

**Chronic Elbow Pain
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
1. Keen NN, Chin CT, Engstrom JW, Saloner D, Steinbach LS. Diagnosing ulnar neuropathy at the elbow using magnetic resonance neurography. <i>Skeletal Radiol.</i> 2012;41(4):401-407.	Observational-Dx	21 patients and 10 volunteers	To evaluate the usefulness of elbow MR neurography in diagnosing UNE.	The mean ulnar nerve size in the symptomatic and normal groups was 0.12 and 0.06 cm(2) ($P<0.001$). The mean relative signal intensity in the symptomatic and normal groups was 2.7 and 1.4 ($P<0.01$). When using a size of 0.08 cm(2), sensitivity was 95% and specificity was 80%.	3
2. Bredella MA, Tirman PF, Fritz RC, Feller JF, Wischer TK, Genant HK. MR imaging findings of lateral ulnar collateral ligament abnormalities in patients with lateral epicondylitis. <i>AJR Am J Roentgenol.</i> 1999;173(5):1379-1382.	Review/Other-Dx	35	Use of MRI to determine whether a relationship exists between lateral epicondylitis and abnormalities of the UCL.	Abnormalities of the lateral UCL were seen more often as the degree of lateral epicondylitis became more severe. In the 9 patients with severe lateral epicondylitis, all patients had thickening of the lateral UCL and 8 had partial/complete tears of that structure. There was surgical correlation in 11 patients.	4
3. Chung CB, Chew FS, Steinbach L. MR imaging of tendon abnormalities of the elbow. <i>Magn Reson Imaging Clin N Am.</i> 2004;12(2):233-245, vi.	Review/Other-Dx	N/A	Review article on MRI of tendon abnormalities of the elbow.	A detailed understanding of common pathology and patterns of injury can facilitate the ease and accuracy of imaging diagnosis of tendon pathology.	4
4. Coel M, Yamada CY, Ko J. MR imaging of patients with lateral epicondylitis of the elbow (tennis elbow): importance of increased signal of the anconeus muscle. <i>AJR Am J Roentgenol.</i> 1993;161(5):1019-1021.	Review/Other-Dx	7	Evaluate MRI findings in patients with chronic lateral epicondylitis.	MRI showed increased signal in the anconeus muscle in all 7 patients.	4
5. Fritz RC, Steinbach LS. Magnetic resonance imaging of the musculoskeletal system: Part 3. The elbow. <i>Clin Orthop Relat Res.</i> 1996(324):321-339.	Review/Other-Dx	N/A	Review article covering the uses of MRI for evaluation of elbow pathology.	MRI is useful for demonstrating tendon, ligament and osseous pathology in the elbow. MRI is most useful in patients who have failed to respond to conservative therapy and additional diagnoses and/or surgery is considered.	4
6. Kijowski R, De Smet AA. Magnetic resonance imaging findings in patients with medial epicondylitis. <i>Skeletal Radiol.</i> 2005;34(4):196-202.	Review/Other-Dx	13 patients 26 controls	A retrospective comparison of the MRI findings of patients with clinically diagnosed medial epicondylitis with the MRI findings of patients of similar age with no clinical evidence of medial epicondylitis.	MRI findings of patients with clinically diagnosed medial epicondylitis included thickening and increased T1 and T2 signal intensity of the common flexor tendon and soft tissue edema around the common flexor tendon. The presence of intermediate to high T2 signal intensity or high T2 signal intensity within the common flexor tendon and the presence of paratendinous soft tissue edema were the most specific findings of medial epicondylitis on MRI.	4

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7. Kijowski R, Tuite M, Sanford M. Magnetic resonance imaging of the elbow. Part II: Abnormalities of the ligaments, tendons, and nerves. <i>Skeletal Radiol.</i> 2005;34(1):1-18.	Review/Other-Dx	N/A	Part II of this comprehensive review on MRI of the elbow discusses the role of MRI in evaluating patients with abnormalities of the ligaments, tendons, and nerves of the elbow.	MRI is useful for detecting tears in the UCL and the LCL, for determining the extent of tendon pathology, for detecting tears of the biceps and triceps and evaluating nerve disorders of the elbow.	4
8. Potter HG, Hannafin JA, Morwessel RM, DiCarlo EF, O'Brien SJ, Altchek DW. Lateral epicondylitis: correlation of MR imaging, surgical, and histopathologic findings. <i>Radiology.</i> 1995;196(1):43-46.	Review/Other-Dx	33	To determine the utility of MRI for clinical management of patients with chronic lateral epicondylitis; correlation with surgical and pathology findings.	Good agreement between MRI and surgery in the definition of tendon degeneration and degree of tear.	4
9. Potter HG, Weiland AJ, Schatz JA, Paletta GA, Hotchkiss RN. Posterolateral rotatory instability of the elbow: usefulness of MR imaging in diagnosis. <i>Radiology.</i> 1997;204(1):185-189.	Review/Other-Dx	9 controls; 9 patients	To evaluate the efficacy of MRI in the assessment of the normal and abnormal ulnar band of the LCL for diagnosis of posterolateral rotatory instability.	MRI is an effective tool in the preoperative diagnosis of posterolateral rotatory instability. This includes assessment of the ulnar band of the LCL.	4
10. Quinn SF, Haberman JJ, Fitzgerald SW, Traugher PD, Belkin RI, Murray WT. Evaluation of loose bodies in the elbow with MR imaging. <i>J Magn Reson Imaging.</i> 1994;4(2):169-172.	Observational-Dx	20	Review of 20 patients with clinical suspicion of intra-articular body(s) that had both MRI of the elbow and subsequent arthroscopic surgery. MRI was compared with arthroscopic findings.	Sensitivity for showing loose bodies with MRI was 100%, and the specificity was 67%. MRI was positive in 16 cases; only 14 were found to have loose body at surgery. MRI and arthroscopy were negative for loose body in 4 cases.	3
11. Schwartz ML, al-Zahrani S, Morwessel RM, Andrews JR. Ulnar collateral ligament injury in the throwing athlete: evaluation with saline-enhanced MR arthrography. <i>Radiology.</i> 1995;197(1):297-299.	Observational-Dx	40	Compare MRI findings with surgical findings to determine whether MR arthrography of the elbow can demonstrate precisely an UCL abnormality in the throwing athlete.	18 (95%) of 19 complete UCL tears and 6 (86%) of 7 partial UCL tears were diagnosed with MR arthrography. Two false-negative findings and no false-positive findings were obtained. MR arthrography useful for detection of incomplete ligament tears.	2
12. Sonin AH, Tutton SM, Fitzgerald SW, Peduto AJ. MR imaging of the adult elbow. <i>Radiographics.</i> 1996;16(6):1323-1336.	Review/Other-Dx	N/A	Review MRI elbow anatomy and illustrates the range of commonly encountered elbow abnormalities including: disruption/tear of ligaments/tendons, osteochondral injury and intra-articular bodies, and synovial-based processes.	Illustrated the utility of MRI in a variety of disorders.	4

