

**American College of Radiology
ACR Appropriateness Criteria®**

Clinical Condition: Chronic Foot Pain

Variant 1: Child or adolescent with painful rigid flat foot. Rule out tarsal coalition.

Radiologic Procedure	Rating	Comments	RRL*
X-ray foot	9	AP, lateral, oblique, and Harris-Beath views. Initial study.	Min
CT foot without contrast	9	Secondary study, but complementary. Recommended if x-ray is unremarkable or equivocal and clinical concern warrants.	Min
MRI foot without contrast	5		None
Tc-99m bone scan foot	2		Med
US foot	2		None
Rating Scale: 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

Variant 2: To rule out reflex sympathetic dystrophy.

Radiologic Procedure	Rating	Comments	RRL*
X-ray foot	9	AP, lateral, and oblique.	Min
Tc-99m bone scan foot	8	If x-rays are not diagnostic.	Med
US foot	2		None
MRI foot without contrast	2		None
CT foot without contrast	2		Min
Rating Scale: 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

Variant 3: Pain and tenderness over head of second metatarsal. Rule out Freiberg's disease.

Radiologic Procedure	Rating	Comments	RRL*
X-ray foot	9	AP, lateral, with or without oblique.	Min
MRI foot without contrast	2		None
CT foot without contrast	2		Min
Tc-99m bone scan foot	2		Med
US foot	2		None
Rating Scale: 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

Clinical Condition:**Chronic Foot Pain****Variant 4:**

Pain and tenderness over the navicular tuberosity, unresponsive to conservative therapy. Radiographs showed accessory navicular.

Radiologic Procedure	Rating	Comments	RRL*
MRI foot without contrast	9		None
Tc-99m bone scan foot	3		Med
CT foot without contrast	2		Min
US foot	2		None
<u>Rating Scale:</u> 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

Variant 5:

Evaluation for inflammatory arthropathy, including rheumatoid arthritis and seronegative arthritis.

Radiologic Procedure	Rating	Comments	RRL*
X-ray foot	9	AP and lateral.	Min
MRI foot without and with contrast	7	See statement regarding contrast in text under "Anticipated Exceptions."	None
US foot	5	Can be used in place of MRI, with the proper expertise.	None
Tc-99m bone scan foot	2		Med
CT foot without and with contrast	1		Min
<u>Rating Scale:</u> 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

Variant 6:

Young athlete presenting with localized pain at the plantar aspect of the heel. Plantar fasciitis is suspected clinically.

Radiologic Procedure	Rating	Comments	RRL*
X-ray foot and ankle	9	Initial study. AP and lateral.	Min
MRI foot without contrast	9	Secondary study, but complementary. Recommended if x-ray is unremarkable or equivocal and clinical concern warrants.	None
US foot	5	Can be used in place of MRI, with the proper expertise.	None
CT foot with or without contrast	2		Min
Tc-99m bone scan foot	2		Med
<u>Rating Scale:</u> 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

Clinical Condition:**Chronic Foot Pain****Variant 7:**

Middle-aged woman with burning pain and paresthesias along the plantar surface of the foot and toes. Clinically, the patient is suspected of having tarsal tunnel syndrome.

Radiologic Procedure	Rating	Comments	RRL*
X-ray foot	9	Initial study. AP, lateral, and oblique.	Min
MRI foot without contrast	9	Secondary study, but complementary. Recommended if x-ray is unremarkable or equivocal and clinical concern warrants.	None
US foot	5	Can be used in place of MRI, with the proper expertise.	None
CT foot with or without contrast	2		Min
Tc-99m bone scan foot	2		Med
Rating Scale: 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

Variant 8:

Patient is complaining of pain in the 3-4 web space with radiation to the toes. Morton's neuroma is clinically suspected.

