Date of origin: 1998
Last review date: 2015

American College of Radiology
ACR Appropriateness Criteria®

Clinical Condition: **Chronic Elbow Pain**

Variant 1: **Evaluation for chronic elbow pain. First test.**

Radiologic Procedure	Rating	Comments	RRL*
X-ray elbow	9		☢
MRI elbow without IV contrast	1		O
MRI elbow without and with IV contrast	1		O
MR arthrography elbow	1		O
CT elbow without IV contrast	1		☢☢
CT elbow with IV contrast	1		☢☢
CT elbow without and with IV contrast	1		☢☢
CT arthrography elbow	1		☢☢
US elbow	1		O
3-phase bone scan elbow	1		☢☢☢
Rating Scale: **1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate**			***Relative Radiation Level**

Variant 2: **Mechanical symptoms (locking, clicking, limited motion); suspect intra-articular osteocartilaginous body or synovial abnormality; radiographs nondiagnostic.**

Radiologic Procedure	Rating	Comments	RRL*
MRI elbow without IV contrast	9	Either routine MRI or MR arthrogram is appropriate. Use of this procedure depends on availability and expertise. If effusion is present, procedure without contrast is preferred.	O
MR arthrography elbow	9	Either routine MRI or MR arthrogram is appropriate. Use of this procedure depends on availability, expertise, and local conditions.	O
CT elbow without IV contrast	8	This is an alternative procedure.	☢☢
CT arthrography elbow	8	This is an alternative procedure.	☢☢
US elbow	3		O
MRI elbow without and with IV contrast	1		O
CT elbow with IV contrast	1		☢☢
CT elbow without and with IV contrast	1		☢☢
3-phase bone scan elbow	1		☢☢☢
Rating Scale: **1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate**			***Relative Radiation Level**

Clinical Condition: **Chronic Elbow Pain**

Variant 3: **Suspect occult fracture or other bone abnormality; radiographs nondiagnostic.**

Radiologic Procedure	Rating	Comments	RRL*
MRI elbow without IV contrast	9		O
CT elbow without IV contrast	5		☢☢
3-phase bone scan elbow	4		☢☢☢
MR arthrography elbow	2		O
CT arthrography elbow	2		☢☢
MRI elbow without and with IV contrast	1		O
CT elbow with IV contrast	1		☢☢
CT elbow without and with IV contrast	1		☢☢
US elbow	1		O
Rating Scale: **1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate**			***Relative Radiation Level**

Variant 4: **Assess stability of osteochondral injury; radiographs nondiagnostic.**

Radiologic Procedure	Rating	Comments	RRL*
MRI elbow without IV contrast	9	This is an alternative procedure.	O
MR arthrography elbow	9	This is an alternative procedure.	O
CT arthrography elbow	8	This is an alternative procedure.	☢☢
MRI elbow without and with IV contrast	5	This procedure may be appropriate but there was disagreement among panel members on the appropriateness rating as defined by the panel's median rating.	O
CT elbow without IV contrast	3		☢☢
CT elbow with IV contrast	1		☢☢
CT elbow without and with IV contrast	1		☢☢
US elbow	1		O
3-phase bone scan elbow	1		☢☢☢
Rating Scale: **1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate**			***Relative Radiation Level**

Clinical Condition: **Chronic Elbow Pain**

Variant 5: **Palpable soft-tissue mass; radiographs nondiagnostic.**

Radiologic Procedure	Rating	Comments	RRL*
MRI elbow without and with IV contrast	9	Contrast may not be necessary in all cases.	O
MRI elbow without IV contrast	7	This is an alternative procedure for some masses.	O
US elbow	7	This is an alternative procedure.	O
CT elbow with IV contrast	3		☢☢
CT elbow without IV contrast	3		☢☢
CT elbow without and with IV contrast	2		☢☢
3-phase bone scan elbow	1		☢☢☢
CT arthrography elbow	1		☢☢
MR arthrography elbow	1		O
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

Variant 6: **Suspect chronic epicondylitis, refractory to empirical treatment; radiographs nondiagnostic.**

