

**Chronic Wrist Pain  
EVIDENCE TABLE**

| Reference  | Study Type       | Patients/<br>Events                                    | Study Objective<br>(Purpose of Study)  | Study Results   | Study<br>Quality |
|--|------------------|--|--|---|------------------|
| 1. Coggins CA. Imaging of ulnar-sided wrist pain. Clin Sports Med. 2006;25(3):505-526, vii.  | Review/Other-Dx  | N/A  | To review imaging and treatment of ulnar-sided wrist pain.   | Conventional radiographs, conventional arthrography, CT, MRI, and MR arthrography are useful for the diagnosis and treatment of ulnar-sided wrist pain.   | 4                |
| 2. Forman TA, Forman SK, Rose NE. A clinical approach to diagnosing wrist pain. Am Fam Physician. 2005;72(9):1753-1758.  | Review/Other-Dx  | N/A  | To review clinical approaches to diagnosis of wrist pain.  | Posterior-anterior and lateral views are necessary to evaluate the bony architecture and alignment, the width and symmetry of the joint spaces, and the soft tissues when radiography is indicated. When the diagnosis remains unclear further imaging modalities like US, technetium bone scan, CT, and MRI are indicated.   | 4                |
| 3. Theumann NH, Etehami G, Duvoisin B, et al. Association between extrinsic and intrinsic carpal ligament injuries at MR arthrography and carpal instability at radiography: initial observations. Radiology. 2006;238(3):950-957. | Observational-Dx | 72 patients with post-traumatic wrist pain 2 observers | To retrospectively compare the presence or absence of carpal instability on radiographs with the findings of magnetic resonance (MR) arthrographic evaluation of intrinsic and extrinsic ligament tears in patients with chronic wrist pain. | Twenty-five triangular fibrocartilage complex, 18 (five partial, 13 complete) scapholunate ligament, and 25 (10 partial, 15 complete) lunotriquetral ligament tears were visualized. Twenty-two (all complete) extrinsic ligament tears were detected: two radial collateral ligament, 10 radioscaphocapitate ligament, and 10 radiolunotriquetral ligament tears. Interobserver agreement regarding intrinsic and extrinsic ligament tear detection at MR arthrography was excellent (kappa = 0.80). Nineteen patients had evidence of carpal instability on radiographs. Fourteen (52%) of 27 patients with at least one complete intrinsic lesion had no sign of carpal instability. On the other hand, the association of scapholunate ligament and/or lunotriquetral ligament and extrinsic ligament tears was significantly correlated (P < .001) with carpal instability at radiography. The presence or absence of carpal instability on radiographs depends on the association between intrinsic and extrinsic ligament tears-even partial ones-rather than on the presence of intrinsic ligament tears alone, even when the tears are complete. | 3                |
| 4. Ozcelik A, Gunal I, Kose N. Stress views in the radiography of scapholunate instability. Eur J Radiol. 2005;56(3):358-361.  | Review/Other-Dx  | 22 patients  | Stress radiographs wrists compared with scaphoid shift test and standard and positional views to evaluate reliability of dorsal and volar stress radiographs on post-traumatic pain patients.  | Static scapholunate (SL) instability diagnosed in four patients, three of whom had positive scaphoid shift tests; however, 18 patients with dynamic SL instability had normal radiographs with abnormality only demonstrated on dorsal stress radiographs.  | 4                |

\* See Last Page for Key

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| 5. Cerezal L, del Pinal F, Abascal F, Garcia-Valtuille R, Pereda T, Canga A. Imaging findings in ulnar-sided wrist impaction syndromes. <i>Radiographics</i> . 2002;22(1):105-121.  | Review/Other-Dx  | N/A                      | Review imaging findings, differential diagnoses and multiple causes of ulnar-sided impaction syndromes.   | Radiography is essential for precise measurement of ulnar variance, but MR and MR arthrography are superior to radiographs for early diagnosis and late complications of other impaction syndromes, impingement, and ulnar styloid impaction.  | 4                |
| 6. Al-Janabi M. Imaging modalities of the painful wrist: the role of bone scintigraphy. <i>Rheumatology (Oxford)</i> . 2002;41(10):1085-1087.   | Review/Other-Dx  | N/A                      | Editorial on the role of bone scintigraphy of the painful wrist   | No results stated.   | 4                |
| 7. Smith TO, Drew BT, Toms AP, Chojnowski AJ. The diagnostic accuracy of X-ray arthrography for triangular fibrocartilaginous complex injury: a systematic review and meta-analysis. <i>J Hand Surg Eur Vol</i> . 2012;37(9):879-887.     | Meta-analysis    | 12 studies, 430 patients | To evaluate the diagnostic test accuracy of X-ray arthrography in the detection of TFCC tear.   | X-ray arthrography presented with a pooled sensitivity of 76.2% and specificity of 92.5% for the detection of complete TFCC tear. The triple-compartment injection X-ray arthrography was superior to the single-compartment injection technique.  | M                |
| 8. Lee RK, Ng AW, Tong CS, et al. Intrinsic ligament and triangular fibrocartilage complex tears of the wrist: comparison of MDCT arthrography, conventional 3-T MRI, and MR arthrography. <i>Skeletal Radiol</i> . 2013;42(9):1277-1285. | Observational-Dx | 5 cadavers; 10 wrists    | To compare the diagnostic performance of multidetector CT arthrography (CTA), conventional 3-T MR and MR arthrography (MRA) in detecting intrinsic ligament and triangular fibrocartilage complex (TFCC) tears of the wrist. Intravenous contrast was administered. | Sensitivities/specificity/accuracy of CTA, conventional MRI, and MRA were 100%/100%/100%, 66%/86%/80%, 100%/86%/90% for the detection of SLL tear, 100%/80%/90%, 60%/80%/70%, 100%/80%/90% for the detection of LTL tear, and 100%/100%/100%, 100%/86%/90%, 100%/100%/100% for the detection of TFCC tear. Overall CTA had the highest sensitivity, specificity, and accuracy among the three investigations while MRA performed better than conventional MR. CTA also had the highest sensitivity, specificity, and accuracy for identifying which component of the SLL and LTL was torn. Membranous tears of both SLL and LTL were better visualized than dorsal or volar tears on all three imaging modalities. | 3                |
| 9. Kocharian A, Adkins MC, Amrami KK, et al. Wrist: improved MR imaging with optimized transmit-receive coil design. <i>Radiology</i> . 2002;223(3):870-876.  | Observational-Dx | 6 volunteers             | To design and evaluate an optimized birdcage transmit-receive coil for the wrist that can provide higher SNR and higher uniformity compared with those with the same-sized PACs.  | Blinded review of wrist images obtained in six volunteers showed that the optimized birdcage coil was preferred in 75% of the comparisons. An optimized birdcage coil designed for wrist imaging has improved both SNR and uniformity compared with those with a phased-array coil with the same geometry.   | 2                |

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| 10. Lenk S, Ludescher B, Martirosan P, Schick F, Claussen CD, Schlemmer HP. 3.0 T high-resolution MR imaging of carpal ligaments and TFCC. <i>Rofo</i> . 2004;176(5):664-667.                                     | Observational-Dx | 10 volunteers                                     | To optimize MR sequences and to determine the diagnostic value of 3.0 Tesla MRI for the visualization and assessment of intrinsic and extrinsic carpal ligaments and the TFCC. | Several sequences obtained at 3.0 T (eg, 2D T2* MEDIC) yield high SNR and CNR with reasonable acquisition times and few artifacts for evaluation of ligaments and TFCC in healthy volunteers, while some 1.5 T sequences yield unacceptable SNR and CNR for visualization of anatomy and diagnostic purposes.  | 4                |
| 11. Saupe N, Prussmann KP, Luechinger R, Bosiger P, Marincek B, Weishaupt D. MR imaging of the wrist: comparison between 1.5- and 3-T MR imaging--preliminary experience. <i>Radiology</i> . 2005;234(1):256-264. | Observational-Dx | 25 healthy volunteers;<br>15 consecutive patients | To compare 1.5 and 3T MR imaging of the wrist.   | CNRs were significantly higher on 3-T MR images than on 1.5-T MR images ( $P < .001$ ; analysis of variance) for all sequences. Visibility of the triangular fibrocartilage complex and intercarpal ligaments and cartilage was significantly better on 3-T MR images than on 1.5-T MR images (paired sign test).  | 3                |
| 12. Zanetti M, Saupe N, Nagy L. Role of MR imaging in chronic wrist pain. <i>Eur Radiol</i> . 2007;17(4):927-938.   | Review/Other-Dx  | N/A   | To review potential and limitations of MRI and direct and indirect MR arthrography in chronic wrist pain.  | MRI correlates well with surgery for internal derangement of the wrist (excellent accuracy) with consistently better results for SL vs LT ligaments, and more variable results depending on TFCC tear location (central vs partial); enhanced MRI best for avascularity and other marrow abnormalities; MRI vs CT for detection of occult fractures remains controversial and of questionable clinical import. | 4                |
| 13. Szabo RM. Distal radioulnar joint instability. <i>J Bone Joint Surg Am</i> . 2006;88(4):884-894.  | Review/Other-Dx  | N/A   | To review the anatomy, classification, and examination of radioulnar joint instability.  | No results stated.   | 4                |

