

# Shoulder Injuries in Throwing Athletes

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## EVALUATION

### I. History

- Pain: Quality, Location and Duration of symptoms
- Actions that worsen symptoms
- the timing of onset of pain
- The point in the throwing cycle at which symptoms are great
- Past history of treatment and prior shoulder problems

### II. Physical Examination

- Complete cervical spine examination
- Observation of posture and symmetry in the standing position
  - Overdevelopment of the dominant-extremity musculature is common.
  - Atrophy of infraspinatus fossa: Suprascapular neuropathy at the spinoglenoid notch
- Palpation of the significant landmarks with elicitation of symptoms
  - AC joint, coracoid process, greater tuberosity, biceps tendon, cuff muscle
- Shoulder range of motion: in both the sitting and supine positions
  - Elevation in the plane of the scapular
  - I/R and E/R at 0° and 90°
  - Scapulohumeral rhythm during active elevation, Scapular winging
- Internal, external, and abduction shoulder strength
  - Scapular retraction strength: the “pinch test” by Kibler
- Stability testing
  - The anterior and posterior drawer tests (Gerber and Ganz)

- The relocation test (Jobe and Kvitne)
- The anterior release test (Gross and Distefano)
- Specialized tests
  - Neer and Hawkins signs
  - Tests for tears of the superior labrum
  - The clunk test, Compression-rotation test: most analogous to the McMurray test in the knee
  - The anterior slide test (Kibler)
  - The active compression test of O' Brien et al.
  - Biceps tension test
  - Biceps load test I, II (Kim)
  - The Crank test (Liu et al)
- A test for internal impingement
  - Pain in the posterior aspect of the shoulder in the late cocking and early acceleration phases of throwing.
  - 90° of abduction, 15° to 20° of forward flexion and maximum E/R
  - 90% sensitivity for diagnosis of partial-thickness undersurface tears of the RC or posterior labrum (K. Meister et al. 1998)

### III. Imaging Studies

- The plain radiographs: I/R and E/R AP views, axillary view, Stryker notch view, outlet view
  - Abnormalities of the greater tuberosity on the AP view
  - Irregularity of the anterior glenoid on the axillary view
  - Posterior humeral head lesions on the Stryker notch view
- MR imaging
  - MR arthrography
  - 90% sensitivity in undersurface tears less than 25% the thickness of the cuff
  - Labral abnormalities

### IV. Isokinetic Testing

- Strength testing

- 90~90 position for I/R and E/R strength
- Abduction/adduction testing in coronal plane
- Recorded at 180 and 300 deg/sec.

#### V. Examination under Anesthesia

- The load and shift test, translation, sulcus tests

### PATHOPHYSIOLOGY

#### Classification

Intraarticular Injuries - Microinstability

- SLAP
- Internal Impingement
- Partial articular surface RCT

Extraarticular Injuries - Suprascapular neuropathy, vascular lesions

#### I. INSTABILITY IN THE THROWING ATHLETES

- Thrower's paradox (Andrews): Treatment is directed toward eliminating subtle pathologic humeral translation without compromising overall motion of the shoulder.
- Should be able to distinguish the type and direction of the instability
- Patients with anterior instability complain that the shoulder wants to slide out the front during late cocking and early acceleration phases.
- Patients with posterior instability complain of pain and subluxation type symptoms in the follow-through phase of throwing.
  1. Anterior / Inferior Instability
  2. Straight Anterior Instability - SLAP/MGHL lesion (rare)
  3. Anterosuperior Instability (rare); SLAC-Superior Labrum Anterior Cuff lesions

#### II. SLAP LESION

- Anatomy
  - Biceps anchor: variable attachment to supraglenoid tubercle (25~50%)

- 50~75% attaches to labrum, more posterior than anterior
- Superior labrum more meniscoid in appearance than inferior labrum
- Normal variants: anterosuperior sublabral foramen
- Buford complex - Cord-like middle glenohumeral ligament
- Pathology
  - Snyder I Superior labral fraying 20%
  - II Biceps/Labral detachment 55%
  - (Morgan/Burkhart subclassification of SLAP II tears: Ant/  
        Post/ Combined)
  - III Superior bucket-handle tear
  - IV Bucket-handle extend into biceps tendon
  - Irregularity at the biceps labral anchor
  - Biceps "arches" with traction
  - Biceps "peelback" with AB/ER
  - + "Drive-through" sign
- Etiology
  - Traction on biceps
  - Glenohumeral instability
  - Glenohumeral compression (ex. Fall on outstretched arm)
- Examination
  - Posterior Jobe relocation test (best for posterior SLAP lesions)
  - O'Brien test
  - Crank test (Liu)
  - Kibler's anterior slide test
- Treatment
  - SLAP I - debride
  - SLAP II - Suture anchor vs. tack repair
  - SLAP III - resect vs. repair
  - SLAP IV - repair if > 30% biceps thickness; otherwise, resect bucket-handle and tenodesis biceps

### III. INTERNAL IMPINGEMENT (SLAP/Microinstability Variants)

- Defined as abnormal contact between the RC undersurface and the glenoid

margin, resulting in tearing of the articular surface RC and the labrum (posterosuperior SLAP tears).

