

Acute Shoulder Pain EVIDENCE TABLE

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Strength of Evidence
1. Pavlov H, Warren RF, Weiss CB, Jr., Dines DM. The roentgenographic evaluation of anterior shoulder instability. <i>Clin Orthop Relat Res</i> 1985; (194):153-158.	13	83	Retrospectively review roentgenograms of patients with unilateral shoulder instability to evaluate the value of different radiographic projections and to correlate the information with the osseous pathology associated with prior glenohumeral dislocation.	Radiographic series that includes an internal rotation, a Stryker notch view, and either a West Point or a Didiee view would maximize the diagnostic yield per radiographic cost, time, and exposure in a patient with an unstable shoulder.	3
2. Brems-Dalgaard E, Davidsen E, Sloth C. Radiographic examination of the acute shoulder. <i>Eur J Radiol</i> 1990; 11(1):10-14.	9	125	Retrospectively evaluate acute shoulder examinations and compare the findings from the 3 radiographs- anteroposterior projection (AP), the transthoracic projection (TT) and apical oblique projection (AO) to see if one of the projections could be omitted from the primary examination without losing diagnostic information.	Examinations were normal in 47 patients. 78 patients had 112 lesions. 17/112 lesions were showed by AO; 8 were isolated lesions. AO and AP presented 111/112 lesions. Study recommends that the routine radiographic examination of the acute shoulder includes the AO and the AP, supplemented with the TT — or another lateral projection — in case of humeral fracture.	3
3. De Smet AA. Anterior oblique projection in radiography of the traumatized shoulder. <i>AJR</i> 1980; 134(3):515-518.	13	132 consecutive shoulder radiographs	Prospective study to evaluate a third projection in trauma cases in addition to AP with internal and external rotation.	84 normal exams and 48 abnormal exams. 29 fractures, dislocations, or acromioclavicular separations were identified. Two fractures of the greater tuberosity were seen only on the AP with external rotation. One humeral head fracture and three scapular fractures were visualized only on the anterior oblique projection.	2
4. De Smet AA. Axillary projection in radiography of the nontraumatized shoulder. <i>AJR</i> 1980; 134(3):511-514.	13	239 consecutive radiographic exams	Prospective analysis of a series of radiographic exams of the shoulder performed on patients without acute trauma. Purpose is to determine if axillary projection revealed pathology not seen on AP films.	109 normal exams and 130 abnormal exams. AP view with external rotation identified 14 abnormalities not seen on the other views. The axillary projection identified 15 abnormalities not seen on other views. If only these two views had been obtained, 99.3% of the abnormalities would have been identified.	2
5. Silfverskiöld JP, Straehley DJ, Jones WW. Roentgenographic evaluation of suspected shoulder dislocation: a prospective study comparing the axillary view and the scapular 'Y' view. <i>Orthopedics</i> 1990; 13(1):63-69.	9	75 consecutive patients	Prospective study to compare axillary and scapular Y views in patients with suspected shoulder dislocation.	<ul style="list-style-type: none"> • Scapular Y view and axillary view resulted in the same diagnosis 69 cases (92%). • 61 patients (81%) preferred the scapular Y view to the axillary view because of less pain. • Scapular Y view was preferred and considered easier to obtain than the axillary view when the technician was skillful with the scapular Y view. 	2
6. Kilcoyne RF, Reddy PK, Lyons F, Rockwood CA, Jr. Optimal plain film imaging of the shoulder impingement syndrome. <i>AJR</i> 1989; 153(4):795-797.	12	N/A	Review optimal radiographs of the shoulder impingement syndrome.	The AP radiograph at a 30 degree caudal angle is helpful in confirming the clinical impression and in selecting patients for surgery.	4

