Date of origin: 1998
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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		☢
Tc-99m bone scan ankle	1		☢☢☢
US ankle	1		O
CT ankle without contrast	1		☢
CT ankle with contrast	1		☢
CT ankle without and with contrast	1		☢
MRI ankle without contrast	1		O
MRI ankle without and with contrast	1		O
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

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

Radiologic Procedure	Rating	Comments	RRL*
Image-guided anesthetic injection hindfoot/ankle	6		Varies
MRI hindfoot/ankle without contrast	5		O
CT hindfoot/ankle without contrast	4		☢
CT hindfoot/ankle with contrast	1		☢
CT hindfoot/ankle without and with contrast	1		☢
MRI hindfoot/ankle without and with contrast	1		O
X-ray hindfoot/ankle stress views	1		☢
Tc-99m bone scan hindfoot/ankle	1		☢☢☢
US hindfoot/ankle	1		O
CT arthrography hindfoot/ankle	1		☢
MR arthrography hindfoot/ankle	1		O
X-ray tenography hindfoot/ankle	1		☢
X-ray arthrography hindfoot/ankle	1		☢
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually 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		O
CT arthrography ankle	6		☢
MR arthrography ankle	6		O
CT ankle without contrast	4		☢
MRI ankle without and with contrast	1		O
CT ankle with contrast	1		☢
CT ankle without and with contrast	1		☢
X-ray ankle stress views	1		☢
Tc-99m bone scan ankle	1		☢☢☢
US ankle	1		O
X-ray tenography ankle	1		☢
X-ray arthrography ankle	1		☢
Image-guided anesthetic injection ankle	1		Varies
Rating Scale: **1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate**			***Relative Radiation Level**

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

Radiologic Procedure	Rating	Comments	RRL*
MRI ankle without contrast	9		O
US ankle	8		O
US-guided anesthetic injection ankle tendon	6		O
MRI ankle without and with contrast	3		O
X-ray ankle stress views	1		☢
Tc-99m bone scan ankle	1		☢☢☢
CT ankle without contrast	1		☢
CT ankle with contrast	1		☢
CT ankle without and with contrast	1		☢
CT arthrography ankle	1		☢
MR arthrography ankle	1		O
X-ray tenography ankle	1		☢
X-ray arthrography ankle	1		☢
Rating Scale: **1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate**			***Relative Radiation Level**

Clinical Condition: **Chronic Ankle Pain**

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

Radiologic Procedure	Rating	Comments	RRL*
MRI ankle without contrast	9		O
MR arthrography ankle	7		O
US ankle	6	Dynamic US imaging.	O
X-ray ankle stress views	5		☢
CT arthrography ankle	5		☢
MRI ankle without and with contrast	1		O
Tc-99m bone scan ankle	1		☢☢☢
CT ankle without contrast	1		☢
CT ankle with contrast	1		☢
CT ankle without and with contrast	1		☢
X-ray tenography ankle	1		☢
X-ray arthrography ankle	1		☢
Image-guided anesthetic injection ankle	1		Varies
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

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

Radiologic Procedure	Rating	Comments	RRL*
MR arthrography ankle	6		O
US ankle	5	Dynamic US imaging.	O
CT arthrography ankle	5		☢
MRI ankle without contrast	5		O
MRI ankle without and with contrast	1		O
X-ray ankle stress views	1		☢
Tc-99m bone scan ankle	1		☢☢☢
CT ankle without contrast	1		☢
CT ankle with contrast	1		☢
CT ankle without and with contrast	1		☢
X-ray tenography ankle	1		☢
X-ray arthrography ankle	1		☢
Image-guided anesthetic injection ankle	1		Varies
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually 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		O
US ankle	3	If focal symptoms are present.	O
MRI ankle without and with contrast	1		O
X-ray ankle stress views	1		☢
Tc-99m bone scan ankle	1		☢☢☢
CT ankle without contrast	1		☢
CT ankle with contrast	1		☢
CT ankle without and with contrast	1		☢
CT arthrography ankle	1		☢
MR arthrography ankle	1		O
X-ray tenography ankle	1		☢
X-ray arthrography ankle	1		☢
Image-guided anesthetic injection ankle	1		Varies
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

Variant 8: **Suspected inflammatory arthritis detected by ankle radiographs. Next study.**