- The most common shoulder injury in the throwing athlete

Pathomechanics:

- Not clear
- Alteration from ideal throwing mechanics (caused by fatigue)

Morgan/Burkhart

- "Posterior" or "combined posterior and superior" SLAP II permits posterosuperior instability → localized traction related posterior articular surface cuff tear
- Tight posterior capsule contributes to posterosuperior labral "peelback" mechanism which may increase SLAP tear or create it initially
- "Pseudolaxity" (anteroinferior) with "drive-through" sign actually caused by posterosuperior instability (circle concept)

Jobe

- Anterior/inferior laxity (microinstability - usually acquired) compromises the obligate posterior rollback leading to an increase in anterior translation.
- In addition, possible G-H hyperangulation may increase the frequency and magnitude of greater tuberosity/cuff contact on the posterosuperior glenoid creating pathologic internal impingement.

Walch

- Frequency and intensity of contact between the greater tuberosity/cuff and posterosuperior glenoid leads to internal impingement pathology
- Decreased humeral retroversion may exacerbate the problem

Kibler

- Loss of scapular synchrony with inefficient scapular elevation and retraction create unstable glenoid platform, hyperangulation of the glenohumeral articulation and increased stress of the anterior capsuloligamentous structure (acquired micro-instability)

- Two types of internal impingement
  - Posterior internal impingement
    - Fraying or tearing of the undersurface of the IS and the posterior portion of the glenoid labrum
    - Maximal cocking or initial acceleration phase of throwing
    - Most posterosuperior RCT probably are caused by internal impingement
  - Superior internal impingement
    - Fraying or tearing of the anterior (supraspinatus) portion of the RC undersurface and the superior labrum.
    - Midacceleration phase of throwing
    - Alteration from ideal throwing mechanics (caused by fatigue)
- Pathology
  - Partial articular surface cuff tearing of posterior SS
  - Posterolateral / superior labral tearing
  - Anteroinferior capsular attenuation
- Etiology
  - Repetitive overhead sports, i.e. Throwing, volleyball, tennis
- Physical Examination
  - Pain +/- clicking sensation
  - Pain reproduced in the cocking phase at the posterior joint line.
  - ↓ I/R, ↑ E/R
  - Positive active compression test
  - +/- Glenohumeral instability
  - The relocation test
- Imaging
  - Cystic & sclerotic changes in the greater tuberosity (1/2)
  - Rounding of the posterior glenoid rim (1/3)
  - Bony exostosis on posteroinferior glenoid rim (Bennett)
  - Partial undersurface RCTs
- Arthroscopic Findings
  - Partial undersurface RCT (>80%)
    - (+) posterolateral glenoid labral detachment (70%)
  - Synovitis and/or fraying of the long head of the biceps

- Chondromalacia : Posterosuperior glenoid rim
- Abrasion or fissure involving posterosuperior glenoid cartilage
- Posterior glenoid exostosis (Bennett lesion)

# Arthroscopic Evaluation

- Inspection involving I/R & E/R of humerus
- Kissing lesion between the RC and posterosuperior glenoid and labrum
  - Implicated in the internal impingement peel-back phenomenon.
- Contact occurred between 90° and 150° of abduction between 9 and 11 o'clock positions posteriorly on a right shoulder.

\* Halbrecht JL, Tirman P, Atkin D (Arthroscopy 1999)

- Reconfirmed by MRI
- Pathology of the RC and superior labrum in the throwing shoulder but not the non-throwing shoulder in each patient.

\* McFarland EG, Hsu CY, Neira C, O'Neil O (J Shoulder Elbow Surg 1999)

- The contact between the RC and posterosuperior glenoid (with the arm in abd and E/R) occurred in a wide spectrum of diseases and was not limited to throwing athletes.

\* Paley KJ, Jobe FW, Pink MM, Kvitne RS, ElAttrache NS (Arthroscopy 2000)

- A/S examination with the position of the relocation test
- Contact between undersurface & the P-S glenoid rim or osteochondral lesions in 100%, undersurface RC fraying in 93%, P-S labral fraying in 88%, anterior fraying in 36%.