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13. Del Grande F, Aro M, Farahani SJ, Wilckens J, Cosgarea A, Carrino JA. Three-Tesla MR imaging of the elbow in non-symptomatic professional baseball pitchers. <i>Skeletal Radiol.</i> 2015;44(1):115-123.	Review/Other-Dx	21 professional non-symptomatic baseball pitchers	To retrospectively evaluate the qualitative and quantitative 3-T MRI features of the elbow in non-symptomatic professional baseball pitchers presenting as major league draft picks or trades.	Collateral ligament thickening was seen in a high proportion, nearly half, however, without features of full thickness tearing. Tendinosis without tearing was seen in 19% (4/21) of common extensors. Cartilage abnormalities were infrequent. Bone abnormalities manifested as edema in 24% (5/21) and humeroulnar osteophytosis. Ulnar nerve signal and/or morphologic abnormalities were seen in a very high proportion, up to 81% (17/21). The olecranon fat pad showed scarring features in about one third. The median ligament thicknesses in mm measured: 4.6 UCL anterior bundle, 1.8 UCL posterior bundle, 1.9 radial collateral ligament, 2.5 lateral UCL, and 0.7 mm annular. The median plica dimensions were 5.3 by 2.2 by 2.7 mm.	4
14. Taljanovic MS, Hunter TB, Fitzpatrick KA, Krupinski EA, Pope TL. Musculoskeletal magnetic resonance imaging: importance of radiography. <i>Skeletal Radiol.</i> 2003;32(7):403-411.	Observational-Dx	1,030 musculoskeletal MRI studies were performed in 1,002 patients	To determine the usefulness of radiography for interpretation of musculoskeletal MRI studies.	Radiographs were essential, very important or added information in 61%–75% of all musculoskeletal MRI cases. Radiographs were judged as essential for reading of MRI studies more often for trauma, infection/inflammation and tumors than for degenerative and miscellaneous/normal diagnoses (chi(2)=60.95, df=16, P<0.0001). The clinical information was rated as “essential” or “useful” significantly more often than not (chi(2)=93.07, df=16, P<0.0001). The clinical and MRI diagnoses were the same or partially concordant significantly more often for tumors than for trauma, infection/inflammation and degenerative conditions, while in the miscellaneous/normal group they were different in 64% of cases. When the diagnoses were different, there were more instances in which radiographs were not available.	3
15. O'Driscoll SW. Stress radiographs are important in diagnosing valgus instability of the elbow. <i>J Bone Joint Surg Am.</i> 2002;84-A(4):686; author reply 686-687.	Review/Other-Dx	N/A	Comment on an article regarding long-term results of treatment of fractures of the medial humeral epicondyle in children.	No results stated in abstract.	4

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16. Lee GA, Katz SD, Lazarus MD. Elbow valgus stress radiography in an uninjured population. <i>Am J Sports Med.</i> 1998;26(3):425-427.	Review/Other-Dx	20 men (40 elbows) and 20 women (40 elbows)	To examine valgus stress radiographs of men and women, none with a history of elbow trauma or instability.	The increase in medial ulnohumeral gapping with either gravity or 5 pounds of stress was statistically significant at both extension and 30 degrees of flexion compared with the unstressed condition. The difference in ulnohumeral gapping between gravity stress and 5 pounds of valgus stress in extension and in 30 degrees of flexion was also significant. The authors found no differences with regard to hand dominance or sex.	4
17. Zubler V, Saupe N, Jost B, Pfirmann CW, Hodler J, Zanetti M. Elbow stiffness: effectiveness of conventional radiography and CT to explain osseous causes. <i>AJR Am J Roentgenol.</i> 2010;194(6):W515-520.	Observational-Dx	94 consecutive patients (71 men, 23 women; mean age, 41 years; range, 18–68 years)	To evaluate the effectiveness of conventional radiography and CT for explaining the osseous causes of elbow stiffness. Analysis of loose bodies and osteophytes on conventional radiography and CT by 2 independent readers.	Accuracy for detecting loose bodies was 67% with conventional radiography and 79% with CT. Accuracy for detecting osteophytes was 69% with conventional radiography and 76% with CT. CT more effective than conventional radiography.	2
18. Grainger AJ, Elliott JM, Campbell RS, Tirman PF, Steinbach LS, Genant HK. Direct MR arthrography: a review of current use. <i>Clin Radiol.</i> 2000;55(3):163-176.	Review/Other-Dx	N/A	Review use of MR arthrography throughout the body, including the elbow.	MR arthrography is useful for demonstrating loose osteochondral fragments, loose bodies, and collateral ligament tears.	4
19. Steinbach LS, Palmer WE, Schweitzer ME. Special focus session. MR arthrography. <i>Radiographics.</i> 2002;22(5):1223-1246.	Review/Other-Dx	N/A	Direct MR arthrography with injection of saline solution or diluted gadolinium can be useful for evaluating certain pathologic conditions in the joints.	MR arthrography is useful for demonstrating ligamentous abnormality and bodies in the elbow joint.	4
20. Theodoropoulos JS, Dwyer T, Wolin PM. Correlation of preoperative MRI and MRA with arthroscopically proven articular cartilage lesions of the elbow. <i>Clin J Sport Med.</i> 2012;22(5):403-407.	Observational-Dx	31 patients	To evaluate the usefulness of MRI in detecting elbow articular cartilage injuries through comparison of preoperative MRI and MR arthrography with arthroscopic findings.	The accuracy of MRI was 45% for chondral injuries of the radius, 65% for the capitellum, 20% for the ulna, and 30% for the trochlea. The accuracy of MR arthrography was 45% for chondral injuries of the radius, 64% for the capitellum, 18% for the ulna, and 27% for the trochlea.	2
21. Anderson MW. Imaging of upper extremity stress fractures in the athlete. <i>Clin Sports Med.</i> 2006;25(3):489-504, vii.	Review/Other-Dx	N/A	To review the most common sites of stress injuries in the upper extremity, their underlying pathophysiology, and their spectrum of imaging findings.	Although a three-phase bone scan is highly sensitive in this regard, MRI has become the study of choice at most centers.	4
22. Ammann W, Matheson GO. Radionuclide Bone Imaging in the Detection of Stress Fractures. <i>Clinical Journal of Sport Medicine.</i> 1991;1(2):115-122.	Review/Other-Dx	N/A	To review the use of radionuclide imaging for clinical diagnosis of overuse bone injuries.	No results stated in abstract.	4

