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The Throwing Shoulder and the Rehabilitation of Baseball Specific Shoulder Injuries

By Ryan Bitzel, MPT

Please Allow Myself to Introduce…Myself…

I'm a Physical Therapist and have been specializing in both the elbow and shoulder in overhead athletes, specifically baseball, for the past 11 years

Previously presented for PhyiscalTherapy.com earlier in the year on the elbow UCL epidemic in Major League Baseball

For those of you who attended that presentation, welcome back and I apologize now for recycling some of my same jokes

For those of you who are new, I simply just want to apologize for my lame jokes before we get started

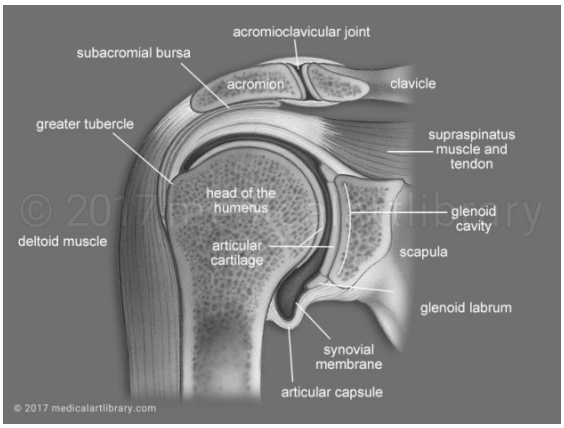
My Bio

- Originally from Canton, Ohio
  - Canton is the football capital of the world and home of the Pro Football Hall of Fame
  - So quite naturally, I went into baseball!
- Intern athletic trainer for the Houston Astros minor league affiliate in Salem, Virginia, in 2003
- Graduated with my Master's Degree in Physical Therapy from Walsh University in North Canton, Ohio, in 2006.
- Staff Physical Therapist for the Steadman-Hawkins Clinic of the Carolinas (Spartanburg, SC) from 2006-2010 and served as the consultant for the Boston Red Sox minor league affiliate Greenville Drive during that time
- Became the Rehabilitation Coordinator for the San Diego Padres in 2010 and served in that capacity until 2017

Course Objectives

- Identify the three anatomical changes that occur in the throwing shoulder compared to the general population.
- Identify the at least two signs and two symptoms of internal impingement. and make a differential diagnosis between internal impingement and subacromial impingement
- Outline a conservative rehab plan featuring three techniques to restore ROM and three strengthening exercises to address GH instability.
- Identify three signs and three symptoms of GH labral tears.
- List the four phases of SLAP repair rehab and four specific exercises associated with each phase.
- Based on the signs and symptoms of internal impingement, the participant will be able to and make a differential diagnosis between internal impingement and subacromial impingement.

Anatomy of the Shoulder

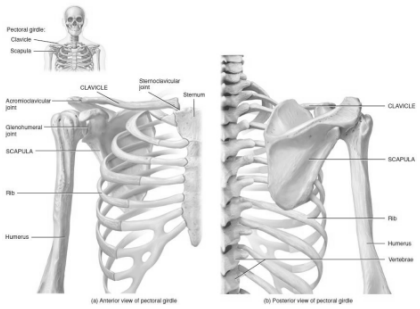


Shoulder Girdle

- Made up of Four Articulations:

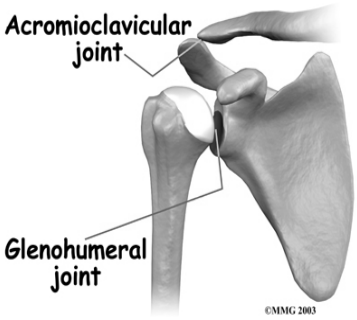
- Glenohumeral Joint
- Acromioclavicular Joint
- Sternoclavicular Joint
- Scapulothoracic Joint

- Talk mainly about the GH Joint for this presentation but will see that the scapulothoracic joint will also play an important role



Glenohumeral Joint

- Articulation between the head of the humerus and the glenoid cavity of the scapula
- Ball and socket joint that allows for three planes of motion:
  - Flexion/Extension
  - ABD/ADD
  - ER and IR



Basic Anatomy of the Shoulder

- But what we don't appreciate sometimes is the fact that the head of the humerus is actually 4x larger than the articular surface of the glenoid cavity
- "Golf Ball Sitting on a tee"
- Basketball sitting on a saucer because it's not static, it's constantly moving and there is more of a "balancing act" that goes on

Mobility vs Stability

- As we know, joints provide both mobility and stability for the two surfaces that are articulating with each other
- Have to sacrifice one for the other
- In the case of the GH joint, there is a lot of mobility in the joint, so an individual needs a lot of secondary stability to maintain the position of the head of the humerus, especially overhead athletes

Stability for the GH Joint

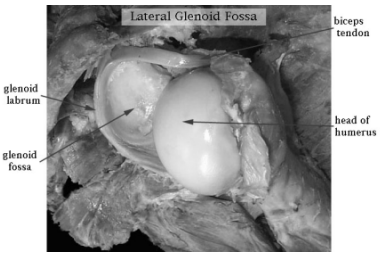
- Two areas of stability in the GH Joint
- 1. Static Stabilizers
  - Joint Capsule
  - GH Ligaments
  - Labrum
- 2. Dynamic Stabilizers
  - Rotator Cuff Muscles
  - Bicep
  - Scapular Stabilizers

Static Stabilizers

- Joint Capsule
- Glenohumeral Ligaments
  - Superior GH Ligament
  - Middle GH Ligament
  - Inferior GH Ligament
- Play only a minor role in shoulder stability

Labrum

- Labrum: Fiberous structure strongly attached around the edge of the glenoid that serves to increase the contact surface between the glenoid and the humeral head[2]
- Deepens the contact surface by up to 50%[2]