• Treatment

- Conservative therapy: Rest, NSAID, Physical therapy

Dynamic stabilization rehabilitation

→ Pericapsular strengthening, posterior capsular stretching

Changing the throwing mechanics in the late cocking phase

→ To avoid forceful E/R and hyperextension in the late cocking phase.

- If anterior instability - consider scope capsular placcation vs. thermal

Capsulorrhaphy vs. anterior capsulolabral reconstruction

- If posterior/combined SLAP II, repair; may also be necessary to perform limited A/S posterior capsular release
- If partial articular surface cuff tear - debride

IV. Partial Articular Cuff Tear

• Pathology

- Repetitive traction on articular surface cuff fibers (i.e. During deceleration of the throwing arm)
- Internal impingement contact with posterosuperior glenoid
- Grading 1: <3 mm defect thickness (<25%)  
2: 3~6 mm (<50%)  
3: >6 mm (>50%)

• Etiology: Repetitive overhead sports / throwing / work

• Examination: (+) Whipple supraspinatus test

• Treatment

- Arthroscopic debridement to stable, healthy cuff tissue
- may consider SAD for grade 1 & 2 articular tears (Warren) but if instability is a component of the pathology, SAD may worsen their Sx!

V. SUPRASCAPULAR NEUROPATHY

• Suprascapular nerve

- Mixed sensorimotor nerve without cutaneous branches
- C5-6 (4)
- Sensory branches to the GH, AC joint and subacromial space
- Mass effect from a paralabral ganglion cyst or through being stretched.
- Supraspinatus & Infraspinatus dysfunction
- Proximal compression of the suprascapular nerve at the suprascapular notch
- The nerve traverses underneath the transverse scapular ligament
- Weakness and atrophy of both the SP and IP
- EMG & nerve conduction study: involvement of both muscle bellies
- Distal compression at the lateral edge of the scapular spine (the terminal



branches of the nerve innervate the infraspinatus muscle)

- At the spinoglenoid notch
- Wasting of only the infraspinatus muscle belly
- 22% loss in E/R strength
- In extreme abduction and E/R (late cocking phase) of the shoulder, the medial tendinous margin between the IS and SS forcefully impinges against the scapular spine, thereby compressing the intervening IS branch of the suprascapular nerve.
- Tx.: spinoglenoid notchplasty

## VI. VASCULAR LESIONS IN THROWING ATHLETES

- Rare
  - Digital vessel thrombosis
  - Proximal thrombosis with distal embolism
  - Aneurysms
  - Vessel compression such thoracic outlet syndrome & quadrilateral syndrome

## VESSEL ANEURYSMS

- Subclavian A, Axillary A, Posterior humeral circumflex A
- Related to repetitive trauma or impingement experienced during the throwing motion.
- The pectoralis minor muscle and humeral head have been implicated in vascular impingement of the axillary and circumflex vessels when the shoulder is in an abducted and E/R rotated position. ----  
“Hyperabduction syndrome” (Wright)
- Diagnosis: Challenging
  - Symptoms are activity related and frequently are long-standing.
  - The extremity should be palpated for pulses and examined in both the neutral position and in the provocative position of hyperabduction & E/R.
  - Inspection of digits and nail beds for evidence of emboli.
  - Auscultation for the presence of a bruit

- Sx: pain, blanching, numbness in the digits  
Easily fatigue, heavy extremity, cold intolerance, hypersensitivity
- DDx: vascular heart disease, vasculitis, cardiac arrhythmias
- Treatment:
  - Rehabilitation, activity modification
  - Segmental excision with primary anastomosis, patching, bypass grafting

#### QUADRILATERAL SPACE SYNDROME (QSS)

- Quadrilateral space
  - The area bordered superiorly by the teres minor, laterally by the humeral shaft, inferiorly by the teres major, medially by the long head of the triceps.
  - The axillary nerve and the posterior humeral circumflex artery (PHCA)
  - Symptoms are increased with forward flexion & E/R, or abd & E/R.
- Physical Examination
  - Symptoms & Signs : similar to those seen in thoracic outlet syndrome
  - Insidious onset of vague posterior shoulder pain
    - Pain poorly localized to the shoulder,
    - Paresthasias in a nondermatomal distribution
    - Discrete point tenderness in the quadrilateral space, generally near the insertion of the teres minor
  - Holding the arm in the cocked position (Abd+E/R) for 1 minute generally will reproduce symptoms associated with QSS. → dampening of the radial pulse
  - Atrophy of the deltoid and /or teres minor in severe QSS or long-standing cases.
  - EMG studies of the deltoid and teres minor may be normal.
  - No specific tests confirm the diagnosis of QSS, which is made on the basis of excluding other pathologic entities.
- Treatment
  - Nonsurgical management: stretching of the posterior capsule and teres

minor

–Surgical decompression of quadrilateral space

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