6 weeks. The prevalence of chronic ankle pain ranges from 9% to 15% in the general adult population [1]. Chronic ankle pain can be caused by a variety of osseous or soft tissue abnormalities, either alone or in combination. Common etiologies of chronic ankle pain include osteoarthritis [2,3], impingement, osteochondral lesion, tarsal coalition, instability, or a chronic sequela of ligament or tendon injury.

In general, osteoarthritis occurs as a result of articular cartilage damage from repetitive microtrauma [2]. Although ankle osteoarthritis is less common than knee and hip osteoarthritis, studies have suggested that ankle osteoarthritis may be more common than previously thought [4]. Unlike the hip and knee, the underlying etiology of ankle osteoarthritis is often a chronic outcome of prior ankle injury, though other factors such as age and body mass index are also significantly associated [4].

Hindfoot impingement can be secondary to trauma or chronic degenerative changes and can occur in multiple directions about the tibiotalar joint (anteromedial, anterior, anterolateral, posteromedial, and posterior impingement are all possibilities) [5]. Talar osteochondral lesion can be a source of chronic ankle pain and it is most commonly found at the posteromedial or anterolateral aspect of the talar dome [6]. Talocalcaneal (subtalar) coalition and calcaneonavicular coalition are the two most common sites of tarsal coalition and can cause chronic ankle pain [7]. The incidence of chronic ankle instability as a sequela of acute ankle sprain has been reported as ranging between 5% and 70% [8]. There are a multitude of ligaments and tendons about the ankle that can result in chronic ankle pain when injured. Among these, chronic ankle pain most commonly results from injury to the lateral ankle ligaments or the peroneal tendons [9,10].

This document describes etiologies of chronic ankle pain in the absence of tumor, infection, or inflammatory arthritis. For the imaging evaluation of inflammatory

arthritis, please refer to the ACR Appropriateness Criteria® topic on “Chronic Extremity Joint Pain-Suspected Inflammatory Arthritis, Crystalline Arthritis, or Erosive Osteoarthritis” [11]. For the imaging evaluation of bone or soft tissue tumor, please refer to the ACR Appropriateness Criteria® topics on “Suspected Primary Bone Tumors” [12] and “Soft Tissue Masses” [13]. If there is concern for osteonecrosis, please refer to the ACR Appropriateness Criteria® topic on “Osteonecrosis” [14]. If there is concern for septic arthritis or osteomyelitis, please refer to the ACR Appropriateness Criteria® topic on “Suspected Osteomyelitis, Septic Arthritis, or Soft Tissue Infection (Excluding Spine and Diabetic Foot)” [15].

## Special Imaging Considerations

Weightbearing radiographs have improved accuracy in the evaluation of hindfoot alignment abnormalities, which can contribute to chronic ankle pain, and should usually be obtained unless contraindicated. Additionally, there may be co-existing pain generators in the midfoot and hindfoot that present primarily as chronic ankle pain. Thus, it may be helpful to obtain weightbearing foot radiographs in addition to weightbearing ankle radiographs. For further description of chronic foot pain, please refer to the separate ACR Appropriateness Criteria® topic on “Chronic Foot Pain” [16].

## Initial Imaging Definition

Initial imaging is defined as imaging at the beginning of the care episode for the medical condition defined by the variant. More than one procedure can be considered usually appropriate in the initial imaging evaluation when:

- There are procedures that are equivalent alternatives (ie, only one procedure will be ordered to provide the clinical information to effectively manage the patient’s care)

OR

- There are complementary procedures (ie, more than one procedure is ordered as a set or simultaneously wherein each procedure provides unique clinical information to effectively manage the patient’s care).

