Exam and Imaging of the Shoulder

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ACSM TEAM PHYSICIAN COURSE Part I
AMERICAN COLLEGE OF SPORTS MEDICINE

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Make the Primary Diagnosis!
PHYSICAL EXAM

- General Exam – 4 positions
  - Standing
  - Sitting
  - Supine
  - Prone

- Also check:
  - Cervical & thoracic spine
  - Scapular symmetry
  - Vascular status
Is It Referred Pain?

• Neck
• Scapula
• Lung
• Ribs
What tests do I do??
SHOULDER: PRINCIPLES & INTRODUCTION

• Many clinical tests are named for someone. Instead of the name, think of motion of joint and forces you apply:
  • Is it labral?
    • Axial loading like McMurray’s
  • Is it the rotator cuff?
    • Compressing or impinging
  • Is it instability?
    • Distraction of joint capsule subluxing the humeral head
Glenohumeral Examination

• Ask the patient . . .
  • Does this cause apprehension and/or pain?
    • Laxity – normal condition and symmetrical
    • Instability pathologic condition and asymmetrical
  • Can you reproduce your symptoms?
Routine Exam

- Seated
  - Glenohumeral
  - Scapulothoracic
- Supine
- Prone

- Repeat equivocal parts of the exam
Determine the primary problem—Make the primary diagnosis

- Capsule/ligaments
- Labrum
- Rotator cuff

Table listing provocative tests and imaging studies

- Glenohumeral instability
- Rotator cuff tear
- Impingement
- Biceps
- SLAP
There are many clinical tests named after someone. Instead of description by name:

• Think of the motion of joint and forces you apply:
  • Is it labral?
    • (Axial loading like McMurray’s)
  • Is it the rotator cuff?
    • (compressing or impinging)
  • Is it instability?
    • (distraction of joint capsule subluxing the humeral head)

• Initial Imaging
  • True AP in 0º external rotation
  • Lateral in scapular plane
  • Axially view

• When imaging studies are indicated during the initial evaluation and treatment of a patient with shoulder pain, appropriate plain “x-rays” should be obtained. More sophisticated imaging studies (such as shoulder MRI, ultrasound, or arthrography) are not indicated.
Imaging

- Plain films
- Make the diagnosis by history and physical and plain films
- Institute treatment
- Re-examine
- Then special Imaging Studies
AP Internal View
Stryker Notch View
Outlet View
Axillary Lateral View
Stryker Notch View
**Imaging**

- **Special Studies**
  - MRI scan
    - With or without gadolinium
  - CT scan
  - Ultrasound
Ultrasonography

- In office
- Accurate
- Low cost

Ultrasound showing symptomatic progression of previously asymptomatic rotator cuff tear.

What about ultrasound?

- Series of 50 patients underwent arthroscopy examined with 3D ultrasound with MR arthrography.
- Results: Arthroscopic diagnosis: Full thickness in 40, partial 5, intact supraspinatus in 5. 3D ultrasound correctly diagnosed 35 out of 40 full-thickness and MR arthrography were 39 out of 40 full-thickness. Partial tears: Ultrasound 2 and MR 1.
- Conclusions: 3D ultrasound promising imaging comparable to MR arthrography for assessment of supraspinatus tendon tears.

When Should an MRI Exam Be Obtained?

- Recent Trauma
- Difficult Physical Exam
- Physical Exam that Does not Match Clinical Symptoms
- Normal Radiographs with Significant Symptoms
- Pre-Operative Planning
- Recent MRI that was Technically Suboptimal

Courtesy Martin L. Schwartz, MD
Clinical Prof. of Radiology, UAB
How Should The MRI Scan Be Performed

• Best Possible Equipment
• Dedicated Coils for the Body Part
• Contrast When Necessary
• Correct Sequences to Define Appropriate Anatomy
• Shortest Exam to Achieve Results and Keep Patient Comfortable

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Contrast Administration

- Intraarticular Contrast Gives Superior Soft Tissue Contrast and Significantly Enhances Diagnostic Capability
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Intraarticular Contrast Injection

- Use Sterile Technique and Fluoroscopic Guidance
- Mix Iodinated Contrast with Dilute Gadolinium Solution to Avoid Air Bubbles
- Use Enough Volume to Distend Joint
- Perform Injection Quickly and as Painlessly as Possible

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When to use contrast

• I use it in SLAP lesions. May improve diagnosis of SLAP, missed grade of 25-5%.

