

AmeriHealth Caritas Louisiana

National Imaging Associates, Inc.*	
Clinical guidelines UPPER EXTREMITY CT (Hand, Wrist, Elbow, Long bone, or Shoulder CT)	Original Date: September 1997
CPT Codes: 73200, 73201, 73202	Last Revised Date: May 2021
Guideline Number: NIA_CG_057-1	Implementation Date: January 2022

INDICATIONS FOR UPPER EXTREMITY CT (HAND, WRIST, ARM, ELBOW, OR SHOULDER) (Plain radiographs must precede CT evaluation):

Some indications are for MRI, CT, or MR or CT Arthrogram. More than one should not be approved at the same time.

If a CT Arthrogram fits approvable criteria below, approve as CT.

Joint specific provocative Orthopedic-orthopedic examination and MRI is contraindicated or cannot be done ([see Table 1](#))

Note: With a positive orthopedic sign, an initial x-ray is always preferred. However, it is not required to approve advanced imaging.

- Shoulder (Bencardino, 2013; Jain, 2017; Loh, 2016; Somerville, 2017)
 - Any positive test listed
 - Rotator cuff weakness (van Kampen, 2014)
 - ~~Neer's Sign~~
 - ~~Hawkins's sign~~
 - ~~Jobe's test (empty can)~~
 - Bear hug test
 - Belly press test
 - Drop aArm test
 - Full can test
 - ~~Hornblower's sign~~
 - Internal rotation lag sign

* National Imaging Associates, Inc. (NIA) is a subsidiary of Magellan Healthcare, Inc.

~~Anterior Shoulder Apprehension test (Bankart Lesion)~~

~~Load and Shift test (Bankart Lesion)~~

~~O'Brien Test~~

- ~~_____~~
- **Supraspinatus test (e.g., Jobe's or Empty can) in the setting of suspected rotator cuff tear** (eg: Jobe's or Empty can) in the setting of suspected rotator cuff tear
- ~~_____~~

- Elbow (Kane, 2014; Karbach, 2017)
 - Any positive test listed
 - Valgus stress
 - **Varus stress**
 - Posterolateral rotatory drawer test
 - **Milking maneuver**
 - **Push-up test**
- Wrist (Pandey, 2014; Ruston, 2013)
 - Any positive test listed
 - Watson test (scaphoid shift test)
 - Scapholunate ballottement test
 - Reagan test (lunotriquetral ballottement test)

Joint or muscle pain without positive findings on an orthopedic exam as listed above, after x-ray completed and an MRI is contraindicated or cannot be performed (Katz, 2013; Mordecai, 2014) (does not apply to young children).

- Persistent joint or musculotendinous pain unresponsive to conservative treatment*, within the last 6 months which includes active medical therapy (physical therapy, chiropractic treatments, and/or ~~physician~~ physician-supervised exercise**) of at least four (4) weeks;
OR
- With progression or worsening of symptoms during the course of conservative treatment

Clinical suspicion of injury with clinical findings, which may be nonspecific, based on mechanism of injury, x-ray completed, and MRI is contraindicated or cannot be ~~done~~ performed

- TFCC (triangular fibrocartilage complex) injury (Barlow, 2016; Ng, 2017)
- SLAP (superior labral anterior to posterior complex) lesions (Somerville, 2017)

Shoulder Impingement (Hawkin's and Neer's signs), after x-ray completed

Unresponsive to conservative treatment*, within the last 6 months which includes active medical therapy (physical therapy, chiropractic treatments, and/or physician supervised exercise**) of at least four (4) weeks; **OR**

With progression or worsening of symptoms during the course of conservative treatment

Other Specific Shoulder Conditions which are approvable after active conservative therapy (above) and x-ray (and MRI cannot be ~~done~~performed or CT is noted to be preferred)

- **Shoulder Impingement—Ht (Hawkin’s, Neer’s, Painful arc, Load and shift, and Yocum tests)**
- **Non–Traumatic Shoulder Instability—Sy (Sulcus, Surprise, Anterior or Posterior draw, Apprehension, Anterior slide, Clunk, Crank, Empty can, HERI (hyperextension-internal rotation) tests)**
- **Glenoid labral tear (i.e., SLAP lesion) if MRI cannot be ~~done~~completed—Ae (Apprehension, Relocation, Surprise, Jobe’s, O’Brien’s, Superior labral, Anterior slide, Jerk, Compression rotation, Crank tests)**

Shoulder Dislocations

(Galvin, 2017; Kilocyne, 2017; Galvin, 2017)

- **Recurrent**
- **First time in any of the situations below that increase the risk or repeated dislocation**
 - **Glenoid or humeral bone loss on x-ray**
 - **14-35 year–old competitive contact sport athlete**

Extremity Mass

- Mass or lesion after non-diagnostic x-ray or ultrasound **(Murphey, 2018)(ACR, 2017)**
 - If superficial, then ultrasound is the initial study-
 - If deep, then x-ray is the initial study-
 - CT is better than MRI to evaluate mass calcification or bone involvement and may complement or replace MRI (Subhawong, 2010)
 - If there is a contraindication to MRI

Known Cancer of the Extremity

(Bestic, 2019; Fitzgerald, 2015; Holzapfel, 2015; Kircher, 2012; Morrison, 2013; NCCN, 2019)

- Cancer staging
- Cancer ~~r~~Restaging
- Signs or symptoms of recurrence

Infection of Bone or Joint

(Dodwell, 2013; Glaudemans, 2019)

MRI and nuclear medicine studies are recommended for acute infection as they are more sensitive in detecting early changes of osteomyelitis (Mandell, 2017). CT is better at

demonstrating findings of chronic osteomyelitis (sequestra, involucrum, cloaca, sinus tracts) as well as detecting soft tissue gas and foreign bodies (Fayad, 2007).

