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American College of Radiology
ACR Appropriateness Criteria®

Acute Hand and Wrist Trauma

Variant: 1 Acute blunt or penetrating trauma to the hand or wrist. Initial imaging.

Procedure	Appropriateness Category	Relative Radiation Level
Radiography area of interest	Usually Appropriate	Varies
US area of interest	Usually Not Appropriate	O
MRI area of interest without and with IV contrast	Usually Not Appropriate	O
MRI area of interest without IV contrast	Usually Not Appropriate	O
Bone scan area of interest	Usually Not Appropriate	☢☢☢
CT area of interest with IV contrast	Usually Not Appropriate	Varies
CT area of interest without and with IV contrast	Usually Not Appropriate	Varies
CT area of interest without IV contrast	Usually Not Appropriate	Varies

Variant: 2 Suspect acute hand or wrist trauma. Initial radiographs negative or equivocal. Next imaging study.

Procedure	Appropriateness Category	Relative Radiation Level
Radiography area of interest repeat in 10-14 days	Usually Appropriate	Varies
MRI area of interest without IV contrast	Usually Appropriate	O
CT area of interest without IV contrast	Usually Appropriate	Varies
US area of interest	Usually Not Appropriate	O
MRI area of interest without and with IV contrast	Usually Not Appropriate	O
Bone scan area of interest	Usually Not Appropriate	☢☢☢
CT area of interest with IV contrast	Usually Not Appropriate	Varies
CT area of interest without and with IV contrast	Usually Not Appropriate	Varies

Variant: 3 Acute wrist fracture on radiographs. Suspect wrist tendon or ligament trauma. Next imaging study.

Procedure	Appropriateness Category	Relative Radiation Level
US wrist	Usually Appropriate	O
MR arthrography wrist	Usually Appropriate	O
MRI wrist without IV contrast	Usually Appropriate	O
CT arthrography wrist	Usually Appropriate	☢
MRI wrist without and with IV contrast	Usually Not Appropriate	O
CT wrist with IV contrast	Usually Not Appropriate	☢
CT wrist without and with IV contrast	Usually Not Appropriate	☢
CT wrist without IV contrast	Usually Not Appropriate	☢
Bone scan wrist	Usually Not Appropriate	☢☢☢

Variant: 4 Initial radiographs showing distal radioulnar joint or carpal malalignment in the absence of fracture. Next imaging study.

Procedure	Appropriateness Category	Relative Radiation Level
MR arthrography wrist	Usually Appropriate	O

MRI wrist without IV contrast	Usually Appropriate	O
CT wrist without IV contrast bilateral	Usually Appropriate	☢
CT arthrography wrist	May Be Appropriate	☢
US wrist	Usually Not Appropriate	O
MRI wrist without and with IV contrast	Usually Not Appropriate	O
CT wrist with IV contrast bilateral	Usually Not Appropriate	☢
CT wrist without and with IV contrast bilateral	Usually Not Appropriate	☢
Bone scan wrist	Usually Not Appropriate	☢☢☢

Variant: 5 Acute hand fracture on radiographs. Suspect hand tendon or ligament trauma. Next imaging study.

Procedure	Appropriateness Category	Relative Radiation Level
US hand	Usually Appropriate	O
MRI hand without IV contrast	Usually Appropriate	O
MRI hand without and with IV contrast	Usually Not Appropriate	O
CT hand with IV contrast	Usually Not Appropriate	☢
CT hand without and with IV contrast	Usually Not Appropriate	☢
CT hand without IV contrast	Usually Not Appropriate	☢
Bone scan hand	Usually Not Appropriate	☢☢☢

Variant: 6 Initial radiographs showing metacarpophalangeal, proximal interphalangeal, or distal interphalangeal joint malalignment in the absence of fracture. Next imaging study.