Radiologic Procedure	Rating	Comments	RRL*
MRI elbow without IV contrast	9	This is an alternative procedure.	O
US elbow	8	This is an alternative procedure.	O
MRI elbow without and with IV contrast	2		O
MR arthrography elbow	2		O
3-phase bone scan elbow	2		☢☢☢
CT elbow without IV contrast	1		☢☢
CT elbow with IV contrast	1		☢☢
CT elbow without and with IV contrast	1		☢☢
CT arthrography elbow	1		☢☢
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

Clinical Condition: **Chronic Elbow Pain**

Variant 7: **Suspect collateral ligament tear; radiographs nondiagnostic.**

Radiologic Procedure	Rating	Comments	RRL*
MRI elbow without IV contrast	9	Either routine MRI or MR arthrogram is appropriate. Use of this procedure depends on availability, expertise, and local conditions.	O
MR arthrography elbow	9	Either routine MRI or MR arthrogram is appropriate. Use of this procedure depends on availability, expertise, and local conditions.	O
X-ray elbow stress views	6		☢
US elbow	6		O
CT arthrography elbow	5		☢☢
CT elbow without IV contrast	2		☢☢
MRI elbow without and with IV contrast	1		O
CT elbow with IV contrast	1		☢☢
CT elbow without and with IV contrast	1		☢☢
3-phase bone scan elbow	1		☢☢☢
Rating Scale: **1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate**			***Relative Radiation Level**

Variant 8: **Suspect biceps tendon tear; radiographs nondiagnostic.**

Radiologic Procedure	Rating	Comments	RRL*
MRI elbow without IV contrast	9	This is an alternative procedure.	O
US elbow	8	This is an alternative procedure.	O
MRI elbow without and with IV contrast	1		O
MR arthrography elbow	1		O
CT elbow without IV contrast	1		☢☢
CT elbow with IV contrast	1		☢☢
CT elbow without and with IV contrast	1		☢☢
CT arthrography elbow	1		☢☢
3-phase bone scan elbow	1		☢☢☢
Rating Scale: **1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate**			***Relative Radiation Level**

Clinical Condition: **Chronic Elbow Pain**

Variant 9: **Suspect nerve abnormality; radiographs nondiagnostic.**

Radiologic Procedure	Rating	Comments	RRL*
MRI elbow without IV contrast	9	This is an alternative procedure.	O
US elbow	8	This is an alternative procedure.	O
MRI elbow without and with IV contrast	2		O
MR arthrography elbow	1		O
CT elbow without IV contrast	1		☢☢
CT elbow with IV contrast	1		☢☢
CT elbow without and with IV contrast	1		☢☢
CT arthrography elbow	1		☢☢
3-phase bone scan elbow	1		☢☢☢
Rating Scale: **1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate**			***Relative Radiation Level**

Variant 10: **Elbow stiffness; suspect heterotopic ossification/osteophytosis by radiography. Next test.**

Radiologic Procedure	Rating	Comments	RRL*
CT elbow without IV contrast	9		☢☢
MRI elbow without IV contrast	5		O
3-phase bone scan elbow	5	This procedure may be appropriate but there was disagreement among panel members on the appropriateness rating as defined by the panel's median rating.	☢☢☢
CT elbow with IV contrast	1		☢☢
CT elbow without and with IV contrast	1		☢☢
MRI elbow without and with IV contrast	1		O
US elbow	1		O
MR arthrography elbow	1		O
CT arthrography elbow	1		☢☢
Rating Scale: **1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate**			***Relative Radiation Level**

Clinical Condition: **Chronic Elbow Pain**

Variant 11: **Suspect inflammatory arthritis or bursitis; radiographs obtained.**

Radiologic Procedure	Rating	Comments	RRL*
MRI elbow without and with IV contrast	9	This is an alternative procedure.	O
MRI elbow without IV contrast	8	This is an alternative procedure.	O
US elbow	7	This is an alternative procedure.	O
3-phase bone scan elbow	3		☢☢☢
CT elbow without IV contrast	1		☢☢
CT elbow with IV contrast	1		☢☢
CT elbow without and with IV contrast	1		☢☢
MR arthrography elbow	1		O
CT arthrography elbow	1		☢☢
Rating Scale: **1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate**			***Relative Radiation Level**