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23. Querellou S, Moineau G, Le Duc-Pennec A, et al. Detection of occult wrist fractures by quantitative radiosintigraphy: a prospective study on selected patients. <i>Nucl Med Commun.</i> 2009;30(11):862-867.	Experimental-Dx	87 patients	To determine the value of quantitative radiosintigraphy in the diagnosis of wrist trauma occult fractures.	From April 2006 to July 2008, 87 patients were enrolled (34 women, 53 men; median age 29 years; range, 15–87 years). Among the 46 pathologic bone scintigrams, 55 occult fractures were highlighted. At follow-up, none presented non-union. One had an undetermined quantitative radiosintigraphy. Among the 40 negative results for quantitative radiosintigraphy at follow-up, only 1 had a non-union. Sensitivity and NPV were 97% and 98%, respectively for carpal fractures. This study highlights the benefit of quantitative radiosintigraphy, which allows the detection of most occult carpal fractures and reduces the risks of complications such as pseudoarthritis.	3
24. Haapamaki VV, Kiuru MJ, Koskinen SK. Multidetector computed tomography diagnosis of adult elbow fractures. <i>Acta Radiol.</i> 2004;45(1):65-70.	Review/Other-Dx	56 patients	To assess acute phase multidetector CT findings in elbow traumas.	A total of 65 fractures and 3 main fracture types were established: 16 (25%) ulnar coronoid process fractures, 13 (20%) radial head fractures, and 12 (18%) humeral supracondylar fractures. 3 main injury mechanisms were falling (38 (68%) patients), falling from high places (6 (11%) patients), and traffic accidents (5 (9%) patients). In 6 (11%) patients, multidetector CT revealed 13 occult fractures in the elbow joint compared to primary radiography. In 4 (7%) patients a displaced fracture fragment was detected in primary radiography, but the origin of the fragment was unclear. In all 4 cases, multidetector CT revealed the origin of the fragment.	4
25. Zuazo I, Bonnefoy O, Tauzin C, et al. Acute elbow trauma in children: role of ultrasonography. <i>Pediatr Radiol.</i> 2008;38(9):982-988.	Observational-Dx	14 patients	To evaluate the potential diagnostic role of US in children who have sustained elbow trauma with an elbow joint effusion but no fracture seen on initial radiographs.	In 7 children US demonstrated a lipohaemarthrosis, and MRI demonstrated a cortical fracture in all these children. Conversely, among the 7 children with simple haemarthrosis seen on US, MRI did not identify a cortical fracture in 6 and demonstrated a cortical fracture in one.	2

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26. Ouellette H, Kassirjian A, Tetreault P, Palmer W. Imaging of the overhead throwing athlete. <i>Semin Musculoskelet Radiol.</i> 2005;9(4):316-333.	Review/Other-Dx	N/A	Review overhead throwing biomechanics as they relate to diagnostic imaging of throwing athletes.	The elbow is typically injured secondary to excessive valgus forces during throwing. The UCL, ulnar nerve, and common flexor tendon origin are all at increased risk of injury. Capitellar osteochondral injuries and loose intra-articular bodies are also frequent.	4
27. Harada M, Takahara M, Sasaki J, Mura N, Ito T, Ogino T. Using sonography for the early detection of elbow injuries among young baseball players. <i>AJR Am J Roentgenol.</i> 2006;187(6):1436-1441.	Observational-Dx	153	A prospective study to determine the usefulness of sonography for detecting elbow injuries among young baseball players.	Sonography showed that 33 subjects had medial epicondylar fragmentation and 2 had early-stage osteochondritis dissecans of the capitellum. In 25 subjects who agreed to further examination and treatment, radiography confirmed the sonographic findings. Sonography can provide an opportunity to detect and treat elbow injuries before they become more advanced.	2
28. Alazraki NP. Radionuclide imaging in the evaluation of infections and inflammatory disease. <i>Radiol Clin North Am.</i> 1993;31(4):783-794.	Review/Other-Dx	N/A	To review the role of radionuclide imaging in the evaluation of infections and inflammatory disease.	The three- or four-phase bone scan is the first line diagnostic imaging technique after a plain radiograph in the evaluation of suspected osteomyelitis. If the bone scan is inconclusive, ¹¹¹ In leukocytes are the second line diagnostic imaging technique, particularly in adults with other bony abnormalities such as degenerative bone changes or trauma. Gallium imaging also may be used, preferably if other bony abnormalities are absent. In children, gallium imaging is the second line diagnostic imaging technique. Once the diagnosis has been made, gallium may be the preferred technique for following response to therapy.	4