Anatomy of the Labrum

- Superior and Inferior aspects of the labrum exhibit significantly different anatomy [2]
- Also unique in the fact the anatomy of the labrum actually changes appearance in varying degrees of humeral rotation[2]
- In fact, the superior and inferior aspects of the labrum are almost the complete opposite of each other

Anatomy of the Labrum[2]

Superior Labrum

- Loose, mobile and has a "meniscal-like" aspect
- Histologically made up of loose connective fibers
- Poor blood supply
- Attaches to the biceps anchor and roughly 50% of the fibers of the long head of the bicep brachii

Inferior Labrum

- Rounded and tightly attached to the glenoid rim
- Histologically made up of fixed, inelastic fiberous tissue
- Well vascularized
- No attachment to the bicep

Anatomy of the Labrum

- Important to know the differences in the histology of the superior vs inferior labrum in regard to injury
- Most often the superior labrum that is injured:
  - More mobile (easily caught)
  - Loose connective tissue (weaker)
  - Poor blood supply (poor healer)
  - Attached to the bicep (Peel Off Mechanism)

How Does the Labrum Provide Joint Stability?[2]

- 1. Creates a physical block between the glenoid and humeral head to limit translation
- 2. Increases the depth of the glenoid cavity
- 3. Increases the concavity-compression effect between the glenoid and the humeral head (creates a vacuum)
- 4. Attachment of the bicep long head helps create further joint stability

Dynamic Stabilizer of the Shoulder

- Rotator Cuff Muscles (Primary Stabilizer of the Shoulder)
  - Supraspinatus
  - Infraspinatus
  - Teres Minor
  - Subscapularis
- Scapular Muscles
  - Middle Trapezius
  - Lower Trapezius
  - Rhomboids
- Bicep

Role of the Bicep in Shoulder Stability

- Bicep-Longhead also plays a role in dynamic shoulder stability
- Contributes to anterior shoulder stability by increasing the shoulder's resistance to torsional forces when the GH joint is placed in an ABD and ER position[2]
- Extremely important for overhead throwers because they are constantly in this position during their sport
- Key: Any disruption of the bicep anchor is detrimental to anterior shoulder stability as it decreases the shoulder's resistance to torsional forces and places a greater stress on the static stabilizers[2]
- In particularly, it stresses the labrum, leading to labral fraying/tears

Section Summary

- GH Joint is a ball and socket joint that allows for three planes of motion with very little stability
- GH stability comes from both static structures (capsule, GH Ligaments and labrum) and dynamic structures (RTC, scapular muscles, bicep)
- Labrum helps to physically block translation of the humeral head on the glenoid, deepens the GH cavity and creates a vacuum to hold the GH in place more effectively

Section Summary

- The superior and inferior labrum are histologically different, with the superior aspect being loose and more mobile, having a poor blood supply and an attachment to the bicep longhead, which makes it more susceptible to injury compared to the inferior aspect
- Most of the GH joint's stability comes from the dynamic stabilizers of the rotator cuff muscles
- Bicep also plays a role in stability by limiting torsion forces in the ABD and ER position; any disruption of the bicep anchor leads to increased forces on the static labrum, resulting in the increased risk for labral injury

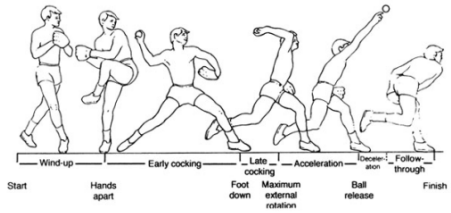
Adaptations of the Throwing Shoulder

Adaptations of the throwing shoulder

- The overhead thrower is a highly skilled athlete[3]
- These athletes require:
  - Flexibility
  - Muscle Strength
  - Coordination
  - Neuromuscular Efficiency (ability to get in/out of extreme positions both efficiently and **safely**)

Phases of Throwing

- To understand the skill that these athletes possess and the force being placed on their shoulders, it's good to take a look at the phases of throwing

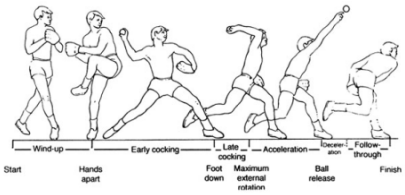


Five Phases of Throwing

- Wind-Up
- Early Cocking
- Late Cocking
- Acceleration
- Deceleration/Follow Through

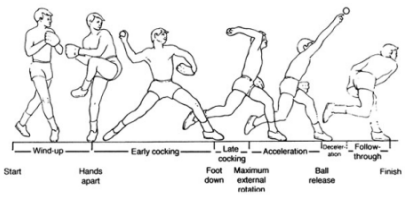
Wind Up[4]

- Preparation to throwing
- Begins when the pitcher begins his initial movement and goes into single leg stance
- Ends when the pitcher's hands break apart



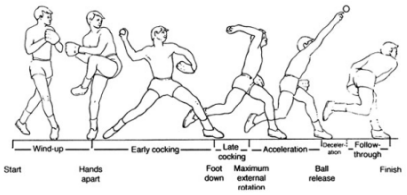
Early Cocking[4]

- Begins when the hands break apart (ball leaves the non-dominant gloved hand)
- Shoulder begins to ABD and ER
- Ends when the pitcher's foot comes into contact with the ground



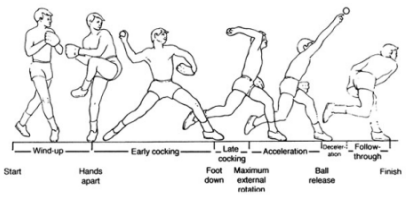
Late Cocking[4]