- Abnormal x-ray or ultrasound
- Negative x-ray but with a clinical suspicion of infection
 - Signs and symptoms of joint or bone infection include:
 - Pain and swelling
 - Decrease range of motion
 - Fevers
 - Laboratory findings of infection include:
 - Elevated ESR or CRP
 - Elevated white blood cell count
 - Positive joint aspiration
- Ulcer (diabetic, pressure, ischemic, traumatic) with signs of infection (redness, warm, swelling, pain, discharge which may range from white to serosanguineous) that is not improving despite treatment and bone or deep infection is suspected
 - Increased suspicion if size or temperature increases, bone is exposed/positive probe-to-bone test, new areas of breakdown, new smell (Bowers, 2020)

Osteonecrosis (Avascular necrosis (AVN)) [MRI is contraindicated or cannot be ~~done~~performed]

(Felten, 2019; Murphey, 2014, 2016; Wenham, 2014)

- Abnormal x-ray
- Normal or indeterminate ~~x~~x-rays but symptomatic and ~~high~~high-risk (e.g., glucocorticosteroid use, renal transplant recipient, glycogen storage disease, alcohol abuse (Fukushima, 2010), sickle cell anemia (Wali, 2011))

Inflammatory Arthropathy (e.g., ~~r~~Rheumatoid ~~a~~aArthritis), and MRI is contraindicated or cannot be ~~done~~performed

(Colebatch, 2013; Sudol-Szopinska, 2013)

- Further evaluation of an abnormality or non-diagnostic findings on prior imaging
- Initial imaging of a single joint for diagnosis or response to therapy after plain films and appropriate lab tests (e.g., RF, ANA, CRP, ESR) (~~Colebatch, 2013~~).
- Follow-up to determine treatment efficacy in the following:
 - Early rheumatoid arthritis
 - Follow-up to determine treatment efficacy of advanced rheumatoid arthritis if x-ray and ultrasound are equivocal or noncontributory
- ~~To determine change in treatment or when diagnosis is uncertain prior to start of treatment~~

Crystalline Arthropathy

- Dual-energy CT can be used to characterize crystal deposition disease, such as gout versus CPPD (Chou, 2017)

Bone Fracture

- Suspected stress or insufficiency fracture with a negative initial x-ray ([ACR, 2016](#)[Bencardino, 2017](#); Sadineni, 2015)
 - Repeat x-rays in 10-14 days if negative or non-diagnostic.
- Intra-articular fractures or carpal bone fractures or instability that may require surgery (Kaewlai, 2008)
- Suspected scaphoid fracture with negative x-rays
- Other upper extremity fractures that may require surgery
- Nonunion or delayed union as demonstrated by no healing between two sets of x-rays. If a fracture has not healed by 4-6 months, there is delayed union. Incomplete healing by 6-8 months is nonunion (Morshed, 2014; Salih, 2015)

Occult wrist ganglion, after indeterminate or negative ultrasound and MRI is contraindicated or cannot be ~~done~~ [performed](#)

(Meena, 2014)

- Clinical suspicion and failed 4 weeks conservative treatment, including all of the following:
 - Activity modification
 - Rest, ice, or heat
 - Splinting or orthotics
 - Medication

Osteochondral lesions (defects, fractures, osteochondritis dissecans) and x-ray ~~done~~ [completed](#)

(Smith, 2012; [Taljanovic, 2019](#); [Fuite, 2014](#); Van Bergen, 2015; Van Dijk, 2010)

- Clinical suspicion based on mechanism of injury and physical findings
- Loose bodies or synovial chondromatosis seen on x-ray or ultrasound
 - In the setting of joint pain (Rajani, 2016)

Foreign Body

(Laya, 2017)

- Indeterminate x-ray and ultrasound

Tendon or Muscle Rupture after x-ray and MRI is contraindicated or cannot be ~~done~~ [performed](#)

(Garras, 2012; Peck, 2017; Wilkins, 2012)

—Clinical suspicion based on mechanism of injury and physical findings ([i.e., Popeye, Hook, Yergasons sign](#))

-

Peripheral Nerve Entrapment ([e.g., carpal tunnel](#)) and MRI is contraindicated or cannot be ~~done~~ [performed](#), including any of the following:

(Domkundwar, 2017; Dong, 2012; Donovan, 2010; Meyer, 2018; Tos, 2015):

- Abnormal ~~e~~Electromyogram or ~~n~~Nerve conduction study
- Abnormal x-ray or ultrasound
- Clinical suspicion and failed 4 weeks conservative treatment including at least two of the following (active treatment with physical therapy is not required):
 - Activity modification
 - Rest, ice, or heat
 - Splinting or orthotics
 - Medication

Brachial Plexopathy (~~Vijayasarithi, 2016~~) and MRI is contraindicated or cannot be ~~done~~**performed**

(Mansukhani, 2013; Vijayasarithi, 2016)

- If mechanism of injury or EMG/NCV studies are suggestive
—Chest MRI is preferred study, but neck and/or shoulder (upper extremity) MRI can be ordered depending on the suspected location of injury

-

Pre-operative/procedural evaluation:

- Pre-operative evaluation for a planned surgery or procedure if the imaging provides diagnostic information that is not available on prior studies (provider should be referred to the health plan for nondiagnostic surgical planning studies.)

