

American College of Radiology ACR Appropriateness Criteria®

Clinical Condition: Shoulder Trauma

Variant 1: Rule out fracture or dislocation (eg, MVA, sports).

Radiologic Procedure	Rating	Comments	RRL*
X-ray shoulder axillary lateral and/or scapular Y	9		Min
X-ray shoulder AP views	9	Grashey recommended with internal and external humeral rotation.	Min
CT shoulder	1		Med
MRI shoulder	1		None
X-ray arthrography shoulder	1		Min
Rating Scale: 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

Variant 2: Acute or recent trauma, normal recent radiographs, significant clinical symptoms.

Radiologic Procedure	Rating	Comments	RRL*
MRI shoulder	5		None
X-ray arthrography shoulder	1		Min
CT shoulder	1		Med
NUC bone scan targeted	1		Med
US shoulder	1		None
Rating Scale: 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

An ACR Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those exams generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the FDA have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.

Clinical Condition:**Shoulder Trauma****Variant 3:****Subacute shoulder pain, questionable bursitis or tendonitis, approximately 3 months duration. First study recommended.**

Radiologic Procedure	Rating	Comments	RRL*
X-ray shoulder AP views	9	Grashey recommended with internal and external humeral rotation.	Min
X-ray shoulder impingement view	1	Majority believe not indicated.	Min
X-ray shoulder scapular Y view	1		Min
US shoulder	1		None
CT arthrography shoulder	1		Low
MRI shoulder	1		None
MR arthrography shoulder	1		None
X-ray arthrography shoulder	1		Min
CT shoulder	1		Med
NUC bone scan targeted	1		Med
X-ray shoulder axillary	No Consensus	Some believe this is indicated.	Min
Rating Scale: 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

Variant 4:**Subacute shoulder pain, suspect rotator cuff tear/impingement, over age 35. Normal radiographs or radiographs that demonstrate coracoacromial arch osteophytes/syndesmophytes.**

Radiologic Procedure	Rating	Comments	RRL*
MRI shoulder	9		None
US shoulder	7	With appropriate expertise.	None
X-ray arthrography shoulder	5	Alternative if patient cannot have MR or if US expertise not available. With or without CT.	Min
CT shoulder	1		Med
MR arthrography shoulder	1		None
Rating Scale: 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

An ACR Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those exams generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the FDA have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.

Clinical Condition:**Shoulder Trauma****Variant 5:****Subacute shoulder pain, under age 35.**

Radiologic Procedure	Rating	Comments	RRL*
MRI shoulder	9	Either MR arthrogram or MR routine is appropriate. Depends on availability, expertise, and local conditions.	None
MR arthrography shoulder	9	Either MR arthrogram or MR routine is appropriate. Depends on availability, expertise, and local conditions.	None
CT arthrography shoulder	4	This is the procedure of choice if MR is contraindicated or not available.	Low
US shoulder	1	US utility is limited in patients with a low likelihood of cuff disease.	None
X-ray arthrography shoulder	1		Min
Rating Scale: 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

Variant 6:**Subacute shoulder pain, suspect instability/labral tear.**

Radiologic Procedure	Rating	Comments	RRL*
MR arthrography shoulder	9		None
MRI shoulder	7	With high field/high resolution and appropriate expertise, this is a good alternative to MRA.	None
CT arthrography shoulder	4	This is the procedure of choice if MR contraindicated or not available. This may change in the future with evolving CT technology.	Low
US shoulder	1		None
X-ray arthrography shoulder	1		Min
Rating Scale: 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

An ACR Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those exams generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the FDA have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.

SHOULDER TRAUMA

Expert Panel on Musculoskeletal Imaging: Lynne S. Steinbach, MD¹; Murray K. Dalinka, MD²; Richard H. Daffner, MD³; Arthur A. DeSmet, MD⁴; George Y. El-Khoury, MD⁵; John B. Kneeland, MD⁶; B.J. Manaster, MD, PhD⁷; William B. Morrison, MD⁸; Helene Pavlov, MD⁹; David A. Rubin, MD¹⁰; Barbara N. Weissman, MD¹¹; Robert H. Haralson III, MD.¹²

Summary of Literature Review

The shoulder is the joint that is the most unstable, has the most mobility, and is difficult to assess clinically.

