MRI Shoulder joint

Normal Anatomy, Rotator Cuff Lesions, Labral Pathology and Impingement Syndrome

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Examination protocol

- Axial scout
- Axial T1, gradient
- Coronal oblique T1, PD, T2
- Sagittal oblique T1 and / or T2
How to know the pulse sequence used?!
## Common MR appearances

<table>
<thead>
<tr>
<th>T1</th>
<th>T2</th>
<th><strong>Structure or lesions</strong></th>
</tr>
</thead>
</table>
| Low | Low | Cortical bone
|     |     | Labrium (ant., post., ...)
|     |     | Ligaments (gleno-humeral,...)
|     |     | Tendons (supraspinatous, biceps,..)
|     |     | Calcification

![MRI images](image-url)
# Common MR appearances

<table>
<thead>
<tr>
<th>T1</th>
<th>T2</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>Low</td>
<td>Fat (subcutaneous, lipoma, …)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bone marrow</td>
</tr>
<tr>
<td>Low</td>
<td>High</td>
<td>Fluid (effusion, cyst, ganglion)</td>
</tr>
</tbody>
</table>

![MRI images](image1.png)
Items to be evaluated

- **Tendons** [supra & infraspinatus, subscapularis and biceps]
- **Ligaments** [gleno-humeral]
- **Bones** [acromion & A/C joint]
- **Labrium**
- **Bursae**
AC Joint

Clavicle

Glenohumeral Joint

Rotator Cuff

Biceps Tendon
Coronal Images $T_1$, PD, $T_2$  

<table>
<thead>
<tr>
<th>Anatomic structures</th>
<th>Items seen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tendons</td>
<td>Supraspinatous</td>
</tr>
<tr>
<td>Ligaments</td>
<td>Inferior GHL (axillary recess)</td>
</tr>
<tr>
<td>Bones</td>
<td>A/C osteoarthritis</td>
</tr>
<tr>
<td>Labrium</td>
<td>Superior / inferior</td>
</tr>
<tr>
<td>Bursae</td>
<td>Subacromial bursa</td>
</tr>
</tbody>
</table>
Axial Images T1, gradient
Middle glenohumeral ligament
### Axial Images $T_1$ and gradient

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Tendons</td>
<td>Subscapularis, Infraspinatous</td>
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<tr>
<td></td>
<td>Biceps (in the groove)</td>
</tr>
<tr>
<td>Ligaments</td>
<td>Middle GHL</td>
</tr>
<tr>
<td>Bones</td>
<td>Humeral head [ Hill-Sack’s ]</td>
</tr>
<tr>
<td>Labrium</td>
<td>Anterior / posterior</td>
</tr>
<tr>
<td>Bursae</td>
<td>Subscapularis/ subcoracoid</td>
</tr>
</tbody>
</table>

![T1 and gradient images](image_url)

- Subscapularis, Infraspinatous Biceps (in the groove)
- Middle GHL
- Humeral head [Hill-Sack’s]
- Anterior / posterior
- Subscapularis/ subcoracoid
Sagittal Images T1 and/or gradient
Acromion shape
### Acromial shapes (Sagittal)

<table>
<thead>
<tr>
<th>Shape</th>
<th>Description</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Flat undersurface</td>
<td>47%</td>
</tr>
<tr>
<td>II</td>
<td>Curved inferior surface</td>
<td>39%</td>
</tr>
<tr>
<td>III</td>
<td>Anterior hook or peak</td>
<td>11%</td>
</tr>
<tr>
<td>IV</td>
<td>Convex under surface</td>
<td>3%</td>
</tr>
</tbody>
</table>
## Sagittal Images $T_1$ and/or $T_2$

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<td>Tendons</td>
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<tr>
<td>Ligaments</td>
<td>Inferior GHL</td>
</tr>
<tr>
<td>Bones</td>
<td>Acromial shape, A/C osteoarthritis</td>
</tr>
<tr>
<td>Labrium</td>
<td>All</td>
</tr>
<tr>
<td>Bursae</td>
<td>Subcorocoid bursa</td>
</tr>
</tbody>
</table>
MR arthrography