Radiologic Procedure	Rating	Comments	RRL*
MRI ankle without and with contrast	9	See statement regarding contrast in text under "Anticipated Exceptions."	O
MRI ankle without contrast	8		O
US ankle	5		O
CT ankle without contrast	1	Dual-energy CT for gout is excluded from consideration due to emerging data.	☢
CT ankle with contrast	1		☢
CT ankle without and with contrast	1		☢
CT arthrography ankle	1		☢
MR arthrography ankle	1		O
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

CHRONIC ANKLE PAIN

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Summary of Literature Review

Introduction/Background

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

Ankle pain is considered chronic when symptoms persist > 6 weeks. Radiography should be considered as the initial imaging study. Radiographs may reveal osteoarthritis, calcified or ossified intra-articular bodies, osteochondral abnormalities, stress fractures, or evidence of prior trauma. Ankle effusions may also be identified in the anterior ankle joint recess by radiography with 53%-74% accuracy [1]. They 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. Weight-bearing radiographs may assist in the evaluation of hindfoot malalignment, though diagnosis cannot be made exclusively with this examination [2].

Multiple Sites of Degenerative Joint Disease in the Foot Seen on Ankle Radiographs

When degenerative changes of the ankle joint are diagnosed based on radiographs, MRI may be considered as the next best examination to evaluate cartilage integrity and associated soft tissues, such as ligaments and tendons, if these injuries are clinically suspected. However, when multiple sites of osteoarthritis are present, it may be important to determine which joint is the cause of symptoms. Several reports have indicated the effectiveness of fluoroscopically guided anesthetic with or without corticosteroid injection of joints and tendon sheaths to identify a source of pain, which aids in surgical planning [3,4].

Suspected Osteochondral Injury with Normal Ankle Radiographs — Value of CT versus MRI

Osteochondral injuries may involve the talar dome, and less commonly the tibial plafond and tarsal navicular bone [5-7]. If this injury is 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 [7] 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

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the highest sensitivity (96%), but CT was more specific (99%). MRI is effective in determining osteochondral injury stability (sensitivity 97%), most commonly appearing as a high signal line deep to the osteochondral lesion on T2-weighted images, or less commonly as a focal defect, an articular fracture, or an adjacent cyst [8]. MRI has also been used to stage these lesions preoperatively with an accuracy of 81% [9] and to assess osteochondral abnormalities after cartilage repair [10,11]. The introduction of contrast into the ankle joint prior to MRI or CT will outline a cartilage surface defect, assisting in the assessment for instability. One study comparing CT arthrography and MR arthrography for talar cartilaginous lesions found an accuracy between 76%-88% using MR arthrography compared to 90%-92% for CT arthrography, suggesting that CT arthrography may be more reliable [12]. High-resolution MRI using a microscopy coil can assist in detecting small, clinically relevant features of talar osteochondral lesions that may be missed on standard MRI, including osteochondral junction separation due to focal collapse of the subchondral bone, reparative cartilage hypertrophy, and bone separation in the absence of cartilage fracture [13]. One study evaluating the role of single photon emission tomography (SPECT)/CT in assessing osteochondral defects in the ankle found that this study affected the surgeon's ultimate decision regarding treatment in 48%-52% of cases as it allowed for improved evaluation of the subchondral bone and subchondral bone plate [14].

Suspected Tendon Abnormality with Normal or Nonspecific 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 diagnosing ankle tendon tears [15]; 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, compared to surgical findings of 94% sensitivity and 90% accuracy [16]. With regard to the tibialis posterior tendon, one study evaluating tendon pathology showed that US was slightly less sensitive than MRI; however, this difference did not significantly affect clinical management [17]. With regard to peroneal tendinopathy and tendon tear, one study found the sensitivities and specificities of MRI to be 83.9% and 74.5%, respectively, for tendinopathy and 54.5% and 88.7%, respectively, for tendon tears [18]. Another study using US showed 100% sensitivity and 90% accuracy in diagnosing peroneal tendon tears [19]. With regard to chronic Achilles tendinopathy, US detected 21/26 and MRI 26/27 cases of tendinosis and partial rupture [20], and another study showed that US can differentiate full-thickness from partial-thickness Achilles tears with 92% accuracy [21].

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, while MRI has a reported 66% accuracy rate for the same diagnosis [22,23]. Diagnostic and therapeutic ankle tenography has also been used, with one study reporting that 47% of patients had prolonged relief of symptoms [24].

