

# IMAGING OF THE POST-OPERATIVE SHOULDER

Laura M. Fayad MD

There are several modalities that can be used to effectively image the post-operative shoulder. Radiography, computed tomography (CT), magnetic resonance (MR) imaging and ultrasound each have advantages and disadvantages for the detection of post-operative complications and recurrent lesions and will be discussed below.

## A. Radiography

Radiography is cheap and fast. Radiography is a baseline examination for all postoperative shoulders. For the detection of recurrent dislocation, implant displacement or loosening, the diagnosis is often easily accomplished with radiography alone, obviating the need for cross-sectional imaging modalities. Unfortunately, with radiography, many other complications (especially involving the soft tissues) cannot be detected or characterized. In the latter cases, advanced imaging with CT, MR or ultrasound must be performed. However, the baseline radiograph serves to identify the type of surgery and helps estimate the degree of artifact that may occur due to a metallic implant. In this way, the radiograph helps to triage the patient to the correct advanced imaging modality.

## B. CT/CT Arthrography

Like radiography, CT imaging is fast. With the advent of 16+ multidetector CT and the ability to create datasets with isotropic resolution, high-resolution 2D multiplanar reconstructions and 3D CT imaging of the post-operative shoulder is currently available. A substantial reduction of metal-related artifact is possible with the creation of 3D CT images using software manipulation. Metal artifact is also reduced by altering the CT acquisition parameters (although the required alterations often result an increased radiation dose to the patient). Where MR imaging is limited in the presence of large amounts of metal, CT imaging may be performed.

In the post-operative shoulder, CT imaging is often utilized for the evaluation of osseous abnormalities (such as post-operative nonunion) and complications which arise from the presence of metallic implants (such as osteolysis/loosening and hardware malplacement). Such post-operative abnormalities are often underestimated by radiography.

CT arthrography improves visualization of the articular soft tissue structures which are not well evaluated by conventional noncontrast CT. Hence, indications for CT

arthrography in the post-operative shoulder include the evaluation of the labrum, rotator cuff and articular cartilage, all of which are not adequately visible by noncontrast CT.

The main disadvantage of CT imaging is its reliance on intra-articular contrast to provide adequate contrast resolution for the assessment of the articular structures. Without CT arthrography, CT use is limited to the assessment of periarticular osseous abnormalities and metallic implant fracture, malpositioning and malfunction.

### **C. MR/MR Arthrography:**

Unlike radiography and CT, MR generally provides excellent contrast resolution for exquisite anatomic delineation of the soft tissues of the shoulder and is the preferred modality for the comprehensive examination of the shoulder. However, the quality of MR images can be markedly degraded by the presence of metal-related susceptibility artifact. The type, the amount and geometry of the metal implant has a bearing on the degree of artifact produced. When imaging a post-operative shoulder with MRI, several changes should be made to the protocol which include the avoidance of gradient echo imaging in favor of fast spin echo imaging, frequency-selective fat suppression and alterations to the bandwidth, voxel size and frequency/phase encoding directions.

Knowing the type of surgery that was performed helps to determine the degree of metal artifact to expect on MR imaging. For example, a typical decompression procedure with acromioplasty +/- distal clavicular resection produces very little artifact, and the shoulder is easily evaluated by conventional MR. However, modifications should probably be made to the protocol with the presence of metallic anchors and screws which produce mild to moderate artifact, where bioabsorbable materials do not require metal-reduction techniques. Metallic prostheses produce severe artifact on MR images, and therefore, other modalities should be sought in their presence.

For the assessment of the post-operative shoulder, MR arthrography is preferred in some centers, as it is felt to improve the accuracy of MR for the evaluation of the post-operative labrum and rotator cuff, given that noncontrast MR shows variable signal and morphologic changes in these structures post-operatively. Distension of the joint nicely delineates the morphology of the articular structures, along with the presence of scar tissue and thickening of the joint capsule following surgery. Abduction-external rotation (ABER) positioning can be especially useful for evaluation of the inferior glenohumeral ligament and displacement of a recurrent labral tear. For the evaluation of the post-operative rotator cuff, one should remember that the MR signal of the cuff on a noncontrast exam is highly variable and may even contain fluid signal within the sutures. Rotator cuff morphology is also variable, with expected post-operative alterations in tendon thickness compared with the baseline rotator cuff tendon. MR arthrography increases the accuracy of conventional MR for the assessment of articular

sided recurrent tears of the rotator cuff, although caution should be used in the interpretation of potential full thickness recurrent tears, given that contrast can pass from the joint to the subacromial bursa through a non-watertight surgical closure of the tendon.

Barring severe metal-related artifact, the disadvantages of MR include its cost and the time required for the exam which some patients cannot tolerate. MR arthrography requires a contrast injection and may be similarly limited by metal artifact.

#### **D. Ultrasound**

Unlike for CT and MR, an ultrasound evaluation of the post-operative shoulder is not limited by the presence of metal. Ultrasound is fast and cheap. It has been shown to be a sensitive test for the detection of a recurrent rotator cuff tear in the post-operative setting. However, the main disadvantage of ultrasound includes the fact that it is operator-dependent and is not useful for evaluation of the labrum.

#### **E. REFERENCES**

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