- Begins when the pitcher's foot strikes the ground
- Shoulder continues into ABD and achieves max ER
- Elbow also comes into flexion between 90-120 degrees
- Forearm pronates to 90 degrees
- Ends when max shoulder ER is achieved



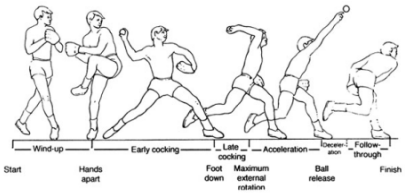
Acceleration[4]

- Begins when max shoulder ER is achieved and the arm begins to come forward
- Shoulder moves into IR and ADD
- Elbow also comes into extension
- Forearm continues to pronate
- Ends with ball release



Deceleration/Follow Through[4]

- Begins after the ball is released
- Dissipation of all of the kinetic energy occurs during this phase
- Elbow goes into rapid extension
- Ends when all motion is complete



Forces on the shoulder during throwing[3]

- Throwing places extraordinary demands on the shoulder
  - Fastest human movement: 7.230 o/s
  - Equals ~20 full revolutions in 1 second!
  - Late cocking to ball release: 0.03 seconds!
- Tremendous forces placed on the shoulder during throwing
  - Anterior displacement on shoulder: 0.5 x BW
  - Distraction forces on the shoulder equal 1-1.5 x BW at ball release
- As a result of these high, repetitive forces, adaptations to the shoulder occur that are not common in the general population

Adaptations to the Throwing Shoulder[5]

- Humeral Retroversion
- Increased External Rotation
- Anterior Laxity

Retroversion of the Humerus[6]

- Retroversion of the humerus: Development of a posteriorly oriented humeral head in response to the habitual activity of overhead throwing

Retroversion of the Humerus

- In a study by Crockett et al, it was shown that there is an average of 17 degrees of humeral retroversion between the throwing and non-throwing shoulders in overhead pitchers compared to the normal, non-throwing population which displayed equal humeral torsion in both their dominant and non-dominant shoulders7
- In a study by Meister et al, showed that the adaptive change of humeral retroversion occurs in overhead throwing adolescents at 12-13 years of age[8]

Increased ER

- Because of the shift of the humeral head into a retroverted position, the range of motion of the shoulder will also change as a result
- With retroversion of the humerus, you will see:
  - Increased ER
  - Conversely decrease in IR
  - Total arc of motion (ER +IR) remains the same
- This increase in ER is actually beneficial and **ESSENTIAL** in overhead throwers because it is the increase in ER that generates velocity on the ball that allows MLB pitchers to achieve speeds from 93-100+ mph and sets them apart from their competition[3]

Anterior Laxity

- Another result of retroversion of the humerus is the "stretching" of the anterior capsule, creating anterior laxity[5]
- The Good: Allows for free movement for the shoulder to achieve more ER
- The Bad: It can also create shoulder instability issues if not managed

The Big Question….

- How much ER is beneficial…and when does the loss of IR become problematic???[3]

Section Summary

- The overhead thrower is a highly skilled athlete requiring flexibility, muscle strength, coordination and neuromuscular control
- Throwing is the fastest recorded human movement and there are tremendous forces placed on the shoulder during throwing, including distraction forces equal to 1-1.5x pitcher's body weight
- As a result, adaptations occur in the throwing shoulder that are not seen in the general population

Section Summary

- Adaptive change includes retroversion of the humerus, increased external rotation and anterior laxity
- Essential that this adaptation occurs because it in the gain of ER that helps create velocity on the ball when pitching

Injuries to the Throwing Shoulder

Injuries to the Throwing Shoulder[3]

- In Major League Baseball, 28% of all injuries occur at the shoulder
- In addition, 22% of all MLB injuries occur at the elbow (these injuries have a correlation with shoulder position during foot strike)
- Overall: Combined 50% of all MLB injuries are upper extremity related
- In MLB, we are also seeing a trend of the length of time missed/days spent on the DL increase
- Which means that these are major injuries that are occurring at the shoulder joint

Injuries to the Throwing Shoulder[3]

- Is this just an MLB problem?
- Statistics show that 75% of injuries in college baseball occur at the shoulder or the elbow

Injuries to the Throwing Shoulder[3]

- In youth baseball, 50% of the players (age 9-14) have complained of shoulder pain
- Latest number show that there are over 17 million kids that play youth baseball in the United States
- Roughly there have been 8.5 million upper extremity injuries in youth baseball
- Also seeing that the number of surgeries in youth baseball are increasing
- Seeing elbow UCL reconstructions as young as 13-14 years of age!
- Why are we seeing this trend in shoulder/elbow injuries in baseball??

Risk Factors for Shoulder Injuries in Baseball[3]

- Velocity
- Overuse
- Fatigue/Conditioning
- Mechanics
- Pitch Type
- Pitcher-Catcher Combo

Velocity

- Studies have shown that pitchers who exhibit higher velocities are at increased risk for shoulder injuries[9]
- Higher velocity = Greater force placed on the stabilizers of the shoulder
- Greater the forces on the shoulder = More microtrauma to the tissue

Overuse[9]

- Shoulder Injuries in baseball have been linked to:

- Playing baseball year round
- Pitching too many innings/year
- Playing on multiple teams
- Specialization (focusing on only baseball)
- Playing other throwing sports
- Excess throwing on the side (showcases, radar gun showings, etc)

Fatigue[10]

- Evidence shows that pitching when tired leads to poor performance and increased risk of injury