## DISCUSSION OF PROCEDURES BY VARIANT

### Variant 1: Adult. Chronic ankle pain. Initial imaging

Initial imaging of chronic ankle pain is used to detect injuries including fractures and malalignment, and to evaluate for arthritis. This imaging information helps to inform the underlying etiology of chronic ankle pain, which will help in tailoring the treatment plan earlier and improve patient

outcomes long term. The benefit to the patient is early detection of the underlying pain source, reduction in treatment delays, and earlier etiology-specific treatment plans that can decrease overall recovery time.

**Radiography Ankle.** Radiographs are effective as the initial imaging study in the evaluation of chronic ankle pain. Radiographs can reveal osteoarthritis, calcified or ossified intraarticular bodies, osteochondral lesion, and chronic fracture or other evidence of prior injury. The prevalence of radiographic osteoarthritis in patients with chronic ankle complaints can be as high as 24.7% [17]. Stress radiographs can be used to evaluate for ankle instability [18]. Osteochondral lesions are most common in the talus and approximately 50% to 70% of these lesions can be seen on routine initial ankle radiographs [19]. Radiographs can also identify synovial osteochondromatosis and erosions from chronic synovitis.

**US Ankle.** There is no evidence to support the use of ultrasound (US) ankle as the first study for the evaluation of chronic ankle pain.

**MRI Ankle Without and With IV Contrast.** There is no evidence to support the use of MRI ankle without and with intravenous (IV) contrast as the first study for the evaluation of chronic ankle pain.

**MRI Ankle Without IV Contrast.** There is no evidence to support the use of MRI ankle without IV contrast as the first study for the evaluation of chronic ankle pain.

**CT Ankle With IV Contrast.** There is no evidence to support the use of CT ankle with IV contrast as the first study for the evaluation of chronic ankle pain.

**CT Ankle Without and With IV Contrast.** There is no evidence to support the use of CT ankle without and with IV contrast as the first study for the evaluation of chronic ankle pain.

**CT Ankle Without IV Contrast.** There is no evidence to support the use of CT ankle without IV contrast as the first study for the evaluation of chronic ankle pain.

**Bone Scan Ankle.** There is no evidence to support the use of bone scan ankle as the first study for the evaluation of chronic ankle pain.

### Variant 2: Adult. Chronic ankle pain. Suspected osteoarthritis or early impingement. Radiographs performed. Next imaging study

The goal of imaging is to further evaluate osteoarthritis or early impingement after radiographs have been performed.

Further imaging can help to evaluate the degree and location of osteoarthritis, in order to determine if it accounts for the patient's pain as well as to help guide appropriate treatment and management.

Imaging can also be used to diagnose ankle impingement syndromes, which can occur in the anterolateral, anterior, anteromedial, posteromedial, and posterior aspects of the tibiotalar joint [20-29]. For example, posterior ankle impingement is commonly seen in ballet dancers where repetitive or acute forced plantar flexion of the foot cause the talus and surrounding soft tissues to be compressed between the tibia and the calcaneus, resulting in bone and/or soft tissue lesions [23].

**MRI Ankle Without IV Contrast.** Several studies support the use of noncontrast MRI as the next imaging study to evaluate for suspected osteoarthritis or early impingement. Specifically, MRI excels in evaluating cartilage integrity, bone marrow, and the associated soft tissues. One study demonstrates a reproducible method for grading the severity of osteoarthritis using a scoring system for the three MRI features of osteoarthritis (cartilage integrity, bone marrow edema, and subchondral cysts) [30]. MRI is also useful in evaluating patients with an uncertain clinical diagnosis, by excluding other pathologic entities that may mimic or coexist with impingement syndromes as well as assisting in surgical planning.

Studies on the accuracy of MRI in diagnosing anterolateral impingement syndrome have drawn varying conclusions, which may be related to varying MRI magnet strengths and inconsistent protocols [31]. Comparing MRI with surgical findings, a study showed MRI sensitivities between 75% and 83% and specificity between 75% and 100% for the diagnosis of anterolateral impingement [31]. However, MRI features suggestive of impingement can be present in asymptomatic individuals, and an accurate diagnosis requires careful correlation of imaging features with clinical findings [32].

