American College of Radiology
ACR Appropriateness Criteria®

Clinical Condition: **Chronic Ankle Pain**

Variant 1: **Chronic ankle pain of any origin — best initial study.**

Radiologic Procedure	Rating	Comments	RRL*
X-ray ankle	9		Min
Tc-99m bone scan ankle	1		Med
US ankle	1		None
CT ankle without contrast	1		Min
MRI ankle without contrast	1		None
Rating Scale: 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

Variant 2: **Multiple sites of degenerative joint disease by ankle radiographs. Next study.**

Radiologic Procedure	Rating	Comments	RRL*
CT ankle without contrast	5		Min
MRI ankle without contrast	5		None
Image guided anesthetic injection ankle	5		NS
X-ray ankle stress views	1		Min
Tc-99m bone scan ankle	1		Med
US ankle	1		None
CT arthrography ankle	1		Min
MR arthrography ankle	1		None
X-ray tenography ankle	1		Min
X-ray arthrography ankle	1		Min
Rating Scale: 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

Clinical Condition: **Chronic Ankle Pain**

Variant 3: **Ankle radiographs normal, suspected osteochondral injury. Next study.**

Radiologic Procedure	Rating	Comments	RRL*
MRI ankle without contrast	9		None
CT arthrography ankle	6		Min
MR arthrography ankle	6	See statement regarding contrast in text under "Anticipated Exceptions."	None
CT ankle without contrast	4		Min
X-ray ankle stress views	1		Min
Tc-99m bone scan ankle	1		Med
US ankle	1		None
X-ray tenography ankle	1		Min
X-ray arthrography ankle	1		Min
Image guided anesthetic injection ankle	1		NS
Rating Scale: 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

Variant 4: **Ankle radiographs normal, suspected tendon abnormality. Next study.**

Radiologic Procedure	Rating	Comments	RRL*
MRI ankle without contrast	9		None
US ankle	8	With appropriate expertise. MRI can show additional unexpected pathology.	None
X-ray ankle stress views	1		Min
Tc-99m bone scan ankle	1		Med
CT ankle without contrast	1		Min
CT arthrography ankle	1		Min
MR arthrography ankle	1		None
X-ray tenography ankle	1		Min
X-ray arthrography ankle	1		Min
Image guided anesthetic injection ankle	1		NS
Rating Scale: 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

Clinical Condition: **Chronic Ankle Pain**

Variant 5: **Ankle radiographs normal, suspected ankle instability. Next study.**

Radiologic Procedure	Rating	Comments	RRL*
MRI ankle without contrast	9		None
MR arthrography ankle	7	See statement regarding contrast in text under "Anticipated Exceptions."	None
X-ray ankle stress views	5		Min
US ankle	5	With appropriate expertise.	None
CT arthrography ankle	5		Min
Tc-99m bone scan ankle	1		Med
CT ankle without contrast	1		Min
X-ray tenography ankle	1		Min
X-ray arthrography ankle	1		Min
Image guided anesthetic injection ankle	1		NS
Rating Scale: 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

Variant 6: **Ankle radiographs normal, suspected ankle impingement syndrome. Next study.**

Radiologic Procedure	Rating	Comments	RRL*
MR arthrography ankle	6	See statement regarding contrast in text under "Anticipated Exceptions."	None
US ankle	5	With appropriate expertise.	None
CT arthrography ankle	5		Min
MRI ankle without contrast	5		None
X-ray ankle stress views	1		Min
Tc-99m bone scan ankle	1		Med
CT ankle without contrast	1		Min
X-ray tenography ankle	1		Min
X-ray arthrography ankle	1		Min
Image guided anesthetic injection ankle	1		NS
Rating Scale: 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

Clinical Condition: **Chronic Ankle Pain**

Variant 7: **Ankle radiographs normal, pain of uncertain etiology. Next study.**

Radiologic Procedure	Rating	Comments	RRL*
MRI ankle without contrast	9		None
US ankle	3	If there are focal symptoms and with appropriate expertise.	None
X-ray ankle stress views	1		Min
Tc-99m bone scan ankle	1		Med
CT ankle without contrast	1		Min
CT arthrography ankle	1		Min
MR arthrography ankle	1		None
X-ray tenography ankle	1		Min
X-ray arthrography ankle	1		Min
Image guided anesthetic injection ankle	1		NS
Rating Scale: 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

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Summary of Literature Review

For assessing chronic ankle pain, there are multiple imaging options, including radiography, stress radiography, radionuclide bone scanning, ultrasound (US), computed tomography (CT), magnetic resonance imaging (MRI), and various injection procedures. Injection procedures include arthrography, CT arthrography, MR arthrography, tenography, and diagnostic injection with anesthetic agents. While there are numerous causes for chronic ankle pain, common etiologies can include osteoarthritis, osteochondral injury, tendon abnormalities, ligament abnormalities and instability, and impingement.