Procedure	Appropriateness Category	Relative Radiation Level
US hand	Usually Appropriate	O
MRI hand without IV contrast	Usually Appropriate	O
MRI hand without and with IV contrast	Usually Not Appropriate	O
CT hand with IV contrast	Usually Not Appropriate	☢
CT hand without and with IV contrast	Usually Not Appropriate	☢
CT hand without IV contrast	Usually Not Appropriate	☢
Bone scan hand	Usually Not Appropriate	☢☢☢

Variant: 7 Suspect penetrating trauma with a foreign body in the soft tissues in the hand or wrist. Initial radiographs are negative. Next imaging study.

Procedure	Appropriateness Category	Relative Radiation Level
US area of interest	Usually Appropriate	O
CT area of interest without IV contrast	Usually Appropriate	Varies
MRI area of interest without IV contrast	May Be Appropriate	O
MRI area of interest without and with IV contrast	Usually Not Appropriate	O
Bone scan area of interest	Usually Not Appropriate	☢☢☢
CT area of interest with IV contrast	Usually Not Appropriate	Varies
CT area of interest without and with IV contrast	Usually Not Appropriate	Varies

Panel Members

Leon Lenchik,

MD[a], Maha Torabi, MD[b], Francesca D. Beaman, MD[c], Daniel E. Wessell, MD, PhD[d], Jennifer K. Bussell, MD[e], R. Carter Cassidy, MD[f], Gregory J. Czuczman, MD[g], Jennifer L. Demertzis, MD[h], Bharti Khurana, MD[i], Alan K. Klitzke, MD[j], Kambiz Motamedi, MD[k], Jennifer L. Pierce, MD[l], Akash Sharma, MD, PhD, MBA[m], Eric A. Walker, MD, MHA[n], Mark J. Kransdorf, MD[o]

Summary of Literature Review

Introduction/Background

Hand injuries account for approximately 20% of emergency department visits [1]. According to the National Hospital Ambulatory Medical Care Survey, 1.5% of all emergency department visits involve hand and wrist fractures. Distal radius fractures are especially common, accounting for up to 18% of fractures in the elderly [2,3]. Because of increasing rates of osteoporosis, the incidence of distal radius fractures has been increasing [4]. Although most distal radius fractures in elderly patients are managed nonoperatively, the use of internal fixation is increasing. Internal fixation has a much higher cost than nonoperative treatment as well as increased rates of hospitalization [5].

For most patients with trauma to the hand and wrist, conventional radiographs provide sufficient diagnostic information to guide the treating physician. However, delayed diagnosis is common because distal radius and scaphoid fractures may be radiographically occult [6]. When initial radiographs are normal but there is high clinical suspicion for fracture, further imaging with additional radiographic projections, CT, or MRI is appropriate. If associated soft-tissue injury is clinically suspected, CT, CT arthrography, MRI, MR arthrography, or ultrasound (US) may be indicated [7-10].

Successful treatment of distal radius fractures requires restoration of radial length, inclination, and tilt, as well as the realignment of the articular fracture fragments [9,11]. The presence of a coronally oriented fracture line, die-punch depression, or more than three articular fracture fragments are common indications for operative reduction [8]. Operative fixation resulting in <2 mm of residual articular surface step-off is usually considered necessary to avoid long-term complications, such as osteoarthritis [9,12].

Discussion of Procedures by Variant

Variant 1: Acute blunt or penetrating trauma to the hand or wrist. Initial imaging.

Variant 1: Acute blunt or penetrating trauma to the hand or wrist. Initial imaging.
A. Bone scan area of interest

Bone scan is not indicated in this clinical setting.

Variant 1: Acute blunt or penetrating trauma to the hand or wrist. Initial imaging.
B. CT area of interest

In patients with intra-articular fractures seen on radiography, CT shows articular fracture fragment displacement, depression, and comminution more accurately than conventional radiographs [7,9,10]. CT measurements of articular surface gap and step-off are more reproducible than radiographs [7]. The addition of 3-D surface-rendered reconstructions to the standard 2-D CT images has been shown to change operative management in up to 48% of intra-articular distal radius fractures [8].