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| 14. De Filippo M, Pogliacomì F, Bertellini A, et al. MDCT arthrography of the wrist: diagnostic accuracy and indications. Eur J Radiol. 2010;74(1):221-225.                                   | Observational-Dx | 44 wrists                 | To evaluate the diagnostic accuracy and indications of arthrography with Multidetector Computed Tomography (arthro-MDCT) of the wrist in patients with absolute or relative contraindications to magnetic resonance imaging (MRI) studies and in patients with periarticular metal implants using diagnostic arthroscopy as the gold standard. | In non-operated and operated wrists the comparison between arthro-MDCT and arthroscopy showed sensitivity, specificity and accuracy ranging between 92% and 94% for triangular fibrocartilage complex (TFCC), between 80% and 100% for intrinsic ligaments located within the proximal carpal compartment, and between 94% and 100% for articular cartilage. Inter-observer agreement between two radiologists, in the evaluation of all types of lesions, was almost perfect (k=0.96) and statistically significant (p<0.05). Arthro-MDCT of the wrist provides an accurate diagnosis to identify chondral, fibrocartilaginous and intra-articular ligament lesions in patients who cannot be evaluated by MRI, and in post-surgical patients. | 3                |
| 15. Moser T, Dosch JC, Moussaoui A, Buy X, Gangi A, Dietemann JL. Multidetector CT arthrography of the wrist joint: how to do it. Radiographics. 2008;28(3):787-800; quiz 911.                | Review/Other-Dx  | N/A                       | Review use of MDCT arthrography of the wrist joint.  | MDCT arthrography is useful in the diagnosis and evaluation of different articular disorders. Main limitation is in evaluation of soft-tissue abnormalities; addition of US or MRI might help.  | 4                |
| 16. Schmid MR, Schertler T, Pfirrmann CW, et al. Interosseous ligament tears of the wrist: comparison of multi-detector row CT arthrography and MR imaging. Radiology. 2005;237(3):1008-1013. | Observational-Dx | 8 patients; 9 cadavers    | Comparison of CT arthrography ( 3 compartment injection) vs unenhanced MRI for intrinsic ligament tears (three segments of SL and LT ligaments) in cadavers, with subsequent direct anatomic correlation.  | CT arthrography is superior to (more sensitive than) MRI for dorsal segment tears, with more equivalent performance for palmar and central tears; for all segments of both ligaments, interobserver agreement is much better for CT arthrography than MRI.  | 2                |
| 17. Teefey SA, Dahiya N, Middleton WD, Gelberman RH, Boyer MI. Ganglia of the hand and wrist: a sonographic analysis. AJR Am J Roentgenol. 2008;191(3):716-720.                               | Meta-analysis    | 55 patients<br>60 ganglia | Retrospective study to analyze the US appearance of ganglia of the hand and wrist.   | 34/60 ganglia were complex: 91% were located within the dorsal or volar wrist; 97% had well-defined margins; 76%, locules; 68% acoustic enhancement; 47% a thick wall; 15% internal reflectors; and 12% blood flow. Of the 23 simple ganglia, 11 involved the extensor or flexor tendon sheath, 73% of which were simple. Study showed that most ganglia are complex rather than simple on US.  | M                |

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| 18. Choi SJ, Ahn JH, Lee YJ, et al. de Quervain disease: US identification of anatomic variations in the first extensor compartment with an emphasis on subcompartmentalization. <i>Radiology</i> . 2011;260(2):480-486. | Observational-Dx | 13 patients;<br>15 wrists | To demonstrate the usefulness of ultrasonography (US) in the detection of anatomic variations in the first extensor compartment of the wrist in patients with de Quervain disease                               | Subcompartmentalization within the first extensor compartment was observed during surgery in 11 of the 15 wrists (73%), including four (27%) that had subcompartmentalization only in the distal portion of this compartment. US was used to identify all 11 wrists showing subcompartmentalization within this compartment (sensitivity, 100%; 95% confidence interval [CI]: 74%, 100%), as well as three of the four wrists with distal incomplete subcompartmentalization. There was one wrist with false-positive distal incomplete subcompartmentalization. US had a positive predictive value in the detection of subcompartmentalization of 73% (95% CI: 47%, 91%). The number of tendon slips in this compartment detected with US was identical to that identified at surgery with one exception. US can be used to depict various types of anatomic variations in the first extensor compartment in patients with de Quervain disease. | 3                |
| 19. Kwon BC, Choi SJ, Koh SH, Shin DJ, Baek GH. Sonographic Identification of the intracompartmental septum in de Quervain's disease. <i>Clin Orthop Relat Res</i> . 2010;468(8):2129-2134.                              | Observational-Dx | 40 patients               | To evaluate the accuracy of sonography for identifying the intracompartmental septum in the first extensor compartment in patients with de Quervain's disease using surgical findings as the reference standard | Sonography identified the intracompartmental septum in 19 of the 19 septum-present wrists and absence of the septum in 23 of the 24 septum-absent wrists. The sensitivity of sonography was 100% (95% confidence interval, 80%-100%), its specificity 96% (95% confidence interval, 78%-100%), accuracy 98% (95% confidence interval, 87%-100%), positive predictive value 95% (95% confidence interval, 74%-100%), and negative predictive value 100% (95% confidence interval, 83%-100%). Sonography also identified septum-like structures in 15 of 37 (41%) asymptomatic contralateral wrists. Sonography is useful for detecting the intracompartmental septum in the first extensor compartment in patients with de Quervain's disease.  | 3                |

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| 20. Kawashiri SY, Suzuki T, Okada A, et al. Musculoskeletal ultrasonography assists the diagnostic performance of the 2010 classification criteria for rheumatoid arthritis. <i>Mod Rheumatol.</i> 2013;23(1):36-43. | Observational-Dx | 69 Patients         | To investigate whether musculoskeletal ultrasonography (MSKUS), in comparison with MRI, assists the diagnostic performance of the 2010 rheumatoid arthritis (RA) classification criteria. No intravenous contrast was administered.   | The indispensable MSKUS finding for differentiating RA was the presence of a PD grade 2 or 3 that was superior to 2010 RA classification criteria or MRI-proven bone edema. We propose that the decision tree algorithm of 2010 RA classification criteria with PD grade 2 or 3 reveals the best discriminative ability.  | 2             |
| 21. Descatha A, Huard L, Aubert F, Barbato B, Gorand O, Chastang JF. Meta-analysis on the performance of sonography for the diagnosis of carpal tunnel syndrome. <i>Semin Arthritis Rheum.</i> 2012;41(6):914-922.   | Meta-analysis    | 13 studies          | To review and pool recent large methodological studies evaluating the diagnosis performance of ultrasonography vs electrodiagnostic testing (EDX)   | Among the 189 articles found, 13 articles were included. A cross-sectional area of the median nerve between 9.5 and 10.5 mm(2) (study included once only), found for 11 studies, gave the pooled sensitivity as 0.84 [0.81 to 0.87] and the likelihood ratio for a negative test as 0.21 [0.17 to 0.27]. Specificity (0.78 [0.69-0.88]) and the likelihood ratio for a positive test (3.74 [2.30-6.10]) were heterogeneous. For a threshold at 7.0 to 8.5 mm(2), pooled sensitivity was 0.94 [0.87 to 1.00], and for 11.5 to 13.0 mm(2) specificity was 0.97 [0.91 to 1.00]. The only significant variable on potential sources of heterogeneity was the cross-sectional area of the median nerve threshold and area under the curve was 0.87 (asymmetric). | M             |
| 22. Fowler JR, Gaughan JP, Ilyas AM. The sensitivity and specificity of ultrasound for the diagnosis of carpal tunnel syndrome: a meta-analysis. <i>Clin Orthop Relat Res.</i> 2011;469(4):1089-1094.                | Meta-analysis    | 3131 wrists         | To determine the sensitivity and the specificity of ultrasound for the diagnosis of CTS in the following three scenarios: (1) using all studies regardless of reference standard; (2) using all studies with EDX as the reference standard; and (3) using all studies with clinical diagnosis as the gold standard. | The composite sensitivity and specificity of ultrasound for the diagnosis of CTS, using all studies, were 77.6% (95% CI 71.6-83.6%) and 86.8% (95% CI 78.9-94.8%), respectively.  | M             |