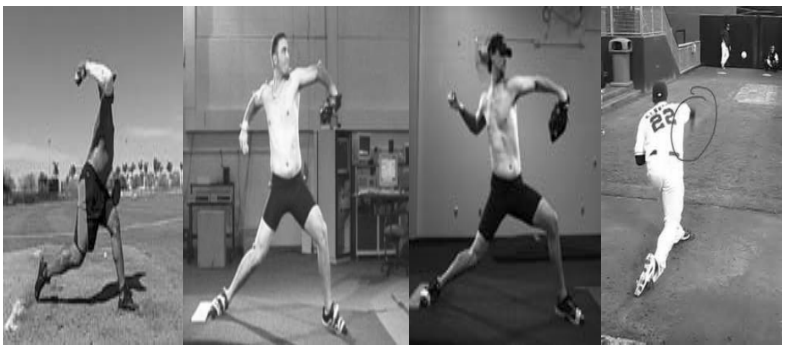
- When the shoulder fatigues and the angle of the arm drops to below 90 degrees of ABD, there is an increased risk of injury

- Causes of fatigue:
  - Poor conditioning
  - Pitching on consecutive days
  - Excessive pitch counts
  - Year-round playing

Mechanics[9]

- Better mechanics lead to lower loads and stress on the shoulder
- Lower loads and stress lead to decreased risk of injury
- We don't all have to be pitching coaches, but we can look for some more common improper mechanics that are "red flags" for shoulder injuries:
  - "Holding Back" (shorter stride, lead with elbow, trunk forward)
  - "Inverted W" (still in shoulder ER at foot contact)
  - Shoulder ABD less than 90 degrees at foot contact/ball release
  - Rebound effect (player cannot eccentrically control the arm at follow through and recoils to slow the arm down)

Mechanics Continued



Pitch Type

- Widely assumed that throwing more curveballs leads to increased risk of injury
- Two separate studies by Nissen and Fleisig found no difference on the amount of stresses placed on the upper extremity (shoulder and elbow) throwing a curveball vs throwing a fastball[11,12]
- Studies did reveal that the change-up was associated with a 29% and 12% reduced risk of injury respectively[11,12]
- Recent study by Chalmers et al followed up to discover a link to pitchers who threw a higher percentage of fastballs were at higher risk of injury[13]
- All ties back into velocity as the primary risk factor

Pitcher-Catcher Combo

- Besides the pitcher, the catcher is the position in baseball who is required to do the most throwing during the game
- Pitchers who are moved from pitcher to catcher during the game or catch on the days they are not pitching are more likely to sustain a shoulder injury compared to if they played another position[3]
- Simply has to do with the volume of throws made

Common Shoulder Injuries in Baseball

- Internal Impingement
- Labral Tears

Section Summary

- Injuries to the upper extremity (shoulder/elbow) account for 50-75% of all injuries in baseball at all levels (MLB, college, youth)
- Number and severity of these injuries are increasing yearly and we are seeing more baseball-related surgeries at younger ages
- Risk factors for these injuries include:
  - Velocity
  - Overuse
  - Fatigue
  - Mechanics
  - Pitch Type
  - Position (Pitcher/Catcher Combo)

Internal Impingement

Internal Impingement Definition

- A set of pathological conditions, including but not limited to: articular surface rotator cuff tears, labral tears, bicep tendonitis, anterior instability, internal rotation deficit and scapular dysfunction[5]

Internal Impingement

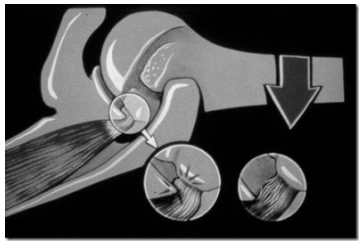
- That definition to me is more of a "junk drawer" term, similar to subacromial impingement, which we know is just one of many structures being pinched in the subacromial space
- So how can we break down internal impingement to a simpler definition based on what we know?

Underlying Cause of Internal Impingement

- First off, we know in a thrower that there is going to be retroversion of the humerus
- Good thing, because it's the retroversion of the humerus that allows the pitcher to throw with increased velocity
- However, the downside of retroversion of the humerus is that it can also be the cause of shoulder dysfunction
- In fact, retroversion is the primary underlying cause of internal impingement
- Secondly...We know that retroversion of the humerus results in:
  - Tight posterior structures (posterior cuff/posterior capsule)
  - Anterior Laxity

Mechanism of Injury[5]

- In the ABD and max ER position of the shoulder, we should have an anterior roll and inferior glide of the head of the humerus
- Factor 1: Tight Posterior structures. Because the tight posterior structures are in the state of contracture, the humeral head is now translated into a superior direction
- Factor 2: Anterior Laxity. Because of the inability to control the anterior roll of the humerus due to anterior laxity, the head of the humerus now glides posteriorly
- Result: In the ABD and max ER position, the humeral head now moves into the posterior-superior direction, resulting in "pinching" of the supraspinatus tendon on the posterior-superior labrum



So, what is Internal Impingement?

- Internal Impingement: The contact between the posterior-superior aspect of the labrum and the undersurface of the rotator cuff tendon[5]

Internal Impingement vs Subacromial Impingement

- Internal Impingement is not to be confused with subacromial impingement
- They are two completely separate entities that need to be thoroughly examined and diagnosed, because:
  - Underlying cause of the condition is different
  - Mechanism of injury is different
  - Signs/symptoms are different
  - Treatment of the conditions are different

Subacromial Impingement vs Internal Impingement

Subacromial Impingement

- Subacromial Impingement: Tendons of the rotator cuff or bursa become irritated from contact with the acromion as they pass through the **subacromial space**
- Root Cause: Rotator Cuff Weakness
- Mechanism: Weak RTC is unable to depress the head of the humerus, resulting in a superior glide of the humeral head, creating contact between the RTC tendons and the acromion