Post-operative/procedural evaluation:

- When imaging, physical, or laboratory findings indicate joint infection, delayed or non-healing, or other surgical/procedural complications-
- Joint prosthesis loosening or dysfunction, x-rays non-diagnostic (Fritz, 2014, 2015)

Note: Any test that suggest joint impingement or instability requires further imaging (list is not all inconclusive)

|

Table 1: Positive Orthopedic Joint Tests, Upper Extremity

ELBOW

Moving valgus stress test
Hook test
Passive forearm pronation
Biceps squeeze test
Biceps Aponeurosis (BA) flex test
Table top relocation test

SHOULDER

~~Anterior draw/anterior load and shift~~

~~Apprehension test~~

Drop Arm Test

~~Dropping sign~~

External rotation lag sign 0 and 90 degrees

Full can test

~~Grind test~~

~~Hawkins or Neer impingement~~

Hook test

Hornsblower test

~~HERI (hyper extension internal rotation)~~

Internal rotation lag sign

~~Jobe (empty can)~~

Lift off test

Popeye sign

~~Posterior draw~~

~~Shift and load test~~

~~Sulcus~~

~~Surprise test~~

~~Yocum~~

WRIST

Snuff box pain (after initial x-ray)

Derby relocation test

Ulnar foveal sign/test

Press test

Ulnocarpal stress test (if concern for TFCC tear)

BACKGROUND

Computed tomography (CT) may be used for the diagnosis, evaluation, and management of conditions of the hand, wrist, elbow, and shoulder. CT is not usually the initial imaging test, but [it](#) is performed after standard radiographs. CT is used for preoperative evaluation or to evaluate specific abnormalities of the bones, joints, and soft tissues of the upper extremities.

OVERVIEW

***Conservative Therapy:** (Musculoskeletal) should include a multimodality approach consisting of a combination of active and inactive components. Inactive components such as rest, ice, heat, modified activities, medical devices, (~~such as including~~ crutches, immobilizer, metal braces, orthotics, rigid stabilizer, or splints, etc. and not to include neoprene sleeves), medications, injections (bursal, and/or joint, not including trigger point), and diathermy, can be utilized. Active modalities may consist of physical therapy, a ~~physician-physician~~-supervised home exercise program~~**~~, and/or chiropractic care.

****Home Exercise Program - (HEP)** – The following two elements are required to meet guidelines for completion of conservative therapy:

- Information provided on exercise prescription/plan AND
- Follow up with member with information provided regarding completion of HEP (after suitable 4-week period), or inability to complete HEP due to physical reason- ~~ie.i.e.~~, increased pain, inability to physically perform exercises. (Patient inconvenience or noncompliance without explanation does not constitute “inability to complete” HEP).

Joint Implants and Hardware - Dual-energy CT may be useful for metal artifact reduction if available, but [it](#) is also imperfect as the correction is based on a projected approximation of x-ray absorption and does not correct for scatter (Boas, 2012). Dual-energy CT can be used to characterize crystal deposition disease, such as gout versus CPPD (Chou, 2017).

CT to Evaluate Shoulder Pain – The initial work-up for chronic shoulder pain includes plain radiographs. When the diagnosis remains unclear, further testing including may include computed tomography. CT is the preferred imaging technique for evaluating bony disorders of the shoulders, e.g., arthritis, tumors, occult fractures, ~~etc.~~ CT may be useful in patients with suspected rotator cuff tears who cannot undergo magnetic resonance imaging (MRI).

Shoulder Dislocation – Glenoid bone loss occurs in anterior shoulder dislocation. Severe degrees of glenoid bone loss are shown on axial radiography, but it can be quantified more definitively using CT. This information is important as it helps to predict the likelihood of further dislocation and the need for bone augmentation surgery. The number of dislocations cannot reliably predict the degree of glenoid bone loss; it is important to quantify glenoid bone loss, initially by arthroscopy and later by CT. In the CT examination, both glenoids can be examined simultaneously, resulting in a comparison of the width of the glenoid in the dislocating shoulder and in the non-dislocating shoulder.

Shoulder fractures – CT may be used to characterize shoulder fractures when more information is needed preoperatively. CT can show the complexity of the fracture, and the displacement, and angulation.

CT and Wrist Fractures – CT is indicated for wrist fractures where there is fracture comminution, displacement, or complex intraarticular extension. CT can provide a detailed evaluation of radiocarpal articular step-off and gap displacement which can predict the development of radiocarpal osteoarthritis. CT can be performed in several planes, providing soft-tissue and bone detail. CT is also useful in determining the position of known fracture fragments and in assessing the union or status of fracture healing.

CT for Preoperative Evaluation – Where more information is needed preoperatively, CT is used to demonstrate fracture complexity, displacement, and angulation.

CT and Scaphoid Fractures – CT is accurate in depicting occult cortical scaphoid fractures. It may be used as a ~~second~~ second-choice diagnostic method when patients are clinically suspected of having a scaphoid fracture but radiographs are negative or equivocal. ~~Usually~~ Usually, the diagnosis of a scaphoid fracture of the wrist is based upon clinical presentation and conventional radiographs. However, a large percentage of patients with a high clinical probability of a scaphoid fracture have unremarkable radiographs. ~~Computed tomography (CT) is another diagnostic tool for patients who have symptoms of a scaphoid fracture but have negative findings on conventional radiographs.~~ Multidetector CT allows coverage of the whole wrist with excellent spatial resolution. It has been proven to be superior to MRI in the detection of cortical involvement of occult scaphoid fractures.

CT and Avascular Necrosis Complicating Chronic Scaphoid Nonunion – Preoperative CT of a scaphoid nonunion may be helpful in identifying avascular necrosis and predicting subsequent fracture union. If the results of CT suggest avascular necrosis, treatment options may include vascularized bone grafts or limited wrist arthrodesis.

CT and Posttraumatic Elbow Effusions - Multidetector computed tomography (MDCT) may help to detect occult fractures of the elbow when posttraumatic elbow effusions are shown on radiographs without any findings of fracture. Effusions may be visualized on radiographs as fat pads, which can be elevated by the presence of fluid in the joint caused by an acute fracture. MDCT may be useful when effusions are shown on radiographs without a visualized fracture, but there is a clinical suspicion of a lateral condylar or radial head fracture.

CT and Avascular Necrosis – Sports, such as racquetball and gymnastics, may cause repeated microtrauma due to the compressive forces between the radial head and capitellum. Focal avascular necrosis and osteochondritis dissecans of the capitellum may result. CT may show the extent of subchondral necrosis and chondral abnormalities. The images may also help detect intraarticular loose bodies.