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| 23. Fowler JR, Munsch M, Tosti R, Hagberg WC, Imbriglia JE. Comparison of ultrasound and electrodiagnostic testing for diagnosis of carpal tunnel syndrome: study using a validated clinical tool as the reference standard. <i>J Bone Joint Surg Am.</i> 2014;96(17):e148. | Observational-Dx | 85 patients                 | To compare the sensitivity and specificity of ultrasound and electrodiagnostic testing by using a validated clinical diagnostic tool as the reference standard.   | With use of the CTS-6 as the reference standard, ultrasound had a sensitivity of 89% and a specificity of 90% in our series of eighty-five patients. Electrodiagnostic testing had a sensitivity of 89% and a specificity of 80%. The positive predictive value of ultrasound was 94% compared with 89% for electrodiagnostic testing. The negative predictive value of ultrasound was 82% compared with 80% for electrodiagnostic testing. Ultrasound was accurate in seventy-six (89%) of the eighty-five cases whereas electrodiagnostic testing was accurate in seventy-three (86%) of the eighty-five cases ( $p = 0.5$ ). | 2                |
| 24. Tai TW, Wu CY, Su FC, Chern TC, Jou IM. Ultrasonography for diagnosing carpal tunnel syndrome: a meta-analysis of diagnostic test accuracy. <i>Ultrasound Med Biol.</i> 2012;38(7):1121-1128.   | Meta-analysis    | 28 studies;<br>3,995 wrists | To assess the reported ultrasonographic diagnostic criteria of CTS and their diagnostic accuracy, with the aim of determining the best cutoff values.   | A CSA-I $\geq 9$ mm(2) is the best single diagnostic criterion, with a diagnostic odds ratio of 40.4 (sensitivity 87.3%, specificity 83.3%).  | M                |
| 25. Teh J, Vlychou M. Ultrasound-guided interventional procedures of the wrist and hand. <i>Eur Radiol.</i> 2009;19(4):1002-1010.   | Review/Other-Dx  | N/A                         | Review rationale, indications, techniques, complications of US-guided interventional procedures of the hand and wrist.  | Study recommends US-guided interventional procedures since they are effective, safe and can be easily performed with the appropriate training.  | 4                |
| 26. Ruegger C, Schmid MR, Pfirrmann CW, Nagy L, Gilula LA, Zanetti M. Peripheral tear of the triangular fibrocartilage: depiction with MR arthrography of the distal radioulnar joint. <i>AJR Am J Roentgenol.</i> 2007;188(1):187-192.                                     | Observational-Dx | 41 patients                 | Retrospective evaluation of MR arthrography (distal radioulnar joint +/- midcarpal injections) vs arthroscopy for detection of peripheral (ulnar-sided) TFCC tears.   | For MR arthrography, sensitivity is 85% and specificity is 76%, with accuracy of 80% for peripheral tears, which are the most difficult to identify.  | 3                |
| 27. Boyesen P, Haavardsholm EA, Ostergaard M, van der Heijde D, Sesseng S, Kvien TK. MRI in early rheumatoid arthritis: synovitis and bone marrow oedema are independent predictors of subsequent radiographic progression. <i>Ann Rheum Dis.</i> 2011; 70(3):428-433.      | Observational-Dx | 55 patients                 | To determine whether MRI and conventional (clinical and laboratory) measures of inflammation can predict 3-year radiographic changes measured by the van der Heijde Sharp score in patients with early rheumatoid arthritis (RA). | All measures of inflammation decreased during the follow-up period. ESR, MRI synovitis and MRI bone marrow oedema were independent predictors of 3-year radiographic progression adjusted for age, sex and anti-citrullinated protein antibodies. The 1-year cumulative measures of MRI synovitis and bone marrow oedema provided an improved explanation of variation (adjusted R(2)) in radiographic change compared with the baseline MRI values (adjusted R(2)=0.32 and 0.20 vs 0.11 and 0.04, respectively).   | 3                |

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| 28. Navalho M, Resende C, Rodrigues AM, et al. Dynamic contrast-enhanced 3-T magnetic resonance imaging: a method for quantifying disease activity in early polyarthritis. <i>Skeletal Radiol.</i> 2012;41(1):51-59. | Observational-Dx | 18 patients               | To determine whether measurement of synovial enhancement and thickness quantification parameters with 3.0-Tesla magnetic resonance imaging (3-T MRI) can reliably quantify disease activity in patients with early polyarthritis. | Synovial signal intensity was quantified at 0, 57 seconds, and 200 seconds following intravenous contrast administration. Both the total enhancement at 200 seconds and the ratio of signal intensities at 200 compared to 57 seconds, correlated strongly with disease activity.  | 3                |
| 29. Tehranzadeh J, Ashikyan O, Anavim A, Tramma S. Enhanced MR imaging of tenosynovitis of hand and wrist in inflammatory arthritis. <i>Skeletal Radiol.</i> 2006;35(11):814-822.                                    | Observational-Dx | 30 patients<br>(72 exams) | To describe the appearance of tenosynovitis in various tendon groups in the wrist and hand and to compare MR enhanced and non-enhanced imaging evaluation of tenosynovitis of hand and wrist in inflammatory arthritis.           | The average T2 brightness scores and post-gadolinium enhancement scores were 1.0 and 1.7, respectively (P<0.001) in the wrist studies. The average T2 brightness scores and post-gadolinium enhancement scores were 0.7 and 1.4, respectively (P<0.001) in the hand studies. The average sensitivity of T2-weighted imaging for detection of tenosynovitis was 40% in the hand and 67% in the wrist tendons, when contrast-enhanced images were used as a reference. Carpal tunnel flexor tendons were the most frequently affected tendons of the wrist. The most frequently affected tendons of the hand were second and third flexor tendons. The hand flexors demonstrated higher degrees of enhancement and larger volumes of the inflamed tenosynovium than did the hand extensors and tendons of the thumb. | 3                |



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| 30. Dohn UM, Ejbjerg BJ, Hasselquist M, et al. Detection of bone erosions in rheumatoid arthritis wrist joints with magnetic resonance imaging, computed tomography and radiography. <i>Arthritis Res Ther.</i> 2008;10(1):R25.   | Observational-Dx | 17 patients and 4 controls         | To determine the performance of magnetic resonance imaging (MRI) and radiography for the detection of bone erosions in rheumatoid arthritis wrist bones, and to test whether measuring volumes of erosions on CT and MRI is reproducible and correlated to semiquantitative assessments (scores) of erosions on CT, MRI and radiography. | With CT as the reference method, the overall sensitivity, specificity and accuracy (concordance) of MRI for detecting erosions were 61%, 93% and 77%, respectively, while the respective values were 24%, 99% and 63% for radiography. The intramodality agreements when measuring erosion volumes were high for both CT and MRI (Spearman correlation coefficients 0.92 and 0.90 (both P < 0.01), respectively). Correlations between volumes and scores of individual erosions were 0.96 for CT and 0.99 for MRI, while they were 0.83 (CT) and 0.80 (MRI) for persons' total erosion volume and total score (all P < 0.01). MRI showed moderate sensitivity and good specificity and accuracy for detection of erosions in rheumatoid arthritis and healthy wrist bones, while radiography showed very low sensitivity. The tested volumetric method was highly reproducible and correlated to scores of erosions. | 1             |
| 31. Duer-Jensen A, Ejbjerg B, Albrecht-Beste E, et al. Does low-field dedicated extremity MRI (E-MRI) reliably detect bone erosions in rheumatoid arthritis? A comparison of two different E-MRI units and conventional radiography with high-resolution CT scanning. <i>Ann Rheum Dis.</i> 2009;68(8):1296-1302. | Observational-Dx | 20 patients and 5 healthy controls | To compare the ability of two different E-MRI units and conventional radiography (CR) to identify bone erosions in rheumatoid arthritis (RA) metacarpophalangeal (MCP) and wrist joints with CT scanning as the standard reference method.   | The sensitivity of the Artoscan for detecting erosions was higher than that of the MagneVu and CR (MCP joints: 0.68, 0.54 and 0.57, respectively; wrists: 0.50, 0.23 and 0.29). Corresponding specificities for detecting erosions were 0.94, 0.93 and 0.99, respectively, in the MCP joints and 0.92, 0.98 and 0.98 in the wrist. The MagneVu allowed visualisation of 1.5 cm of the ventral-dorsal diameter of the bone. In the wrist, 31.6% of bones were visualised entirely and 37.9% of bones were 67-99% visualised. In MCP joints, 84.2% of bones were visualised entirely and 15.8% of bones were 67-99% visualised. With CT as the reference method for detecting erosions in RA hands, the Artoscan showed higher sensitivity than the MagneVu and CR. All imaging modalities had high specificities. The better performance of the Artoscan should be considered when selecting an imaging method in RA.  | 2             |