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<p>29. Freed JH, Hahn H, Menter R, Dillon T. The use of the three-phase bone scan in the early diagnosis of heterotopic ossification (HO) and in the evaluation of Didronel therapy. <i>Paraplegia</i>. 1982;20(4):208-216.</p>	<p>Review/Other-Dx</p>	<p>52 patients</p>	<p>To investigate the use of a three-phase bone scan for early detection of heterotopic ossification formation and as a method of evaluating Didronel treatment.</p>	<p>There were 23 patients in the series who either showed heterotopic ossification by X-ray on admission or developed heterotopic ossification on follow-up X-rays before beginning Didronel therapy. A three-phase bone scan revealed increased vascularity and accumulation of radioactivity on the bone scan in all areas of ossification on the X-ray and in some areas that did not appear to be involved. The other 29 patients had serial three-phase bone scans, X-ray study, and an alkaline phosphatase determination at approximately 2-week intervals. Didronel treatment was started as soon as the precursor phase of heterotopic ossification was demonstrated on the three-phase bone scan in most of these patients. 9 have not developed ossification that could be seen in X-rays during 3 months of continuing study. 6 patients seen at follow-up during the past year had known heterotopic ossification of 4 to 7 years duration. The three-phase bone scan was used to predict the maturity of heterotopic ossification in these patients. The study indicates that increased vascularity precedes rather than being secondary to heterotopic ossification formation as is suggested in the literature. Didronel treatment appears to be most effective if initiated during this precursor phase.</p>	<p>4</p>

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30. Palestro CJ. Radionuclide imaging of osteomyelitis. <i>Semin Nucl Med.</i> 2015;45(1):32-46.	Review/Other-Dx	N/A	To review radionuclide imaging of osteomyelitis.	FDG is the radionuclide test of choice for spinal infection. The test is sensitive, with a high NPV, and reliably differentiates degenerative from infectious vertebral body end-plate abnormalities. Data on the accuracy of FDG for diagnosing diabetic pedal osteomyelitis are contradictory, and its role for this indication remains to be determined. Initial investigations suggested that FDG accurately diagnoses prosthetic joint infection; more recent data indicate that it cannot differentiate infection from other causes of prosthetic failure. Preliminary data on the PET agents gallium-68 and iodine-124 fialuridine indicate that these agents may have a role in diagnosing osteomyelitis.	4
31. American College of Radiology. ACR Appropriateness Criteria®: Soft-Tissue Masses. Available at: https://acsearch.acr.org/docs/69434/Narrative/ . Accessed September 30, 2015.	Review/Other-Dx	N/A	Evidence-based guidelines to assist referring physicians and other providers in making the most appropriate imaging or treatment decision for a specific clinical condition.	N/A	4
32. Beltran J, Rosenberg ZS. Diagnosis of compressive and entrapment neuropathies of the upper extremity: value of MR imaging. <i>AJR Am J Roentgenol.</i> 1994;163(3):525-531.	Review/Other-Dx	N/A	Review article on MRI in the evaluation of suspected compressive and entrapment neuropathies about the elbow joint.	Compressive and entrapment neuropathies of the upper extremity can produce a group of clinical syndromes, many of which have features that can be shown with MRI.	4
33. Obradov M, Anderson PG. Ultra sonographic findings for chronic lateral epicondylitis. <i>JBR-BTR.</i> 2012;95(2):66-70.	Observational-Dx	49 patients	To assess which individual gray-scale and color Doppler US findings and their combination are strongly associated with lateral epicondylitis. Also to determine whether chronic lateral epicondylitis is possible without any positive US findings.	Neovascularity determined by color Doppler and 4 gray-scale US findings—a convex external contour, an erosive lateral epicondular cortex, internal calcifications, or a tear—have a specificity and PPV of 100% with conclusive likelihood ratios. However, only the sensitivity for neovascularity is above 50%. A combination of gray-scale and color Doppler shows sensitivity between 92% to 100%, a 90% specificity with a 98% PPV and a high likelihood ratio (9 to 10).	3

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34. Poltawski L, Ali S, Jayaram V, Watson T. Reliability of sonographic assessment of tendinopathy in tennis elbow. <i>Skeletal Radiol.</i> 2012;41(1):83-89.	Observational-Dx	19 people	To assess the reliability and compute the minimum detectable change using sonographic scales to quantify the extent of pathology and hyperaemia in the common extensor tendon in people with tennis elbow.	Intraclass correlation coefficient values for inter-rater reliability ranged from 0.35 (95% CI: 0.05, 0.60) for fibrillar disruption to 0.77 (0.55, 0.88) for overall greyscale score, and 0.89 (0.79, 0.95) for hyperaemia. Test-retest reliability ranged from 0.70 (0.48, 0.84) for tendon thickening to 0.82 (0.66, 0.90) for overall greyscale score and 0.86 (0.73, 0.93) for calcification. The minimum detectable change for the greyscale total score was 2.0/12 and for the hyperaemia score was 1.1/5.	4
35. Martinoli C, Bianchi S, Giovagnorio F, Pugliese F. Ultrasound of the elbow. <i>Skeletal Radiol.</i> 2001;30(11):605-614.	Review/Other-Dx	N/A	To review US evaluation of soft tissues of the elbow.	US identifies ulnar nerve abnormalities and extrinsic lesions. Occult fractures, osteophytes and intra-articular loose bodies can also be imaged. US is able to assess the presence of capsular and synovial processes and to differentiate them from soft tissue tumors in para-articular swelling.	4
36. Park GY, Lee SM, Lee MY. Diagnostic value of ultrasonography for clinical medial epicondylitis. <i>Arch Phys Med Rehabil.</i> 2008;89(4):738-742.	Observational-Dx	21 elbows from 18 patients with clinical medial epicondylitis; 25 elbows without medial epicondylitis	Prospective single-blind study to assess the US findings and to evaluate the value of US as a diagnostic method for detecting clinical medial epicondylitis.	US revealed positive findings in 20/21 elbows with medial epicondylitis and was negative in 23/25 without medial epicondylitis. US showed sensitivity, specificity, accuracy, PPV, and NPV for clinical medial epicondylitis of 95.2%, 92%, 93.5%, 90.9%, and 95.8%, respectively. US is informative and accurate for the detection of clinical medial epicondylitis.	2