Internal Impingement

- Internal impingement is the contact of the rotator cuff tendons on the posterior-superior labrum
- Root Cause: Retroversion of the humerus
- Mechanism: Posterior RTC/capsule tightness results in a superior glide of the head of the humerus and anterior laxity results in the posterior roll of the humerus, creating contact between the RTC tendons and posterior-superior labrum

Signs and Symptoms

Subacromial Impingement[1]

- Generalized pain in the lateral shoulder (referred pattern)
- Limited ROM with flexion and ABD with the presence of a painful arc (60-120 degrees) and often a shoulder hike
- Pain with daily activities as well as at rest and especially with sleeping
- Pain and weakness with MMT of the RTC

Internal Impingement[5]

- Localized pain on the posterior aspect of the shoulder
- Limited ROM with IR; excessive ER
- No pain with daily activities; pain is only present when throwing and usually occurs in during the late cocking/early acceleration phase or they have a very difficult time "loosening up" when throwing
- MMT of the RTC is usually strong and little to no pain

Treatment

Subacromial Impingement

- Treat the underlying cause: RTC weakness
- Plan of care: Revolve around strengthening the RTC

Internal Impingement

- Treat the underlying cause: Humeral retroversion
- Can't change osseous adaptions
- So treat the resulting issues:
  - Posterior shoulder tightness
  - Anterior shoulder laxity
- Plan of care: Revolve around posterior shoulder mobility and anterior shoulder stability

Key to remember:

- Important to make a differential diagnosis between subacromial and internal impingement
- Throwers can still have subacromial impingement as well as internal impingement, so don't just automatically rule out subacromial impingement just because they are a thrower
- Should make it easier in a non-thrower because they will not be susceptible to internal impingement due to no retroversion of the humerus, so you can generally rule that diagnosis out in non-throwing populations

Section Summary

- Internal Impingement is the contact made between the posterior-superior labrum and the undersurface of the rotator cuff tendon
- Primarily due to retroversion of the humerus and it's resulting posterior shoulder tightness and anterior laxity
- Posterior tightness leads to a superior glide of the humeral head and the anterior laxity leads to a posterior roll of the humeral head when the arm is in the ABD/Max ER position, leading to the contact between the tendon and the labrum

Section Summary

- Internal Impingement is not the same as subacromial impingement, which is the contact between the tendons of the RTC and the acromion in the subacromial space
- Underlying cause of subacromial impingement is RTC weakness
- Results in a superior glide of the head of the humerus during overhead activities and results in the contact between the RTC tendons and the acromion

Section Summary

- On exam, the signs and symptoms of internal impingement involve posterior pain only with throwing and usually in the late cocking/early acceleration phase or they have difficulty “loosening up” but have no pain with any other daily activity and they are limited with IR
- On exam, the signs and symptoms of subacromial impingement involve lateral shoulder pain, usually with daily activity and especially sleeping at night, as well as limited and painful flexion (presence of a painful arc or shoulder hike) and ABD as well as RTC weakness
- Treatment of internal impingement will involve mobility of the posterior shoulder structures and anterior stability strengthening
- Treatment of subacromial impingement will involve strengthening of the RTC

Shoulder Examination

Exam

- ROM!!!
- Joint Mobility
- Strength
- Special Tests

Range of Motion

- With internal impingement, we know that we will see increased ER and loss of IR due to retroversion of the humerus
- How do we know what "good" range of motion is for these athletes?

GIRD[3]

- GIRD: **G**ross **I**nternal **R**otation **D**eficit
- How to measure:
  - Take the measurement for IR on the dominant shoulder
  - Take the measurement of IR on the non-dominant shoulder
  - Compare the two measurements
- Determined to have GIRD if the difference between the dominant and non-dominant IR was greater than/equal to 20 degrees loss of IR
- Assumed to be due to the loss of IR
- Example: Right Handed Pitcher
  - Right shoulder: IR: 20 degrees
  - Left Shoulder: IR: 50 degrees

Problem with GIRD

- During the throwing motion, there is an excessive amount of ER that occurs with very little IR[3]
- Also, there are very large eccentric forces that occur on the shoulder when throwing:[14]
  - Teres Minor–84% MVC
  - Infraspinatus–34% MVC
  - Supraspinatus–39% MVC

GERI[3]

- Combination of all of these eccentric forces leads to an increase in ER **in addition to** the excessive ER seen with humeral head retroversion
- Study by Reinold et al shows an increase of 5 degrees of ER from pre- to post-season measurements in college and professional baseball players
- Results in GERI
- GERI: **G**ross **E**xternal **R**otation **I**ncrease

The Solution[3]

- Instead of looking purely at GIRD, we now look at Total Range of Motion (TROM) by measuring and comparing the total ER + IR arcs of both the dominant and non-dominant side and compare
- This takes into account humeral retroversion and the excessive ER seen in pitchers
- Total arcs of the dominant and non-dominant side should be within 5 degrees of each other, otherwise there is a true loss of IR
- Example: Right Handed Pitcher
  - Right shoulder: 125 degrees ER, 20 degrees IR (Total arc of 145 degrees)
  - Left shoulder: 90 degrees ER, 50 degres IR (Total arc of 140 degrees) –loose?