Chronic Ankle Pain of Any Origin — Best Initial Study

Radiography should be considered as the initial imaging study to evaluate chronic ankle pain. Radiographs may reveal osteoarthritis, calcified or ossified intra-articular bodies, osteochondral abnormalities, and evidence of prior trauma. Ankle effusions may also be identified in the anterior ankle joint recess by radiography with 53%-74% accuracy. There are often associated with ligamentous injury or fracture [1]. The presence of ossific fragments can indicate ligamentous injury or retinaculum avulsion, while periostitis can occur adjacent to tenosynovitis. Radiographs can also identify synovial osteochondromatosis and erosions from chronic synovitis. Routine radiographs of the ankle typically include anteroposterior, lateral, and mortise views; the latter obtained by internally rotating the foot 15 to 20 degrees.

Multiple sites of Degenerative Joint Disease Seen on Ankle Radiographs

When degenerative changes affect the ankle joint, MRI may be considered to evaluate cartilage integrity and associated soft tissues, such as ligaments and tendons, if this information is needed. However, when multiple sites of osteoarthrosis are present, it may be important to determines which joint is the cause of symptoms. Several reports have indicated the effectiveness of fluoroscopically guided anesthetic and corticosteroid injection of joints and tendon sheaths to identify a source of pain, which aided in surgical planning [2,3].

Suspected Osteochondral Injury with Normal Ankle Radiographs

Osteochondral injuries may involve the talar dome and uncommonly the tibial plafond [4,5]. If associated with fracture, osseous cyst, or osteochondral defect, radiography (and bone scan) may show the abnormality: however, 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 showed that 41% of osteochondral abnormalities of the ankle were missed on radiography, while CT (noncontrast, multidetector with multiplanar reformatted images) and routine MRI performed similar to arthroscopy; MRI had the highest sensitivity at 0.96, but CT was more specific at 0.99 [5]. MRI is also effective in determining if an osteochondral lesion is unstable (sensitivity 0.97), most commonly appearing as a high signal line deep to the osteochondral lesion on T2-weighted images, or less commonly a focal defect, an articular fracture, or an adjacent cyst [6]. MRI has also been used to assess osteochondral abnormalities after cartilage repair [7,8]. While comparison studies evaluating MR arthrography and CT arthrography for talus osteochondral abnormalities are lacking, the introduction of contrast into the ankle joint prior to MRI or CT will outline a cartilage surface defect.

Suspected Tendon Abnormality with Normal Ankle Radiographs

Possible tendon abnormalities include tenosynovitis, tendinopathy, tendon tear (partial or complete), and tendon subluxation or dislocation. Both MRI and US can effectively demonstrate ankle tendon abnormalities, although US results are more dependent on operator skill and expertise. It is generally accepted that MRI can achieve high sensitivities (>90%) in the diagnosis of ankle tendon tears [9]; however, US can produce similar results, with one study showing that it had a sensitivity of 100% and an accuracy of 93% in diagnosing ankle tendon tears

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compared to surgical findings [10]. With regard to the tibialis posterior tendon, one study evaluating tendon pathology showed that US was slightly less sensitive than to MRI but without affecting clinical management [11]. With regard to peroneal tendon tears, one study of 14 suspected tendon tears on MRI revealed two false-positive and one false-negative result compared to surgical findings [12], while another study using US showed 100% sensitivity and 90% accuracy in diagnosing peroneal tendon tears [13]. With regard to chronic Achilles tendinopathy, US detected 21/26 and MRI 26/27 cases of tendinosis and partial rupture compared to surgery [14], and another study showed that US can differentiate full-thickness from partial-thickness Achilles tears with 92% accuracy compared to surgical findings [15].

One significant advantage of US over MRI is in the dynamic assessment for tendon subluxation and dislocation, with a reported positive predictive value of 100% compared to surgical findings [16]. Diagnostic and therapeutic ankle tenography has also been used with one study reporting that 47% of patients had prolonged relief of symptoms [17].

Suspected Ankle Instability with Normal Ankle Radiographs

In the absence of findings on routine radiography, imaging options to evaluate ligamentous integrity include stress radiography, MRI, MR arthrography, and US. One study has shown that MR arthrography was more accurate (100%) in diagnosing chronic anterior talofibular and calcaneofibular ligament tears than MRI (59%-63%) and stress radiography (65%) [18]. This is in contrast to MRI evaluation of acute lateral ankle ligament tears where accuracy has been reported as 94% [19]. US has also been shown to be effective in evaluating acute lateral ankle ligament tears, with accuracy of 100% for anterior talofibular and 92% for calcaneofibular ligament tears proven at surgery [20]. With regard to tears of the tibiofibular ligaments of the tibiofibular syndesmosis, MRI has a reported accuracy of 100% [21]. While MRI can also demonstrate interosseous membrane tears [22], US has a proven sensitivity of 89% and specificity of 94.5% in diagnosing interosseous membrane tears shown at surgery [22,23]. When compared to stress radiography, MRI offers the additional advantage of evaluating for injuries associated with or mimicking lateral instability such as tenosynovitis, tendon injury, and osteochondral lesions [24]. MRI may also be used to evaluate the ankle after lateral ligament reconstruction [25].