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| 32. Boyesen P, Haavardsholm EA, van der Heijde D, et al. Prediction of MRI erosive progression: a comparison of modern imaging modalities in early rheumatoid arthritis patients. <i>Ann Rheum Dis</i> . 2011;70(1):176-179. | Observational-Dx | 84 patients         | To examine the associations between modern imaging modalities and joint damage measured as 1-year MRI erosive progression, in early rheumatoid arthritis (RA) patients. | 3 of the 79 patients (67%) who completed the follow-up had MRI erosive progression (dependent variable). USGS and MRI bone marrow oedema (BME) were in multivariate analyses independent predictors of 1-year MRI erosive progression. There was a trend towards higher MRI synovitis score and 3-month DXR BMD loss in patients developing MRI erosions. On an individual level, USGS inflammation, MRI synovitis and MRI BME also somewhat better predicted outcome than rheumatoid factor, anticitrullinated protein antibodies and disease activity score 28. USGS inflammation and MRI BME were independent predictors of MRI erosive progression in early RA patients on a group level. The exact prognosis of the individual patients could not be determined by imaging alone. | 3                |

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| 33. Hetland ML, Ejbjerg B, Horslev-Petersen K, et al. MRI bone oedema is the strongest predictor of subsequent radiographic progression in early rheumatoid arthritis. Results from a 2-year randomised controlled trial (CIMESTRA). Ann Rheum Dis. 2009;68(3):384-390. | Experimental-Dx | 219 total patients  | To identify predictors of radiographic progression in a 2-year randomised, double-blind, clinical study (CIMESTRA) of patients with early rheumatoid arthritis (RA). | Baseline values: median DAS28 5.6 (range 2.4-8.0); anti-CCP positive 61%; radiographic erosions 56%. At 2 years: DAS28 2.0 (0.5-5.7), in DAS remission: 56%, radiographic progression 26% (wrist+MCP group, similar for wrist-only group). MRI bone oedema score was the only independent predictor of delta-TSS (wrist+MCP group: coefficient = 0.75 (95% CI 0.55 to 0.94), p<0.001; wrist-only group: coefficient = 0.59 (95% CI 0.40 to 0.77), p<0.001). Bone oedema score explained 41% of the variation in the progression of TSS (wrist+MCP group), 25% in wrist-only group (Pearson's r = 0.64 and r = 0.50, respectively). Results were confirmed by sensitivity analyses. In a randomised controlled trial aiming at remission in patients with early RA, baseline RAMRIS MRI bone oedema score of MCP and wrist joints (and of wrist only) was the strongest independent predictor of radiographic progression in hands, wrists and forefeet after 2 years. MRI synovitis score, MRI erosion score, DAS28, anti-CCP, SE, smoking, age and gender were not independent risk factors. | 1                |

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|--|------------------|---------------------|--|--|------------------|
| 34. Zheng S, Robinson E, Yeoman S, et al. MRI bone oedema predicts eight year tendon function at the wrist but not the requirement for orthopaedic surgery in rheumatoid arthritis. <i>Ann Rheum Dis.</i> 2006;65(5):607-611.              | Observational-Dx | 42 total patients   | To investigate the role of early magnetic resonance imaging (MRI) of the wrist in predicting functional outcome in rheumatoid arthritis. | At 8 years, tendon function was highly correlated with hand function (Sollerman score, R = -0.51, p = 0.005) and global function (health assessment questionnaire score, R = 0.53, p = 0.004). Using a model incorporating baseline and 1 year MRI scores, the MRI bone oedema score was strongly predictive of tendon function at 8 years (chi(2)(2) = 15.3, p = 0.0005), as was the MRI bone erosion score (chi(2)(2) = 9.23, p = 0.01). Hand function was also predicted by the baseline MRI erosion score (p = 0.02). MRI variables did not predict the requirement for surgery, but patients who had surgery were more likely to show progression of MRI bone erosion scores between baseline and 1 year (p = 0.008). Extensive MRI bone oedema and erosions at the wrist in early rheumatoid arthritis predict tendon dysfunction and impaired hand function in the medium term but not the requirement for joint or tendon surgery. | 3                |
| 35. McAlindon T, Kissin E, Nazarian L, et al. American College of Rheumatology report on reasonable use of musculoskeletal ultrasonography in rheumatology clinical practice. <i>Arthritis Care Res (Hoboken)</i> . 2012;64(11):1625-1640. | Review/Other-Dx  | N/A                 | A report by American College of Rheumatology on reasonable use of musculoskeletal ultrasonography in rheumatology clinical practice.     | N/A  | 4                |
| 36. Oneson SR, Timins ME, Scales LM, Erickson SJ, Chamoy L. MR imaging diagnosis of triangular fibrocartilage pathology with arthroscopic correlation. <i>AJR Am J Roentgenol.</i> 1997;168(6):1513-1518.                                  | Observational-Dx | 178 imaging exams   | To compare MR imaging with arthroscopy in evaluating triangular fibrocartilage (TFC) pathology.  | Sensitivity for detecting central degenerative perforations was 91% for both observers I and II. Sensitivity for detecting radial slitlike tears was 100% and 86% for observers I and II, respectively. Sensitivity for detecting ulnar-sided avulsions was 25% and 50% for observers I and II, respectively. MR imaging is accurate in revealing TFC perforations.  | 3                |

**Chronic Wrist Pain  
EVIDENCE TABLE**

| Reference  | Study Type       | Patients/<br>Events  | Study Objective<br>(Purpose of Study)  | Study Results  | Study Quality |
|--|------------------|--|--|--|---------------|
| 37. Anderson ML, Skinner JA, Felmlee JP, Berger RA, Amrami KK. Diagnostic comparison of 1.5 Tesla and 3.0 Tesla preoperative MRI of the wrist in patients with ulnar-sided wrist pain. J Hand Surg Am. 2008;33(7):1153-1159. | Observational-Dx | 102 patients   | To evaluate the diagnostic comparison of 1.5 Tesla and 3.0 Tesla preoperative MRI of the wrist in patients with ulnar-sided wrist pain.  | A tear of the TFCC was identified retrospectively on 1.5T images in 49 of 58 patients and on 3.0T images in 15 of 16 patients. Compared with the gold standard of arthroscopy, 1.5T wrist MRI in this patient population had a sensitivity of 85%, a specificity of 75%, and an accuracy of 83% for reader 1 for the detection of a tear of the TFCC. In the same patient population, 3.0T wrist MRI had a sensitivity of 94%, a specificity of 88%, and an accuracy of 91% for reader 1. For reader 2, the improvement in sensitivity for the lunotriquetral ligament between the 1.5T and 3.0T images was statistically significant. The sensitivity, specificity, and accuracy of 3.0T wrist MRI for the TFCC is consistently higher compared with those of 1.5T wrist MRI. The trend suggests that 3.0T wrist MRI provides improved capability for detection of TFCC injuries. Given the available sample size, however, the confidence intervals around the point estimates are wide and overlapping. Further studies are needed to confirm or refute our results of the estimated sensitivity, specificity, and accuracy parameters. | 2             |
| 38. Moser T, Dosch JC, Moussaoui A, Dietemann JL. Wrist ligament tears: evaluation of MRI and combined MDCT and MR arthrography. AJR Am J Roentgenol. 2007;188(5):1278-1286.   | Observational-Dx | 45 patients, 12 phantom for contrast selection 2 observers | In vitro and in vivo study to evaluate MRI and combination of MDCT arthrography and MR arthrography (one injection) for diagnosis of wrist ligament tears and cartilage abnormalities, with clinical and operative follow-up. Complete SL and LT tears defined as involving all 3 (dorsal, central, volar) segments; partial defined as involving 1 or 2 segments. | Sensitivity and specificity calculated for multiple anatomic sites (SL, LT, TFCC) and observers, with SL and LT ligaments evaluated equally well by all three techniques; however, CT arthrography best for partial tears (SL, LT), TFCC tears, and cartilage abnormalities, and statistically significantly better than MRI; MR arthrography more sensitive than MRI but not statistically significant. Sensitivity: CTA > MRA > MRI, especially for articular cartilage defects, ulnar-sided TFCC tears, and partial SL and LT ligament tears.   | 1             |