There is no evidence to support the use of CT with intravenous (IV) contrast in the setting of acute hand and wrist trauma.

Variant 1: Acute blunt or penetrating trauma to the hand or wrist. Initial imaging.
C. MRI area of interest

MRI is not indicated initially in this clinical setting.

Variant 1: Acute blunt or penetrating trauma to the hand or wrist. Initial imaging.
D. Radiography area of interest

Radiography is always indicated as the initial imaging for suspected acute hand and wrist trauma. For most joints of the extremities, especially those involving the wrist, hand, and fingers, a radiographic examination that includes only 2 views is not adequate for detecting fractures [13]. For patients with suspected distal radius fractures**,** a 3-view examination of the wrist usually includes a posteroanterior (PA), a lateral, and a 45° semipronated oblique view [11]. One study [14] reports that a fourth projection—a semisupinated oblique—increases diagnostic yield for distal radius fractures.

A standard 3-view radiographic examination of the hand shows most fractures and dislocations of the metacarpals and phalanges [13]. For phalangeal injuries, some centers include a PA examination of the entire hand, whereas others limit the examination to the injured finger. An internally rotated oblique projection, in addition to the standard externally rotated oblique, increases diagnostic yield for phalangeal fractures [15].
Most fractures of the thumb are visible on a 2-view radiographic examination, although there is a slight increase in diagnostic yield with the addition of an oblique projection [13], which can be obtained along with a PA examination of the whole hand.

In patients with suspected finger tendon injuries, radiographs are used to detect fracture fragments, as large fragments may require open reduction and internal fixation. Radiographs are usually sufficient for the evaluation of osseous "mallet" injuries, which include bony avulsion at the insertion of the extensor mechanism of the finger to the distal interphalangeal joint [16]. In these injuries, involvement of more than one-third of the articular surface usually requires operative fixation. Palmar displacement of the distal phalanx or an interfragmentary gap of >3 mm is also an indication for surgery [16]. With extensor tendon injuries, radiographs are commonly used to assess for bone involvement and determine need for operative fixation [17].

Variant 1: Acute blunt or penetrating trauma to the hand or wrist. Initial imaging.
E. US area of interest

US is not indicated initially in this clinical setting.

Variant 2: Suspect acute hand or wrist trauma. Initial radiographs negative or equivocal. Next imaging study.

Variant 2: Suspect acute hand or wrist trauma. Initial radiographs negative or equivocal. Next imaging study.
A. Bone scan area of interest

Bone scan is not indicated in this clinical setting.

Variant 2: Suspect acute hand or wrist trauma. Initial radiographs negative or equivocal. Next imaging study.

B. CT area of interest

When the initial radiographs are equivocal, CT without IV contrast is commonly used to exclude or confirm suspected wrist fractures [18]. CT shows intra-articular extension of distal radius fractures more frequently than radiography. Three-dimensional reconstructions can be particularly helpful in preoperative planning for complex articular injuries [7,8].

CT should be used to exclude an occult fracture of the upper extremity. Unlike MRI, CT cannot evaluate for concomitant ligamentous injuries [19-21].

CT is useful in diagnosing injuries that are difficult to recognize on radiographs, such as carpometacarpal joint fracture dislocations. For metacarpal and digital fractures, CT is usually not indicated during acute injury [22].

There is no evidence to support the use of CT with IV contrast in the setting of acute hand and wrist trauma.

Variant 2: Suspect acute hand or wrist trauma. Initial radiographs negative or equivocal. Next imaging study.
C. MRI area of interest

When initial radiographs are normal but there is high clinical suspicion for fracture, MRI without IV contrast can detect fractures of the distal radius and carpal bones [12,23-25]. One study of patients in which the radiographic findings did not explain the clinical symptoms reported that the MRI led to a change in diagnosis in 55% of patients and a change in patient management in 66% [12]. However, another study of patients with acutely injured wrists reported that the MRI did not predict the need for treatment better than the combination of physical examination and radiography [23]. More importantly, there was no difference in outcomes with MRI compared with radiography [24].

