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 a~~A~~rm test
    - Full can test
    - Hornblower's sign
    - **Internal rotation lag sign**

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

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~~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 (Pand~~e~~ay, 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—H~~t (H~~awkin's, Neer's, Painful arc, Load and shift, and Yocum tests~~)~~**
- **Non-Traumatic Shoulder Instability—S~~y (S~~ulcus, Surprise, Anterior or Posterior draw, Apprehension, Anterior slide, Clunk, Crank, Empty can, HERI (hyperextension-internal rotation) tests~~)~~**
- **Glenoid labral tear (~~ie~~i.e., SLAP lesion) if MRI cannot be ~~don~~completed—A~~e~~ (~~A~~pprehension, Relocation, Surprise, ~~Jobe's,~~ O'Brien's, Superior labral, Anterior slide, Jerk, Compression rotation, Crank tests~~)~~**

Shoulder D~~d~~islocations

(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~~R~~estaging
- 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
  - Fever~~s~~
- 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~~R~~heumatoid a~~A~~rthritis)~~,~~ 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~~.~~
- I**nitial i**maging 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:**
  - **Eearly rheumatoid arthritis**
  - **A~~Follow-up to determine treatment efficacy of a~~dvanced 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;Tuite, 2014; Van Bergen, 20156; 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 (iei.e., Popeye, Hook, Yergasons sign)
-

Peripheral Nerve Entrapment (e.g., carpal tunnel) and MRI is contraindicated or cannot be doneperformed, including any of the following:

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

- Abnormal eElectromyogram or nNerve 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 ~~(Vijayasarathi, 2016)~~ and MRI is contraindicated or cannot be ~~done~~**performed**
(Mansukhani, 2013; Vijayasarathi, 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- ~~i.e.~~**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. UsuallyUsually, 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
May 2021	• Additional signs for rotator cuff tear that are considered useful • Removed signs for impingement, shoulder instability and glenoid labral tear since active conservative therapy should be done first Added section about impingement, nontraumatic shoulder instability and glenoid labral tear requiring active conservative therapy • Added the following information: ~~about~~ shoulder dislocation, ~~Added information about~~ suspected bone infection in the setting of ulcers and neuropathy ~~Additional information about~~, brachial plexopathy • ~~Clarified that pre-operative imaging is for diagnostic purposes only~~
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 osteomyeltis • Added information about crystalline arthropathy and dual energy CT • Added information about nonunion/delayed union • Included loose bodies or synovial chondromatosis
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 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'.~~
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- ~~Revised the information about an evaluation of an extremity mass.~~
- ~~Expanded information about osteomyeltis~~
- ~~Added information about crystalline arthropathy and dual energy CT~~
- ~~Added information about nonunion/delayed union~~
- ~~Included loose bodies or synovial chondromatosis~~

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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.