**Chronic Wrist Pain  
EVIDENCE TABLE**

| Reference   | Study Type       | Patients/<br>Events      | Study Objective<br>(Purpose of Study)   | Study Results  | Study<br>Quality |
|---|------------------|--------------------------|---|--|------------------|
| 39. Magee T. Comparison of 3-T MRI and arthroscopy of intrinsic wrist ligament and TFCC tears. AJR Am J Roentgenol. 2009;192(1):80-85.  | Observational-Dx | 300 consecutive patients | To assess the sensitivity and specificity of MRI at 3 T compared with arthroscopy for detection of intrinsic wrist ligament and triangular fibrocartilage complex (TFCC) tears. | MR sensitivity for detection of TFCC tears was 86%, for detection of scapholunate tears was 89%, and for detection of lunatotriquetral tears was 82%. MR specificity for detection of tears was 100%. MR arthrography sensitivity for detection of ligament and TFCC tears was 100%. There were three patients in whom contrast media passed between joint spaces without an anatomic abnormality seen. These patients underwent arthroscopy with no tears seen. MRI at 3 T is sensitive and specific for detection of wrist ligament tears. MR arthrography is more sensitive for ligament evaluation but can result in false-positive findings because of microperforations. | 2                |
| 40. Omlor G, Jung M, Grieser T, Ludwig K. Depiction of the triangular fibro-cartilage in patients with ulnar-sided wrist pain: comparison of direct multi-slice CT arthrography and direct MR arthrography. Eur Radiol. 2009;19(1):147-151. | Observational-Dx | 15 patients              | To compare direct multi-slice CT arthrography (MSCT-AG) and direct MR arthrography (MR-AG) of the wrist with regard to the depiction of the triangular fibrocartilage (TFC).    | Mean scores for MSCT-AG and MR-AG, respectively, were 2.5/2.0, 3.2/2.5 and 2.8/2.4 for the radial, central and ulnar portion of the TFC on its proximal side, and 2.7/2.0, 3.1/2.3 and 2.9/2.4 for the radial, central and ulnar portion on its distal side (n = 15). Paired Student's t-test showed no significant difference between MSCT-AG and MR-AG (P > 0.05). The authors were unable to show a significant difference in the visibility of TFCC lesions with the two techniques, using two observers. There was no independent gold standard, so no statement can be made about the accuracy of CT arthrography for the TFCC.  | 2                |
| 41. Taljanovic MS, Goldberg MR, Sheppard JE, Rogers LF. US of the intrinsic and extrinsic wrist ligaments and triangular fibrocartilage complex--normal anatomy and imaging technique. Radiographics. 2011;31(1):e44.                       | Review/Other-Dx  | N/A                      | Review role of US in imaging of intrinsic and extrinsic wrist ligaments and triangular fibrocartilage complex.  | Promising results have been published on US and sonoarthrography of the intrinsic wrist ligaments and the triangular fibrocartilage complex and on US of the majority of extrinsic wrist ligaments. Visualization of these structures can be achieved by using high-frequency linear transducers.  | 4                |

**Chronic Wrist Pain  
EVIDENCE TABLE**

| Reference   | Study Type       | Patients/<br>Events | Study Objective<br>(Purpose of Study)   | Study Results  | Study<br>Quality |
|---|------------------|---------------------|---|--|------------------|
| 42. Taljanovic MS, Sheppard JE, Jones MD, Switlick DN, Hunter TB, Rogers LF. Sonography and sonoarthrography of the scapholunate and lunotriquetral ligaments and triangular fibrocartilage disk: initial experience and correlation with arthrography and magnetic resonance arthrography. J Ultrasound Med. 2008;27(2):179-191. | Observational-Dx | 16 patients         | Prospective study to determine the value of US and sonoarthrography in evaluation of dorsal bands of the SL ligament, LT ligament, and TFCC disk in correlation with arthrography and MR arthrography.  | For SLL, results were concordant for all imaging modalities in 15 patients (93.75%) and partially concordant in 1 (6.25%). For LTL, results were concordant for all imaging modalities in 12 patients (75%), partially concordant in 3 (18.75%), and discordant in 1 (6.25%). For TFCC, the results were concordant for all imaging modalities in 13 patients (81.25%), partially concordant in 2 (12.5%), and discordant in 1 (6.25%). The arthroscopic and imaging findings were concordant for 3 SLL, 3 LTL, and 3 TFCC disks.  | 3                |
| 43. Scheck RJ, Kubitzek C, Hierner R, et al. The scapholunate interosseous ligament in MR arthrography of the wrist: correlation with non-enhanced MRI and wrist arthroscopy. Skeletal Radiol. 1997;26(5):263-271.  | Observational-Dx | 41 patients         | To compare three-compartment MR wrist arthrography with non-enhanced MRI in correlation with wrist arthroscopy, and to evaluate the potential of MR arthrography for consistently visualizing all parts of the scapholunate interosseous ligament of the wrist (SLIL) and exactly diagnosing the site and extent of SLIL defects. | Demonstration of SLIL defects was possible with high diagnostic confidence in 42% of SLIL segments by non-enhanced MRI and in 94% by MR arthrography. With wrist arthroscopy as the standard of reference, sensitivity and specificity values for SLIL perforations were 52%/34% for non-enhanced MRI and 90%/87% for MR arthrography. MR arthrography, using three-dimensional volume acquisition with thin slices (0.6-1.0 mm), combines the advantages of three-compartment arthrography and non-enhanced MRI. It shows the precise location and magnitude of ligamentous defects of all parts of the SLIL, correlates well with wrist arthroscopy and has potential implications for diagnosis and treatment planning. | 3                |