Like CT, MRI shows intra-articular extension of distal radius fractures more frequently than radiography. Unlike CT, MRI shows concomitant ligament injuries, including tears of the scapholunate ligament, which may affect surgical treatment [26,27]. Despite these advantages, MRI performed immediately at the time of injury has little added value for determining which patients go on to surgery [23].

MRI is especially useful in evaluating hand soft-tissues injuries, including the collateral ligaments, volar plates, tendons, and pulleys. For metacarpal and digital fractures, MRI is usually not indicated during acute injury [22].

There is no evidence to support the use of MRI with IV contrast in the setting of acute hand and wrist trauma.

Variant 2: Suspect acute hand or wrist trauma. Initial radiographs negative or equivocal. Next imaging study.
D. Radiography area of interest repeat in 10-14 days

In patients with clinical suspicion of hand or wrist fracture and negative radiographs, one option is to place the patient in a short arm cast and repeat the radiographs at 10 to 14 days [13]. The downside of this option is that it results in delay of diagnosis, which may lead to functional impairment.

Variant 2: Suspect acute hand or wrist trauma. Initial radiographs negative or equivocal. Next imaging study.
E. US area of interest

US may have a limited utility for evaluating bone injuries. Christiansen et al [28] reported 47% sensitivity and 61% specificity of US for the detection of scaphoid fractures. They concluded that US is not suitable for the early diagnosis of scaphoid fracture. In contrast, Hauger et al [29] reported that using cortical disruption as a diagnostic criterion on US is an accurate sign for detecting occult fractures of the scaphoid waist. Further study of US for the diagnosis of occult fractures is needed.

Variant 3: Acute wrist fracture on radiographs. Suspect wrist tendon or ligament trauma. Next imaging study.

Variant 3: Acute wrist fracture on radiographs. Suspect wrist tendon or ligament trauma. Next imaging study.
A. Bone scan wrist

Bone scan is not indicated in this clinical setting.

Variant 3: Acute wrist fracture on radiographs. Suspect wrist tendon or ligament trauma. Next imaging study.
B. CT arthrography wrist

When conventional radiographs do not show carpal malalignment, CT arthrography may be used to diagnose ligamentous tears, causing dynamic instability [32,33]. There is a growing body of literature comparing the diagnostic accuracy of MRI (at 1.5T or 3T), MR arthrography (indirect or direct at 1.5T or 3T), and CT arthrography. Overall, CT arthrography is reported to have the highest sensitivity, specificity, and accuracy.

For the detection of scapholunate ligament tear, CT arthrography has sensitivity, specificity, and accuracy of nearly 100%. For the detection of lunotriquetral ligament tear, CT arthrography has approximately 100% sensitivity, 80% specificity, and 90% accuracy. Compared with arthroscopy, CT arthrography has 80% to 100% sensitivity for scapholunate and lunotriquetral ligament tears [33-35].

Compared to MR arthrography, CT arthrography detects partial ligament tears more accurately, detects articular cartilage defects more accurately, and has greater interobserver agreement [33]. Both CT arthrography and MR arthrography have a very high accuracy for diagnosing tears of the scapholunate ligament and lunotriquetral ligament; both are more accurate than conventional MRI [36].

The accuracy of CT arthrography for extrinsic ligament injuries is unknown [37].

Variant 3: Acute wrist fracture on radiographs. Suspect wrist tendon or ligament trauma. Next imaging study.
C. CT wrist

CT is not indicated in this clinical setting.