• Acute dislocation instability. May use if I think there is an associated SLAP. 50% of SLAP tears are unstable.
MRI Scan with Intraarticular Gadolinium

- Varying position
  - Arm at Side IR + ER
  - Thumb down and up
    - Hyper Abduction
Abducted externally rotated position to diagnose peel back--ABER view

- Advantages may not need intra-articular gadolinium to diagnose SLAP tear
- Must have method so patient will be comfortable and not move
- Recent studies show ABER view in patients with unstable SLAP lesions had posterior humeral head translation in ABER compared to neutral abduction of greater than 3 mm
- Look for humeral head position or position of the labrum and glenoid posterior-superior
Arm position, ER
Arm position, IR
Arm position hyper-abduction, ER

ABER view
Complete radial tear of the interval horn/body junction), with a high-grade radial tear of the posterior horn/root junction seen as well (series 3, image 16).
Sagittal shoulder view for labrum like axial view for radial LMT of the knee
Bankart Lesion

Courtesy- Stoller, Diagnostic Imaging Orthopaedics

Courtesy Martin L. Schwartz, MD Clinical Prof. of Radiology, UAB
Perthes Lesion

Courtesy-Stoller, Diagnostic Imaging Orthopaedics

Courtesy Martin L. Schwartz, MD Clinical Prof. of Radiology, UAB
ALPSA (Anterior Labroligamentous Periosteal Sleeve Avulsion) Lesion

Courtesy-Stoller, Diagnostic Imaging Orthopaedics

Courtesy Martin L. Schwartz, MD Clinical Prof. of Radiology, UAB
HAGL (Humeral Avulsion of the Glenohumeral Ligament) Lesion

Courtesy Martin L. Schwartz, MD
Clinical Prof. of Radiology, UAB
15 YO Basketball Athlete

- Unstable shoulder
- Anterior instability
- Normal MRI

SURPRISE!
HAGL Lesion
Rotator Cuff Testing

- Empty can position
- Weakness in internal rotation
Subscapularis Tear

- Mechanism usually acute, one event
- Physical exam
  - Increased ER
  - Apprehension on adduction
  - Positive lift-off tests
    - Belly-press: upper subscapularis involved
    - Behind-back: lower subscapularis involved
Clinical exam: subscapularis tear

“I was unable to get my wallet out of my back pocket.”
Subscapularis Footprint

- 2.5 cm superior-to-inferior
- 1.5 cm medial-to-lateral
- Widest superiorly
**FIG 4.** Superior view of right shoulder. (A) Normal relation of biceps tendon to bicipital groove. (B) Rupture of transverse humeral and coracohumeral ligaments, but no disruption of subscapularis tendon. (C) Tear of subscapularis tendon and coracohumeral and transverse humeral ligaments (as occasionally occurs when the humerus dislocates anteriorly. (Modified from Hitchcock HH, Bechtol CO. Observations on the role of the tendon of the long head of the biceps brachii in its causation. *J Bone Joint Surg* 1948;30A:263–273, with permission).
Function of the Biceps

- Proximally the biceps acts to stabilize the shoulder, and act as an adductor (short head), weak shoulder flexor and humeral head depressor
- Distally acts as an elbow supinator and flexor
- Important function in deceleration of throwing arm
Proximal Biceps Tendon Instability and Tears

• Rarely occur in isolation
• More commonly part of spectrum of biceps dysfunction involving the tendon and associated restraints
  • Cuff tears
  • Subscapularis tears
Labrum & Capsule

- Labral Function
- Stability
- Bumper
- Biceps attachment
- Shock absorber
Glenoid : Labrum

Tee : Golf Ball
Seal : Ball
Contact Lens : Eyeball
SLAP (Superior Labrum Anterior to Posterior) Lesion

Courtesy Martin L. Schwartz, MD
Clinical Prof. of Radiology, UAB
Shoulder: Peel-back sign
THE THROWER’S SHOULDER
“Internal Impingement”
4 Critical Components

Internal Rotation Deficit
INTERNAL IMPINGEMENT

An “over-rotation” phenomenon

Arthroscopic Findings
Internal Impingement
X-Ray and MRI Findings
SLAP (Superior Labrum Anterior to Posterior) Lesion

Courtesy Martin L. Schwartz, MD
Clinical Prof. of Radiology, UAB
Internal Impingement on ABER (ABduction External Rotation) View

Courtesy Martin L. Schwartz, MD
Clinical Prof. of Radiology, UAB
Bennett Lesion (Thrower’s Exostosis)

Courtesy Martin L. Schwartz, MD
Clinical Prof. of Radiology, UAB
Labral Tear With Paralabral Cyst

Courtesy Martin L. Schwartz, MD
Clinical Prof. of Radiology, UAB
Suprascapular Notch
Compression Causes
Supraspinatus and Infraspinatus Weakness

Spinoglenoid Notch
Compression Causes
Infraspinatus Weakness only
Correlation of arm position and anatomic restraints to testing (Anterior glenohumeral ligament (AGH) capsule)