* See Last Page for Key

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7. Teefey SA, Rubin DA, Middleton WD, Hildebolt CF, Leibold RA, Yamaguchi K. Detection and quantification of rotator cuff tears. Comparison of ultrasonographic, magnetic resonance imaging, and arthroscopic findings in seventy-one consecutive cases. <i>J Bone Joint Surg Am</i> 2004; 86-A(4):708-716.	9	71 consecutive cases	Prospective study to compare the accuracy of US and MRI for detection and measurement of the size of rotator cuff tears, with arthroscopic findings used as the standard.	<ul style="list-style-type: none"> 45/46 full-thickness tears were identified by US; MRI identified all 46. 13/19 partial-thickness rotator cuff tears were identified by US; MRI identified 12/19. Overall accuracy for both imaging tests was 87%. US correctly predicted the degree of retraction of 73% of the full-thickness tears and the length of 85% of the partial-thickness tears, and MRI correctly predicted the retraction and length of 63% and 75%, respectively. US correctly predicted the width of 87% of the full-thickness tears and 54% of the partial-thickness tears, and MRI correctly predicted the width of 80% and 75%, respectively. No significant differences between US and MRI were demonstrated ($P>0.05$). 	2
8. Balich SM, Sheley RC, Brown TR, Sauser DD, Quinn SF. MR imaging of the rotator cuff tendon: interobserver agreement and analysis of interpretive errors. <i>Radiology</i> 1997; 204(1):191-194.	10	222	Retrospective, single blinded study to evaluate accuracy in interpretation of shoulder MRI and interobserver agreement. Five radiologists independently and retrospectively twice interpreted the MRI.	<ul style="list-style-type: none"> Full-thickness tears: sensitivity 84%-96%, specificity 94%-98%, and accuracy 92%-97%. Partial tears: sensitivity 35%-44%, specificity 85%-97%, and accuracy 77%-87%. Statistically significant difference in readers in no tear category, but not in tear categories. Increased radiologist experience improves ability to diagnose tears. 	2

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9. Chandnani VP, Yeager TD, DeBerardino T, et al. Glenoid labral tears: prospective evaluation with MRI imaging, MR arthrography, and CT arthrography. <i>AJR</i> 1993; 161(6):1229-1235.	9	30	Prospective study to compare MRI, MR arthrography and CT arthrography to determine sensitivity of each technique in detecting labral tears and determining labral detachment or degeneration.	<ul style="list-style-type: none"> • Labral tear was detected on MRI in 26 (93%) of 28, on MR arthrograms in 27 (96%) of 28, and on CT arthrograms in 19 (73%) of 26. • A detached labral fragment was detected on MRI in 12 (46%) of 26, on MR arthrograms in 25 (96%) of 26, and on CT arthrograms in 13 (52%) of 25. • Labral degeneration was detected on MRI in 2 (11%) of 18, on MR arthrograms in 10 (56%) of 18, and on CT arthrograms in four (24%) of 17. • MRI and MR arthrography showed labral tears with greater sensitivity than CT arthrography. MR arthrography was the most sensitive of the three techniques (96% sensitive for labral tear). 	2
10. Hodler J, Kursunoglu-Brahme S, Snyder SJ, et al. Rotator cuff disease: assessment with MR arthrography versus standard MR imaging in 36 patients with arthroscopic confirmation. <i>Radiology</i> 1992; 182(2):431-436.	9	36 shoulders in 36 patients	Comparison of standard MRI with MR arthrography for detection of rotator cuff disease in patients with arthroscopic confirmation.	<ul style="list-style-type: none"> • Sensitivity of MR arthrography alone was 71%; specificity, 84%; and accuracy, 78%. • Sensitivity of standard proton-density weighted and T2-weighted MRI alone was 41%; specificity, 79%; and accuracy, 61%. • MR arthrography was superior to standard MRI for demonstrating partial tears at the articular surface. 	3
11. Legan JM, Burkhard TK, Goff WB, 2nd, et al. Tears of the glenoid labrum: MR imaging of 88 arthroscopically confirmed cases. <i>Radiology</i> 1991; 179(1):241-246.	10	88	To prospectively evaluate the accuracy of MRI in enabling diagnosis of surgically correctable labral abnormalities.	<ul style="list-style-type: none"> • MRI enabled accurate prediction of anterior labral tears, with sensitivity of 95%, specificity of 86%, and accuracy of 92%. • MRI less effective in the prediction of tears of the superior labrum, with a sensitivity of 75%, a specificity of 99%, and an accuracy of 95%. • MRI is highly accurate, noninvasive technique for the clinical evaluation of shoulder instability. 	2
12. Beltran J, Rosenberg ZS, Chandnani VP, Cuomo F, Beltran S, Rokito A. Glenohumeral instability: evaluation with MR arthrography. <i>Radiographics</i> 1997; 17(3):657-673.	12	N/A	Review MRI of the glenohumeral joint and present the MR arthrographic appearances of the normal glenohumeral joint, anterior and posterior glenohumeral instability and superior labral anterior and posterior (SLAP) lesions.	MR arthrography is superior to other imaging techniques in the evaluation of glenohumeral instability. This technique is better than conventional MRI for visualization of capsulolabral and ligamentous structures.	4