Variant 3: Acute wrist fracture on radiographs. Suspect wrist tendon or ligament trauma. Next imaging study.
D. MR arthrography wrist

At 1.5T, MR arthrography has greater sensitivity compared with conventional MRI [45,46]. Both MRI and MR arthrography have poor to moderate sensitivity for partial ligament tears [47,48]. When only complete tears are considered, MRI and MR arthrography may be equivalent [33].

The accuracy of MR arthrography for extrinsic ligament assessment is unknown [37].

Variant 3: Acute wrist fracture on radiographs. Suspect wrist tendon or ligament trauma. Next imaging study.
E. MRI wrist

When conventional radiographs do not show carpal malalignment, MRI is commonly used to diagnose ligamentous tears. In the clinical setting of dynamic instability, MRI or MR arthrography may be performed. Modern MR techniques using 3T systems, dedicated wrist coils, and 3-D isovolumetric sequences offer fast imaging times with high spatial and contrast resolution [36,38].

In general, 1.5T MRI has moderate sensitivity for the detection of scapholunate ligament tears and poor sensitivity for lunotriquetral ligament tears [35]. A meta-analysis of 11 studies reported sensitivities and specificities of 70% and 90% for detection of scapholunate ligament tears and 31% and 89% for detection of lunotriquetral ligament tears, respectively [39].

Sensitivity of 3T MRI is slightly better than 1.5T for the diagnosis of interosseous ligament tears. Reported sensitivities range from 65% to 89% for scapholunate ligament tears and 60% to 82% for lunotriquetral ligament tears [36,40-42]. Some investigators consider the diagnostic accuracy of 3T MRI and MR arthrography to be comparable [38].

The accuracy of MRI for extrinsic ligament assessment is unknown [37].

Extensor carpi ulnaris tendinopathy, tenosynovitis, and tendon rupture can be evaluated with MRI or US [43]. However, dynamic instability may be missed on MRI, unless sequences are performed in pronation and supination [44].

Variant 3: Acute wrist fracture on radiographs. Suspect wrist tendon or ligament trauma. Next imaging study.
F. US wrist

High-frequency US is useful for visualizing wrist tendons as well as intrinsic and extrinsic carpal ligaments [44,49,50]. Dynamic "clenched fist” maneuvers may be performed to improve detection of low-grade injuries [51].

For tears of the dorsal band of the scapholunate ligament, US sensitivity varies from 46% to 100% and specificity from 92% to 100% [50-52]. For the dorsal band of the lunotriquetral ligament, US sensitivity ranges from 25% to 50% and specificity from 90% to 100% [52,53]. US visualization of lunotriquetral ligament (particularly the structurally important volar band) is limited [49].

US can show dynamic subluxation of the extensor carpi ulnaris tendon during forced supination [44].

Variant 4: Initial radiographs showing distal radioulnar joint or carpal malalignment in the absence of fracture. Next imaging study.

**Variant 4: Initial radiographs showing distal radioulnar joint or carpal malalignment in the

absence of fracture. Next imaging study.
A. Bone scan wrist

Bone scan is not indicated in this clinical setting.

Variant 4: Initial radiographs showing distal radioulnar joint or carpal malalignment in the absence of fracture. Next imaging study.
B. CT arthrography wrist

Distal radioulnar joint instability and traumatic triangular fibrocartilage injuries can be evaluated with CT arthrography [56,57].

Variant 4: Initial radiographs showing distal radioulnar joint or carpal malalignment in the absence of fracture. Next imaging study.
C. CT wrist

CT is the modality of choice for evaluating distal radioulnar joint stability [54]. The CT protocol should include imaging of both wrists in maximal pronation, neutral position, and maximal supination.

CT examination with coronal, sagittal, and 3-D reformed images help demonstrate the extent of injury and help in treatment planning, particularly in cases of chronic perilunate dislocation [55].

Variant 4: Initial radiographs showing distal radioulnar joint or carpal malalignment in the absence of fracture. Next imaging study.
D. MR arthrography wrist

MR arthrography increases the diagnostic accuracy for proximal lamina (foveal) triangular fibrocartilage tears [56,57].