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37. van Kollenburg JA, Brouwer KM, Jupiter JB, Ring D. Magnetic resonance imaging signal abnormalities in enthesopathy of the extensor carpi radialis longus origin. <i>J Hand Surg Am.</i> 2009;34(6):1094-1098.	Observational-Dx	24 elbows; 48 control elbow MRIs	Test the hypothesis that patients with MRI signal abnormalities consistent with enthesopathy of the extensor carpi radialis brevis are equally likely to have findings consistent with an extensor carpi radialis brevis defect or LCL abnormality.	Patients diagnosed with enthesopathy of the extensor carpi radialis brevis were more likely than control patients to have signal changes consistent with enthesopathy of the extensor carpi radialis brevis origin (24/24 vs 9/48; $P < .001$). Proportion of patients with a partial thickness defect of the extensor carpi radialis brevis origin (14/24 vs 4/9) was comparable between patients diagnosed with enthesopathy of the extensor carpi radialis brevis origin and controls. Signal changes in the LCL were comparable in patients diagnosed with enthesopathy of the extensor carpi radialis brevis origin and control patients (8/24 vs 2/9; $P = .27$), and no patient had clinical evidence of instability. Further study needed in the use of MRI in the management of patients with enthesopathy of the extensor carpi radialis brevis origin.	3
38. Herber S, Kalden P, Kreitner KF, Riedel C, Rompe JD, Thelen M. [MRI in chronic epicondylitis humeri radialis using 1.0 T equipment--contrast medium administration necessary?]. <i>Rofo.</i> 2001;173(5):454-459.	Review/Other-Dx	42 patients and 10 elbow joints of healthy controls	To evaluate the diagnostic value and confidence of contrast-enhanced MRI in patients with lateral epicondylitis in comparison to clinical diagnosis.	In 39/42 patients the STIR sequence showed an increased signal intensity of the common extensor tendon. Increased MR signal of the LCL combined with a thickening and a partial rupture or a full thickness tear have been observed in 15/42 cases. A bone marrow edema at the lateral epicondilus was noticed in 6 of the studied patients and a joint effusion in 18/42 patients. After administration of contrast media, the authors noticed an average increase of signal intensity by about 150%. However, enhanced MRI did not provide additional information.	4

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39. Pienimaki TT, Takalo RJ, Ahonen AK, Karppinen JI. Three-phase bone scintigraphy in chronic epicondylitis. <i>Arch Phys Med Rehabil.</i> 2008;89(11):2180-2184.	Observational-Dx	59 patients	To assess the utility of 3-phase bone scintigraphy as a complementary diagnostic method in chronic epicondylitis.	The bone uptake of (99m)Tc-HDP of the affected epicondyle was 33% and 17% higher in men and women, respectively, compared with the corresponding healthy epicondyle ($P<.001$ and $P=.007$). High bone uptake of (99m)Tc-HDP was associated with better work ability, grip strength, and muscle performance in both sexes but was not correlated with the pain measures. Blood flow phases had a positive correlation with the duration of symptoms and a negative correlation with the bone uptake of (99m)Tc-HDP, grip strength, and work ability. High bone uptake of (99m)Tc-HDP among patients with chronic epicondylitis was associated with better muscle strength, work ability, and arm function. In chronic cases, a higher degree of bone uptake of (99m)Tc-HDP may thus indicate a healing response in the bone tissue.	2
40. Mulligan SA, Schwartz ML, Broussard MF, Andrews JR. Heterotopic calcification and tears of the ulnar collateral ligament: radiographic and MR imaging findings. <i>AJR Am J Roentgenol.</i> 2000;175(4):1099-1102.	Observational-Dx	42 patients	Compare radiographic and MRI findings to describe the radiographic and MRI appearance of heterotopic calcification in the UCL.	Of the 34 patients who underwent surgery, 26 patients (76%) had either partial or complete tears of the UCL. Heterotopic calcification in the UCL may be associated with partial or complete tears. The MRI detection of heterotopic calcification is less sensitive than that of radiography of the elbow.	3
41. Glajchen N, Schwartz ML, Andrews JR, Gladstone J. Avulsion fracture of the sublime tubercle of the ulna: a newly recognized injury in the throwing athlete. <i>AJR Am J Roentgenol.</i> 1998;170(3):627-628.	Review/Other-Dx	3 patients	Original report describing avulsion fracture of the sublime tubercle in 3 patients.	Avulsion fracture of the sublime tubercle is a less common cause of medial elbow pain in throwing athletes and is produced by valgus stress. This problem is best evaluated with a combination of plain radiographs and coronal MRIs. Two of the 3 patients had surgical confirmation.	4
42. Steinbach LS, Schwartz M. Elbow arthrography. <i>Radiol Clin North Am.</i> 1998;36(4):635-649.	Review/Other-Dx	N/A	Focuses on technique and capabilities of conventional, CT and MR arthrography.	MR arthrography is useful for demonstrating loose osteochondral fragments, loose bodies, and collateral ligament tears. CT arthrography with air is recommended for loose bodies.	4