Radiologic Procedure	Rating	Comments	RRL*
X-ray foot	9	Initial study. AP and lateral.	Min
MRI foot without and with contrast	9	Secondary study, but complementary. Recommended if x-ray is unremarkable or equivocal and clinical concern warrants. See statement regarding contrast in text under "Anticipated Exceptions."	None
US foot	5	Can be used in place of MRI, with the proper expertise.	None
CT foot without and with contrast	2		Min
Tc-99m bone scan foot	2		Med
Rating Scale: 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

Variant 9:

Athlete with pain and tenderness over tarsal navicular; Radiographs are unremarkable.

Radiologic Procedure	Rating	Comments	RRL*
MRI foot without contrast	9		None
CT foot without contrast	6	Especially for follow-up of healing fractures.	Min
Tc-99m bone scan foot	2	If MRI cannot be performed.	Med
US foot	2		None
Rating Scale: 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

Clinical Condition:**Chronic Foot Pain****Variant 10:****Evaluation for suspected tendonopathy.**

Radiologic Procedure	Rating	Comments	<u>RRL*</u>
X-ray foot	9	Initial study. AP and lateral.	Min
MRI foot without contrast	9	Secondary study, but complementary. Recommended if x-ray is unremarkable or equivocal and clinical concern warrants.	None
US foot	5	Can be used in place of MRI, with the proper expertise.	None
Tc-99m bone scan foot	1		Med
CT foot without contrast	1		Min
<u>Rating Scale:</u> 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

CHRONIC FOOT PAIN

Expert Panel on Musculoskeletal Imaging:
James N. Wise, MD¹; Richard H. Daffner, MD²;
Barbara N. Weissman, MD³; Erin Arnold, MD⁴;
D. Lee Bennett, MD, MA⁵; Judy S. Blebea, MD⁶;
Jon A. Jacobson, MD⁷; William B. Morrison, MD⁸;
William K. Payne III, MD, MPH⁹; Charles S. Resnik,
MD¹⁰; Catherine C. Roberts, MD¹¹; Mark E. Schweitzer,
MD¹²; Leanne L. Seeger, MD¹³; Mihra S. Taljanovic,
MD.¹⁴

Summary of Literature Review

Many conditions can affect the foot and cause chronic foot pain. Some of these conditions and techniques to image them are reviewed here.

Tarsal Coalition

Tarsal coalition is a congenital abnormality resulting from fibrous, cartilaginous, or osseous union of two or more tarsal bones. Calcaneonavicular and middle-facet talocalcaneal coalitions are the most common. In about half the patients the coalition is bilateral. Calcaneonavicular coalition is easily detected on oblique radiographs of the foot and confirmed by computed tomography (CT). Talocalcaneal (subtalar) coalition is often associated with severe valgus deformity of the hind foot, rigid painful flat foot, and restricted subtalar motion. It is frequently overlooked on standard foot radiographs because of overlapping structures; however, secondary signs on the lateral view could be suggestive of a subtalar coalition. These signs include talar beaking, flattening and broadening of the lateral talar process, positive C-sign, and narrowing of the posterior talocalcaneal joint [1]. A well-penetrated axial view (Harris-Beath view) can demonstrate the posterior and middle subtalar joints [2].

CT of the subtalar joint is usually diagnostic [3]. Magnetic resonance imaging (MRI) has been shown to be effective in depicting all types of coalition [4].

¹Principal Author, University of Arkansas for Medical Sciences, Little Rock, Arkansas.

²Panel Chair, Allegheny General Hospital, Pittsburgh, Pennsylvania.

³Panel Vice-chair, Brigham and Women's Hospital, Boston, Massachusetts.

⁴Illinois Bone and Joint Institute, Morton Grove, Illinois, American College of Rheumatology.

⁵University of Iowa Health Center, Iowa City, Iowa.

⁶Cleveland Clinic, Cleveland, Ohio.

⁷University of Michigan Medical Center, Ann Arbor, Michigan.