Variant 4: Initial radiographs showing distal radioulnar joint or carpal malalignment in the absence of fracture. Next imaging study.
E. MRI wrist

Distal radioulnar joint instability and traumatic triangular fibrocartilage injuries are usually associated with fluid in the distal radioulnar joint, which aids in the evaluation of the triangular fibrocartilage components on conventional MRI.

Variant 4: Initial radiographs showing distal radioulnar joint or carpal malalignment in the absence of fracture. Next imaging study.
F. US wrist

US is not indicated in this clinical setting.

Variant 5: Acute hand fracture on radiographs. Suspect hand tendon or ligament trauma. Next imaging study.

Variant 5: Acute hand fracture on radiographs. Suspect hand tendon or ligament trauma. Next imaging study.
A. Bone scan hand

Bone scan is not indicated in this clinical setting.

Variant 5: Acute hand fracture on radiographs. Suspect hand tendon or ligament trauma. Next imaging study.
B. CT hand

CT has limited use for the diagnosis of soft-tissue injuries of the hand.

Variant 5: Acute hand fracture on radiographs. Suspect hand tendon or ligament trauma. Next imaging study.
C. MRI hand

MRI is ideal for evaluating tendon injuries and helping with surgical planning [58,59]. MRI is commonly used for the diagnosis of Stener lesions of the thumb [60] and the diagnosis of pulley system injuries [61].

Hergan et al [62] reported a 100% sensitivity and specificity for assessment of thumb ulnar collateral ligament tears. Spaeth et al [63] reported a sensitivity of 100% and specificity of 94% for detection of displaced ulnar collateral ligament tears in 16 cadaveric specimens.

Variant 5: Acute hand fracture on radiographs. Suspect hand tendon or ligament trauma. Next imaging study.
D. US hand

A Stener lesion occurs when the aponeurosis of the adductor pollicis muscle becomes interposed between the ruptured ulnar collateral ligament of the thumb and its site of insertion at the base of the proximal phalanx. This lesion can be identified by absence of ulnar collateral ligament and the presence of a hypoechoic mass proximal to the apex of the metacarpal tubercle [64]. Dynamic examination shows the relationship of the aponeurosis to the retracted ligament stump [65].

US allows for diagnosis of pulley system injuries [66,67].

Variant 6: Initial radiographs showing metacarpophalangeal, proximal interphalangeal, or distal interphalangeal joint malalignment in the absence of fracture. Next imaging study.

Variant 6: Initial radiographs showing metacarpophalangeal, proximal interphalangeal, or distal interphalangeal joint malalignment in the absence of fracture. Next imaging study.
A. Bone scan hand

Bone scan is not indicated in this clinical setting.

Variant 6: Initial radiographs showing metacarpophalangeal, proximal interphalangeal, or distal interphalangeal joint malalignment in the absence of fracture. Next imaging study.
B. CT hand

CT has limited use for the diagnosis of soft-tissue injuries of the fingers.

Variant 6: Initial radiographs showing metacarpophalangeal, proximal interphalangeal, or distal interphalangeal joint malalignment in the absence of fracture. Next imaging study.
C. MRI hand without and with IV contrast

MRI is ideal for evaluating tendon injuries and helping with surgical planning [58]. MRI may be used to assess capsule and collateral ligament injuries of the proximal interphalangeal and metacarpophalangeal joints [68].

For flexor tendon injuries, Rubin et al [69] reported a sensitivity of 92% and specificity of 100% in cadavers. Drapé et al [58] reported sensitivity and specificity of 100% for diagnosis of tendon re-tears after flexor tendon repair and a sensitivity of 91% and specificity of 100% for diagnosis of peritendinous adhesions in 63 injured fingers. Jersey finger refers to avulsion injury of flexor digitorum profundus from insertion at base of distal phalanx. In patients with jersey finger, MRI is commonly used to evaluate the level of tendon retraction, the quality of the tendon stump, and the associated injuries including pulley injuries [16]. In clinically equivocal cases, MRI may demonstrate injury to the central slip or the extensor hood [16].