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43. Magee T. Accuracy of 3-T MR arthrography versus conventional 3-T MRI of elbow tendons and ligaments compared with surgery. <i>AJR Am J Roentgenol.</i> 2015;204(1):W70-75.	Observational-Dx	54 patients	To assess the accuracy of 3-T MR arthrography of the elbow vs conventional 3-T MRI of the elbow, compared with surgery.	In 54 patients, the diagnoses made on MRI and MR arthrogram examinations were the same. In 16 patients, MR arthrogram examinations revealed additional findings that were not clearly seen on conventional MRI examinations. There were 6 full-thickness extensor tendon tears, 7 radial collateral ligament tears, and 3 partial-thickness UCL tears seen on MR arthrography that were not well seen on conventional MRI. In 9 patients, MR arthrogram showed ligaments and tendons to be intact that appeared torn on conventional MRI. There were 6 UCLs and 3 common flexor tendons found to be intact on MR arthrography examination that appeared to be torn on conventional MRI. All MR arthrography findings were confirmed at surgery.	3
44. Baumer P, Dombert T, Staub F, et al. Ulnar neuropathy at the elbow: MR neurography--nerve T2 signal increase and caliber. <i>Radiology.</i> 2011;260(1):199-206.	Observational-Dx	20 patients and 20 controls	To assess nerve T2 signal and caliber as diagnostic signs at MR neurography in UNE.	Diagnostic performance, as determined with AUC, was excellent for nerve T2 signal to discriminate UNE from a normal finding (AUC = 0.94; 95% CI: 0.87, 1.00) and was excellent for nerve caliber to discriminate severe from mild UNE (AUC = 0.95; 95% CI: 0.85, 1.00). Qualitative assessment demonstrated sensitivity of 83% and specificity of 85% for MR neurography of UNE.	3
45. Downey R, Jacobson JA, Fessell DP, Tran N, Morag Y, Kim SM. Sonography of partial-thickness tears of the distal triceps brachii tendon. <i>J Ultrasound Med.</i> 2011;30(10):1351-1356.	Review/Other-Dx	5 patients	To retrospectively characterize the sonographic appearance of partial-thickness distal triceps brachii tendon tears.	5 patients had a partial-thickness distal triceps brachii tendon tear at surgery (n = 4) or MRI (n = 1). All cases only involved the superficial tendon layer (combined long and lateral heads) with retraction of a fractured olecranon enthesophyte fragment. The deep tendon layer (medial head) was intact in all cases with no joint effusion.	4

**Chronic Elbow Pain
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
46. Festa A, Mulieri PJ, Newman JS, Spitz DJ, Leslie BM. Effectiveness of magnetic resonance imaging in detecting partial and complete distal biceps tendon rupture. <i>J Hand Surg Am.</i> 2010;35(1):77-83.	Observational-Dx	22 partial and 24 complete distal biceps tendon ruptures	To evaluate the effectiveness of MRI in diagnosing partial and complete distal biceps tendon ruptures as determined at the time of surgery.	The overall sensitivity and specificity of MRI were 92.4% and 100%, respectively, in detecting distal biceps tendon ruptures. The sensitivity and specificity of MRI for complete tears were 100% and 82.8%, respectively. The sensitivity and specificity of MRI for partial tears were 59.1% and 100%, respectively.	3
47. Frijlink DW, Brekelmans GJ, Visser LH. Increased nerve vascularization detected by color Doppler sonography in patients with ulnar neuropathy at the elbow indicates axonal damage. <i>Muscle Nerve.</i> 2013;47(2):188-193.	Review/Other-Dx	137 patients with confirmed UNE, 24 patient controls, and 70 healthy controls	To establish the prevalence of increased intraneural vascularization detected by US in patients with UNE and to determine its relationship to clinical, US, and electrodiagnostic findings.	Intraneural vascularization US was found in 21 (15%) of 137 patients with UNE, in 1 (4%) of 24 patient controls, and in 0 of 70 healthy controls ($P=0.001$). Patients with intraneural vascularization US were more likely to have severe weakness ($P=0.01$), severe atrophy of ulnar-innervated muscles ($P=0.008$), axonal damage ($P=0.001$), and more pronounced nerve enlargement ($P=0.03$) than those without intraneural vascularization US.	4
48. Tagliafico A, Gandolfo N, Michaud J, Perez MM, Palmieri F, Martinoli C. Ultrasound demonstration of distal triceps tendon tears. <i>Eur J Radiol.</i> 2012;81(6):1207-1210.	Review/Other-Dx	8 patients	To describe the role of US in distal triceps tendon tears evaluation.	N = 4 complete tears of the triceps tendon and n = 4 partial tears of the distal triceps involving the lateral/superficial head were identified. Patients with partial tear had a history of a single traumatic event that determined a sudden eccentric contraction of the triceps muscle against resistance. US demonstrated on axial and longitudinal planes a partial tear of the triceps brachii tendon that resulted in a fusiform swelling and retraction of the lateral/superficial head in 4 patients. It was possible to identify the normal insertion of the medial head of the triceps moving the transducer medially. MR and surgical findings were concordant with US findings in every patient.	4

**Chronic Elbow Pain
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
49. Tagliafico A, Michaud J, Perez MM, Martinoli C. Ultrasound of distal brachialis tendon attachment: normal and abnormal findings. <i>Br J Radiol.</i> 2013;86(1025):20130004.	Review/Other-Dx	3 cadaveric specimens, 30 normal volunteers and 125 patients	To demonstrate normal and abnormal findings of distal brachialis tendon attachment in cadavers, normal volunteers and patients by means of US.	In all cases, US demonstrated the distal brachialis tendon shaped by 2 distinct tendons belonging to the deep head and superficial head of the brachialis muscle. Correlative MRI demonstrated that the brachialis is composed of 2 distinct tendons in 83% of volunteers (25/30). In the patient group, 4 avulsions with bony detachment involving the deep head, 1 delayed onset muscular soreness and 3 tendinous detachments with no bony avulsion involving 1 or 2 tendons were identified. The 4 patients with bony avulsion were immediately referred to the orthopedic surgeon for a presurgical evaluation. Patients without bony avulsion were not referred to the surgeon.	4
50. Miller TT, Adler RS, Friedman L. Sonography of injury of the ulnar collateral ligament of the elbow-initial experience. <i>Skeletal Radiol.</i> 2004;33(7):386-391.	Review/Other-Dx	8 patients	To describe the US appearance of injuries of the UCL of the elbow.	Tears of the UCL are manifested sonographically as nonvisualization of the ligament or alteration of the normal morphology.	4
51. Miller TT, Shapiro MA, Schultz E, Kalish PE. Comparison of sonography and MRI for diagnosing epicondylitis. <i>J Clin Ultrasound.</i> 2002;30(4):193-202.	Observational-Dx	11 patients	Prospective study to compare the sensitivity and specificity of US with those of MRI in evaluating epicondylitis.	Sensitivity for detecting epicondylitis ranged from 64% to 82% for US and from 90% to 100% for MRI. Specificity ranged from 67% to 100% for US and from 83% to 100% for MRI. Used as an initial imaging tool, US might be adequate for diagnosing this condition in many patients.	1
52. Sofka CM, Adler RS. Sonography of cubital bursitis. <i>AJR Am J Roentgenol.</i> 2004;183(1):51-53.	Review/Other-Dx	3 patients	To describe the US appearance of cubital bursitis and to illustrate the use of US guidance for therapeutic injections.	Cubital bursitis can be diagnosed with US. Power Doppler imaging can aid in providing information about active inflammation. Two patients were treated using US guided decompression of the bursa and steroid injection with good clinical results.	4