CHRONIC ELBOW PAIN

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Summary of Literature Review

Introduction/Overview of Imaging Modalities

Chronic elbow pain may be caused by a variety of osseous abnormalities, soft-tissue abnormalities, or both. Radiography is most helpful for assessing bony structures, calcification, or ossification. Computed tomography (CT), magnetic resonance imaging (MRI), and ultrasonography (US) are the most commonly used additional imaging studies. Although CT and US can be used for specific indications, MRI effectively demonstrates most abnormalities in the elbow. MRI provides important diagnostic information for evaluating the elbow in many different conditions, including collateral ligament injury; epicondylitis; injury to the biceps and triceps tendons; and abnormality of the ulnar, radial, or median nerve; and for evaluating masses about the elbow joint [1-13]. There are a lack of studies showing the sensitivity and specificity of MRI in many of these conditions; most studies demonstrate MRI findings in patients either known or highly likely to have a specific condition. Imaging choices will be considered for a variety of specific clinical variants in the following sections.

Discussion of Imaging Modalities by Variant

Variant 1: Evaluation for chronic elbow pain. First test.

Radiographs are the best initial imaging study for a patient with chronic elbow pain. In some cases, radiographs may reveal the definitive cause of the problem (eg, osseocartilaginous intra-articular body (IAB), osteophytes, heterotopic ossification, osteochondritis dissecans, or calcification in and around the joint in the form of hydroxyapatite deposition or calcium pyrophosphate crystal deposition). Exclusion of an osseous abnormality with radiographs may be helpful when conservative therapy is planned. Radiographs are also a useful adjunct to interpretation if musculoskeletal MRI is subsequently performed [14].

Instability may be difficult to diagnose clinically and some authors suggest that radiographic stress views can be helpful in diagnosing valgus instability [15]. Specific techniques for obtaining these radiographs have been recommended [15] and comparison to the unaffected side may also be of help [16].

Variant 2: Mechanical symptoms (locking, clicking, limited motion); suspect intra-articular osteocartilaginous body or synovial abnormality; radiographs nondiagnostic.

CT and CT arthrography with single-contrast (iodinated contrast or air) and double-contrast (iodinated contrast and air) techniques are superior to radiography for detecting a chondral or osteochondral lesion or IAB [17]. Both of these studies have limitations; a small IAB may be obscured by contrast or confused with air bubbles (double-contrast arthrography). A CT air arthrogram can avoid confusion of air bubbles with IABs. Regardless of method, detection of an IAB is limited by its size and location within the elbow joint, although detection is enhanced by the presence of joint effusion [5].

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Some authors recommend MRI as the initial study [10,12]. MRI following direct intra-articular contrast administration (MR arthrography) is preferred to routine MRI for diagnosing an IAB [18,19]. MRI and MR arthrography are limited in their ability to detect purely cartilaginous lesions in the elbow [20].

Variant 3: Suspect occult fracture or other bone abnormality; radiographs nondiagnostic.

Initial evaluation should begin with radiography, but if the radiographs are nondiagnostic, both traumatic and stress fractures may be identified with MRI and 3-phase bone scan [21-23]. CT may have utility in detection and further evaluation of acute traumatic elbow fractures [24], as well as limited usefulness in identifying stress fractures at the elbow [21]. US is helpful in demonstrating lipohemarthrosis in cases of occult elbow fractures in children [25].

Variant 4: Assess stability of osteochondral injury; radiographs nondiagnostic.

Some authors advocate MRI as the initial study for suspected osteochondral fracture [10,12]. Intravenous (IV) or intra-articular contrast has some limited usefulness in the diagnosis of chondral injuries on MRI [20]. Both CT and MRI can assess for osteochondral fragment stability [26]. MRI following direct intra-articular contrast administration (MR arthrography) can play a role in improving evaluation of stability of an osteochondral lesion [18,19]. Similarly, CT arthrography provides more diagnostic information than standard CT in this setting. Although US may show osteochondral abnormalities in some situations [27], MRI offers a more comprehensive evaluation. IV contrast (indirect arthrography) used in conjunction with MRI can be useful in situations where direct arthrography is not an option.