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13. Gusmer PB, Potter HG, Schatz JA, et al. Labral injuries: accuracy of detection with unenhanced MR imaging of the shoulder. <i>Radiology</i> 1996; 200(2):519-524.	10	103	To prospectively assess the accuracy of unenhanced MRI in detection and localization of labral injuries.	37 torn anterior, 36 torn superior, and 19 torn posterior labral were identified at surgery. The sensitivity for detection of these tears with MRI was 100%, 86%, and 74%, respectively; the specificity was 95%, 100%, and 95%, respectively. Unenhanced MRI was 95% accurate in detection of labral injuries.	2
14. Jee WH, McCauley TR, Katz LD, Matheny JM, Ruwe PA, Daigneault JP. Superior labral anterior posterior (SLAP) lesions of the glenoid labrum: reliability and accuracy of MR arthrography for diagnosis. <i>Radiology</i> 2001; 218(1):127-132.	10	80	Retrospectively review MR arthrograms to determine the reliability and accuracy of MR arthrography for the diagnosis of SLAP tears. MR arthrograms were independently scored by 3 observers for the presence and type of SLAP lesion.	25 SLAP tears at arthroscopy. Sensitivity, specificity, and accuracy of each reader were 92%, 84%, and 86%; 92%, 82%, and 85%; and 84%, 69%, and 74%, respectively. Interobserver agreement for SLAP tears was substantial (kappa=0.77) to moderate (kappa=0.52, kappa=0.44). MR arthrography of the shoulder is reliable and accurate for detection of SLAP tears.	3
15. Jim YF, Chang CY, Wu JJ, Chang T. Shoulder impingement syndrome: impingement view and arthrography study based on 100 cases. <i>Skeletal Radiol</i> 1992; 21(7):449-451.	9	523	Prospective evaluation combining the shoulder impingement view and arthrography made in patients presenting with chronic shoulder pain. Patients were radiographed with conventional views and impingement views.	100 subacromial spurs on impingement view only. 18 seen on conventional view. 35 patients had cuff tear. Size of the bony spur was strongly associated with the incidence of rotator cuff tear (P<0.02).	2
16. Palmer WE, Brown JH, Rosenthal DI. Labral-ligamentous complex of the shoulder: evaluation with MR arthrography. <i>Radiology</i> 1994; 190(3):645-651.	10	48 shoulders	Prospective study to determine the value of MR arthrography in the assessment of labral-ligamentous complex and test the hypothesis that the inferior glenohumeral ligament is an important anatomic feature of clinical instability.	MR arthrographic findings had sensitivity of 91% and specificity of 93%. MR arthrography accurately shows the relationship of labral lesions to the origins of the glenohumeral ligaments and helps in distinction between stable and unstable lesions.	3
17. Palmer WE, Caslowitz PL. Anterior shoulder instability: diagnostic criteria determined from prospective analysis of 121 MR arthrograms. <i>Radiology</i> 1995; 197(3):819-825.	10	121	Prospective, blinded study to determine MR arthrographic criteria in the diagnosis of anterior glenohumeral instability.	MR arthrograms showed labral abnormalities with 92% sensitivity, 92% specificity. Inferior labral-ligamentous lesions predicted anterior instability with 76% sensitivity and 98% specificity. Capsular insertion sites played no role in prediction of shoulder instability.	1
18. Shankman S, Bencardino J, Beltran J. Glenohumeral instability: evaluation using MR arthrography of the shoulder. <i>Skeletal Radiol</i> 1999; 28(7):365-382.	12	N/A	Review use of MR arthrography for evaluation of glenohumeral instability.	MR arthrography has advantages over routine MRI. Normal variants are present that mimic pathology.	4
19. Steinbach LS, Palmer WE, Schweitzer ME. Special focus session. MR arthrography. <i>Radiographics</i> 2002; 22(5):1223-1246.	12	N/A	Review article to demonstrate capabilities of direct and indirect MR arthrography for evaluation of joints in the human body.	Direct MR arthrography is useful for demonstrating rotator cuff tears and labral pathology. Abduction external rotation is helpful for labral tears. Indirect MR arthrography is not indicated for labral tears.	4