**CT Ankle Without IV Contrast.** Although MRI provides superior depiction of the cartilage, noncontrast CT can be a useful complementary examination in the evaluation of osteoarthritis or early impingement beyond what the initial radiographs show, including improved visualization of osteophytes and subchondral cysts [5]. Additionally, CT allows for better localization of osteophytes, aids in preoperative planning [33], and detects intraarticular bodies that may be associated with impingement [34]. One study of patients with anterior tibiotalar impingement demonstrated the usefulness of CT in depicting the location, size, and morphology of osteophytes to better assist in surgical planning and excision of symptomatic lesions [35].

CT can also be useful for depiction of osseous causes of impingement, such as chronic osseous productive changes in the region of os trigonum or fracture of the lateral tubercle of the talus [23].

Weightbearing CT has been shown to be helpful in the evaluation of hindfoot alignment in patients with ankle osteoarthritis [36]. One retrospective study showed that weightbearing CT is highly reliable for assessing hindfoot alignment, and when compared to hindfoot alignment view radiographs, hindfoot alignment view radiographs overestimated 3.9 mm of varus alignment when compared with weightbearing CT [37].

**US Ankle.** There is insufficient evidence to support use of US ankle as the next imaging study for the evaluation of suspected osteoarthritis or early impingement.

When comparing US and arthroscopic findings in the evaluation of anterolateral ankle impingement, a study found that US had a sensitivity and specificity of 77% and 57%, respectively [38]. In another study, US also showed abnormal soft tissues in anterolateral impingement, with a reported accuracy of 100% [39], noting that this study had a relatively small sample size of 17 patients.

**MR Arthrography Ankle.** There is insufficient evidence to support the use of MR arthrography ankle as the next imaging study in the evaluation of suspected osteoarthritis or early impingement.

MR arthrography has been shown to be accurate in demonstrating soft tissue scarring in the anterolateral recess [40], with one study showing 100% accuracy for the evaluation of soft tissue abnormality in patients with suspected clinical anterolateral impingement [24]. For anterior and medial ankle impingement syndromes, MR arthrography has also been shown to be useful in assessing for soft tissue abnormalities that can lead to impingement [40]. However, for posterior ankle impingement MR arthrography offers few advantages over conventional MRI [40].

**MRI Ankle Without and With IV Contrast.** There is insufficient evidence to support the use of MRI ankle without and with IV contrast as the next study in the evaluation of suspected osteoarthritis or early impingement.

Contrast-enhanced, fat-suppressed, 3-D, fast gradient-recalled acquisition in steady state with radiofrequency spoiling MRI was shown in a study to have an accuracy of 94.4%, sensitivity of 76.5%, and specificity of 96.9% in the evaluation for soft tissue impingement [41].

**CT Ankle With IV Contrast.** There is no evidence to support the use of CT ankle with IV contrast for the evaluation of osteoarthritis or early impingement.

**CT Ankle Without and With IV Contrast.** There is no evidence to support the use of CT ankle with and without IV contrast for the evaluation of osteoarthritis or early impingement.

**CT Arthrography Ankle.** There is insufficient evidence to support the use of CT arthrography ankle as the next imaging study in the evaluation of suspected osteoarthritis or early impingement.

In one study evaluating for anterolateral ankle impingement, CT arthrography was shown to have a sensitivity and specificity of 97% and 71%, respectively [38].

**Bone Scan Ankle.** There is no evidence to support the use of bone scan ankle for the evaluation of osteoarthritis or early impingement.

### Variant 3: Adult. Chronic ankle pain. Suspected osteochondral lesion. Radiographs performed. Next imaging study

The goal of imaging is to further evaluate suspected osteochondral lesion. Osteochondral lesions may involve the talar dome, or less commonly, the tibial plafond or navicular [42–44]. If an osteochondral injury is associated with fracture, osseous cyst, or osteochondral lesion, radiography may show the abnormality, but radiography often fails to show the extent of the osteochondral injury and will be initially negative if the injury is limited to the articular hyaline cartilage. One multimodality study [44] showed that 41% of osteochondral abnormalities of the ankle were missed on radiography.