⁸Thomas Jefferson University Hospital, Philadelphia, Pennsylvania.

⁹American Academy of Orthopaedic Surgeons, Chicago, Illinois.

¹⁰University of Maryland School of Medicine, Baltimore, Maryland.

¹¹Mayo Clinic, Phoenix, Arizona.

¹²University of Ottawa, Ottawa, Ontario, Canada.

¹³David Geffen School of Medicine, University of California Los Angeles, Los Angeles, California.

¹⁴University of Arizona Health Sciences Center, Tucson, Arizona.

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Reprint requests to: Department of Quality & Safety, American College of Radiology, 1891 Preston White Drive, Reston, VA 20191-4397.

Inversion-recovery MRI may reveal bone marrow edema along the margins of the abnormal articulation, which is an important clue to the diagnosis [5].

Reflex Sympathetic Dystrophy

Reflex sympathetic dystrophy (RSD), also called complex regional pain syndrome type I (CRPS I), is characterized clinically by pain, tenderness, swelling, diminished motor function, and vasomotor instability [6]. Conditions associated with RSD of the foot include fractures and other trauma, central nervous system (CNS) and spinal disorders, and peripheral nerve injury. RSD has also been described in children; the patients are predominantly girls [7]. Early diagnosis favorably affects outcome [6]. Diffuse osteopenia of the involved part is seen in 69% of patients with RSD [8]. The osteopenia patterns are not pathognomonic and can be seen as a result of disuse. Three-phase radionuclide scans have been used to diagnose RSD [8-10]. Holder et al [11] reported a characteristic delayed bone scan pattern consisting of diffuse increased tracer throughout the foot, with juxta-articular accentuation of tracer uptake. Overall sensitivity in this study was 100%, specificity 80%, positive predictive value 54%, and negative predictive value 100%. There are no specific findings on MRI in patients with RSD [12]. Using power Doppler sonography, patients with RSD of the lower extremity have increased power Doppler flow compared with asymptomatic control subjects [13].

Avascular Necrosis of the Metatarsal Head (Freiberg's Disease)

This disease is characterized by pain, tenderness, swelling, and limitation of motion in the affected metatarsophalangeal (MTP) joint [14]. The disease is usually detected in adolescents, and adolescent girls predominate about three or four to one. Radiographic changes are characteristic, and they show increased density of the metatarsal head, and flattening, collapse, cystic changes, and widening of the MTP joint. The second metatarsal is most commonly affected, although the third and fourth can also be occasionally involved [15].

Painful Accessory Bones

Potentially painful normal variants such as accessory navicular and os trigonum have been described [16-18]. Pain in the presence of an accessory navicular has been attributed to traumatic or degenerative changes at the synchondrosis or to soft-tissue inflammation. Symptomatic accessory navicular bones have been studied with radionuclide bone scans and MRI. Symptomatic lesions are reported to show increased radiotracer uptake or marrow edema across the synchondrosis [19,20].

For a painful os trigonum, selective arthrography of the synchondrosis followed by local anesthetic injection localizes the source of pain [21,22].

Arthritis

All the common forms of arthritis, including rheumatoid and seronegative arthritis, affect the feet and can cause chronic foot pain. Most of the arthritides are best evaluated with radiography [23]. Charcot changes are still best detected and followed by radiography also [24]. There is now evidence that gadolinium-enhanced MRI can be helpful in detecting early rheumatoid arthritis [25,26] and seronegative arthritis [27,28].

Chronic heel pain can be caused by calcaneal stress fractures, tarsal tunnel syndrome, and plantar fasciitis. When the heel pain is bilateral, the seronegative arthritides warrant consideration.