**Chronic Elbow Pain
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
53. Lobo Lda G, Fessell DP, Miller BS, et al. The role of sonography in differentiating full versus partial distal biceps tendon tears: correlation with surgical findings. <i>AJR Am J Roentgenol.</i> 2013;200(1):158-162.	Observational-Dx	45 consecutive elbow US cases with surgical confirmation and 6 cases of a clinically normal distal biceps tendon	To determine the accuracy of US for distinguishing complete rupture of the distal biceps tendon vs partial tear and vs a normal biceps tendon.	US showed 95% sensitivity, 71% specificity, and 91% accuracy for the diagnosis of complete vs partial distal biceps tendon tears. Posterior acoustic shadowing at the distal biceps had sensitivity of 97% and accuracy of 91% for indicating complete tear vs partial tear and sensitivity of 97%, specificity of 100%, and accuracy of 98% for indicating complete tear vs normal tendon.	3
54. Sofka CM, Potter HG. Imaging of elbow injuries in the child and adult athlete. <i>Radiol Clin North Am.</i> 2002;40(2):251-265.	Review/Other-Dx	N/A	Describe the US appearance of cubital bursitis.	Cubital bursitis can be evaluated with US. Power Doppler imaging can aid in providing information about active inflammation.	4
55. Bordalo-Rodrigues M, Rosenberg ZS. MR imaging of entrapment neuropathies at the elbow. <i>Magn Reson Imaging Clin N Am.</i> 2004;12(2):247-263, vi.	Review/Other-Dx	N/A	Review normal anatomy, clinical features, and MRI assessment of nerve entrapment syndromes at the elbow.	Specific MRI signs in association with clinical findings can supply an accurate diagnosis.	4
56. Vucic S, Cordato DJ, Yiannikas C, Schwartz RS, Shnier RC. Utility of magnetic resonance imaging in diagnosing ulnar neuropathy at the elbow. <i>Clin Neurophysiol.</i> 2006;117(3):590-595.	Observational-Dx	52 patients	A retrospective, nonblinded study by a single observer to assess the sensitivity of MRI in diagnosing UNE, especially in cases where neurophysiologic studies were non-localizing, determine the spectrum of MRI abnormalities in patients presenting with symptoms and signs of UNE, assess whether MRI findings differ between grades of UNE severity; and to see if MRI findings give an input into the pathological mechanisms of UNE.	The sensitivity of MRI at diagnosing UNE was higher than conventional nerve conduction studies, 90% vs 65%, respectively. In addition, the MRI studies were highly sensitive in patients with nonlocalizing UNE.	3
57. Beekman R, Van Der Plas JP, Uitdehaag BM, Schellens RL, Visser LH. Clinical, electrodiagnostic, and sonographic studies in ulnar neuropathy at the elbow. <i>Muscle Nerve.</i> 2004;30(2):202-208.	Observational-Dx	102 patients	A prospective study of patients having either purely sensory signs (35%) or sensorimotor signs (65%) of UNE to determine possible correlations between the clinical characteristics, electrophysiological features, and sonographic ulnar-nerve diameter.	Although UNE is clinically heterogeneous, the electrophysiological and sonographic findings are fairly consistent despite the clinical manifestations.	3
58. Spinner RJ, Goldner RD, Fada RA, Sotereanos DG. Snapping of the triceps tendon over the lateral epicondyle. <i>J Hand Surg Am.</i> 1999;24(2):381-385.	Review/Other-Dx	1 patient	Description of the use of MRI to demonstrate snapping of the triceps over the lateral epicondyle.	Case report of a 65-year-old woman who presented with lateral elbow pain and snapping exacerbated by elbow flexion. The snapping lateral head of the triceps was shown as the etiology on flexion MRI. A differential diagnosis of the disorder is included.	4

**Chronic Elbow Pain
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
59. Spinner RJ, Hayden FR, Jr., Hipps CT, Goldner RD. Imaging the snapping triceps. <i>AJR Am J Roentgenol.</i> 1996;167(6):1550-1551.	Review/Other-Dx	6 symptomatic and 1 asymptomatic; 12 volunteers	Description of use of MRI to aid in delineating the etiology of the snapping elbow and assess the relationships of the medial triceps, ulnar nerve, and medial epicondyle in elbow flexion.	MRI can reveal the anatomic structures that cause 2 snaps with elbow flexion. When clinically indicated, MRI with the elbow fully flexed should supplement standard elbow MRI.	4
60. Park GY, Kim JM, Lee SM. The ultrasonographic and electrodiagnostic findings of ulnar neuropathy at the elbow. <i>Arch Phys Med Rehabil.</i> 2004;85(6):1000-1005.	Observational-Dx	13 patients	Prospective study to evaluate and compare the morphologic changes of the UNE, using US, between patients with cubital tunnel syndrome and retrocondylar compression syndrome determined with electrodiagnosis.	US detected the morphologic changes and the extent of the UNE.	3
61. Jacobson JA, Jebson PJ, Jeffers AW, Fessell DP, Hayes CW. Ulnar nerve dislocation and snapping triceps syndrome: diagnosis with dynamic sonography--report of three cases. <i>Radiology.</i> 2001;220(3):601-605.	Review/Other-Dx	3 patients	Review cases of patients who underwent US evaluation of the elbow and subsequent open elbow surgery for symptomatic ulnar nerve dislocation.	Dynamic US of the elbow was used to aid in the accurate diagnosis of and differentiation between ulnar nerve dislocation and snapping of the medial triceps muscle.	4
62. Bodner G, Harpf C, Meirer R, Gardetto A, Kovacs P, Gruber H. Ultrasonographic appearance of supinator syndrome. <i>J Ultrasound Med.</i> 2002;21(11):1289-1293.	Review/Other-Dx	4 patients	To describe US findings in 4 patients with supinator syndrome (ie, deep branch of the radial nerve).	An enlarged deep branch of the radial nerve was found in all 4 patients at the affected side. Electroneurographic testing and surgical inspection confirmed the US findings. The mean transverse diameter was 4.2 mm (range, 3.8–4.5 mm), and the anteroposterior diameter was 3.3 mm (range, 2.5–3.8 mm). In volunteers, the mean transverse diameter was 2.13 mm (range, 1.7–2.6 mm), and the mean anteroposterior diameter was 1.3 mm (range, 1.0–1.5 mm).	4
63. Lindenhovius AL, Jupiter JB. The posttraumatic stiff elbow: a review of the literature. <i>J Hand Surg Am.</i> 2007;32(10):1605-1623.	Review/Other-Dx	N/A	Review the biologic response to trauma, the possible etiologic events that may lead to fibrosis of the capsules and heterotopic ossification, nonsurgical and surgical management of stiffness, and expected outcomes of treatment.	No results stated in abstract.	4