Study[15]

- In a study by Wilk et al, 369 professional baseball pitchers were measured for both ER and IR on both their dominant and non-dominant sides
- On the throwing shoulder, ROM averaged:
  - 132 degrees of ER
  - 52 degrees of IR
- Showed what we expected, that the dominant shoulder had an increase of ER with a subsequent loss of IR
- However, when the TROM measurement was compared to the non-dominant side, there was no significant side to side difference in TROM

Now….How to Measure IR

Techniques to measure IR

- The way in which you take your IR measurement and what you stabilize could greatly effect the numbers
- Remember, only dealing with a 5 degree margin
- How one clinician takes a measurement and records to compared to another clinician can lead to differing results

Ways to Measure IR

- No Stabilization?
- Anterior Stabilization?
- Scapular Stabilization?
- *Photos: Wilk, "GIRD, GERI and TROM in Overhead Throwers" 2016

Studies[16]

- In a study by Wilk et al, three different techniques for measuring shoulder IR were performed with inter-rater reliability compared
- Looked at visual observation (no stabilization), anterior stabilization and scapular stabilization on 39 professional baseball players
- All three methods had fair inter-rater reliability, however scapular stabilization provided the best inter-rater reliability
- Concluded this measurement (scapular stabilization) should be recommended when measuring PROM for IR

Joint Mobility

- With overhead throwers, always want to check joint mobility
- Usually will display increased anterior laxity with anterior-to-posterior glides
- May also have a (+) Apprehension test, especially in the max ER position

Strength

- Good to test MMT for the RTC and scapula, as any weakness in these muscles will be contributing factors to joint stability and can be addressed during treatments
- For me, it's more important to test FUNCTIONAL strength because often times, the RTC can be strong in the static position, but fails functionally to stabilize the shoulder during these extreme movements

Functional Strength

- Stabilization in the throwing position
  - Put the athlete in the max ER-90 degrees ABD position
  - Perform manual rhythmic stabilization in this position
  - If they fatigue/fail to hold this position, then functional strength is issue
  - Pass/Fail: 30 seconds
- PNF Patterns
  - D2 Diagonal Pattern will closely mimic the muscle firing patterns of the upper extremity we see with throwing
  - Can they perform these with good form, strength and endurance?
  - Pass/Fail: 24 reps (max endurance exercise) with good form and strength
- Eccentric ER
  - Done to see if they have enough eccentric strength to properly decelerate the shoulder
  - Test in the sidelying ER position and have them eccentrically resist IR
  - Pass/Fail Can they hold against my resistance for 5 seconds

Functional Strength Testing

- As a clinician, our hands can tell us more about the patient's strength than anything else
- TRUST your manual skills
- Functional strengthening tests now become treatments (stab in throwing positions, D2 PNF patterns, eccentric ER with manual resistance) and become a great way to test-retest as the player progresses
- Plus, the manual feedback from the player is beneficial to them because it feels like a step beyond just the normal dumbbell/tubing exercises and let's them know you are taking the time to care

Additional ROM/Strength Testing

- Core Strength
- Glute Strength

Special Tests

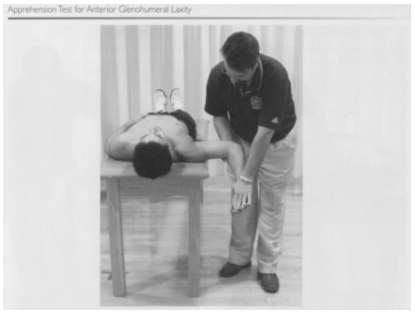
- Apprehension Test
- Internal Impingement Test

Apprehension Test

- Patient is supine on the table
- Therapist/trainer stabilizes the anterior head of the humerus and rotates the shoulder into max ER
- Stabilizing hand of the therapist/trainer is then removed from the anterior humerus
- Positive test: Feeling of apprehension

Internal Impingement Test

- First described by Jobe
- Patient is supine with the arm ABD to 90-100 degrees with max ER
- Patient pulls the arm anteriorly (into IR) with the therapist/trainer resisting
- Positive: Shoulder pain is reproduced



Diagnostic Imaging

- Usually not ordered by the MDs
- Why? Remember, the tear is located on the articular side of the RTC tendons and may only involve a small portion of the total cross section
- May also open up "Pandora's Box," because it could also reveal lesions that are asymptomatic and now the player becomes worried because he's got a tear
- If wanted to confirm, MRI-arthrogram is gold standard
- Studies show that MRI-arthrogram sensitivity and specificity for detection of internal impingement is greater than 84%, even with tears involving less than 25% of the cuff[5]
- More so to help get an idea of the severity of the cuff inflammation or to see if the labrum is involved

Prognosis

- Conservative treatment is usually successful with good outcomes
- Surgery is only performed (debridement of the undersurface of the cuff) if conservative treatment fails to make improvements or return the player to game level

Section Summary

- Exam should primarily include ROM screening
- ROM should be measured by taking the total arcs of both the throwing and non-throwing side and compared
- Difference of 5 degrees in TROM is considered to be a loss of IR
- Best way to measure IR is in the supine position with scapular stabilization

Section Summary

- Exam should also include joint mobilization, MMT and functional strength testing, as well as special tests
- Also good to evaluate core strength, glute strength and ankle mobility and balance
- Diagnostics are usually not performed, although MRI can help determine the severity of the condition and if there is labral involvement
- Prognosis is usually good with conservative treatment

Treatment of Internal Impingement

Treatment of Internal Impingement

- Treatment of internal impingement is very specific compared to subacromial impingement
- Simplest way to break down the treatment is to treat the causes of internal impingement
  - Loss of IR
  - Anterior Glenohumeral Instability

Phases of Rehab for Internal Impingement

- Phase I: Decrease pain/inflammation and restore ROM
- Phase II: Baseline Strengthening
- Phase III: Functional Strengthening
- Phase IV: Return to Sport Activity (Throwing Program)

Phase I: Decreasing Pain and Inflammation

- Athlete needs to take a break from throwing!
- Rest is critical in helping to restore function to these athletes. No throwing, no dry work off the mound or in the mirror, NOTHING!!
- May be prescribed either over the counter or prescription oral anti-inflammatories or be given an cortisone injection by the MD
- Modalities include:
  - Ultrasound/Phonophoresis
  - Iontophoresis
  - H-Wave or other E-stim
  - Hivamat
  - Ice