**Chronic Wrist Pain  
EVIDENCE TABLE**

| Reference  | Study Type       | Patients/<br>Events              | Study Objective<br>(Purpose of Study)  | Study Results  | Study<br>Quality |
|--|------------------|----------------------------------|--|--|------------------|
| 44. Scheck RJ, Romagnolo A, Hierner R, Pfluger T, Wilhelm K, Hahn K. The carpal ligaments in MR arthrography of the wrist: correlation with standard MRI and wrist arthroscopy. J Magn Reson Imaging. 1999;9(3):468-474. | Observational-Dx | 35 patients                      | To assess the value of three-compartment magnetic resonance (MR) wrist arthrography in comparison with non-enhanced magnetic resonance imaging (MRI) for the evaluation of 13 individual wrist ligaments | The delineation of individual wrist ligaments was rated as "good" in 10% of non-enhanced MR and 90% of MR arthrography images. Ligament evaluation was possible with high diagnostic confidence in 11% by non-enhanced MR imaging and 90% by MR arthrography. With wrist arthroscopy as the standard of reference, average sensitivities/specificities/accuracies for the diagnosis of full-thickness ligamentous defects were 0.81/0.75/0.77 for non-enhanced MR imaging and 0.97/0.96/0.96 for MR arthrography. The findings suggest that MR arthrography is more accurate than standard MRI in delineating and evaluating the ligaments of the wrist. | 2                |
| 45. Manaster BJ, Mann RJ, Rubenstein S. Wrist pain: correlation of clinical and plain film findings with arthrographic results. J Hand Surg Am. 1989;14(3):466-473.  | Observational-Dx | 72 consecutive patients          | To correlate clinical and radiographic findings with arthrographic results in patients with wrist pain.  | In 72 consecutive patients who had digital subtraction wrist arthrograms, both clinical sites of pain and plain film abnormalities were correlated with arthrographic findings. The results indicate that those patients with ulnar-sided pain more commonly have perforations in that region (88%). Radial-sided pain is a poor indicator of a radial site of perforation. Scapholunate dissociation does not correlate highly with scapholunate perforation (26%).   | 3                |
| 46. Parellada AJ, Gopez AG, Morrison WB, et al. Distal intersection tenosynovitis of the wrist: a lesser-known extensor tendinopathy with characteristic MR imaging features. Skeletal Radiol. 2007;36(3):203-208.       | Review/Other-Dx  | 5 patients                       | Presents MRI findings of extensor tenosynovitis at distal intersection of 2nd/3rd compartment tendons, and anatomic details involved in pathogenesis of condition.                                       | All patients had signs of tenosynovitis; tendinosis follows tenosynovitis; one patient had reactive edema at Lister's tubercle.  | 4                |
| 47. Anderson SE, Steinbach LS, Stauffer E, Voegelin E. MRI for differentiating ganglion and synovitis in the chronic painful wrist. AJR Am J Roentgenol. 2006;186(3):812-818.  | Observational-Dx | 34 patients; 2 blinded observers | Retrospective study to determine if preoperative IV-contrast-enhanced MRI can distinguish between ganglion (including occult dorsal ganglia) and synovitis in chronic wrist pain.                        | MRI accurate in preoperative differentiation of ganglion vs synovitis in chronic dorsal wrist pain; four main radiographs criteria useful—margin, shape, internal structure, and enhancement, with shape and internal structure most helpful. For ganglia, MR sensitivity = 89-94%; specificity = 85-95%.  | 3                |



**Chronic Wrist Pain  
EVIDENCE TABLE**

| Reference  | Study Type      | Patients/<br>Events | Study Objective<br>(Purpose of Study)  | Study Results  | Study<br>Quality |
|--|-----------------|---------------------|--|--|------------------|
| 48. American College of Radiology. ACR Appropriateness Criteria®: Soft-Tissue Masses. Available at: <a href="https://acsearch.acr.org/docs/69434/Narrative/">https://acsearch.acr.org/docs/69434/Narrative/</a> .          | 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 soft-tissue masses.          | N/A  | 4                |
| 49. American College of Radiology. ACR Appropriateness Criteria®: Acute Hand and Wrist Trauma. Available at: <a href="https://acsearch.acr.org/docs/69418/Narrative/">https://acsearch.acr.org/docs/69418/Narrative/</a> . | 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 Acute Hand and Wrist Trauma. | N/A  | 4                |
| 50. Dwek JR, Cardoso F, Chung CB. MR imaging of overuse injuries in the skeletally immature gymnast: spectrum of soft-tissue and osseous lesions in the hand and wrist. <i>Pediatr Radiol</i> . 2009;39(12):1310-1316.     | Review/Other-Dx | 125 MR exams        | To demonstrate the MR appearance of a spectrum of overuse injuries in the skeletally immature wrist and hand of pediatric gymnasts.  | Of the MR studies reviewed, 10 gymnasts were identified, all girls age 12-16 years (mean age 14.2 years) who presented with wrist or hand pain. Three of these children had bilateral MR exams. Abnormalities included chronic physal injuries in three children. Two girls exhibited focal lunate osteochondral defects. Triangular fibrocartilage tears were present in three girls, one of whom had a scapholunate ligament tear. Two girls manifested metacarpal head flattening and necrosis. A variety of soft-tissue and osseous lesions can be encountered in the skeletally immature gymnast. Familiarity with these stress-related injuries is important for accurate diagnosis. | 4                |
| 51. Rhemrev SJ, Ootes D, Beeres FJ, Meylaerts SA, Schipper IB. Current methods of diagnosis and treatment of scaphoid fractures. <i>Int J Emerg Med</i> . 2011;4:4.  | Review/Other-Dx | N/A                 | To review methods of diagnosis and treatment of scaphoid fractures.  | No results stated in abstract.   | 4                |
| 52. Mujoomdar M, Russell E, Dionne F, et al. Optimizing Health System Use of Medical Isotopes and Other Imaging Modalities. Ottawa (ON)2012.   | Review/Other-Dx | N/A                 | To provide national guidance on the optimal use of 99mTc during a situation of reduced supply.   | No results stated in abstract.   | 4                |

**Chronic Wrist Pain  
EVIDENCE TABLE**

| Reference   | Study Type       | Patients/<br>Events           | Study Objective<br>(Purpose of Study)   | Study Results  | Study<br>Quality |
|---|------------------|-------------------------------|---|--|------------------|
| 53. Yin ZG, Zhang JB, Kan SL, Wang XG. Diagnosing suspected scaphoid fractures: a systematic review and meta-analysis. Clin Orthop Relat Res. 2010;468(3):723-734.                                    | Meta-analysis    | 26 studies                    | To assess and compare the diagnostic performance of bone scintigraphy, MRI, and CT for diagnosing suspected scaphoid fractures.   | The pooled sensitivity, specificity, natural logarithm of the diagnostic odds ratio, and the positive and negative likelihood ratios were, respectively, 97%, 89%, 4.78, 8.82, and 0.03 for bone scintigraphy; 96%, 99%, 6.60, 96, and 0.04 for MRI; and 93%, 99%, 6.11, 93, and 0.07 for CT. Bone scintigraphy and MRI have equally high sensitivity and high diagnostic value for excluding scaphoid fracture; however, MRI is more specific and better for confirming scaphoid fracture.                | M                |
| 54. Foex B, Speake P, Body R. Best evidence topic report. Magnetic resonance imaging or bone scintigraphy in the diagnosis of plain x ray occult scaphoid fractures. Emerg Med J. 2005;22(6):434-435. | Review/Other-Dx  | 4 articles with best evidence | To establish whether MRI or bone scintigraphy is better at identifying scaphoid fractures not apparent on plain x-rays.   | MRI is the investigation of choice in the clinically suspected scaphoid fracture after negative initial and 10-14 day follow up x-rays. A bone scan is a reasonable alternative in patients with claustrophobia.   | 4                |
| 55. Allainmat L, Aubault M, Noel V, Baulieu F, Laulan J, Eder V. Use of hybrid SPECT/CT for diagnosis of radiographic occult fractures of the wrist. Clin Nucl Med. 2013;38(6):e246-251.              | Review/Other-Dx  | 5 images                      | To report typical examples illustrating the incremental diagnosis value of hybrid SPECT/CT compared with planar scintigraphy with semiquantitative analysis in the diagnosis of radiographic occult fractures of the wrist. | No results stated in abstract.   | 4                |
| 56. Querellou S, Arnaud L, Williams T, et al. Role of SPECT/CT compared with MRI in the diagnosis and management of patients with wrist trauma occult fractures. Clin Nucl Med. 2014;39(1):8-13.      | Observational-Dx | 57 patients                   | To evaluate the utility of SPECT/CT in the management of occult carpal fractures.   | From December 2009 to May 2011, 57 patients were enrolled. Fifty-seven SPECT/CT and 52 MRI scans were obtained. Twenty-eight patients had normal imaging results, whereas 29 patients presented bone bruise and/or fractures. Ten patients were concordant according to SPECT/CT and MRI; 2 patients presented fractures on SPECT/CT without MRI performed; 17 patients had partially discordant results. Only 1 patient presented a nonunion at the follow-up, whereas both investigations were positive. | 2                |