CT and Acute Osseous Trauma – Many elbow injuries result from repetitive microtrauma rather than acute trauma and the injuries are sometimes hard to diagnose. Non-displaced fractures are not always evident on plain radiographs. When fracture is suspected, CT may improve diagnostic specificity and accuracy.

CT and Wrist Tumor – Osteoma does not often occur in the wrist. Symptoms may resemble atypical tenosynovitis. Pain may seem to be related to an injury. CT, [however](#), may be used to evaluate a suspected tumor and may visualize a round lucency surrounded by a rim of sclerosis. CT can give details about the location of the tumor, relative to joints.

Upper Extremity Osteomyelitis and Septic Arthritis – CT helps to distinguish among the types of musculoskeletal infections. Its specific imaging features help identify the forms of infection in the bones and soft tissue. Osteomyelitis, a bone infection most commonly associated with an open fracture or direct trauma, is often not detected in the initial conventional radiographic evaluation because bone changes are not evident for 14-21 days after the onset of infection. CT is also used to help diagnose septic arthritis; CT features include joint effusion and bone erosions around the joint.

Adhesive Capsulitis a.k.a. Frozen Shoulder (Ramirez, 2019; Redler, 2019; Small, 2018) - MRI is the preferred modality for imaging after a failure of improvement with active conservative therapy. Affected patients have impaired range of shoulder motion with forward flexion, abduction, and external and internal rotation which may be associated with pain. Clinically, it can be distinguished from rotator cuff pathology where passive range of motion is preserved, or neoplasm which may also have associated fever or weight loss. Treatment is with a combination of intracapsular steroid injection and active conservative care. Anti-inflammatory medications are also given to facilitate active treatment. When nonsurgical management, including anti-inflammatory medication, active care (physical therapy, a supervised home exercise program or manipulations), and injections, have failed to provide relief of symptoms by 9 to 12 months, surgical intervention is indicated, but this represents the minority of patients.

American Academy of Pediatrics “Choosing Wisely” Guidelines advise against ordering advanced imaging studies (MRI or CT) for most musculoskeletal conditions in a child until all appropriate clinical, laboratory and plain radiographic examinations have been completed. “History, physical examination, and appropriate radiographs remain the primary diagnostic modalities in pediatric ~~orthopaedics~~[orthopedics](#), as they are both diagnostic and prognostic for the great majority of pediatric musculoskeletal conditions. Examples of such conditions would include, but not be limited to, the work up of injury or pain (spine, knees, and ankles), possible infection, and deformity. MRI examinations and other advanced imaging studies frequently require sedation in the young child (5 years old or less) and may not result in appropriate interpretation if clinical correlations cannot be made. Many conditions require specific MRI sequences or protocols best ordered by the specialist who will be treating the patient... if you believe findings warrant additional advanced imaging, discuss with the consulting ~~orthopaedic~~[orthopedic](#) surgeon to make sure the optimal studies are ordered [\(AAP, 2018\).](#)”

POLICY HISTORY

Date	Summary
<p><u>May 2021</u></p>	<ul style="list-style-type: none"> ● <u>Additional signs for rotator cuff tear that are considered useful</u> ● <u>Removed signs for impingement, shoulder instability and glenoid labral tear since active conservative therapy should be done first</u> — <u>Added section about impingement, nontraumatic shoulder instability and glenoid labral tear requiring active conservative therapy</u> ● <u>Added the following information: about shoulder dislocation,</u> — <u>Added information about suspected bone infection in the setting of ulcers and neuropathy</u> — <u>Additional information about, brachial plexopathy</u> ● <u>Clarified that pre-operative imaging is for diagnostic purposes only</u>
<p><u>May 2020</u></p>	<ul style="list-style-type: none"> ● <u>Expanded the list of orthopedic signs and Added note: With a positive orthopedic sign, an initial x-ray is always preferred. However, it is not required to approve advanced imaging.</u> ● <u>Added information about adhesive capsulitis</u> ● <u>Clarified that if an CT Arthrogram fits approvable criteria, approve as CT.</u> ● <u>Revised the information about an evaluation of an extremity mass.</u> ● <u>Expanded information about osteomyelitis</u> ● <u>Added information about crystalline arthropathy and dual energy CT</u> ● <u>Added information about nonunion/delayed union</u> ● <u>Included loose bodies or synovial chondromatosis</u>
<p><u>May 2019</u></p>	<ul style="list-style-type: none"> ● <u>Added initial statement about approvals: ‘Some indications are for MRI, CT, or MR or CT Arthrogram. More than one should not be approved at the same time’.</u> ● <u>Expanded Extremity mass indications including adenopathy; and mass with increased risk for malignancy</u> ● <u>Modified Known Cancer indication to be more broad – ‘cancer staging, cancer restaging, signs or symptoms of recurrence’</u> ● <u>Expanded sections for bone fracture and infection of bone or joint to include list of signs or symptoms and laboratory findings (elevated ESR or CRP, elevated white blood cell count, positive joint aspiration)</u>

May 2019

- ~~Added initial statement about approvals: ‘Some indications are for MRI, CT, or MR or CT Arthrogram. More than one should not be approved at the same time’.~~
- ~~Expanded Extremity mass indications including adenopathy; and mass with increased risk for malignancy~~
- ~~Modified Known Cancer indication to be more broad — ‘cancer staging, cancer restaging, signs or symptoms of recurrence’~~
- ~~Expanded sections for bone fracture and infection of bone or joint to include list of signs or symptoms and laboratory findings (elevated ESR or CRP, elevated white blood cell count, positive joint aspiration)~~

May 2020

- ~~Expanded the list of orthopedic signs and Added note: With a positive orthopedic sign, an initial x ray is always preferred. However, it is not required to approve advanced imaging.~~
- ~~Added information about adhesive capsulitis~~
- ~~Clarified that if an CT Arthrogram fits approvable criteria, approve as CT.~~
- ~~Revised the information about an evaluation of an extremity mass.~~
- ~~Expanded information about osteomyelitis~~
- ~~Added information about crystalline arthropathy and dual energy CT~~
- ~~Added information about nonunion/delayed union~~
- ~~Included loose bodies or synovial chondromatosis~~

REFERENCES

American Academy of Pediatrics (AAP) Section on Orthopaedics and the Pediatric Orthopaedic Society of North America. Choosing Wisely®. <http://www.choosingwisely.org/clinician-lists/aap-posna-mri-or-ct-for-musculoskeletal-conditions-in-children/>. Released February 12, 2018.