All radiographic shoulder studies should include frontal examinations with both internal and external humeral rotation. The frontal views can be done straight anterior posterior (AP). AP to the scapula by turning the patient into a 30 degree posterior oblique (Grashey) projection, or in both projections, but the committee recommends obtaining at least one of the frontal projections in the Grashey position to profile the glenohumeral joint. Some patients should have an axillary lateral view, a scapular Y view, or both; one or the other is advisable if there is a question of instability or dislocation. The transthoracic view has little to offer but still seems to turn up when outside films become available for review. There have been several reports assessing special views for the evaluation of shoulder impingement and the anterior acromion. An upright 30-degree caudad-angled radiograph or a suprascapular outlet view will suffice in most cases.

Arthrography was the mainstay of evaluation for rotator cuff tear until the advent of shoulder magnetic resonance imaging (MRI). Arthrography is currently used only as a potential study in patients with suspected rotator cuff disease who have a contraindication to MRI, in regions where shoulder ultrasound (US) expertise is not available. Computed tomography (CT) is useful for characterizing fractures if more information is needed pre-operatively. It can demonstrate fracture complexity, displacement and angulation, especially with the use of reformations. CT arthrography is a second-line procedure for shoulders with suspected instability or labral disorders, when MR arthrography and MRI are unavailable or contraindicated. US can be used to evaluate the tendons of the rotator cuff

and the biceps. It is operator-dependent and limited in evaluation of the other important deep shoulder structures and marrow. It can be used to determine if a partial-thickness or full-thickness rotator cuff tear is present. Shoulder MRI is currently the procedure of choice for evaluation of occult fractures and the shoulder soft tissues, including the tendons, ligaments, muscles, and labrocapsular structures.

MRI can aid in detecting osseous and soft tissue abnormalities that may predispose to or be the result of shoulder impingement. The soft tissue abnormalities in the supraspinatus tendon, subacromial bursa, and biceps tendon are well seen. The osseous lesions include morphologic abnormalities of the acromion, acromioclavicular joint, and coracoacromial ligament. When a tendon has a signal intensity abnormality without focal disruption or associated findings to suggest a partial-thickness tear, the terms “tendinosis” or “tendinopathy” have been used to signify an underlying tendon degeneration or inflammation. These terms suggest that there is a chronic, often pre-existing degenerative process. The presence of tendinous enlargement and a heterogeneous signal pattern that demonstrates diffuse increased signal intensity on T1-weighting often with a slight increase in signal intensity on T2-weighting is seen in patients with tendinosis. Partial-thickness tears of the rotator cuff can be seen inferiorly at the articular surface, superiorly at the bursal surface, or within the tendon substance. Tears at the articular surface are the most common type of partial-thickness tears. These are the only types of partial-thickness tears demonstrated by conventional shoulder arthrography. Full-thickness tears of the rotator cuff tendons can be accurately identified using conventional non-arthrographic MRI with high sensitivity and specificity. Increased signal intensity extending from the inferior to the superior surface of the tendon on all imaging sequences is an accurate sign of a full-thickness rotator cuff tear. Ten percent of rotator cuff tears will only present with morphologic changes. Tendon retraction, muscle atrophy, and fatty infiltration are important prognosticators. This type of information can be useful for decisions regarding conservative versus operative repair, type of operative repair (open, mini open, or arthroscopic cuff repair; substitute or muscle transfer) and to provide a postoperative prognosis. If there is any question concerning the distinction between a full-thickness and partial-thickness tear, MR arthrography is recommended. It is particularly helpful if the abnormal signal intensity extends from the undersurface of the tendon.

The shoulder joint is the most unstable joint in the body. Instability can be difficult to diagnose, and the pain produced by the unstable shoulder could be mistaken for

¹Principal Author, University of California, San Francisco, Calif; ²Panel Chair, University of Pennsylvania Hospital, Philadelphia, Pa; ³Allegheny General Hospital, Pittsburgh, Pa; ⁴University of Wisconsin, Madison, Wis; ⁵University of Iowa Hospitals and Clinics, Iowa City, Iowa; ⁶University of Pennsylvania Hospital, Philadelphia, Pa; ⁷University of Colorado Health Science Center, Denver, Colo; ⁸Thomas Jefferson University Hospital, Philadelphia, Pa; ⁹Hospital for Special Surgery, New York, NY; ¹⁰Mallinckrodt Institute of Radiology, St. Louis, Mo; ¹¹Brigham & Women's Hospital, Boston, Mass; ¹²Southeast Orthopedics, Knoxville, Tenn, American Academy of Orthopaedic Surgeons.