**MRI Ankle Without IV Contrast.** Noncontrast MRI enables accurate detection and characterization of osteochondral lesions via detailed evaluation of the hyaline cartilage as well as bone marrow edema or subchondral cystic changes associated with an osteochondral lesion. One multimodality prospective study demonstrated sensitivity and specificity of 96% for noncontrast MRI in diagnosing osteochondral lesions of the talus [44]. Beyond simple osteochondral lesion identification, MRI can also be used to grade these lesions preoperatively [45]. In the same study, MRI performed similarly to arthroscopy in the evaluation of osteochondral lesions of the ankle. Despite the high sensitivity of MRI, CT showed a higher specificity (99%) when compared with MRI (96%) [44].

One study reported an accuracy of 81% for noncontrast MRI in osteochondral lesion grading when using arthroscopy as the reference standard [46]. In another retrospective study of 54 patients, Mintz et al [47] reported 95% sensitivity, 100% specificity, 100% positive predictive value, and 88% negative predictive value for noncontrast MRI in identifying focal osteochondral lesion when using

arthroscopy as the reference standard. This study also reported accuracy of 83% for noncontrast MRI in the grading of osteochondral lesions with regard to lesion stability and possible displaced fragment.

**CT Ankle Without IV Contrast.** CT ankle without IV contrast can be used to evaluate for radiographically occult osteochondral lesions in patients with persistent pain despite conservative measures [19]. In one multimodality study, noncontrast CT demonstrated sensitivity of 81% (versus 96% for noncontrast MRI) in the detection of osteochondral lesions. The reported specificity for osteochondral lesion detection was high for both modalities in this study (99% for CT and 96% for MRI) [44]. Specifically, CT is optimal for assessing the subchondral bone plate.

**CT Arthrography Ankle.** The introduction of contrast into the tibiotalar joint prior to CT will outline a cartilage surface defect, assisting in lesion detection and assessment for instability [6]. One retrospective study showed that CT arthrography had improved detection and visualization of cartilage defects when compared to conventional MRI with higher interobserver agreement in CT arthrography [48]. Another study found that CT arthrography was statistically better in detecting chondral flapping or subchondral exposure of osteochondral lesions in the talus when compared to conventional MRI with an accuracy of 88.6% for CT arthrography compared to an accuracy of 57.1% for conventional MRI [49].

**US Ankle.** There is no evidence to support the use of US ankle for the evaluation of osteochondral lesions in the ankle.

**MR Arthrography Ankle.** There is no evidence to support MR arthrography as the next imaging study in the evaluation of suspected osteochondral lesion.

When assessing for talar cartilaginous lesions, one study found an accuracy of 76% to 88% using MR arthrography as compared with 90% to 92% for CT arthrography [50]. Multiple other studies have demonstrated very high sensitivity and specificity of noncontrast MRI in osteochondral lesion detection without the need for intraarticular contrast [44,46].

**MRI Ankle Without and With IV Contrast.** There is no evidence to support the use of MRI ankle without and with IV contrast in the evaluation of osteochondral lesions in the ankle.

**CT Ankle With IV Contrast.** There is no evidence to support the use of CT ankle with IV contrast in the evaluation of osteochondral lesions in the ankle.

**CT Ankle Without and With IV Contrast.** There is no evidence to support the use of CT ankle without and with

IV contrast in the evaluation of osteochondral lesions in the ankle.

**Bone Scan Ankle.** There is no evidence to support the use of bone scan ankle as the next imaging study for suspected osteochondral lesions in the ankle.

In a retrospective study of 12 patients who had both MRI and single-photon emission computed tomography (SPECT)/CT of the ankle prior to arthroscopic treatment of osteochondral lesion, the addition of SPECT/CT helped to identify the exact location of the active defect, especially in patients who had multifocal defects or revision surgeries [51].

