MR Imaging of the Postoperative Shoulder: Glenohumeral Instability

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Introduction

Postoperative imaging of the shoulder includes the use of radiographs, ultrasound, CT, CT arthrography, MRI and MR arthrography. For glenohumeral instability, most would agree that MRI and MR arthrography are preferred for evaluation of the symptomatic postoperative shoulder with glenohumeral instability. Although magnetic resonance provides excellent soft-tissue visualization, assessment can be a challenging task for a number of reasons. These include the artifacts of magnetic susceptibility that are produced by metal, both in the hardware placed in the shoulder and by small micrometallic shavings related to burring by surgical instruments that remain in the tissues. Scarring and altered morphology are often present. Various types of surgical procedures are done of which the radiologist should be aware. The focus of this talk will be on the role of MRI for evaluation of the postoperative shoulder for instability. A background will be provided regarding the different lesions and their treatment followed by the expected postoperative appearance and complications.

Technical Considerations

Some changes in protocol might be helpful in the presence of metal hardware. These include alteration of sequences. Removal of selective fat suppression and gradient echo sequences is advised. Fast Spin Echo with a lower TE, STIR, IDEAL, and metal suppression sequences such as SEMAC (Slice Encoding for Metal Artifact Correction) and MAVRIC (GE systems) can be employed. Higher bandwidth and matrix as well as a larger field of view can decrease metal artifact. Sometimes swapping phase and frequency can also reduce artifact, especially for asymmetrical metal hardware.

MR arthrography is useful for evaluating the contour of the labrum and assessing for loose hardware. We usually enter anteriorly with a 1 ½ inch needle through the rotator interval and inject a test of approximately 2 cc iodinated contrast to ensure that the joint is reached. This is followed up with 10 cc of a 20 cc dilute gadolinium mixture that contains 5 cc Ropivacaine, 15 cc saline (or iodinated contrast) and .1 cc of gadolinium. If MRI is contraindicated, CT arthrography can be performed.
**Glenohumeral Instability**

The shoulder is the most unstable joint in the body. This often leads to labral and tendon tears, cartilage lesions and osseous defects that require surgical treatment to restore stability and function. The glenohumeral joint is statically stabilized by labrum, glenohumeral ligaments and capsule as well as articular bony congruity of the humeral head with the glenoid rim. Dynamic stabilization is provided by the rotator cuff and long head of the biceps brachi tendons and muscles.

There is a surgical triage classification that characterizes two primary types of glenohumeral instability. One form is called TUBS (Traumatic Unidirectional instability with a Bankart lesion best treated with Surgery). This type of instability is often seen in patients younger than 30 years who end up with recurrent dislocations. Another group of patients with instability, called AMBRI (Atraumatic Multidirectional instability that is Bilateral, responds to Rehabilitation and, as a last resort, Inferior capsular shift). Bidirectional and multidirectional instability are initially best treated with physical therapy.

Ninety five percent of dislocations are in an anterior direction. The humeral head lies anteromedial to the glenoid. In approximately 90% of primary anterior dislocations the labrocapsular complex is injured. Of these up to 71% have Hill Sachs lesions. Glenoid rim fractures and deficiency can also result.

**Labrocapsular Repair**

Arthroscopic repair is indicated when conservative therapy has failed, in circumstances of recurrent instability and continued pain. More exposure via an open surgery is needed when there is extensive repair or associated capsular injury.

Symptomatic labral tears can be treated with debridement or repair. Anatomic repair attempts to reproduce the native anatomy reattaching the labrum to the glenoid rim with surgical anchors, sutures or screws. These surgical components can be metallic or bioabsorbable. Metallic devices produce some artifact on MRI, whereas, bioabsorbable suture anchors do not and present as a barely detectable signal void. Bioabsorbable materials dissolve over time.

Using MR arthrography, recurrent or residual labral tears are seen with 92% accuracy. The postoperative labrum should lie in the normal anatomic position and may be diminutive or truncated from debridement. The same criteria used for evaluation of labral tears preoperatively can be used following surgery. A labrum
may normally appear attenuated after debridement. A recurrent or residual tear would be diagnosed if the labrum was disorted or filled with fluid or contrast into or under the labral substance.