**Chronic Wrist Pain  
EVIDENCE TABLE**

| Reference   | Study Type       | Patients/<br>Events                                       | Study Objective<br>(Purpose of Study)   | Study Results   | Study<br>Quality |
|---|------------------|---|---|---|------------------|
| 57. Fox MG, Gaskin CM, Chhabra AB, Anderson MW. Assessment of scaphoid viability with MRI: a reassessment of findings on unenhanced MR images. <i>AJR Am J Roentgenol.</i> 2010;195(4):W281-286.  | Observational-Dx | 29 patients   | To evaluate the accuracy of unenhanced T1-weighted MR images in predicting the vascular status of the proximal pole of the scaphoid in patients with chronic scaphoid fracture nonunions. | Unenhanced MRI had a sensitivity, specificity, and accuracy of 55%, 94%, and 79%, respectively, for diagnosing AVN. Increased proximal pole STIR signal was noted with similar frequencies in patients with and without AVN. T1-weighted unenhanced MRI is an acceptable alternative to delayed contrast-enhanced MRI in the preoperative assessment of the vascular status of the proximal pole of the scaphoid in patients with chronic fracture nonunions. STIR images were not beneficial in determining proximal pole viability.   | 2                |
| 58. Cerezal L, Abascal F, Canga A, Garcia-Valtuille R, Bustamante M, del Pinal F. Usefulness of gadolinium-enhanced MR imaging in the evaluation of the vascularity of scaphoid nonunions. <i>AJR Am J Roentgenol.</i> 2000;174(1):141-149. | Observational-Dx | 30 consecutive patients                                   | To identify the role of gadolinium-enhanced MR imaging in the preoperative evaluation of the vascular status of the proximal fragment in scaphoid nonunions.                              | Unenhanced MR imaging showed a global sensitivity of 36%, specificity of 78%, and accuracy of 68% in the preoperative evaluation of the vascular status of the proximal fragment. Correlation with the surgical findings was not statistically significant ( $p < 0.149$ ). Global sensitivity, specificity, and accuracy of gadolinium-enhanced MR imaging were 66%, 88%, and 83%, respectively. Correlation with the surgical findings was good ( $p < 0.0001$ ). Gadolinium-enhanced sequences allowed accurate diagnosis and enabled the creation of prognostic groups having better correlation with surgical findings and postoperative results. Gadolinium-enhanced MR imaging is the most reliable imaging method for investigating the vascularity of the proximal pole in scaphoid nonunions. | 2                |
| 59. Bordalo-Rodrigues M, Schweitzer M, Bergin D, Culp R, Barakat MS. Lunate chondromalacia: evaluation of routine MRI sequences. <i>AJR Am J Roentgenol.</i> 2005;184(5):1464-1469.   | Observational-Dx | 34 (24 patients: indirect MR arthrography)<br>2 observers | Retrospective review to determine MRI detection of lunate chondral defects with arthroscopic correlation.   | For lunate chondral defects, MR showed sensitivity/specificity 77%/86%. Marrow edema commonly accompanied lesions.  | 2                |

**Chronic Wrist Pain  
EVIDENCE TABLE**

| Reference  | Study Type       | Patients/<br>Events  | Study Objective<br>(Purpose of Study)   | Study Results   | Study<br>Quality |
|--|------------------|--|---|---|------------------|
| 60. Saupe N, Pfirrmann CW, Schmid MR, Schertler T, Manestar M, Weishaupt D. MR imaging of cartilage in cadaveric wrists: comparison between imaging at 1.5 and 3.0 T and gross pathologic inspection. <i>Radiology</i> . 2007;243(1):180-187.      | Observational-Dx | 10 cadaveric wrists from 9 subjects                          | To evaluate prospectively the diagnostic accuracy of MR imaging in the identification of cartilage abnormalities at 3.0 and 1.5 T in cadaveric wrists, with gross pathologic findings as the standard of reference.   | 170 cartilage surfaces were graded. The sensitivity and specificity for cartilage lesions were 43%-52% and 82%-89%, respectively, at 1.5 T and 48%-52% and 82% at 3.0 T. Differences in assessment did not reach statistical significance ( $P > .99$ ). Highest sensitivities were found in the proximal carpal row (67%-71%); lowest sensitivities were found in the distal carpal row (14%-24%). Interobserver agreement was higher for imaging at 3.0 T ( $\kappa = 0.634$ ) than at 1.5 T ( $\kappa = 0.267$ ). The performance of MR imaging for the detection of articular cartilage abnormalities in the wrist depends on anatomic location. Interobserver agreement is higher for imaging at 3.0 than at 1.5 T, but diagnostic performances were not significantly different ( $P > .99$ ) at either field strength. | 2                |
| 61. Tajika T, Kobayashi T, Yamamoto A, Kaneko T, Takagishi K. Diagnostic utility of sonography and correlation between sonographic and clinical findings in patients with carpal tunnel syndrome. <i>J Ultrasound Med</i> . 2013;32(11):1987-1993. | Experimental-Dx  | 50 wrists in 34 patients, 81 wrists in 45 healthy volunteers | To investigate the accuracy of carpal tunnel syndrome diagnosis by comparing the cross-sectional area of the median nerve measured at the level of proximal inlet of the carpal tunnel with that measured at the level of the distal radioulnar joint on sonography and to evaluate the correlation between sonographic and neurophysiologic findings and clinical findings assessed by the Carpal Tunnel Syndrome Instrument of the Japanese Society for Surgery of the Hand (JSSH). | The diagnosis of carpal tunnel syndrome determined by the Delta cross-sectional area was more accurate than the diagnosis determined by the proximal area on receiver operating characteristic curve analysis ( $P = .006$ ). Statistically significant correlations were found between proximal area, Delta area, and nerve conduction velocity findings (proximal, $r = 0.45$ ; $P = .0013$ ; Delta, $r = 0.44$ ; $P = .001$ ). The proximal and distal areas were positively correlated with the JSSH symptom severity score (proximal, $r = 0.39$ ; $P = .005$ ; distal, $r = 0.35$ ; $P = .014$ ).   | 3                |

**Chronic Wrist Pain  
EVIDENCE TABLE**

| Reference   | Study Type       | Patients/<br>Events  | Study Objective<br>(Purpose of Study)  | Study Results  | Study<br>Quality |
|---|------------------|--|--|--|------------------|
| 62. Ashraf AR, Jali R, Moghtaderi AR, Yazdani AH. The diagnostic value of ultrasonography in patients with electrophysiologically confirmed carpal tunnel syndrome. <i>Electromyogr Clin Neurophysiol.</i> 2009;49(1):3-8.                        | Observational-Dx | 70 wrists  | To evaluate the diagnostic value of ultrasonography in patients with electrophysiologically confirmed carpal tunnel syndrome.  | The ultrasonographic measurements of median nerves were found to be increased significantly in patients with carpal tunnel syndrome when compared with controls, particularly in terms of cross-sectional area (P <0.001). According to receiver-operating-characteristics curve results, the most optimal cutoff value for the cross-sectional area of the median nerve was obtained at the level of middle carpal tunnel, which was 9.3 mm <sup>2</sup> , with a sensitivity of 80% and specificity of 77.5%. CONCLUSION: Ultrasonographic examination of the median nerve seems to be a promising method in the diagnosis of carpal tunnel syndrome, evaluating the morphologic changes of the median nerve in patients with clinical signs and symptoms. Further studies with wider series are needed to confirm our | 3                |
| 63. Klauser AS, Halpern EJ, De Zordo T, et al. Carpal tunnel syndrome assessment with US: value of additional cross-sectional area measurements of the median nerve in patients versus healthy volunteers. <i>Radiology.</i> 2009;250(1):171-177. | Observational-Dx | 68 patients; 100 wrists with CTS 58 patients; 93 wrists – healthy volunteers | To compare cross-sectional area (CSA) measurements of the median nerve obtained at the level of the carpal tunnel (CSAc) with those from more proximally (CSAp), at the level of the pronator quadratus muscle to improve diagnosis of carpal tunnel syndrome (CTS). | Delta CSA threshold of 2 mm (2) had the greatest sensitivity (99%) and specificity (100%) for the diagnosis of CTS. Delta CSA was more accurate than CSAc.   | 3                |
| 64. Sernik RA, Abicalaf CA, Pimentel BF, Braga-Baiak A, Braga L, Cerri GG. Ultrasound features of carpal tunnel syndrome: a prospective case-control study. <i>Skeletal Radiol.</i> 2008;37(1):49-53.   | Observational-Dx | 31 patients; 40 wrists, 37 asymptomatic volunteers, 63 wrists                | To examine the most adequate cut-off point for median nerve cross-sectional area and additional ultrasound features supporting the diagnosis of carpal tunnel syndrome (CTS).  | In CTS the median nerve cross-sectional area was increased compared with the control group. Median nerve cross-sectional area of 10 mm(2) (DT) and 9 mm(2) (IT) had high sensitivity (85% and 88.5%, respectively), specificity (92.1% and 82.5%) and accuracy (89.3% and 82.5%) in the diagnosis of CTS. CTS patients had an increased carpal tunnel AP diameter, flexor retinaculum thickening, reduced median nerve mobility and decreased median nerve echogenicity. Ultrasound assists in the diagnosis of CTS using the median nerve diameter cut-off point of 10 mm(2) (DT) and 9 mm(2) (IT) and several additional findings.   | 3                |