Phase I: Restoring ROM

- Other critical component during Phase I is restoring ROM
- Dealing with tight posterior structures (posterior capsule/posterior cuff) that result in a loss of IR
- How to restore IR:
  - Stretching
  - Soft tissue
  - Positioning

Stretching

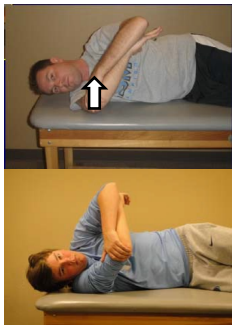
- Often times, a posterior shoulder stretching program is given to these athletes to help treat this condition
- Makes sense because the posterior capsule is tight, so you want to focus on stretching that (treat the deficits)
- Which stretch is the best?
  - Sleeper stretch?
  - Cross body stretch?
- Should the player self stretch?

Stretching studies

- In a study by McClure et al, it was determined that the cross body stretch increased shoulder IR ROM significantly greater compared to the sleeper stretch
- Sleeper stretch is often times performed incorrectly by the patient and often times results in the patient impinging themselves rather than helping to improve motion.
- Cross body stretch also has it's controversies, as the inability to stabilize the scapula in this position can also result in subacromial impingement

Stretching studies continued

- In a study by Wilk et at, it was determined that modified version of both the sleeper stretch and cross body stretch increased IR ROM in the overhead throwing athlete and reduced the risk of impingement compared to their originals[18]



How to avoid these complications?

- In a study by Bailey et al, it was determined that therapist-assisted manual stretching of the shoulder with the cross body stretch significantly improved IR ROM compared to the subjects given the self-stretch program at home[18]
- Stress manual therapy with all of these patients
- Not only does it produce better results, but safer by being able to stabilize the scapula….and the players like it because it shows you care!

Stretching in ER?

- Aggressive stretching in ER should be AVOIDED in these athletes
- Already have significant excessive ER and any further stretching into ER will like result in even greater anterior laxity and actually make the condition worse
- OK to restore normal ER if limited by guarding by doing a subscap or pec soft tissue release, but do not go beyond normal ER with treatment

Soft Tissue

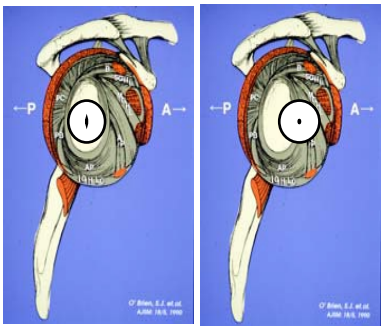
- We have seen that humeral retroversion results in tight posterior structures (posterior capsule/posterior cuff) which results in the loss of IR
- MOST of the IR loss (85%, Wilk et al) is due to osseous changes that we cannot correct[3]
- However, where does the additional loss of IR come from?
- Is the problem more capsular or posterior cuff?
- Study by Reinold et al showed that the loss of IR is furthered by the large eccentric forces on the RTC, thus resulting in the shortening of these tissues, especially in repetitive overhead athletes[19]
- Very beneficial to these athletes that, in addition to stretching the capsule with manual cross body stretching, that lengthening of posterior rotator cuff muscles is essential in the recovery of these athletes

Soft tissue techniques

- I'm a big manual therapy guy and have taken a lot of manual therapy continuing education classes, but to me, how you as a clinician decide to restore IR with soft tissue techniques doesn't matter, use what you feel comfortable with, as long as you address the soft tissue restrictions
- Examples to use:
  - Active release/myofascial release techniques
  - IASTM (Graston, Hawkgrips, etc)
  - Functional Range Release (great supraspinatus release in sidelying)
  - Dry needling/trigger point release

Positioning

- Also good to help centralize the head of the humerus in the glenoid
  - Techniques: humeral head setting
- Also good to address the posture of the scapulothoracic spine which we briefly mentioned earlier during the anatomy portion:
  - PRI to restore positioning of the thoracic spine
  - Cut down on some of the soft tissue work so you aren't constantly digging in and irritating tissue



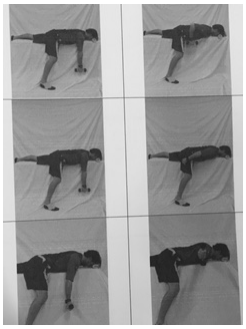
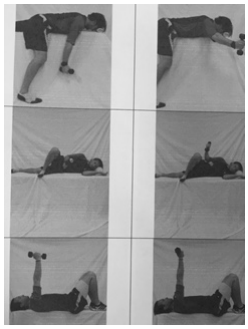
Phase I Goal

- Player is pain-free at rest/activities of daily living
- Player is able to maintain their IR ROM
- For me personally, I like 5 days of symptom-free, maintained IR motion
- Key: DO NOT stop re-checking and/or treating IR going forward to the next phases! As you add strengthening exercises, you will be adding stress on the shoulder and you need to monitor their response throughout

Phase II: Baseline Strengthening

- Remember, this is strengthening with a focus on addressing ANTERIOR INSTABILITY
- Stay out of the throwing position during this time
- Still mostly isometric/concentric strengthening at this time
- Add your traditional RTC program (Throwers 10, tubing etc)
- Remember…these are athletes that NEED stabilization and need to return to a higher level so make sure to spice up their rehab program with sport specific exercises and add stabilization where you can
- Also focus on core and glute strengthening at this time

Thrower's 10 Exercises

Problem with the Throwers 10

Add Sport Specific and Stabilization Components

- Players will like it, more difficult and challenging for them, more bang for your buck!