Suspected Ankle Instability with Normal or Nonspecific Ankle Radiographs

In the absence of findings on routine radiography, imaging options to evaluate ligamentous integrity include stress radiography, MRI, MR arthrography, CT arthrography, and US. One study evaluating anterior talofibular ligament injury demonstrated a diagnostic accuracy of 67% for stress radiography, 91% for US, and 97% for MRI when compared to arthroscopic findings. Additionally, US identified the exact location of the injury in 63% of cases compared to 93% for MRI [25]. Another study comparing US and CT arthrography for diagnosing of anterior talofibular ligament damage showed an accuracy of 61% using US and 71% for CT arthrography [26]. MRI evaluation of anterior talofibular ligament and calcaneofibular ligament tears has demonstrated accuracies of 91.7% and 87.5%, respectively, when compared to arthroscopic findings [27]. With regard to tears of the tibiofibular ligaments of the tibiofibular syndesmosis, MRI has a reported accuracy of 100% [28]. While MRI can also demonstrate interosseous membrane tears [29], US has a proven sensitivity of 89% and specificity of 94.5% in diagnosing interosseous membrane tears shown at surgery [29,30]. MRI offers the additional 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 [31]. MRI may also be used to evaluate the ankle after lateral ligament reconstruction [32].

Suspected Ankle Impingement Syndrome with Normal or Nonspecific 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 [33-43]. One study involving anterolateral ankle impingement compared US and CT arthrography to arthroscopic findings. The study found sensitivities and specificities of 77% and 57%, respectively, for US and 97% and 71%, respectively, for CT arthrography, a statistically significant difference [44]. Studies on the accuracy of MRI in diagnosing anterolateral impingement syndrome have drawn different conclusions. One study suggested that this may be related to varying MRI magnet strengths and inconsistent protocols, and demonstrated sensitivities between 75%-83% and specificity between 75%-100%, with the axial images being the most important for the diagnosis [45].

MRI is useful in confirming the diagnosis, evaluating patients with an uncertain clinical diagnosis, and planning surgery. Additionally, it can help exclude other pathologic entities that may mimic or coexist with impingement syndromes. However, MRI features supportive of impingement may be present in asymptomatic individuals, and an accurate diagnosis requires careful correlation of imaging features with clinical features [46]. US also showed abnormal soft tissues in anterolateral impingement, with a reported accuracy of 100% in one study [47]. 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 [33,36,39,40]. 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 [40,41]. US-guided injection has been shown as an effective treatment with posteromedial ankle impingement [48].

Suspected Stress Fracture

Stress fractures can also be a cause of chronic ankle pain (see the ACR Appropriateness Criteria® topic on "Stress (Fatigue/Insufficiency) Fracture, Including Sacrum, Excluding Other Vertebrae").

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 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 [49]. MRI is effective in detecting osseous stress injuries [50]. Overall, MRI is the imaging test that globally evaluates all anatomic structures, including bone marrow [51]. US with dynamic evaluation should be considered when symptoms are only present during specific movements or positions [52,53].

Suspected Arthritis

The majority of cases of ankle arthritis are post-traumatic in nature. However any of the common forms of arthritis can affect the ankle, including rheumatoid and seronegative arthritis [54]. Radiography remains the initial and most important test for evaluating arthritis, but MRI can be helpful in evaluating the inflammatory arthropathies as it can detect the stigmata of the disease earlier, oftentimes when patients are still asymptomatic in the ankle joint [55,56]. MRI with intravenous contrast can be particularly helpful in diagnosing the inflammatory arthropathies, especially if it is early in the disease course, and as a tool for visualizing pannus in rheumatoid arthritis and assessing the response to therapy [57]. Similarly, US may be used to reliably diagnose these disorders [58].

Summary

- Initial evaluation of chronic ankle pain should begin with radiography.
- When a patient has 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.
- Dynamic US should be considered in assessing 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* [59].

Relative Radiation Level Information

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

Relative Radiation Level Designations		
Relative Radiation Level*	**Adult Effective Dose Estimate Range**	**Pediatric Effective Dose Estimate Range**
O	0 mSv	0 mSv
☢	<0.1 mSv	<0.03 mSv
☢☢	0.1-1 mSv	0.03-0.3 mSv
☢☢☢	1-10 mSv	0.3-3 mSv
☢☢☢☢	10-30 mSv	3-10 mSv
☢☢☢☢☢	30-100 mSv	10-30 mSv
*RRL assignments for some of the examinations cannot be made, because the actual patient doses in these procedures vary as a function of a number of factors (eg, region of the body exposed to ionizing radiation, the imaging guidance that is used). The RRLs for these examinations are designated as "Varies".		

Supporting Documents

- ACR Appropriateness Criteria® Overview
- Procedure Information
- Evidence Table

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