~~American College of Radiology (ACR). ACR Appropriateness Criteria®. <https://acsearch.acr.org/list>. Published 2014.~~

Arnander M, Tennent D. Clinical assessment of the glenoid labrum. *Shoulder Elbow*. 2014;6(4):291–299.

Barlow SJ. A non-surgical intervention for triangular fibrocartilage complex tears. *Physiother Res Int*. 2016 Dec; 21(4):271-276.

Beaman FD, Von Herrmann PF, Kransdorf MJ, et al. American College of Radiology ACR Appropriateness Criteria® - Suspected osteomyelitis, septic arthritis, or soft tissue infection (excluding spine and diabetic foot). *J Am Coll Radiol*. 2017 May; 14: S326-S337. <https://acsearch.acr.org/docs/3094201/Narrative/>.

Bencardino JT, Gyftopoulos S, Palmer WE. Imaging in anterior glenohumeral instability. *Radiology*. 2013 Nov; 269(2).

[Bencardino JT, Stone TJ, et al. ACR Appropriateness Criteria Stress \(Fatigue/Insufficiency\) Fracture, Including Sacrum, Excluding Other Vertebrae. *J Am Coll Radiol*. 2017 May; 14\(5S\):S293-S306.](#)

[Bestic JM, Wessell DE, Beaman FD, et al. American College of Radiology ACR Appropriateness Criteria® - Primary Bone Tumors. <https://acsearch.acr.org/docs/69421/Narrative/>. Revised 2019.](#)

Biederwolf NE. A proposed evidence-based shoulder special testing examination algorithm: clinical utility based on a systematic review of the literature. *Int J Sports Phys Ther*. 2013;8(4):427–440.

Boas FE, Fleischman D. CT artifacts: Causes and reduction techniques. *Imaging Med*. 2012; 4(2):229-240.

[Bowers S, Franco E. Chronic wWounds: Evaluation and mManagement. *Am Fam Physician*. 2020 Feb; 101\(3\):159-66.](#)

Buck FM, Jost B, Hodler J. Shoulder arthroplasty. *Eur Radiol*. 2008; 18(12):2937-2948. doi: 10.5167/uzh-11349.

Cheimonidou AZ, Lamnisis D, Lisacek-Kiosoglous A, et al. Validity and reliability of the finkelstein test. *Trends in Medicine*. 2019; 19:1-7. Available at <https://www.oatext.com/pdf/TiM-19-183.pdf> Accessed April 21, 2020.

Chou H, Chin TY, Peh WCG. Dual-energy CT in gout – A review of current concepts and applications. *J Med Radiat Sci*. 2017 Mar; 64(1):41-51.

Chuang TY, Adams CR, Burkhart SS. Use of preoperative three-dimensional computed tomography to quantify glenoid bone loss in shoulder. *Arthroscopy*. 2008; 24(4):376-382. doi:10.1016/j.arthro.2007.10.008.

Colebatch AN, Edwards CJ, Østergaard M, et al. EULAR recommendations for the use of imaging of the joints in the clinical management of rheumatoid arthritis. *Ann Rheum Dis*. 2013; 72:804-814. <http://ard.bmj.com/content/72/6/804>.

[Consigliere P, Haddo O, Levy O, et al. Subacromial impingement syndrome: Management challenges. *Orthop Res Rev*. 2018 Oct 23; 10:83-91. doi:10.2147/ORR.S157864.](#)

DaSilva M, Goodman A, Gil J, et al. Evaluation of Ulnar-sided Wrist Pain. *J Am Acad Orthop Surg*. 2017; 25(8):e150-e156.

Dodwell ER. Osteomyelitis and septic arthritis in children: current concepts. *Curr Opin Pediatrics*. 2013 Feb; 25(1):58–63.

Domkundwar S, Autkar G, Khadilkar SV, et. al. Ultrasound and EMG–NCV study (electromyography and nerve conduction velocity) correlation in diagnosis of nerve pathologies. *J Ultrasound*. 2017 Jun; 20(2):111-122.

Dommett RM, Redaniel MT, Stevens MC, et al. Features of cancer in teenagers and young adults in primary care: A population-based nested case-control study. *Br J Cancer*. 2013; 108(11):2329. Epub 2013 Apr 25.

Dong Q, Jacobsen JA, Jamadar DA, et al. Entrapment neuropathies in the upper and lower limbs: Anatomy and MRI features. *Radiol Res Practice*. 2012:230679.

Donovan A, Rosenberg ZS, Cavalcanti CF. MR imaging of entrapment neuropathies of the lower extremity. *Radiographics*. 2010; 30(4).

Fayad LM, Carrino JA, Fishman EK. Musculoskeletal infection: Role of CT in the emergency department. *Radiographics*. 2007; 27:1723-36.

Felten R, Pemin P, Caillard S, et al. Avascular osteonecrosis in kidney transplant recipients: Risk factors in a recent cohort study and evaluation of the role of secondary hyperparathyroidism. *PLOS ONE*. February 22, 2019.

Fitzgerald JJ, Roberts CC, Daffner RH, et al. American College of Radiology ACR Appropriateness Criteria® - Follow-up of Malignant or Aggressive Musculoskeletal Tumors. <https://acsearch.acr.org/docs/69428/Narrative/>. Published 2015.

Fritz J, Lurie B, Miller TT, et al. MR imaging of hip arthroplasty implants, *RadioGraphics*. 2014; 34(4):E106-E132. <http://pubs.rsna.org/doi/abs/10.1148/rg.344140010>.