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20. Tirman PF, Bost FW, Garvin GJ, et al. Posterosuperior glenoid impingement of the shoulder: findings at MR imaging and MR arthrography with arthroscopic correlation. <i>Radiology</i> 1994; 193(2):431-436.	9	8	Retrospective review to determine the utility of MRI and MR arthrography in evaluation of arthroscopic findings of posterosuperior glenoid impingement.	MR arthrography was superior to routine MRI in all 4 cases where both were compared. Positioning the shoulder in abduction and external rotation was beneficial in 3 of the 4 cases.	4
21. Neviaser RJ, Neviaser TJ. Recurrent instability of the shoulder after age 40. <i>J Shoulder Elbow Surg</i> 1995; 4(6):416-418.	4	12	Prospective review of restoration of shoulder stability with surgical repair of rotator cuff structures.	All patients demonstrated shoulder stability with repair of the rotator cuff	2
22. Steinbach LS, Chung CB, Yoshioka H. Technical Considerations for MRI of Upper Extremity Joints. In: Chung CB, Steinbach LS, eds. <i>MRI of the Upper Extremity Shoulder, Elbow, Wrist and Hand</i> Philadelphia, PA: Lippincott Williams & Wilkins 2010:211.	15	N/A	Book Chapter	Table 2.5 demonstrates a widespread practice commonly accepted by Orthopedic Surgeons and Musculoskeletal Radiologists. MRA is not commonly recommended for patients over age 35.	N/A
23. Sperling JW, Potter HG, Craig EV, Flatow E, Warren RF. Magnetic resonance imaging of painful shoulder arthroplasty. <i>J Shoulder Elbow Surg</i> 2002; 11(4):315-321.	10	19 patients (21 studies)	Retrospective study to determine the value of a modified MR technique in identifying pathology after shoulder arthroplasty. MRI was performed in 42 painful shoulder arthroplasties, 22 of which underwent subsequent revision surgery, allowing surgical confirmation of the pathology identified on MRI. One hemiarthroplasty was excluded because of motion artifact, leaving 21 studies (19 patients) to be correlated to the surgical findings.	MRI correctly predicted full-thickness rotator cuff tears in 10/11. 10/21 shoulders did not have a rotator cuff tear, and MRI correctly predicted the absence of a tear in 8/10. MRI also correctly predicted glenoid cartilage wear in 8/9 shoulders.	3

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24. Wagner SC, Schweitzer ME, Morrison WB, Fenlin JM, Jr., Bartolozzi AR. Shoulder instability: accuracy of MR imaging performed after surgery in depicting recurrent injury--initial findings. <i>Radiology</i> 2002; 222(1):196-203.	9	24	Retrospective analysis of postoperative MRI obtained in patients with recurrent signs or symptoms of instability in whom subsequent surgical correlation was performed to determine the accuracy in diagnosing recurrent injury. 12 nonenhanced MRI and 6 indirect and 6 direct MR arthrograms were retrospectively reviewed with consensus to determine the presence or absence of recurrent labral or rotator cuff tear.	<ul style="list-style-type: none"> • The overall accuracy of postoperative MRI was 79% in depicting recurrent labral tear and 88% in depicting recurrent rotator cuff tear. • Indirect MR arthrography had 100% accuracy for recurrent labral tear detection, while direct MR arthrography and nonenhanced MRI had accuracies of 67% and 75%, respectively. • Direct MR arthrography was more sensitive, 100% vs 71%, but less specific, 60% vs 80%, than nonenhanced MRI in depicting recurrent labral tears. • Direct MR arthrography had 100% accuracy in depicting rotator cuff tear, whereas both indirect MR arthrography and nonenhanced MRI had 83% accuracy. • MRI, indirect MR arthrography in particular, appears to be an accurate means of evaluating the shoulder following instability surgery. 	2
25. Billet FP, Schmitt WG, Gay B. Computed tomography in traumatology with special regard to the advances of three-dimensional display. <i>Arch Orthop Trauma Surg</i> 1992; 111(3):131-137.	13	506	Review data file to evaluate CT in traumatology with special regard to the advances of 3D display.	3D images are beneficial in the preoperative evaluation of maxillofacial and calvarial anomalies and destruction of the skull base. Fractures of the spine, sternoclavicular joint, shoulder, acetabulum, knee, and calcaneus can be examined very well. However, 3D reconstruction does not convey new details.	3
26. Castagno AA, Shuman WP, Kilcoyne RF, Haynor DR, Morris ME, Matsen FA. Complex fractures of the proximal humerus: role of CT in treatment. <i>Radiology</i> 1987; 165(3):759-762.	9	17 consecutive patients	Retrospective study to examine the importance of CT in the evaluation of complex proximal humeral fractures, compare CT findings with radiography, and evaluate the impact of CT on subsequent treatment of the patients.	Surgery done in 8 patients; CT demonstrated significant abnormalities not definitely shown with radiography. In 6/8 patients, CT scans demonstrated unsuspected abnormalities that directed the choice of surgical procedure. CT scans provide clinically useful information for the treatment of complex proximal humeral fractures when radiographs provide inadequate or indefinite information.	3
27. Buckwalter KA, Rydberg J, Kopecky KK, Crow K, Yang EL. Musculoskeletal imaging with multislice CT. <i>AJR</i> 2001; 176(4):979-986.	12	N/A	Review on the advantages of musculoskeletal imaging with multislice CT.	Multislice CT permits anatomical coverage combined with thin slice widths at low pitch settings. It also facilitates scanning of obese patients as well as patients with metal hardware.	4