Reprint requests to: Department of Quality & Safety, American College of Radiology, 1891 Preston White Drive, Reston, VA 20191-4397.

An ACR Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those exams generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the FDA have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.

that of shoulder impingement, cervical disc disease, acromioclavicular joint disease, and other processes. During the last decade, MRI has allowed for direct visualization of many of the lesions related to instability, aiding in diagnosis as well as therapeutic planning and follow-up. Although high resolution non-enhanced MRI has been shown to have high accuracy rates for demonstrating labral tears, direct MR arthrography with intra-articular injection of a dilute gadolinium solution has gained popularity during the last decade because of its ability to distend the joint and outline labral and capsular structures as well as the undersurface of the rotator cuff.

Relative Radiation Level Information

Potential adverse health effects associated with radiation exposure are an important factor to consider when selecting the appropriate imaging procedure. Because there is a wide range of radiation exposures associated with different diagnostic procedures, a relative radiation level (RRL) indication has been included for each imaging examination. The RRLs are based on effective dose, which is a radiation dose quantity that is used to estimate population total radiation risk associated with an imaging procedure. Additional information regarding radiation dose assessment for imaging examinations can be found in the ACR Appropriateness Criteria® [Radiation Dose Assessment Introduction](#) document.

Relative Radiation Level Designations	
Relative Radiation Level	Effective Dose Estimate Range
None	0
Minimal	< 0.1 mSv
Low	0.1-1 mSv
Medium	1-10 mSv
High	10-100 mSv

References

- Balich SM, Sheley RC, Brown TR, et al. MR imaging of the rotator cuff tendon: Interobserver agreement and analysis of interpretive errors. *Radiology* 1997; 204(1):191-194.
- Billet FP, Schmitt WG, Gay B. Computed tomography in traumatology with special regard to the advances of three-dimensional display. *Arch Orthop Trauma Surg* 1992; 111(3):131-137.
- Brems-Dalgaard E, Davidsen E, Sloth C. Radiographic exam of the acute shoulder. *Eur J Radiol* 1990; 11(1):10-14.
- Castagno AA, Shuman WP, Kilcoyne RF, et al. Complex fractures of the proximal humerus: role of CT in treatment. *Radiology* 1987; 165(3):759-762.
- Gusmer PB, Potter HG, Schatz JA et al. Labral injuries: accuracy of detection with unenhanced MR imaging of the shoulder. *Radiology* 1996; 200(2):519-524.
- Chandnani VP, Yeager TD, DeBerardino T, et al. Glenoid labral tears: prospective evaluation with MR imaging, MR arthrography, and CT arthrography. *AJR* 1993; 161(6):1229-1235.
- Shankman S, Bencardino J, Beltran J. Glenohumeral instability: evaluation using MR arthrography of the shoulder. *Skeletal Radiol* 1999; 28(7):365-382.