Fritz J, Lurie B, Potter HG. MR imaging of knee arthroplasty implants. *Radiographics*. 2015 Aug; 35(5).

Fukushima W, Fujioka M, Kubo T, et al. Nationwide epidemiologic survey of idiopathic osteonecrosis of the femoral head. *Clin Orthop Relat Res*. 2010 Oct; 468(10):2715-24. Epub 2010 Mar 12.

Gaddey HL, Riegel AM. Unexplained lymphadenopathy: Evaluation and differential diagnosis. *Am Fam Physician*. 2016 Dec 1; 94(11):896-903.

[Galvin JW, Ernat JJ, Waterman BR, Joseph W et al. "The epidemiology and natural history of anterior shoulder instability." *Current Reviews in Musculoskeletal Medicine* vol. 2017 Dec; 10\(4\): \(2017\): 411-424.](#)

Garras DN, Raikin SM, Bhat SB, et al. MRI is Unnecessary for Diagnosing Acute Achilles Tendon Ruptures: Clinical Diagnostic Criteria. *Clin Orthop Relat Res*. 2012 Aug; 470(8): 2268–2273.

[Gismervik SØ, Drogset JO, Granviken F, Rø M, Leivseth G. Physical examination tests of the shoulder: A systematic review and meta-analysis of diagnostic test performance. *BMC Musculoskeletal Disord*. 2017 Jan 25; 18\(1\):41.](#)

Glaudemans AWJM, Jutte PC, et al. Consensus document for the diagnosis of peripheral bone infection in adults: A joint paper by the EANM, EBJIS, and ESR (with ESCMID endorsement). *Eur J Nucl Med Mol Imaging*. 2019; 46(4):957–970.

Hixson KM, Horris HB, McLeod TCV, et al. The Diagnostic Accuracy of Clinical Diagnostic Tests for Thoracic Outlet Syndrome. *J Sport Rehabil*. 2017; 26(5):459-465.

Holtby R, Razmjou H. Accuracy of the Speed's and Yergason's tests in detecting biceps pathology and SLAP lesions: comparison with arthroscopic findings. *Arthroscopy*. 2004; 20(3):231-6.

Holzapfel K, Regler J, Baum T, et al. Local Staging of Soft-Tissue Sarcoma: Emphasis on Assessment of Neurovascular Encasement—Value of MR Imaging in 174 Confirmed Cases. *Radiology*. 2015 Jan; 275(2).

Jain NB, Luz J, Higgins LD, et al. The Diagnostic Accuracy of Special Tests for Rotator Cuff Tear: The ROW Cohort Study. *Am J Phys Med Rehabil*. 2017 Mar; 96(3): 176–183.

Kaewlai R, Avery L, et al. Multidetector CT of Carpal Injuries: Anatomy, Fractures, and Fracture-Dislocations. *Radiographics*. 2008; 28(6).

Kane SF, Lynch JH, Taylor JC. Evaluation of elbow pain in adults. *Am Fam Physician*. 2014 Apr 15; 89(8):649-657.

Karbach LE, Elfar J. Elbow instability: Anatomy, biomechanics, diagnostic maneuvers, and testing. *J Hand Surg Am*. 2017 Feb; 42(2): 118–126.

Katz JN, Brophy RH, Chaisson CE, et al. Surgery versus physical therapy for a meniscal tear and osteoarthritis. *N Engl J Med*. 2013; 368:1675-1684.

[Kilcoyne KG, Parada SA et al. Prevention and management of post-instability glenohumeral arthropathy. *World J Orthop*. 2017 Mar 18; 8\(3\):229-241.](#)

Kircher MF, Willman JK. Molecular body imaging: MR imaging, CT, and US. Part II. Applications. *Radiology*. 2012; 264(2):349.

Laya BF, Restrepo R, Lee EY. Practical imaging evaluation of foreign bodies in children: An update. *Radiol Clin North Am*. 2017 Jul; 55(4):845-867.

Lee YJ, Sadigh S, Mankad K, et al. The imaging of osteomyelitis. *Quant Imaging Med Surg*. 2016 Apr; 6(2):184–198.

Lester B, Halbrecht J, Levy IM, Gaudinez R. "Press test" for office diagnosis of triangular fibrocartilage complex tears of the wrist. *Ann Plast Surg*. 1995 Jul; 35(1):41-5.

Loh B, Lim JBT, Tan AHC. Is clinical evaluation alone sufficient for the diagnosis of a Bankart lesion without the use of magnetic resonance imaging? *Ann Transl Med*. 2016 Nov; 4(21):419.

Mandell JC, Khurana B, Smith JT, et al. Osteomyelitis of the lower extremity: Pathophysiology, imaging, and classification, with an emphasis on diabetic foot infection. *Emerg Radiol*. 2017.

Mansukhani KA. Electrodiagnosis in traumatic brachial plexus injury. *Ann Indian Acad Neurol.* 2013 Jan-Mar; 16(1):19-25. doi:10.4103/0972-2327.

Meena S, Gupta A. Dorsal wrist ganglion: Current review of literature. *J Clin Orthop Trauma.* 2014 Jun; 5(2): 59–64.

Meyer P, Lintingre P-F, Pesquer L, et al. The Median Nerve at the Carpal Tunnel ... and Elsewhere. *J Belgian Soc Radiol.* 2018; 102(1):17.

Mohseni S, Shojaiefard A, Khorgami Z, et al. Peripheral lymphadenopathy: Approach and diagnostic tools. *Iran J Med Sci.* 2014 Mar; 39(2 Suppl):158–170.

Mordecai SC, Al-Hadithy N, Ware HE, et al. Treatment of meniscal tears: An evidence based approach. *World J Orthop.* 2014 Jul 18; 5(3):233–241.