Axial, Sagittal and coronal T2 Fat suppression

- **Direct** intra articular injection of 1ml Gd-DTPA diluted with 20 ml saline
- **Indirect** IV Gd DTPA injection followed by active joint movement+ imaging after 10 minutes
MR shoulder arthrography
Value of MR arthrography [IGHL labral complex]
Items to be evaluated

- **Tendons** [supra & infraspinatus, subscapularis and biceps]
- **Ligaments** [gleno-humeral]
- **Bones** [acromion & A/C joint]
- **Labrium**
- **Bursae**
Tendons

◆ Rotator cuff tendons
  - Supraspinatus
  - Infraspinatus
  - Teres minor
  - Subsacpularis

◆ Biceps tendon
Tendons
Rotator cuff 4 muscles

- Supraspinatous
- Infraspinatous
- Teres minor

<table>
<thead>
<tr>
<th>Origin</th>
<th>Insertion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Posterior aspects of scapula</td>
<td>Greater tuberosity</td>
</tr>
</tbody>
</table>
Tendons
Rotator cuff

Supraspinatus (Coronal image)
Low signal in T1 and T2 WIs
**Tendons**  
**Rotator cuff**

Intermediate signal in T1 & PD not in T2 WIs

- Magic angle tendon at 55 to the static magnetic field
- Prominent muscle slip

Supraspinatous Two muscle slips
Normal supraspinatotous tendon
Supraspinatus tendon degeneration

**Tendinosis/ tendinopathy**
- Tendinous enlargement
- Intermediate signal T1 and T2 WIs
- Normal tendon thickness = 2-4 mm
Supraspinatous tendon degeneration

Intermediate signal in T1 and in T2 WIs within the tendon
Supraspinatus tendon Partial tear

Articular surface

Bursal surface
Supraspinatous tendon Partial tear

- MR sensitivity 91%
- 2 times more common than complete tear
- Surface defect [Articular-Bursal]
Supraspinatous tendon Partial tear

- Small amount of fluid in the subacromial bursa
- MR arthrography in articular surface partial tear
- Abduction and external rotation (ABER) may help
Partial surface tear
Partial Intrasubstance tear
Supraspinatous tendon full thickness tear

- MR sensitivity 88%

- Primary signs
  - Tendon defect → communication between the glenohumeral joint and subacromial bursa.
Case 1

Complete tear

Case 2 A&B
Full thickness tear
Supraspinatous tendon complete tear

**Primary signs**

- Tendon defect
- Complete absence → humeral head in direct contact with the undersurface of acromion

Massive tear
Supraspinatous tendon full thickness tear

- **Secondary signs**
  - Fluid in the subacromial bursa
  - Muscle retraction
  - Obliteration of the peritendinous fat by granulation tissue

Tear+ retraction+ atrophy
Supraspinatous tendon full thickness tear
Chronic full thickness tear with severe muscle atrophy

Full thickness tear with no muscle atrophy
Sher et al. 1995

- 34% of asymptomatic individuals have rotator cuff tears
- 54% of asymptomatic individuals above 60 years have tears
Deposition of calcium in the supraspinatous tendon → ↑ tendon thickness

- Low signal in T1 and T2 WIs
- Usually asymptomatic
- Pain in 30-45% of cases
- Common at the critical zone
Calcific tendenitis + ?!
Calcific tendinitis
Infraspinatous tendon
Infraspinatous tendon tear

- Rare
- Young athletes
- Seen in all imaging planes
Under surface tear of the infraspinatous (ABER)
Subscapularis tendon

Normal tendon
Normal subscapularis tendon
Subscapularis tendon tear

- Uncommon
- Old patient with recurrent dislocation
- Axial images
Subscapularis tendon tear
Subscapularis tendon tear

Common associations

- Supra and infraspinatous tears
- Biceps tendon abnormalities
Subscapularis tendon tear
Subscapularia rupture + Biceps abnormalities
Post traumatic?
AC Osteoarthritis with tendenopathy + ?!
Impingement syndrome

Progressive painful compression of the supraspinatus tendon

- Usually affects the critical zone
- 95% rotator cuff tears result from chronic impingement
Impingement syndrome

Osseous abnormalities

- Acromion
- A/C joint
Impingement syndrome

Osseous abnormalities

- Acromion shapes
- OS acromiale
- Acromial pathology
Acromial shapes (Sagittal)