MRI allows for the assessment of pulley system lesions [66,67]. MRI can accurately depict the pulley system, particularly the A2 and A4 pulleys, with lower sensitivity for A3 and A5 pulleys [70]. Hauger et al [70] reported direct identification of A2 and A4 pulleys in 12 of 12 cases (100%) and direct diagnosis of an abnormal A2 pulley in 100% and A4 pulley in 91% of 33 cases.

For volar plate injuries, MRI may be used to diagnose tears that do not involve the underlying bone [71]. This is important because untreated lesions can result in contractures or joint laxity [72].

MRI of the extensor system has not been as well studied as that of the flexor system. Drapé et al [73] reported a sensitivity of 89% to 92% for evaluation of normal sagittal bands of the extensor hood. For the detection of extensor hood injuries, MRI sensitivity ranges from 28% to 85% [74].

MRI is especially useful for detection of ulnar collateral ligament and radial collateral ligament injuries. Pfirrmann et al [74] reported a sensitivity of 67% and a specificity of 91% for collateral ligament injuries of the lesser metacarpophalangeal joints. With MR arthrography, sensitivity and specificity increased to 75% and 98%, respectively [74].

Variant 6: Initial radiographs showing metacarpophalangeal, proximal interphalangeal, or distal interphalangeal joint malalignment in the absence of fracture. Next imaging study.
D. US hand

Dynamic US allows direct visualization of subluxation/dislocation of the extensor tendon while the patient flexes the metacarpophalangeal joint [16,75].

US helps evaluate injured flexor tendons and, in cases of completely lacerated tendons, helps identify the location of the proximal tendon stump [76].

US allows for assessment of pulley system injuries [66,67], particularly the A2 and A4 pulleys, with lower sensitivity for A3 and A5 pulleys [70].

Variant 7: Suspect penetrating trauma with a foreign body in the soft tissues in the hand or wrist. Initial radiographs are negative. Next imaging study.

Variant 7: Suspect penetrating trauma with a foreign body in the soft tissues in the hand or wrist. Initial radiographs are negative. Next imaging study.
A. Bone scan area of interest

Bone scan is not indicated in this clinical setting.

Variant 7: Suspect penetrating trauma with a foreign body in the soft tissues in the hand or wrist. Initial radiographs are negative. Next imaging study.
B. CT area of interest

CT has high sensitivity for detection of radiopaque foreign bodies [77,78]. In case of penetration of foreign body into deep tissues or bone, CT is recommended [79].

There are no studies of the hand and wrist. For comparable studies regarding foreign bodies in the feet, CT has 63% sensitivity and 98% specificity. CT detection rates depend on the attenuation values of the foreign bodies. CT is superior to MRI in identifying water-rich fresh wood [80].

Variant 7: Suspect penetrating trauma with a foreign body in the soft tissues in the hand or wrist. Initial radiographs are negative. Next imaging study.
C. MRI area of interest

MRI has lower sensitivity compared to CT for detection of foreign bodies [78,79].

For foreign bodies in the feet, MRI has 58% sensitivity and 100% specificity. MRI detection rates depend on the associated susceptibility artifact [80]. There are no comparable studies of the hand and wrist.

MRI may be useful in certain circumstances, such as with complicated foreign bodies. MRI helps identify foreign bodies by the presence of air or metal susceptibility artifact or adjacent edema or fibrosis. MRI may also be used to exclude associated osteomyelitis (see the ACR Appropriateness Criteria® topic on "Suspected Osteomyelitis, Septic Arthritis, or Soft Tissue Infection (Excluding Spine and Diabetic Foot)" [81]) or abscess [77].