~~Morrison WB, Weissman BN, Kransdorf MJ, et al. American College of Radiology ACR Appropriateness Criteria®—Primary Bone Tumors. <https://acsearch.acr.org/docs/69421/Narrative/>. Published 2013.~~

Morshed S. Current Options for Determining Fracture Union. *Adv Med.* 2014; 708574.

Mullan CP, Madan R, Trotman-Dickenson B, et al. Radiology of chest wall masses. *AJR.* 2011:197(3).

Murphey MD, Foreman KL, Klassen_Fischer MK, et al. From the radiologic pathology archives imaging of osteonecrosis: Radiologic-pathologic correlation. *RadioGraphics.* 2014 Jul 14; 34(4).

Murphey MD, Roberts CC, Bencardino JT, et al. American College of Radiology ACR Appropriateness Criteria® - Osteonecrosis of the Hip. *J Am Coll Radiol.* 2016; 13:147-155. <https://acsearch.acr.org/docs/69420/Narrative/>.

Murphey MD, Wessell DE, et al. ACR Appropriateness Criteria® Soft-Tissue Masses. *J Am Coll Radiol.* 2018 May; 15(5 Suppl):S189-S197.

Nazarian LN, Jacobson JA, Benson CB, et al. Imaging algorithms for evaluating suspected rotator cuff disease: Society of Radiologists in Ultrasound Consensus Conference Statement. *Radiology.* 2013; 267(2):589-595. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3632808/>.

National Comprehensive Cancer Network (NCCN). Imaging guidelines. 2019. https://www.nccn.org/professionals/physician_gls/default.aspx.

Ng AW, Chu CM, Lo WN, et al. Assessment of capsular laxity in patients with recurrent anterior shoulder dislocation using MRI. *AJR Am J Roentgenol.* 2009; 192(6): 1690-1695. doi:10.2214/AJR.08.1544.

[Ng AW, Griffith JF, Fung CS, et al. MR imaging of the traumatic triangular fibrocartilaginous complex tear. *Quant Imaging Med Surg.* 2017; 7\(4\):443-460. <http://doi.org/10.21037/qims.2017.07.01>.](#)

O'Driscoll SW, Goncalves LB, Dietz P. The hook test for distal biceps tendon avulsion. *Am J Sports Med.* 2007; 35(11):1865-9.

Pandey T, Slaughter AJ, Reynolds KA, et al. Clinical orthopedic examination findings in the upper extremity: Correlation with imaging studies and diagnostic efficacy. *Radiographics.* 2014; 34:E24–E40

Peck J, Gustafson KE, Bahner DP. Diagnosis of achilles tendon rupture with ultrasound in the emergency department setting. *Int J Academ Med.* 2017; 3(3):205-207.

Ramirez J. Adhesive capsulitis: Diagnosis and management. *Am Fam Physician.* 2019 Mar 1; 99(5):297-300.

[Rajani R, Quinn R. Synovial chondromatosis. *OrthoInfo.* 2016 Dec. <https://orthoinfo.aaos.org/en/diseases--conditions/synovial-chondromatosis>](#)

Rayegani SM, Adybeik A, Kia MA. Sensitivity and specificity of two provocative tests (Phalen's test and Hoffmann-Tinel's sign) in the diagnosis of carpal tunnel syndrome. *J Orthop Med.* 2004; 26(2):51-53.

Razmjou H, Christakis M, Dwyer T, et al. Diagnostic accuracy of clinical tests in detecting rotator cuff pathology. *Orthop Sports Med. Open Access J.* 2019; 2(4):170-179.

Redler LH, Dennis MS. Treatment of adhesive capsulitis of the shoulder. *J Am Acad Orthop Surg.* 2019 Jun 15; 27(12):e544-e554.

Rhee RB, Chan KK, Lieu JG, Kim BS, Steinbach LS. MR and CT arthrography of the shoulder. *Semin Musculoskelet Radiol.* 2012 Feb; 16(1):3-14. Epub 2012 Mar 23.

Ruston J, Konan S, Rubinraut E, et al. Diagnostic accuracy of clinical examination and magnetic resonance imaging for common articular wrist pathology. *Acta Orthop Belg.* 2013; 79:375-380.

Sadineni RT, Psumarthy A, Bellapa NC, et al. Imaging patterns in MRI in recent bone injuries following negative or inconclusive plain radiographs. *J Clin Diagn Res.* 2015 Oct; 9(10):TC10–TC13.

[Salih S, Blakey C, et al. The callus fracture sign: A radiological predictor of progression to hypertrophic non-union in diaphyseal tibial fractures. *Strat Traum Limb Recon.* 2015; 10:149–153.](#)

Sawalha S, Fischer J. The accuracy of "subacromial grind test" in diagnosis of supraspinatus rotator cuff tears [published correction appears in *Int J Shoulder Surg.* 2016 Jan-Mar; 10(1):53]. *Int J Shoulder Surg.* 2015;9(2):43–46.

Scalcione LR, Gimber LH, Ho AM, et al. Spectrum of carpal dislocations and fracture-dislocations: Imaging and management. *Am J Roentgenol.* 2014; 203:541-550.

Sinha S, Peach AH. Diagnosis and management of soft tissue sarcoma. *BMJ.* 2010; 341:c7170.

Small KM, Adler RS, Shah SH, et al. American College of Radiology ACR Appropriateness Criteria® - Shoulder Pain: Atraumatic. *JACR.* 2018 Nov; 15(Suppl 11):S388-S402. <https://acsearch.acr.org/docs/3101482/Narrative/>. Published 2017.

Smith ML, Bain GI, Chabrel N, et al. Using computed tomography to assist with diagnosis of avascular necrosis complicating chronic scaphoid nonunion. *J Hand Surg Am.* 2009; 34(6):1037-1043. doi:10.1016/j.jhsa.2009.02.016.

Smith TO, Drew BT, Toms AP, et al. Accuracy of magnetic resonance imaging, magnetic resonance arthrography and computed tomography for the detection of chondral lesions of the knee. *Knee Surg Sports Traumatol Arthrosc.* 2012 Dec; 20(12):2367-79. Epub 2012 Jan 24.