#### Variant 4: Adult. Chronic ankle pain. Suspected tarsal coalition. Radiographs performed. Next imaging study

The goal of imaging is to further evaluate suspected tarsal coalition. Coalitions can be suspected based on radiographic findings but can be better defined and imaged with cross-sectional imaging. In particular, the size of the tarsal coalition is better seen with cross-sectional imaging, which has implications for prognosis because increasing size of the coalition is correlated with worse patient outcomes following resection [7].

**MRI Ankle Without IV Contrast.** In a retrospective study, noncontrast MRI showed a cumulative sensitivity and specificity of 95.8% and 94.3% in identifying tarsal coalitions with almost perfect interreader agreement [52]. Additionally, stress reaction across the synchondrosis is best visualized with MRI [7]. Since the presence of subtalar osteoarthritis in combination with tarsal coalition confers a worse postresection prognostic outcome, MRI allows for the evaluation of the subtalar cartilage [53]. MRI can quantify the size of the tarsal coalition, which is the main prognostic factor in postresection prognosis [7]. A blinded study of MRI and CT scans on 20 patients found that MRI was as accurate as CT scanning for detecting tarsal coalitions [54].

In addition to identifying the tarsal coalition itself, MRI is useful for assessing associated pathology, including adjacent and distant bone marrow edema, osteochondral lesion of the talar dome, joint effusion, and accessory anterolateral talar facet [52].

**CT Ankle Without IV Contrast.** CT can be used to better demonstrate tarsal coalition and assess for degenerative changes at the synchondrosis [7]. Additionally, the size of the osseous coalition can be optimally determined by CT, which has implications for prognosis following resection [7,55]. Coexisting findings of hindfoot deformity and subtalar arthritis can be seen well with CT, and if present, also correlate with postresection prognosis.

**US Ankle.** There is no evidence to support the use of US ankle for the evaluation of tarsal coalition.

**MR Arthrography Ankle.** There is no evidence to support the use of MR arthrography ankle for the evaluation of tarsal coalition.

**MRI Ankle Without and With IV Contrast.** There is no evidence to support the use of MRI ankle without and with IV contrast for the evaluation of tarsal coalition.

**CT Ankle With IV Contrast.** There is no evidence to support the use of CT ankle with IV contrast for the evaluation of tarsal coalition.

**CT Ankle Without and With IV Contrast.** There is no evidence to support the use of CT ankle without and with IV contrast for the evaluation of tarsal coalition.

**CT Arthrography Ankle.** There is no evidence to support the use of CT arthrography ankle for the evaluation of tarsal coalition.

**Bone Scan Ankle.** There is no evidence to support the use of bone scan ankle for the evaluation of tarsal coalition.

#### Variant 5: Adult. Chronic ankle pain. Suspected instability or ligamentous injury. Radiographs performed. Next imaging study

The goal of imaging is to evaluate for chronic ankle pain cause by ligamentous injury and instability after radiographs have been performed. Ligamentous injury in the setting of chronic ankle pain often involves the anterior talofibular ligament (ATFL). Clinically, the integrity of the ligament is assessed by the anterior drawer test where the extent of anterior talar displacement in the sagittal plane is measured. There is mixed reliability of the anterior drawer test [56], and therefore imaging can play a role in diagnosing ligamentous injury. In the absence of findings on routine radiography, imaging options to evaluate ligamentous integrity include stress radiography, noncontrast MRI, MR arthrography, CT arthrography, and US.

**MRI Ankle Without IV Contrast.** Noncontrast MRI demonstrated a diagnostic accuracy of 97% when compared to arthroscopic findings in the evaluation of ATFL injury. Additionally, MRI identified the exact location of the injury in 93% of the cases [57]. Comparing MRI with arthroscopy, studies have shown a range of accuracies of chronic lateral ligament tearing (either partial or complete), ranging from 77% to 92% for the ATFL and 88% to 92% for the calcaneofibular ligament [58,59]. For the evaluation of deep deltoid ligament tears, MRI is both sensitive and specific compared with arthroscopy, with reported values of 96% and 98%, respectively [60].