<table>
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<tr>
<th>Arm Position</th>
<th>Primary Restraint</th>
<th>Secondary Restraint</th>
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<tr>
<td>0°</td>
<td>AGH: Superior and Middle</td>
<td>Posterior capsule</td>
</tr>
<tr>
<td>45°</td>
<td>AGH: Middle</td>
<td>Posterior capsule inf. Anterior, inferior GH Ligament</td>
</tr>
<tr>
<td>90°</td>
<td>AGH: Inferior</td>
<td>Middle Glenohumeral Post. Ligament posterior capsule</td>
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Shoulder Stability Tests
Instability

- Treatment anterior
  - Anterior dislocation x1
  - Immobilization consider arthroscopy in young high-demand athletes
  - MRI helpful
- Surgery
  - Arthroscopic
  - Open
Instability

- Labral tears
  - Avulsion
  - Degenerative
- Capsular insufficiency
- Define pathologic direction
  - Anterior
    - Classic Bankart lesion
    - Labral avulsion anterior-inferior
  - Posterior
- Multidirectional
Surgical Stabilization

Bony Bankart

"Classic" Bankart rupture periosteum
Clinic Radiographs

- Confirm humeral head radiolucency consistent with Hill-Sachs lesion
(From Rockwood CA, Matsen FA. The Shoulder, Vol. 1, 1990, Fig. 5-12, p. 185)
Look for Hill-Sachs and Bankart lesion. Arthroscopic excision of bone and mobilization of AIGHL and anterior repair performed
Prone Posterior Instability Test
Posterior Instability Test
S/P Open anterior shoulder reconstruction
Multi-Directional Instability, bilateral shoulders.

More symptomatic on operated right side.
Multi-Directional Instability

- Voluntary posterior direction - symptomatic
Posterior Labrum Tear

Posterior Instability

Reverse Bankart Lesion
18 YO Right-Hand-Dominant Discus Thrower

• Threw the discus
• Felt pop, pain, inability to move her arm
• Went to the emergency room

Posterior Dislocation

• X-rays showed humeral head posteriorly dislocated on axillary view
• This direction of dislocation still is missed in emergency rooms
Posterior Dislocation
EUA Severe Posterior Instability
Literature review
MRI scans and athletes
MR imaging shoulder and the wrist in asymptomatic elite athletes

Division 1A athletes:
Volleyball players (12)
Swimmers (6)
Gymastics (15)

– no history of pain, normal exam

Asymptomatic MR changes of the shoulder in swimmers and volleyball players and the wrist in gymnastics, similar to those where intervention of rest or surgery is necessary.

Swimmers have moderate change in the labrum (83%), ligamentous abnormalities (67%); volleyball – moderate (50%) and severe (80%) changes, rotator cuff (25% moderate, 17% severe); tendon muscle (25% moderate) (8% severe)

Gymnasts: wrist ligaments (40% mild, 60% moderate), tendons (53% mild, 47% moderate), cartilage (60% mild, 33% moderate, 7% severe), cysts/fluids (80%), carpal tunnel changes (53%)

545 baseball players underwent MRs of shoulder and elbow, junior high school, high school collegiates players.

Results: Junior high school sustained a high proportion of OCD compared to high school and college.

High school, college were more like to have UCL injuries or SLAP tears in junior high. Pitchers, outfielders would more often have UCL injuries. Taller and heavier players were more likely to have UCL injuries and SLAP tear in high school and junior high school than in the control group.

MRI scans and assessment of detection of Hill-Sachs lesion and Bankart lesion – 87 patients – 55 intra-articular contrast (63%), 32 no contrast (67%).

- MRs interpreted by two radiologists and correlated with the operative report and images at arthroscopy
- Cartilage injuries were detected in 55 patients (63%), Bankart lesion in 66 patients (76%) and Hill Sachs lesion in 55 patients (62%), sensitivity, specificity (87.2%, 80.6%). Sensitivity and specificity Bankart lesions (98% and 95%)

MRI scans and assessment of detection of Hill-Sachs lesion and Bankart lesion – 87 patients – 55 intra-articular contrast (63%), 32 no contrast (67%).

- Sensitivity of Hill Sachs was 96.3% and specificity 90.6%.
- No difference was found in MR examination with and without gadolinium ($p = 0.89$)
- Conclusion: High sensitivity and specificity of articular cartilage injuries in shoulder glenohumeral instability – don’t need contrast for this.

Evaluation of glenoid labrum with 3-T MR – Is intraarticular contrast necessary?

• 42 patients: 28 men, 14 women, mean age 33 underwent MR arthrography and conventional MRI. 2 patients bilateral; 22 patients underwent arthroscopy.