Som A, Singh P. Finkelstein Sign. [Updated 2020 Feb 10]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2020 Jan-. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK539768/> Accessed April 21, 2020.

Somerville LE, Wilits K, Johnson AM, et al. Clinical assessment of physical examination maneuvers for superior labral anterior to posterior lesions. *Surg J (NY).* 2017 Oct; 3(4):e154–e162.

Subhawong TK, Fishman EK, Swart JE, et al. Soft-tissue masses and masslike conditions: What does CT add to diagnosis and management? *AJR Am J Roentgenol.* 2010 Jun; 194(6):1559–1567.

Sudol-Szopinska I, Cwikla JB. Current imaging techniques in rheumatology: MRI, scintigraphy and PET. *Pol J Radiol*. 2013 Jul-Sep; 78(3):48–56.

[Taljanovic, MS, Chang, EY, Ha, AS, et al. American College of Radiology Appropriateness Criteria® - Acute Trauma to the Knee. Revised 2019.](https://acsearch.acr.org/docs/69419/Narrative/)

[https://acsearch.acr.org/docs/69419/Narrative/.](https://acsearch.acr.org/docs/69419/Narrative/)

Tay SC, Tomita K, Berger RA. The "ulnar fovea sign" for defining ulnar wrist pain: an analysis of sensitivity and specificity. *J Hand Surg Am*. 2007; 32(4):438-44.

Tos P, Crosio A, Pugliese P, et. el. Painful scar neuropathy: principles of diagnosis and treatment. *Plast Aesthet Res*. 2015; 2:156-64.

~~Tuite MJ, Daffner RH, Weissman BN, et al. American College of Radiology Appropriateness Criteria® - Acute Trauma to the Knee. [https://acsearch.acr.org/docs/69419/Narrative/.](https://acsearch.acr.org/docs/69419/Narrative/) Published 2014.~~

Turan A, Celtikci P, Tufan A, et al. Basic radiological assessment of synovial diseases: A pictorial essay. *Eur J Rheumatol*. 2017 Jun; 4(2):166-74.

Van Bergen CJA, Gerards RM, Opdam KTM, et, al. Diagnosing, planning and evaluating osteochondral ankle defects with imaging modalities. *World J Orthop*. 2015 Dec 18; 6(11):944–953.

Van Dijk CN, Reilingh ML, Zengerink M, et al. Osteochondral defects in the ankle: Why painful? *Knee Surg Sports Traumatol Arthrosc*. 2010 May; 18(5):570–580.

[Van Kampen DA, van den Berg T. The diagnostic value of the combination of patient characteristics, history, and clinical shoulder tests for the diagnosis of rotator cuff tear. *J Orthop Surg Res*. 2014; 9:70.](#)

[Vijayasarithi A, Chokshi C. MRI of the brachial Plexus: A practical review. *Applied Radiology*. 2016 May: 9-18.](#)

[Wali Y, Almaskan S. Avascular necrosis of the hip in sickle cell disease in oman. Is it serious enough to warrant bone marrow transplantation? *Sultan Qaboos Univ Med J*. 2011 Feb; 11\(1\):127–128.](#)

Welling RD, Jacobson JA, Jamadar DA, et al. MDCT and radiography of wrist fractures: Radiographic sensitivity and fracture patterns. *AJR Am J Roentgenol*. 2008; 190:10-16. doi:10.2214/AJR.07.2699.

Wenham CYJ, Grainger AJ, Coaghan PG. The role of imaging modalities in the diagnosis, differential diagnosis and clinical assessment of peripheral joint osteoarthritis. *Osteoarthritis Cartilage*. 2014; 22(2014):1692e1702.

[Wilkins R, Bisson LJ. Operative versus nonoperative management of acute achilles tendon ruptures: A quantitative systematic review of randomized controlled trials. *Am J Sports Med*. 2012; 40\(9\):2154.](#)

Yin ZG, Zhang JB, Kan SL, et al. Diagnosing suspected scaphoid fractures: A systematic review and meta-analysis. *Clin Orthop Relat Res*. 2010; 468(3):723-734.
<http://doi.org/10.1007/s11999-009-1081-6>.

Zoga AC, Weissman BN, Kransdorf MJ, et al. American College of Radiology ACR Appropriateness Criteria® - Soft Tissue Masses. <https://acsearch.acr.org/docs/69434/Narrative/>. Published 2017.

Zwerus EL, Somford MP, Maissan F, et al. Physical examination of the elbow, what is the evidence? A systematic literature review. *Br J Sports Med*. 2018; 52(19):1253-1260.

Reviewed / Approved by  M. Atif Khalid, M.D., Medical Director, Radiology

GENERAL INFORMATION

It is an expectation that all patients receive care/services from a licensed clinician. All appropriate supporting documentation, including recent pertinent office visit notes, laboratory data, and results of any special testing must be provided. If applicable: All prior relevant imaging results and the reason that alternative imaging cannot be performed must be included in the documentation submitted.

Disclaimer: Magellan Healthcare service authorization policies do not constitute medical advice and are not intended to govern or otherwise influence the practice of medicine. These policies are not meant to supplant your normal procedures, evaluation, diagnosis, treatment and/or care plans for your patients. Your professional judgement must be exercised and followed in all respects with regard to the treatment and care of your patients. These policies apply to all Magellan Healthcare subsidiaries including, but not limited to, National Imaging Associates (“Magellan”). The policies constitute only the reimbursement and coverage guidelines of Magellan. Coverage for services varies for individual members in accordance with the terms and conditions of applicable Certificates of Coverage, Summary Plan Descriptions, or contracts with governing regulatory agencies. Magellan reserves the right to review and update the guidelines at its sole discretion. Notice of such changes, if necessary, shall be provided in accordance with the terms and conditions of provider agreements and any applicable laws or regulations.