MRI is even more accurate when assessing the inferior tibiofibular ligaments (syndesmosis) with a reported accuracy of 100% [61]. Additionally, MRI can also demonstrate interosseous membrane tears [62]. MRI offers the advantage of evaluating for injuries associated with or mimicking lateral instability that may not be diagnosed on stress radiography, such as tenosynovitis, tendon injury, and osteochondral lesions [63]. MRI can also be useful in evaluating the ankle after lateral ligament reconstruction [64].

**US Ankle.** There is insufficient evidence to support US as the next imaging study for suspected instability or ligamentous injury, given the superior sensitivity and specificity of noncontrast MRI in this clinical setting.

In a prospective multicenter study of 157 patients [65] who had arthroscopic treatment of chronic ankle instability after one modality of preoperative imaging (49 had CT arthrography, 63 had US, and 45 had MRI), the authors reported slightly lower sensitivity and accuracy of US (61%-70% sensitivity and 67%-76% accuracy for US) versus CT arthrography (sensitivity of 86%-90% and accuracy of 82%-89% for CT arthrography) or MRI (sensitivity of 79%-85% and accuracy of 71%-80% for MRI) in the classification of ATFL integrity, when using the arthroscopy findings as the reference standard.

When evaluating for ATFL injury, another study demonstrated a diagnostic accuracy of 91% for US when using arthroscopy as the reference standard. However, the same study demonstrated a diagnostic accuracy of 97% for MRI. Moreover, US only identified the exact location of the injury in 63% of cases (versus 93% for MRI).

Another study of 56 patients with positive anterior drawer stress test who underwent both CT arthrography and US reported imaging evidence of ATFL abnormality on 71% of the CT arthrograms and 61% of the US, noting that these findings were not confirmed by arthroscopy [9]. The purpose of this study was to support US as a possible alternative to CT arthrography, noting that MRI was not included in the study. The main usefulness of US (over CT or MRI) is the capability of dynamically stressing a ligament and looking for laxity or frank separation of the injured ligament. With regard to interosseous membrane tears, a 1995 study reported sensitivity of 89% and specificity of 94.5% for US in diagnosing interosseous membrane tears that were confirmed at surgery [66].

**Radiography Ankle Stress Views.** Stress radiographs can be used to assess ankle instability [18,67], noting that some authors have questioned their accuracy [68,69]. When evaluating ATFL injury, a study demonstrated a diagnostic accuracy of 67% for stress radiography [57]. Subtalar

stress radiography using forced dorsiflexion and supination [68] or talar rotation [70] can be used to evaluate subtalar laxity.

**MR Arthrography Ankle.** There is no evidence to support the use of MR arthrography ankle as the next imaging study in the evaluation of suspected instability or ligamentous injury.

**MRI Ankle Without and With IV Contrast.** There is no evidence to support the use of MRI ankle without and with IV contrast as the next imaging study in the evaluation of suspected instability or ligamentous injury.

**CT Ankle With IV Contrast.** There is no evidence to support the use of CT ankle with IV contrast as the next imaging study in the evaluation of suspected instability or ligamentous injury.

**CT Ankle Without and With IV Contrast.** There is no evidence to support the use of CT ankle without and with IV contrast as the next imaging study in the evaluation of suspected instability or ligamentous injury.

**CT Ankle Without IV Contrast.** There is insufficient evidence to support the use of CT ankle without IV contrast as the next imaging study in the evaluation of suspected instability or ligamentous injury.

Advantages of weightbearing CT when compared to conventional imaging modalities include the ability to image the ankle during weightbearing stress, displaying the distal tibiofibular articulation in multiple dimensions and allowing comparison with the contralateral ankle [71-75].