- Palmer WE, Brown JH, Rosenthal DI. Labral-ligamentous complex of the shoulder: Evaluation with MR arthrography. *Radiology* 1994; 190(3):645-651.
- Steinbach LS, Palmer WE, Schweitzer ME. Special focus session. MR arthrography. *RadioGraphics* 2002; 22(5):1223-1246.
- Beltran J, Rosenberg ZS, Chandnani VP, et al. Glenohumeral instability: evaluation with MR arthrography. *RadioGraphics* 1997; 17:657-673.
- Cisternino SJ, Rogers LF, Struffelbam BC, Kruglik GD. A radiographic sign of posterior shoulder dislocation. *AJR* 1978; 130(5):951-954.
- Chandnani VP, Yeager TD, DeBerardino T, et al. Glenoid labral tears: prospective evaluation with MR imaging, MR arthrography, and CT arthrography. *AJR* 1993; 161(6):1229-1235.
- De Smet AA. Anterior oblique projection in radiography of the traumatized shoulder. *AJR* 1980; 134(3):515-518.
- De Smet AA. Axillary projects in radiography of the non-traumatized shoulder. *AJR* 1980; 134(3):511-514.
- Farin PU, Jaroma H. Acute traumatic tears of the rotator cuff: value of sonography. *Radiology* 1995; 197(1):269-273.
- Gusmer PB, Potter HG, Schatz JA, et al. Labral injuries: accuracy of detection with unenhanced MR imaging of the shoulder. *Radiology* 1996; 200(2):519-524.
- Hammar MV, Wintzell GB, Astrom KG, et al. Role of US in the preoperative evaluation of patients with anterior shoulder instability. *Radiology* 2001; 219(1):29-34.
- 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. *Radiology* 1992; 182(2):431-436.
- Iannotti JP, Zlatkin MB, Esterhai JL, et al. Magnetic resonance imaging of the shoulder: sensitivity, specificity, and predictive value. *J Bone Joint Surg Am* 1991; 73(1):17-29.
- Jacobson JA, Lancaster S, Prasad A, et al. Full-thickness and partial-thickness supraspinatus tendon tears: Value of US signs in diagnosis. *Radiology* 2004; 230(1):234-242.
- Jee WH, McCauley TR, Katz LD, et al. Superior labral anterior posterior (SLAP) lesions of the glenoid labrum: Reliability and accuracy of MR arthrography for diagnosis. *Radiology* 2001; 218(1):127-132.
- Jim YF, Chang CY, Wu JJ, Chang T. Shoulder impingement syndrome: impingement view and arthrography study based on 100 cases. *Skeletal Radiol* 1992; 21(7):449-451.
- Kilcoyne RF, Reddy PK, Lyons F, Rockwood CA Jr. Optimal plain film imaging of shoulder impingement syndrome. *AJR* 1989; 153(4):795-797.
- Legan JM, Burkhard TK, Goff WB II, et al. Tears of the glenoid labrum: MR Imaging of 88 arthroscopically confirmed cases. *Radiology* 1991; 179(1):241-246.
- Mink JH, Harris E, Rappaport M. Rotator cuff tears: evaluation using double contrast-shoulder arthrography. *Radiology* 1985; 157(3):621-623.
- Palmer WE, Brown JH, Rosenthal DI. Labral-ligamentous complex of the shoulder: evaluation with MR arthrography. *Radiology* 1994; 190(3):645-651.
- Palmer WE, Caslowitz PL. Anterior shoulder instability: diagnostic criteria determined from prospective analysis of 121 MR arthrograms. *Radiology* 1995; 197(3):819-825.
- Shankman S, Bencardino J, Beltran J. Glenohumeral instability: evaluation using MR arthrography of the shoulder. *Skeletal Radiol* 1999; 28(7):365-382. Review.
- Sidor ML, Zuckerman JD, Lyon T, et al. The Neer classification system for proximal humeral fractures. An assessment of interobserver reliability and intraobserver reproducibility. *J Bone Joint Surg Am* 1993; 75(12):1745-1750.
- Silfverskiold JP, Straehley DJ, Jones WW. Roentgenographic evaluation of suspected shoulder dislocation: prospective study comparing the axillary view and the scapular "Y" view. *Orthopaedics* 1990; 13(1):63-69.

An ACR Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those exams generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the FDA have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.

31. Steinbach LS, Palmer WE, Schweitzer ME. MR arthrography. *RadioGraphics* 2002; 22(5):1223-1246.
32. Tirman PFJ, Bost FW, Garvin GJ, et al. Posterosuperior glenoid impingement of the shoulder: Findings at MR imaging and MR arthrography with arthroscopic correlation. *Radiology* 1994;193(2):431-436.
33. van Holsbeeck MT, Kolowich PA, Eyler WR, et al. US depiction of partial-thickness tear of the rotator cuff. *Radiology* 1995; 197(2):443-446.
34. Waldt S, Burkart A, Lange P, et al. Diagnostic performance of MR arthrography in the assessment of superior labral anteroposterior lesions of the shoulder. *AJR* 2004; 182(5):1271-1278.
35. Wiener SN, Seitz WH Jr. Sonography of the shoulder in patients with tears of the rotator cuff: accuracy and value for selecting surgical options. *AJR* 1993; 160(1):103-107.
36. Workman TL, Burkhard TK, Resnick D, et al. Hill-Sachs lesion: comparison of detection with MR imaging, radiography and arthroscopy. *Radiology* 1992; 185(3):847-852.
37. Zanetti M, Weishaupt D, Jost B, et al. MR imaging for traumatic tears of the rotator cuff: high prevalence of greater tuberosity fractures and subscapularis tendon tears. *AJR* 1999; 172(2):463-467.

An ACR Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those exams generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the FDA have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.