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28. McMenamin D, Koulouris G, Morrison WB. Imaging of the shoulder after surgery. <i>Eur J Radiol</i> 2008; 68(1):106-119.	12	N/A	Review of the radiologic evaluation following surgery for subacromial impingement rotator cuff lesions and glenohumeral instability.	MR arthrography is sufficient in assessing the majority of complications following surgery for rotator cuff repair and instability. CT is superior for bony assessment and imaging hardware. US is useful in postoperative evaluation of dynamic assessment and direct clinical correlation.	4
29. Jacobson JA, Lancaster S, Prasad A, van Holsbeeck MT, Craig JG, Kolowich P. Full-thickness and partial-thickness supraspinatus tendon tears: value of US signs in diagnosis. <i>Radiology</i> 2004; 230(1):234-242.	10	50 consecutive US studies of the shoulder	Retrospective review of US studies of the shoulder in patients who had arthroscopic follow-up to determine value of US signs in the diagnosis of a surgically identifiable supraspinatus tendon tear.	Secondary US signs such as greater tuberosity cortical irregularity and joint fluid are most valuable in the diagnosis of supraspinatus tendon tear. Sensitivity 60%; specificity 100%; PPV 100%; NPV 78%; accuracy 84%.	2
30. Prickett WD, Teefey SA, Galatz LM, Calfee RP, Middleton WD, Yamaguchi K. Accuracy of ultrasound imaging of the rotator cuff in shoulders that are painful postoperatively. <i>J Bone Joint Surg Am</i> 2003; 85-A(6):1084-1089.	10	44 consecutive patients	Retrospective review to evaluate the diagnostic accuracy of US for evaluating the rotator cuff in shoulders that are painful postoperatively. Results of US were compared with intraoperative findings of the arthroscopic examination (gold standard).	The sensitivity and specificity of US for identifying rotator cuff integrity postoperatively were 91% and 86%, respectively. The accuracy was 89%.	2
31. American College of Radiology. <i>Manual on Contrast Media</i> . Available at: http://www.acr.org/SecondaryMainMenuCategories/quality_safety/contrast_manual.aspx .	15	N/A	Guidance document on contrast media to assist radiologists in recognizing and managing risks associated with the use of contrast media.	N/A	3

Evidence Table Key

Study Type Key

Numbers 1-7 are for studies of therapies while numbers 8-15 are used to describe studies of diagnostics.

1. Randomized Controlled Trial — Treatment
2. Controlled Trial
3. Observation Study
 - a. Cohort
 - b. Cross-sectional
 - c. Case-control
4. Clinical Series
5. Case reviews
6. Anecdotes
7. Reviews
8. Randomized Controlled Trial — Diagnostic
9. Comparative Assessment
10. Clinical Assessment
11. Quantitative Review
12. Qualitative Review
13. Descriptive Study
14. Case Report
15. Other (Described in text)

Strength of Evidence Key

- Category 1 - The conclusions of the study are valid and strongly supported by study design, analysis and results.
- Category 2 - The conclusions of the study are likely valid, but study design does not permit certainty.
- Category 3 - The conclusions of the study may be valid but the evidence supporting the conclusions is inconclusive or equivocal.
- Category 4 - The conclusions of the study may not be valid because the evidence may not be reliable given the study design or analysis.