**CT Arthrography Ankle.** There is insufficient evidence to support CT arthrography as the next imaging study to evaluate suspected instability/ligamentous injury as only a few studies of the ATFL exist and other ligaments have not been fully investigated.

In a prospective multicenter study of 157 patients [65] who had arthroscopic treatment of chronic ankle instability after one modality of preoperative imaging (49 had CT arthrography, 63 had US, and 45 had MRI), the authors reported the following statistical data for classification of ATFL integrity using arthroscopy as the reference standard (ranges reflect the two independent observers): CT arthrography had sensitivity of 86% to 90% and specificity 67% to 83% with accuracy of 82% to 89%; US had sensitivity of 61% to 70% and specificity of 86% to 80% with accuracy of 67% to 76%; and MRI had sensitivity of 79% to 85% and specificity of 46% to 64% with accuracy of 71% to 80%. The authors acknowledge several limitations, including that CT arthrography cannot distinguish between scar tissue and normal ligament fibers.

**Bone Scan Ankle.** There is no evidence to support the use of bone scan ankle as the next imaging study in the evaluation of suspected instability or ligamentous injury.

### **Variant 6: Adult. Chronic ankle pain. Suspected tendon pathology. Radiographs performed. Next imaging study**

The goal of imaging is to diagnose chronic ankle pain due to suspected tendon pathology after radiographs have been performed. This imaging information will help to improve patient outcomes through early detection of tendon-specific pathology, thereby decreasing treatment delays and guiding targeted management of the pain generator.

**US Ankle.** US has been shown to produce similar results as MRI in diagnosing ankle tendon tears [76,77]. One study showed that US had a sensitivity of 100% and an accuracy of 93% compared with surgical findings [78]. US was slightly less sensitive than MRI when evaluating the tibialis posterior tendon, but this difference did not significantly affect clinical management [79].

When evaluating for peroneal tendon tears, US showed 100% sensitivity and 90% accuracy [80], suggesting that US may be more useful than MRI.

With regard to chronic Achilles tendinopathy, US detected 21 of 26 cases of tendinosis and partial rupture [81], and another study showed that US can differentiate full-thickness from partial-thickness Achilles tendon tears with 92% accuracy [82].

One significant advantage of US is in the dynamic assessment for tendon subluxation or dislocation, with a reported positive predictive value of 100%.

**MRI Ankle Without IV Contrast.** Noncontrast MRI can achieve high sensitivity (>90%) in diagnosing ankle tendon tears [83]. One study showed for MRI, sensitivity and specificity for peroneal tendinopathy was 83.9% and 74.5%, respectively and for partial tear was 83.9% and 74.5%, respectively [84]. However, MRI evidence of peroneal tendon pathology should be treated with caution because up to 34% of asymptomatic patients may have a chronic tear of the peroneus brevis tendon [85].

MRI is more sensitive than US in the evaluation of tibialis posterior tendon injury, noting that this difference did not significantly affect clinical management in patients [79]. In cases of Achilles tendinosis and partial rupture, MRI detected 26 of 27 cases in a series [81]. In the assessment of tendon subluxation/dislocation, another study reported an accuracy rate of 66% for MRI when compared to dynamic US [86].

**MR Arthrography Ankle.** There is no evidence to support the use of MR arthrography ankle as the next imaging study in the evaluation of suspected tendon pathology.

**MRI Ankle Without and With IV Contrast.** There is no evidence to support the use of MRI ankle without and with contrast as the next imaging study in the evaluation of suspected tendon pathology.

**CT Ankle With IV Contrast.** There is no evidence to support the use of CT ankle with IV contrast as the next imaging study in the evaluation of suspected tendon pathology.

**CT Ankle Without and With IV Contrast.** There is no evidence to support the use of CT ankle without and with IV contrast as the next imaging study in the evaluation of suspected tendon pathology.