Variant 5: Palpable soft-tissue mass; radiographs nondiagnostic.

Both MRI and US effectively evaluate suspected soft tissue masses around the elbow. IV contrast is needed for MR evaluation of some, but not all, soft-tissue masses. For example, simple lipoma has a characteristic appearance without contrast. CT can be used as an alternative procedure, particularly for patients who have a contraindication to MRI, but is a second-tier imaging study. As with MRI, IV contrast can be a useful adjunct for diagnosis but is not necessary in all cases. Since palpable soft tissue masses are typically located outside the joint, arthrography is not appropriate for initial evaluation of a mass. Masses with hyperemia or inflammatory masses may be detected with 3-phase bone scan [28-30]. For more detailed information and references, see the ACR Appropriateness Criteria® "Soft-Tissue Masses" [31].

Variant 6: Suspect chronic epicondylitis, refractory to empirical treatment; radiographs nondiagnostic.

Epicondylitis, caused by tendon degeneration and tear of the common extensor tendon laterally ("tennis elbow") or the common flexor tendon medially (in pitchers, golfers, and tennis players), is a common clinical diagnosis. Imaging is usually not necessary [32]. MRI or US may be useful for confirming the diagnosis in refractory cases and to exclude associated tendon and ligament tears [4,5,8,33-37]. IV contrast does not significantly aid in diagnosis of this entity [38]. Epicondylitis may be detected on 3-phase bone scan [39].

Variant 7: Suspect collateral ligament tear; radiographs nondiagnostic.

Radiographs can be useful to identify heterotopic calcification (ossification) of the ulnar collateral ligament [40]. This finding may be associated with partial or complete tears of that structure. Avulsion of the ulnar collateral ligament at the insertion site on the ulna is a source of chronic medial elbow pain in the throwing athlete. Although US has been shown to detect medial epicondylar fragmentation of the humerus in throwing athletes [27], this finding is optimally evaluated with a combination of radiographs and MRI [41]. MR arthrography has been advocated to distinguish complete tears from partial tears of the ulnar collateral ligament [7,42]. At 3T, MR arthrography is more accurate than conventional MRI in detection of ligament tears [43]. With the use of appropriate pulse sequences, MRI is an effective tool in the preoperative diagnosis of posterolateral rotatory instability. This includes assessment of the ulnar band of the lateral collateral ligament [9]. Stress views may be useful in assessing medial or lateral stability.

Variant 8: Suspect biceps tendon tear; radiographs nondiagnostic.

US has been shown to be helpful for diagnosing abnormalities of the distal biceps and triceps tendons, flexor and extensor tendons, ligaments, and nerves, providing an alternative to MRI although MRI is typically used in this clinical scenario [33-35,44-53]. Neither IV nor intra-articular contrast assists in MR diagnosis. Evaluation of the biceps tendon with CT is limited and not usually appropriate.

Variant 9: Suspect nerve abnormality; radiographs nondiagnostic.

The ulnar nerve is particularly vulnerable to trauma from a direct blow in the region of the superficially located restricted space of the cubital tunnel. Anatomic variations of the cubital tunnel retinaculum can contribute to ulnar neuropathy [54]. Axial T1-weighted MR images have been shown to depict the size and shape of the nerve, and axial T2-weighted or short tau inversion recovery images may show an increased signal in the presence of neuritis [1,44,55]. Both are more sensitive than conventional nerve conduction studies [56]. US may also show ulnar nerve enlargement and increased vascularity [47] and, when added to electrodiagnostic tests, increases sensitivity for the diagnosis of ulnar neuropathy at the elbow from 78% to 98% [57]. A snapping of the medial head of the triceps can cause recurrent dislocation of the ulnar nerve. This diagnosis can be confirmed with MRI or CT using axial images with the elbow in flexion and extension [55,58,59]. US is ideal for dynamic assessment of ulnar nerve subluxation and dislocation, as well as for confirmation of snapping triceps syndrome [60,61]. Radial nerve, median nerve, and other entrapment syndromes can also be evaluated with MRI [5,32,55,62].