Plantar Fasciitis

Plantar fasciitis is the most common cause of plantar heel pain. It may occur in isolation or as a manifestation of a systemic disease such as the seronegative spondyloarthropathies, rheumatoid arthritis, gout, or systemic lupus erythematosus (SLE) [17]. In athletes, plantar fasciitis is a common cause of foot pain and it is attributed to mechanical stresses, presumably due to repetitive trauma causing microtearing of the plantar fascia at its origin as well as fascial and perifascial inflammation. Plantar fasciitis is also common in obese patients and in patients with flat feet. Typically radiography is insensitive to fasciitis, but it should be the initial study. Bone scintigraphy and MRI have been shown to be helpful in arriving at a diagnosis [16-18,29,30]. Ultrasonography (US) has been shown by Cardinal et al [31] to be effective in differentiating normal plantar fascia from those involved with plantar fasciitis.

Tarsal Tunnel Syndrome

This syndrome is a compressive neuropathy of the posterior tibial nerve or one of its branches. Patients typically complain of poorly localized burning pain and paresthesias along the plantar surface of the foot and toes [32,33]. Inflammatory processes or mass lesions in the tarsal tunnel are described as the cause for this syndrome in most of patients with this syndrome. Such lesions are best imaged by MRI [32-34].

Interdigital (Morton's) Neuroma

Morton's Neuroma is a nonneoplastic perineural fibrous proliferation involving a plantar digital nerve. Clinical symptoms include pain in the involved web space that often radiates to the toes. It is frequently asymptomatic [35]. These neuromas are seen more often in women and typically involve the three-four or less commonly the two-three intermetatarsal space. They are best detected on MRI using T1-weighted or T1-weighted, fat-suppressed images with gadolinium enhancement and T2-weighted images [36]. The diagnosis of Morton's neuroma at MRI becomes relevant only when the transverse diameter of the lesion is 5 mm or more and can be correlated with the clinical findings [37]. High-resolution US has been used successfully to diagnose Morton's neuromas [38]. US may approach the

sensitivity of MRI in detecting Morton's neuromas with appropriate expertise [39,40].

Tendinopathies

Tendinopathies, ranging from tendinosis to complete tear, in and around the foot can result in significant foot pain and disabilities. The most commonly affected tendons are the Achilles tendon, posterior tibial tendon, and peroneal tendons. Tendon dysfunction is best imaged with MRI and US [41-46].

Hallux Valgus

Hallux valgus is a common foot disorder resulting in significant morbidity. Preoperative evaluation and measurements and postoperative follow-up are best performed with weight-bearing posteroanterior and lateral radiographs of the feet [47-49].

Neoplasm

Neoplasm is another cause of chronic foot pain, and (diagnostically) these lesions in the foot can be approached as other neoplasms in the musculoskeletal system are (see ACR Appropriateness Criteria® topic on "[Soft Tissue Masses](#)" and topic on "[Bone Tumors](#)").

Stress Fractures

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

Osteomyelitis

Osteomyelitis can be a cause of chronic foot pain (see the ACR Appropriateness Criteria® topic on "[Suspected Osteomyelitis in Patients with Diabetes Mellitus](#)").

Summary

- Radiography is the foundation for imaging chronic foot pain. It is the initial study or the first step in the imaging algorithm for evaluating pedal pathology.
- CT is the secondary modality of choice to evaluate for tarsal coalition if radiographs are equivocal or unremarkable and clinical concern warrants further imaging evaluation.
- Tc-99m-labeled methylene diphosphonate (MDP) bone scan is the modality of choice for evaluating RSD if radiographs are equivocal or unremarkable and clinical concern warrants further imaging evaluation.
- MRI or US (if local expertise allows) is complementary to radiography.
- In evaluating for inflammatory arthropathy, plantar fasciitis, tarsal tunnel syndrome, interdigital (Morton's) neuroma, and/or tendonopathy, MRI or US is indicated if the initial radiograph is equivocal or unremarkable and clinical concern warrants further imaging.

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/1.73m²), 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/1.73m². For more information, please see the [ACR Manual on Contrast Media](#) [50].

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

Supporting Document(s)

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

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