I  Flat undersurface  47%
II  Curved inferior surface  39%
III  Anterior hook or peak  11%
IV  Convex under surface  3%
80% of patients with rotator cuff tears have type III acromion
Impingement syndrome

Osseous abnormalities

- Acromioclavicular joint [osteoarthritis] [Sagittal / coronal]
- Callus + osteophytes → impingement
  subchondal cysts + marrow edema
Normal AC joint

OA
Impingement syndrome

Soft tissue abnormalities

- Supraspinatous tendon
  - Tendinosis
  - Calcific tendinitis
- Subacromial bursitis
- Biceps tendon abnormalities

Severe Tendinosis
Bursae

- Subacromial/ subdeltoid bursa
- Subscapularis bursa
- Subcoracoid bursa
Bursae

Subacromial/subdeltoid bursa

- Below the acromion
- Above the supraspinatus tendon
- Communicates with the joint space in cases of full thickness tear of supraspinatus

Full thickness tear
Bursae
Subacromial/ subdeltoid bursa

Full thickness tear
Supraspinatous tendinopathy
+ brusitis
Bursae

Subacromial brusitis

- Fluid above the supraspinatous tendon:
  - Intact supraspinatous tendon = brusitis
  - Torn tendon = supportive sign of tear

Effusion + brusitis
Subscapularis bursa

Between the subscapularis and the MGHL may communicate with the joint space

Subcoracoid bursa

Between the corcoid process and subscapularis muscle

Communicates with the joint space
سبحانك اللهم و بحمدك نشهد أن لا إله إلا انتَ نستغفرك و نتوب اليك

Thank you

Mamdouh Mahfouz MD
Glenoid labrium

- Fibrous connective tissue structure
- Low signal in T1 and T2 WIs
- Usually triangular in configuration
- Rounded, cleaved, notched (variants)
Labrum on MR images

- Anterior and posterior labrium (axial)
- Inferior and superior labrium (coronal)

Normal Glenoid labrium
Gleno- humeral instability

Anterior instability [IGHL/LC] 95%

- Lesions of the anterior labrum and inferior glenohumeral ligament
- Assess the anterior labrum at the level of the Subscapularis tendon in the axial image.
Sub-labral foramen
Bankart's lesion

- IGHL-Labral complex avulsion
- Rupture periostium
- Fractured labrium [osseous Bankart]
- May be associated with HAGL
- Young patient with history of dislocation
- Do not occur spontaneously
Bankart lesion
Detachment of the anterior labrum as well as the related periostium
Bankart lesion
Bankart lesion
Osseous Bankart

Avulsion of the anterior labrium + detachment of the inferior glenoid rim
Osseous Bankart lesion
OSSEOUS BANKART
OSSEOUS BANKART
Hill- Sachs fracture 1940

- Grooved defect in the postrolateral aspect of the humeral head in cases of anterior instability
- 75% of cases with recurrent dislocation have Hill - Sachs fracture
- HS fracture is pathognomonic of Bankart’s lesion
Mechanism of Hill Sach’s injury
Bankart lesion + Hill Sachs
Hill-Sachs fracture
Bankart lesion + Hill Sachs
Greater tuberosity fracture
Hill–Sachs lesion

Greater tuberosity fracture
Bankart lesion + Hill Sachs
- Small tear at the base of a non-displaced or slightly displaced anterior labrium
- Young patient with history of dislocation
Perthes lesion; Avulsed labrum with intact perostium
ALPSA
Anterior Labroligamentous Periosteal Sleeve Avulsion

Bankart lesion + intact periostium → medial and inferior displacement of the labrium

ALPSA is converted to Bankart at arthroscopy
ALPSA lesion
ALPSA LESION

Medial displacement with inferior rotation of the labrum
Perthes Lesion

Bankart lesion

ALPSA
Posterior instability  2-4%  

Reverse of Bankart  
- Torn posterior labrium  
- Antromedial humeral head defect  
- Anterior humeral [ lesser tub. Edema]  

Reverse of Bankart with Anterior labral tear
Reverse of Bankart

- Torn posterior labrium
- Antromedial humeral head defect
سبحانك اللهم و بحمدم نشيد ان لا اله الا انت نستغفرك و نتوب اليك

Thank you