**Chronic Wrist Pain  
EVIDENCE TABLE**

| Reference   | Study Type       | Patients/<br>Events        | Study Objective<br>(Purpose of Study)   | Study Results   | Study<br>Quality |
|---|------------------|----------------------------|---|---|------------------|
| 65. Akcar N, Ozkan S, Mehmetoglu O, Calisir C, Adapinar B. Value of power Doppler and gray-scale US in the diagnosis of carpal tunnel syndrome: contribution of cross-sectional area just before the tunnel inlet as compared with the cross-sectional area at the tunnel. Korean J Radiol. 2010;11(6):632-639. | Observational-Dx | 42 patients                | To determine the value of gray-scale and power Doppler ultrasonography in the evaluation of carpal tunnel syndrome (CTS).     | A statistically significant difference was found between patients and the control group for mean CSAb, area difference, percentage area increase, and flattening ratio ( $p < 0.001$ , $p < 0.001$ , $p < 0.001$ , $p < 0.05$ , respectively). From the ROC curve we obtained optimal cut-off values of 11 mm <sup>2</sup> for CSAb, 3.65 for area difference, 50% for the percentage of area increase, and 2.6 for the flattening ratio. The mean number of vessels obtained by power Doppler ultrasonography from the median nerve was 1.2. We could not detect vessels from healthy volunteers. Mean CSAbs related to vascularity intensity scores were as follows: score 0: 12.3 +/- 2.8 mm <sup>2</sup> , score 1: 12.3 +/- 3.1 mm <sup>2</sup> , score 2: 14.95 +/- 3.5 mm <sup>2</sup> , score 3: 19.3 +/- 3.8 mm <sup>2</sup> . The mean PI value in vessels of the median nerve was 4.1 +/- 1. Gray-scale and power Doppler ultrasonography are useful in the evaluation of CTS. | 3                |
| 66. Mallouhi A, Pulzl P, Trieb T, Piza H, Bodner G. Predictors of carpal tunnel syndrome: accuracy of gray-scale and color Doppler sonography. AJR Am J Roentgenol. 2006;186(5):1240-1245.  | Observational-Dx | 151 patients<br>206 wrists | To retrospectively assess the accuracy of gray-scale and color Doppler sonography in the diagnosis of carpal tunnel syndrome. | Carpal tunnel syndrome was confirmed in 172 wrists at nerve conduction studies. A median nerve cross-sectional area of at least 0.11 cm <sup>2</sup> was calculated as a definition of median nerve swelling. In comparison with nerve conduction studies, nerve swelling showed the highest accuracy (91%) among gray-scale sonography criteria, and the presence of intraneural hypervascularization showed the highest accuracy (95%) among all sonography criteria. Logistic regression analysis showed that nerve hypervascularization was the only variable that independently predicted median nerve entrapment (odds ratio, 16.4; 95% confidence interval, 8.7-31.1; $p < 0.001$ ). Color Doppler sonography is more accurate than gray-scale sonography for characterizing median nerve involvement in patients with suspected carpal tunnel syndrome.   | 4                |

**Chronic Wrist Pain  
EVIDENCE TABLE**

| Reference  | Study Type       | Patients/<br>Events | Study Objective<br>(Purpose of Study)  | Study Results  | Study<br>Quality |
|--|------------------|---------------------|--|--|------------------|
| 67. Rempel D, Evanoff B, Amadio PC, et al. Consensus criteria for the classification of carpal tunnel syndrome in epidemiologic studies. <i>Am J Public Health</i> . 1998;88(10):1447-1451.  | Review/Other-Dx  | N/A                 | Group of research physicians met with a goal of defining and ranking consensus criteria for the classification of carpal tunnel syndrome in epidemiologic studies.   | Agreement reached by group: First, no perfect gold standard exists for carpal tunnel syndrome. Combination of electrodiagnostic study findings and symptom characteristics will provide the most accurate information for classification of carpal tunnel syndrome. Second, use of only electrodiagnostic study findings is not recommended. Finally, in the absence of electrodiagnostic studies, specific combinations of symptom characteristics and physical examination findings may be useful in some settings but are likely to result in greater misclassification of disease status.  | 4                |
| 68. Martins RS, Siqueira MG, Simplicio H, Agapito D, Medeiros M. Magnetic resonance imaging of idiopathic carpal tunnel syndrome: correlation with clinical findings and electrophysiological investigation. <i>Clin Neurol Neurosurg</i> . 2008;110(1):38-45.                 | Observational-Dx | 74 patients         | To compare clinical evaluation, electrophysiological investigation and magnetic resonance findings in assessing the severity of idiopathic carpal tunnel syndrome.   | Cross-sectional area of median nerve was smaller at hamate level than at radio-ulnar joint and pisiform levels ( $p<0.001$ ). With exception of median nerve area at hamate level, there was a lower degree of correlation between MRI parameters and findings obtained by clinical assessments and electrophysiological measurements. The median nerve area at hamate level correlated negatively with duration of symptoms, two-point discrimination, symptoms severity score and positively with sensory nerve conduction velocity ( $p<0.01$ ). In patients with idiopathic carpal tunnel syndrome, median nerve area measured by wrist magnetic resonance at hamate level may be considered as a valuable indicator to grading the severity of disease. | 3                |
| 69. Jarvik JG, Comstock BA, Heagerty PJ, et al. Magnetic resonance imaging compared with electrodiagnostic studies in patients with suspected carpal tunnel syndrome: predicting symptoms, function, and surgical benefit at 1 year. <i>J Neurosurg</i> . 2008;108(3):541-550. | Observational-Dx | 120 patients        | Prospective enrollment of patients with carpal tunnel syndrome to compare the value of MRI with electrodiagnostic studies for: 1) prediction of 1-year outcomes and 2) identification of patients who are likely to benefit from surgical treatment. | The authors recontacted 105 of 120 participants at 12 months. Of these, 30 patients had had surgery and 75 had not. Patients who had undergone surgery showed greater improvement at 1 year than those who had not had surgery. The length of the abnormal T2-weighted nerve signal on MRI and median-ulnar sensory latency difference were the strongest predictors of surgical benefit. Findings obtained with MRI of the carpal tunnel predict surgical benefit independently of nerve conduction studies.  | 2                |

**Chronic Wrist Pain  
EVIDENCE TABLE**

| Reference  | Study Type       | Patients/<br>Events | Study Objective<br>(Purpose of Study)   | Study Results   | Study<br>Quality |
|--|------------------|---------------------|---|---|------------------|
| 70. Aoki T, Oshige T, Matsuyama A, et al. High-resolution MRI predicts steroid injection response in carpal tunnel syndrome patients. <i>Eur Radiol.</i> 2014;24(3):559-565.   | Observational-Dx | 163 wrists          | To correlate median nerve T2 signal and shape at the carpal tunnel with steroid injection (SI) response in carpal tunnel syndrome (CTS) patients and to determine if high-resolution MRI at 3 T can be used to predict SI response in these patients. No intravenous contrast was administered. | 113 of the 163 wrists (69.3%) responded well to SI. The percentage of improvement was 81.7% (49/60) in group 1, 69.9% (51/73) in group 2, and 43.3% (13/30) in group 3 (P < 0.01). On stepwise logistic regression analysis high-resolution MRI was the only significant independent factor for SI response in CTS patients (P < 0.01). | 2                |
| 71. American College of Radiology. ACR Appropriateness Criteria® Radiation Dose Assessment Introduction. Available at: <a href="http://www.acr.org/~media/ACR/Documents/AppCriteria/RadiationDoseAssessmentIntro.pdf">http://www.acr.org/~media/ACR/Documents/AppCriteria/RadiationDoseAssessmentIntro.pdf</a> . | Review/Other-Dx  | N/A                 | Guidance document on exposure of patients to ionizing radiation.  | N/A   | 4                |



## 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