Paralabral cysts may form adjacent to labral tears, especially in cases of SLAP lesions and posterior labral tears. Some paralabral cysts will resolve after repair of the labral tear. If a paralabral cyst is present, it can often be decompressed arthroscopically under the labral edge. Sometimes, open surgery is required to remove the cyst, especially if it is causing nerve entrapment.

The glenohumeral ligaments and capsule may also tear with recurrent instability. For those who fail conservative therapy, anatomic repair with re-attachment of the capsule and capsular tightening can be performed. This is termed “capsular shift”, and it involves tightening of the capsule by shifting the inferior capsule superiorly and suturing it in place. An alternative method is thermal or laser shrinkage of the capsule. This has fallen out of favor because it can weaken or overtighten the capsule. An open anterior capsular shift may be considered in cases of multidirectional instability or after a failed arthroscopic procedure.

On MRI following capsulorrhaphy, the capsule should be continuous and watertight. It is often thickened. Redundancy and excessive scarring are complications. Other MR findings of failed capsulorrhaphy include discontinuity and fraying of the capsule at the humeral or glenoid insertion, new labral tear, bony Bankart and/or acute Hill Sachs lesion.

Contraindications to arthroscopy include large engaging Hill Sachs lesions, significantly deficient inverted pear glenoid and HAGL lesions, which represent avulsion of the humeral attachment of the anterior band of the inferior glenohumeral ligament. HAGL lesions are usually sutured.

Complications of Bankart repair include recurrent tear, loose or dislodged anchors and sutures, inflammatory response and infection. A loose suture anchor can present with surrounding increased signal on MRI. Sometimes the head of a screw can be released into the joint as the screw resorbs. Most suture anchors fail through the suture. Sometimes the anchors can become prominent producing painful crepitus and glenohumeral articular cartilage destruction. Metal and plastic implants can migrate into the joint. The bioabsorbable materials vary. Polyglyconate tacks may cause pain, restricted motion, synovitis, and foreign body granuloma formation. Polylactic acid implants have a better track record.

**Non-anatomic Soft Tissue Repair**

Rarely performed today, there are two surgical procedures that are used to prevent recurrent anterior instability by tightening the anterior portion of the glenohumeral joint. These include the Putti-Platt and Magnussen-Stack procedures. The former involves anterior capsular tightening and shortening of
the subscapularis tendon. The latter involves transfer of the subscapularis tendon from the lesser tuberosity to the greater tuberosity.

**Bone Graft Augmentation Procedures**

Glenoid deficiency is caused by fractures or attritional bone loss related to recurrent anterior instability. It results in an inverted pear configuration of the glenoid which can be identified in the sagittal plane of cross sectional studies such as CT and MR. An inverted pear glenoid results in recurrent instability and, if significant, should be treated with a bone graft augmentation. Of those patients who experience recurrent anterior instability, 10% have no osseous defect, 40% have glenoid bone loss and 50% have a bony Bankart fragment. There are various ways to determine glenoid bone deficiency. One is with a best fit circle. Another is through estimation of width loss using the distance from bare spot of the glenoid to the posterior rim. In a normal shoulder, the distance from bare spot to the anterior rim should be similar to the posterior distance.

The deficient glenoid is treated with allograft bone fragment incorporation. The transfer of the coracoid process with its attached tendons to the anteroinferior glenoid is termed the modified Bristow-Laterjet procedure. An iliac crest graft can also be used. Complications include nonunion and loosening, fracture, or dislodgement of hardware.

The Hill Sachs lesion is an impaction fracture of the posterolateral humeral head. It is seen in up to 71% of first time dislocators and 93% of recurrent dislocators. A large defect can result in recurrent engagement of the humeral head on the glenoid, sometimes resulting in locking that requires surgical reduction. The size of the lesion requiring repair is currently debated. The location of the lesion is also important. There are several ways to surgically manage a large Hill Sachs lesion. A Weber (rotational) osteotomy increases retroversion. A bone graft substitution can be used to reproduce the round anatomic surface of the humeral head. The postoperative appearance would be a smooth contour to the humeral head. Complications include nonunion, displacement of bone graft and infection. Remplissage (which means “to fill”) can be used with infraspinatus tenodesis, rendering the defect extra-articular. Arthroplasty is the last resort when there is more damage to the joint and tendons.