• Of 22 arthroscopies, 26 labrum tears, 18 shoulders, 4 were normal. Conventional MR identified 9 of the 12 and MR arthroscopy identified 9 of 12 superior, 7 of 9 posterior, 8 of 9 posterior.

• Conclusions: Power of the study is small suggesting that intraarticular contrast is helpful, particularly in tears of anterior labrum.

Outcome nonoperative treatment of symptomatic rotator cuff tears

- 59 shoulders in 54 patients, mean age 58 years, treated nonoperatively. MRs acquired six months after initial study.

- Conclusions: Factors with progression documented by MR: rotator cuff tear age more than 60, full thickness tear, fatty infiltration rotator cuff.

Rotator Cuff Diagnosis Study

- Accuracy of MR arthrography and abduction external rotation – partial thickness rotator cuff tear – sensitivity and specificity –
  
  **Result:** Accuracy of each reader on MR imaging without ABER view 83%, 90%, 86%, and 83%, 80%, and 82%; with ABER, accuracy, the sensitivity is 92%, 70%, 82%, specificity 92%, 80%, 86%

- ABER view in routine sequences increases sensitivity and inter- and intraobserver agreements for partial rotator cuff tears. No mention of SLAP tears.

Are 3-T MRI scan or arthrogram necessary?

- 150 patients underwent conventional shoulder MR and MR arthrography. Group of patients that were less than 50 years old selected for arthroscopy. No prior surgery.

- Results: 3 full-thickness, 9 partial-thickness supraspinatus tears, 7 SLAP tears, 6 anterior labral tears, 2 posterior tears. Seen on MR arthrography but not conventional MR.

- Conclusions: MR arthrography significantly increased sensitivity for detection of partial-thickness articular surface supraspinatus tears, anterior labral tears, and SLAP tears, compared to conventional MR 3-T.

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You May Not Have Seen It

But It Has Seen You.
16 YO RHD Male Differential Diagnosis
Left shoulder pain
No Injury
Positive O’Brien’s Test

- SLAP tear
- Anteroinferior glenohumeral instability
- Proximal humeral lesion
- Normal anterior labrum
- Proximal humeral lesion just lateral to biceps
16 YO RHD Male
16 YO RHD Male  Bone scans
CT scans

- Well corticated thick-bordered proximal humeral lesion
- Small peripheral snowflake radiodensities
- No calcification or nidus
Differential diagnosis: Proximal humeral lesion

- Osteoid osteoma
- Atypical enchondroma
- Infection with sequestrum
- Chondroblastoma
- Osteochondrritis dissecans
Operative Findings
Open Excisional Biopsy

- Thin cortical bone
- Brownish appearance of tumor
- Lesion just lateral to biceps
- Excisional biopsy
- No bone graft
- No arthroscopy performed
Characteristic of classic chondroblastosoma:
Cartilaginous matrix
Rich cellularity
Round distinct cells
Multi-nucleated giant cells

Diagnosis reclassified as “chondroblastoma of bone”

12 YO Male Soccer Athlete

- Pain in left shoulder, 1 to 2 years
- No injury
- PE: normal stability
- Mildly tender firm axillary mass
Dx: Synovial Sarcoma

- Underwent limb salvage sarcoma resection and chemotherapy
22YO LHD Male

- Multiple osteochondroma
- Girlfriend noted scapular asymmetry
Remember to examine scapular position

- Have patient reproduce symptoms
- If scapula is unstable, shoulder problems will result
- An unstable scapula is similar to firing a cannon out of a canoe
Scapular Dysfunction

• If exists, shoulder function is like firing a cannon out of a canoe!
• Remember the scapula!
  • Tightness anterior
  • Forward head
  • Overdeveloped pectoralis
    • Scapular movements
  • Touch medial borders
  • Elbows to back pocket
  • Shrugs
  • Clockwise/counterclockwise
Protraction/Retraction of the Scapula
**Rotation**

- External + Internal
- Downward + Upward

**Tators**

- Re- + Pro-

**Elevators**

- Upward + Downward

**Tilters**

- Posterior + Anterior

**Tractors**

- Pro- and Re-
Neurologic stretch injury from lifting heavy dumbbells, suprascapular (C5) nerve involved
Scapular asymmetry - golfer
Like firing a cannon out of a canoe . . .
CONCLUSIONS

- Don’t order a test if you can’t read it.
- Communicate with the radiologist at your imaging center.
- A bad scan is worse than no scan.
- In KY, we have many MRI scanners. Shoulder scans are notoriously bad if ordered by someone who is unable to examine a shoulder.
“Sometimes an MRI report just doesn’t help...”
Listen, Look, Examine

“I’ll have to do some x-rays to be sure, but I’m guessing you dislocated your shoulder.”