Variant 10: Elbow stiffness; suspect heterotopic ossification/osteophytosis by radiography. Next test.

CT is superior to radiography in the preoperative assessment of osteophytosis or heterotopic ossification in the patient with symptomatic stiff elbow [17,63]. The inflammatory component of heterotopic ossification can be detected on the early phases of a 3-phase bone scan, and the delayed images will reveal increased uptake due to the bone formation [29,64]. Bone scintigraphy has been used in early detection of heterotopic ossification and in assessing its metabolic activity to appropriately time surgical removal [64]. MRI can also be used for this diagnosis, but osseous detail is inferior to CT. IV contrast does not contribute to this diagnosis. The use of US is limited because of shadowing from bone formation.

Variant 11: Suspect inflammatory arthritis or bursitis; radiographs obtained.

Chronic elbow pain can also be caused by a number of joint-related processes, such as inflammatory arthritis and synovial proliferative disorders. Evaluation begins with radiography to assess for joint distention and erosions. MRI can also show erosions and is effective in characterizing synovitis (a low signal suggests hemosiderin) and the extent and activity of disease [65]. In the setting of rheumatoid arthritis, US can also be used to detect joint effusion, synovitis, and erosions [66]. Bicipitoradial and interosseous bursitis around the distal biceps tendon is a source of elbow pain that can be assessed with MRI or US [52,67]. MRI also demonstrates the effects of the bursa on adjacent structures, including the posterior interosseous and median nerves [67]. Inflammatory arthritis or bursitis can be detected by the early phases of a 3-phase bone scan, as well as on the delayed images, by increased uptake [28-30].

For imaging of osseous tumors see the ACR Appropriateness Criteria® "Primary Bone Tumors" [68] and ACR Appropriateness Criteria® "Metastatic Bone Disease" [69].

Summary of Recommendations

- Initial evaluation of chronic elbow pain should begin with radiography.
- Chondral and osteochondral abnormalities can be further evaluated with MRI or CT. The addition of arthrography is helpful, especially for detecting intra-articular bodies.
- Radiographically occult bone abnormalities can be detected with MRI, CT, or bone scintigraphy.
- Soft-tissue abnormalities (tendons, ligaments, nerves, joint recesses, and masses) are well demonstrated with MRI or US.
- Dynamic assessment with US is effective for diagnosing nerve or muscle subluxation.

Summary of Evidence

Of the 69 references cited in the *ACR Appropriateness Criteria® Chronic Elbow Pain* document, all of them are categorized as diagnostic references including 1 well designed study, 8 good quality studies, and 14 quality studies that may have design limitations. There are 46 references that may not be useful as primary evidence.

The 69 references cited in the *ACR Appropriateness Criteria® Chronic Elbow Pain* document were published from 1982-2015.

While there are references that report on studies with design limitations, 9 well designed or good quality studies provide good evidence.

Relative Radiation Level Information

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

Relative Radiation Level Designations		
Relative Radiation Level*	**Adult Effective Dose Estimate Range**	**Pediatric Effective Dose Estimate Range**
O	0 mSv	0 mSv
☢	<0.1 mSv	<0.03 mSv
☢☢	0.1-1 mSv	0.03-0.3 mSv
☢☢☢	1-10 mSv	0.3-3 mSv
☢☢☢☢	10-30 mSv	3-10 mSv
☢☢☢☢☢	30-100 mSv	10-30 mSv

*RRL assignments for some of the examinations cannot be made, because the actual patient doses in these procedures vary as a function of a number of factors (eg, region of the body exposed to ionizing radiation, the imaging guidance that is used). The RRLs for these examinations are designated as “Varies”.

Supporting Documents

For additional information on the Appropriateness Criteria methodology and other supporting documents go to www.acr.org/ac.

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