Suspected Ankle Impingement Syndrome with Normal Ankle Radiographs

Imaging can also be used to diagnose ankle impingement syndromes, which can occur in the anterolateral, anterior, anteromedial, posteromedial, and posterior aspects of the ankle joint [26-36]. In one study, CT arthrography was found to be more accurate than arthroscopy in diagnosing anterolateral impingement syndrome [30]. Studies on the accuracy of MRI in diagnosing anterolateral impingement syndrome have drawn different conclusions. While one study found considerable overlap in the MRI findings in patients with anterolateral impingement and in control individuals [28], another found that MRI was useful when an ankle effusion was present [35], and a third found no overlap in the MRI appearance of ankles with anterolateral impingement and control ankles [31]. US also showed abnormal soft tissues in anterolateral impingement with a reported accuracy of 100% in one study [37]. There are only limited reports on the use of MRI for the other forms of ankle impingement syndrome, so its accuracy in these conditions is not well established [26,29,32,33]. MR arthrography has been found to be an accurate method for assessing both anterolateral and anteromedial impingement with the advantage of joint capsule distention by intra-articular contrast injection [33,34]. US-guided injection has been shown as an effective treatment with posteromedial ankle impingement [38].

Pain of Uncertain Etiology with Normal Ankle Radiographs

When chronic ankle pain is of unclear etiology, normal ankle radiographs can be followed by other imaging tests, primarily directed by clinical findings. If the patient has a focal soft-tissue abnormality, both US and MRI can be considered. Peripheral nerve-related symptoms can be evaluated with US or MRI; however, US has the benefit of higher resolution. If symptoms are believed to originate from osseous structures, MRI or possibly bone scan can be considered, as well as CT if there is concern for fracture. CT has been shown to be superior to radiography for fracture detection [39]. MRI is effective in detecting osseous stress injuries [40]. Overall, MRI is the imaging test that globally evaluates all anatomic structures, including bone marrow [41]. US with dynamic evaluation should be considered when symptoms are only present during specific movements or positions [42,43].

Summary

- Initial evaluation of chronic ankle pain should begin with radiography.
- With multiple sites of degenerative change, pain relief after fluoroscopically guided anesthetic joint injection can indicate which joint is the source of symptoms.
- If there is concern for focal soft-tissue abnormality, such as tendon or ligament abnormality, MRI or US may be considered, with the latter requiring an experienced operator for optimal accuracy.
- Dynamic US should be considered with any soft-tissue abnormality that requires specific joint movement or positioning to produce symptoms, such as with tendon subluxation.
- For suspected osseous abnormality, MRI, CT, and possibly bone scan can be used.
- Overall, MRI is the imaging method that globally evaluates all structures of the ankle.

- If there is concern for an intra-articular process such as osteochondral abnormality or ankle impingement, MR arthrography or MRI may be used, with the latter more effective in the presence of a joint effusion than when no effusion is present.

Anticipated Exceptions

Nephrogenic systemic fibrosis (NSF) is a disorder with a scleroderma-like presentation and a spectrum of manifestations that can range from limited clinical sequelae to fatality. It appears to be related to both underlying severe renal dysfunction and the administration of gadolinium-based contrast agents. It has occurred primarily in patients on dialysis, rarely in patients with very limited glomerular filtration rate (GFR) (ie, <30 mL/min/1.73m^2), and almost never in other patients. There is growing literature regarding NSF. Although some controversy and lack of clarity remain, there is a consensus that it is advisable to avoid all gadolinium-based contrast agents in dialysis-dependent patients unless the possible benefits clearly outweigh the risk, and to limit the type and amount in patients with estimated GFR rates <30 mL/min/1.73m^2. For more information, please see the ACR *Manual on Contrast Media* [44].

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. Additional information regarding radiation dose assessment for imaging examinations can be found in the ACR Appropriateness Criteria® Radiation Dose Assessment Introduction document.

Relative Radiation Level Designations	
Relative Radiation Level*	**Effective Dose Estimate Range**
None	0
Minimal	< 0.1 mSv
Low	0.1-1 mSv
Medium	1-10 mSv
High	10-100 mSv
*RRL assignments are not included for some examinations. The RRL assignments for the NS (not specified) exams cannot be made because the RRL depends on the region of the body exposed to ionizing radiation, and the body part will vary as a function of the clinical situation.	

Supporting Document(s)

- ACR Appropriateness Criteria® Overview
- Evidence Table

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