**CT Ankle Without IV Contrast.** There is no evidence to support the use of CT ankle without IV contrast as the next imaging study in the evaluation of suspected tendon pathology.

**CT Arthrography Ankle.** There is no evidence to support the use of CT arthrography ankle as the next imaging study in the evaluation of suspected tendon pathology.

**Bone Scan Ankle.** There is no evidence to support the use of bone scan ankle as the next imaging study in the evaluation of suspected tendon pathology.

## **SUMMARY OF HIGHLIGHTS**

This is a summary of the key recommendations from the variant tables. Refer to the complete narrative document for more information.

- **Variant 1:** Radiographs of the ankle are usually appropriate for the initial imaging of chronic ankle pain.
- **Variant 2:** For suspected osteoarthritis or early impingement, either noncontrast MRI or noncontrast CT could be performed. MRI excels in the evaluation of cartilage integrity, bone marrow, and the adjacent soft tissues. Alternatively, CT can be helpful in preoperative planning to evaluate osseous changes (bony remodeling, osteophyte formation, and intraarticular bodies).
- **Variant 3:** For suspected osteochondral lesion, either noncontrast MRI (preferred) or noncontrast CT should be performed. MRI excels in evaluating purely cartilaginous lesions and in evaluating the stability/grade of osteochondral lesions. Although slightly less sensitive than noncontrast MRI,

noncontrast CT is a viable alternative to MRI with high specificity in identification of osteochondral lesions. Although CT arthrography has improved sensitivity over noncontrast CT, the noncontrast examinations are preferred since an arthrographic injection is not required to perform the examination.

- **Variant 4:** For suspected tarsal coalition, either noncontrast MRI or noncontrast CT could be performed. As alternatives, both CT and MRI can accurately identify the coalition itself. MRI provides the additional benefit of demonstrating associated stress reaction and/or reactive edema at the coalition (thereby confirming that the coalition is a pain generator).
- **Variant 5:** For suspected instability or chronic ligamentous injury, noncontrast MRI is usually appropriate due to its superior depiction of all ligaments, including deeper ligaments that cannot be assessed by US. US and stress view radiographs may be helpful adjuncts for the dynamic evaluation of the lateral ankle ligaments (US) or the deltoid ligament (stress view radiographs).
- **Variant 6:** For suspected tendon pathology, either noncontrast MRI or US should be performed. MRI allows simultaneous depiction of all of the ankle tendons, noting that deep accessory tendons are relatively common about the ankle. As a complementary option, US enables dynamic evaluation of a particular tendon through range of motion with the probe targeted to the patient's site of pain.

## SUPPORTING DOCUMENTS

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

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

## GENDER EQUALITY AND INCLUSIVITY CLAUSE

The ACR acknowledges the limitations in applying inclusive language when citing research studies that predates the use of the current understanding of language inclusive of diversity in sex, intersex, gender, and gender-diverse people. The data variables regarding sex and gender used in the cited literature will not be changed. However, this guideline

will use the terminology and definitions as proposed by the National Institutes of Health [87].

## RELATIVE RADIATION LEVEL INFORMATION

Potential adverse health effects associated with radiation exposure are an important factor to consider when selecting the appropriate imaging procedure. Because there is a wide range of radiation exposures associated with different diagnostic procedures, a relative radiation level (RRL) indication has been included for each imaging examination. The RRLs are based on effective dose, which is a radiation dose quantity that is used to estimate population total radiation risk associated with an imaging procedure. Patients in the pediatric age group are at inherently higher risk from exposure, because of both organ sensitivity and longer life expectancy (relevant to the long latency that appears to accompany radiation exposure). For these reasons, the RRL dose estimate ranges for pediatric examinations are lower as compared with those specified for adults (see Table 2). Additional information regarding radiation dose assessment for imaging examinations can be found in the ACR Appropriateness Criteria® Radiation Dose Assessment Introduction document [88].

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