In cases of suspected traumatic nerve injury of the hand and wrist, MRI with dedicated neurography sequences (eg, diffusion weighted) has shown improved visualization of the injured nerves [82].

Variant 7: Suspect penetrating trauma with a foreign body in the soft tissues in the hand or wrist. Initial radiographs are negative. Next imaging study.
D. US area of interest

US is superior to radiography for detection of radiolucent foreign bodies and is recommended as the first choice when the foreign body is located within the superficial soft tissues with no bone around it [78,79,83].

US allows for better localization of radiopaque foreign bodies, assessment of tendons and vascular structures, and US-guided removal of the foreign body [77].

Summary of Highlights

- **Variant 1:** Radiographs area of interest is usually appropriate for the initial imaging of adults with acute blunt or penetrating trauma to the hand or wrist.
- **Variant 2:** Repeat radiographs in 10–14 days, MRI without IV contrast, or CT without IV contrast is usually appropriate as the next imaging study for adults with acute hand or wrist trauma when initial radiographs are negative or equivocal. These procedures are equivalent alternatives.
- **Variant 3:** MR arthrography of wrist, MRI of wrist without IV contrast, CT arthrography of wrist, or US of wrist is usually appropriate as the next imaging study for adults with suspected wrist tendon or ligament trauma and when radiographs show acute wrist fracture. These procedures are equivalent alternatives.
- **Variant 4:** CT of both wrists without IV contrast, MRI of wrist without IV contrast, or MR arthrography of wrist is usually appropriate as the next imaging study for adults when initial radiographs shows distal radioulnar joint or carpal malalignment in the absence of fracture.

These procedures are equivalent alternatives.

- **Variant 5:** MRI of hand without IV contrast or US of hand is usually appropriate as the next imaging study for adults with suspect hand tendon or ligament trauma and when radiographs show acute hand fracture. These procedures are equivalent alternatives.
- **Variant 6:** MRI of hand without IV contrast or US of hand is usually appropriate as the next imaging study when initial radiographs show metacarpophalangeal, proximal interphalangeal or distal interphalangeal joint malalignment in the absence of fracture. These procedures are equivalent alternatives.
- **Variant 7:** US of the area of interest or CT of the area of interest without IV contrast is usually appropriate as the next imaging study for adults with suspect penetrating trauma with a foreign body in the soft-tissues in the hand or wrist and when initial radiographs are negative. These procedures are equivalent alternatives.

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.

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.

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 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 (e.g., region of the body exposed to ionizing radiation, the imaging guidance that is used). The RRLs for these examinations are designated as "Varies."

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[a]Wake Forest University School of Medicine, Winston Salem, North Carolina. [b]Research Author, Wake Forest University School of Medicine, Winston Salem, North Carolina. [c]Panel Chair, University of Kentucky, Lexington, Kentucky. [d]Panel Vice-Chair, Mayo Clinic, Jacksonville, Florida.

[e]Northwestern Memorial Hospital, Chicago, Illinois; American College of Physicians. [f]UK Healthcare Spine and Total Joint Service, Lexington, Kentucky; American Academy of Orthopaedic Surgeons. [g]Radiology Imaging Associates, Denver, Colorado. [h]Washington University School of Medicine, Saint Louis, Missouri. [i]Brigham & Women's Hospital, Boston, Massachusetts; Committee on Emergency Radiology-GSER. [j]Roswell Park Comprehensive Cancer Center, Buffalo, New York; Commission on Nuclear Medicine and Molecular Imaging. [k]David Geffen School of Medicine at UCLA, Los Angeles, California. [l]University of Virginia, Charlottesville, Virginia. [m]Mayo Clinic, Jacksonville, Florida; Commission on Nuclear Medicine and Molecular Imaging. [n]Penn State Milton S. Hershey Medical Center, Hershey, Pennsylvania and Uniformed Services University of the Health Sciences, Bethesda, Maryland. [o]Specialty Chair, Mayo Clinic, Phoenix, Arizona.