**Chronic Elbow Pain
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
64. Shehab D, Elgazzar AH, Collier BD. Heterotopic ossification. <i>J Nucl Med.</i> 2002;43(3):346-353.	Review/Other-Dx	N/A	To review current concepts of classification, etiology, pathophysiology, diagnosis, and treatment of heterotopic ossification.	Although clinically significant HO occurs infrequently, appropriate use of laboratory and imaging data, particularly alkaline phosphatase values, PGE2, and bone scintigraphy, permits early detection and more successful management of this fascinating yet troublesome ailment. For many patients at risk for HO, either a nonsteroidal anti-inflammatory drug or local radiation therapy is recommended.	4
65. Jbara M, Patnana M, Kazmi F, Beltran J. MR imaging: Arthropathies and infectious conditions of the elbow, wrist, and hand. <i>Radiol Clin North Am.</i> 2006;44(4):625-642, ix.	Review/Other-Dx	N/A	Reviews seropositive and seronegative inflammatory arthropathies, with emphasis on early detection and surveillance, as well as gout, synovial osteochondromatosis, pigmented villonodular synovitis, tenosynovitis, and de Quervain's tenosynovitis.	Because of overlapping clinical signs and symptoms, MRI plays an important role in delineating the features and staging for a variety of arthropathies and infectious conditions of the elbow, wrist, and hand.	4
66. Lerch K, Borisch N, Paetzel C, Grifka J, Hartung W. Proposal for a sonographic classification of target joints in rheumatoid arthritis. <i>Rheumatol Int.</i> 2005;25(3):215-219.	Observational-Dx	425 patients 1,211 joints	To classify sonographically the joint damage of target joints in patients with rheumatoid arthritis during a long-term cross-sectional study.	In reference to the elbow joint, overall percentages for intra- and interobserver reliability of US were 90.8% and 88.8%, respectively. US is a valuable tool for assessing and classifying joint alteration in rheumatoid arthritis. Particularly in early stages of joint affection, US is superior to radiography in detecting soft tissue changes and minor erosions.	2
67. Skaf AY, Boutin RD, Dantas RW, et al. Bicipitoradial bursitis: MR imaging findings in eight patients and anatomic data from contrast material opacification of bursae followed by routine radiography and MR imaging in cadavers. <i>Radiology.</i> 1999;212(1):111-116.	Review/Other-Dx	8 patients	Comparative study to review the use of radiography and MRI after contrast material opacification of the bursae to demonstrate the anatomy of the bicipitoradial bursa and to report findings in patients with bicipitoradial bursitis.	The anatomy of the bicipitoradial bursa is demonstrated by radiography and MRI. MRI allows accurate diagnosis of bicipitoradial bursitis and its effects on adjacent structures.	4
68. American College of Radiology. ACR Appropriateness Criteria®: Primary Bone Tumors. Available at: https://acsearch.acr.org/docs/69421/Narrative/ . Accessed September 30, 2015.	Review/Other-Dx	N/A	Evidence-based guidelines to assist referring physicians and other providers in making the most appropriate imaging or treatment decision for a specific clinical condition.	N/A	4
69. American College of Radiology. ACR Appropriateness Criteria®: Metastatic Bone Disease. Available at: https://acsearch.acr.org/docs/69431/Narrative/ . Accessed September 30, 2015.	Review/Other-Dx	N/A	Evidence-based guidelines to assist referring physicians and other providers in making the most appropriate imaging or treatment decision for a specific clinical condition.	N/A	4

* See Last Page for Key

Evidence Table Key

Study Quality Category Definitions

- *Category 1* The study is well-designed and accounts for common biases.
- *Category 2* The study is moderately well-designed and accounts for most common biases.
- *Category 3* There are important study design limitations.
- *Category 4* The study is not useful as primary evidence. The article may not be a clinical study or the study design is invalid, or conclusions are based on expert consensus. For example:
 - a) the study does not meet the criteria for or is not a hypothesis-based clinical study (e.g., a book chapter or case report or case series description);
 - b) the study may synthesize and draw conclusions about several studies such as a literature review article or book chapter but is not primary evidence;
 - c) the study is an expert opinion or consensus document.
- M = Meta-analysis

Dx = Diagnostic

Tx = Treatment

Abbreviations Key

AUC = Area under the receiver operating characteristic curve

CI = Confidence interval

CT = Computed tomography

FDG-PET = Fluorine-18-2-fluoro-2-deoxy-D-glucose-positron emission tomography

LCL = Lateral collateral ligament

MRI = Magnetic resonance imaging

NPV = Negative predictive value

PPV = Positive predictive value

UCL = Ulnar collateral ligament

UNE = Ulnar neuropathy at the elbow

US = Ultrasound