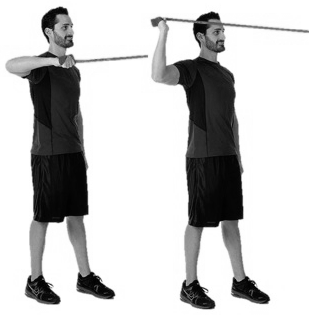


Tubing Program

- Again, add different sport specific and stabilization components where you can
- Examples:
  - Sit on exercise ball (core)
  - Stand on foam on stance leg (glute/core)
  - Add band around ankles (glute)

Tubing in 90-90 ER?

- Good Exercise? Often given as part of rehab and part of the thrower's 10…
- Isotonic contraction during tubing in 90-90 position results in the anterior roll of the humerus into an already unstable anterior capsule
- Feeds into the problem rather than improving it
- Stay below 90 degrees with isotonic
- This position is OK for isometrics (no movment, so no roll/slide)



Stabilization Program in Phase II

- Exercises should include:
  - Manual stabilization exercises in supine punch
  - RTC Throwers 10/Tubing with manual stabilization
  - Scapular stabilization with manual stabilization
  - Closed-Kinetic Chain Exercises (planks, wall push-ups, etc)

Goals for Phase II

- Pain-free at rest/daily activities and with all exercises
- Maintaining IR
- 5/5 strength with MMT (RTC/scap)
- Able to maintain stabilization in supine for 30 seconds

Phase III: Functional Strengthening

- Continue to focus on addressing anterior stability
- But now start to take into functional overhead and throwing positions
- Add plyometric and eccentric component

Phase III Exercises

- Manual stabilization in the throwing position
  - Remember: It is critical that you work in max ER
  - Dangerous position but they NEED to have strength in this position to be successful so have to work in extremes
- PNF D2/D1 Diagonal Patterns
- Eccentric sidelying ER
- Plyometric exercises
  - Two handed med ball tosses
  - One handed (wall dribbles, ball drops, rebounder ball tosses ER and overhead)
- Deceleration exercises
  - Deceleration ball tosses

Manual Stabilization in Throwing Position

D2/D1 PNF Patterns

Plyometric Medicine Ball Tosses

Plyometric Ball Drops

Rebounder Ball Tosses

Deceleration Ball Tosses

Phase III Goals

- Pain-free at rest and with all exercises
- Maintaining IR
- Able to maintain stability in the throwing position (Max ER) vs manual rhythmic stabilization for 30 seconds
- Able to perform 24 reps (max endurance) of D2/D1 PNF patterns maintaining proper form, good strength and no fatigue

Phase IV: Return to Play Program (Throwing Program)

- Once all of the goals from phase III are achieved, the athlete is not ready to just jump in and return to play
- Needs to be a gradual return to play throwing program
- Rule of thumb: However many weeks the player was shut down from throwing is the number of weeks it should take to build them back up with a return to play throwing program.
  - Example: Player was down from throwing for 4 weeks, it will take a 4 week return to play throwing program
- Build in 15 feet increments starting at 60 feet. Fastball only until reach the mound.
- For professional baseball players, minimum of 150 feet and max of 180 feet (also depends on position, catcher 130, outfielder 200 feet) before they throw off of the mound, as mechanics change at 180 feet and beyond
- Pitching coaches can help with throwing programs
- Does NOT include their bullpen work/live BP's which will come after the throwing program…so actually a little longer

Phase IV Goals

- Pain-free completion of their throwing program, including bullpens and live BPs
- Maintaining IR

Section Summary

- When treating internal impingement, there needs to be very specific components added into their rehab program
- Simplest way to treat is to focus on the causes of the condition:
  - Loss of IR
  - Anterior Instability

Section Summary

- Phase I includes decreasing pain/inflammation with rest, anti-inflammatories and modalities and restoring IR with stretching, soft tissue work to the posterior cuff and positioning
- Cross body stretch is preferred to the sleeper stretch and manual stretching is preferred to self stretching
- Make sure that you are constantly checking IR throughout the entire rehab process

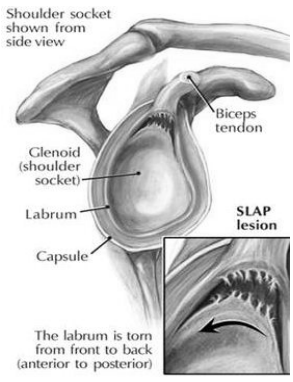
Section Summary

- Phase II centers around baseline strengthening using as many manual stabilization techniques as you can, working them into the thrower's 10, tubing program and adding core/glute work when possible as well, as well as the addition of CKC exercises
- Phase III centers around functional strengthening, continuing stabilization work now in throwing positions, especially max ER, PNF patterns and adding in eccentric and plyometric work
- Phase IV includes a gradual return to throwing program

SLAP Lesions

SLAP Lesions

- If left untreated, internal impingement can gradually lead to tears of the labrum
- SLAP Lesion: Superior Lesion Anterior to Posterior
- Also a direct factor of retroversion of the humerus
  - Tight Posterior Structures (posterior capsule/posterior cuff)
  - Anterior Instability



Mechanism of Injury of SLAP Lesion[2]

- Traumatic: Usually occurs when the athlete falls on an outstretched arm and the impact forces the head of the humerus in an anterior to posterior direction
- Atraumatic: Occurs over time as a result of microtrauma to the tissue

Atraumatic Labral Tears

- Factor 1: Tight Posterior Structures
- During the late cocking/early acceleration phase, the posterior cuff has to elongate to eccentrically control the motion of the arm as it comes forward
- Problem: If these structures are in an overly shortened position and cannot elongate to control the motion, compensation has to occur
- This compensation comes from the bicep now having to eccentrically contract to assist in controlling the deceleration of the arm
- Remember: Bicep anchor attaches to the superior labrum!

Theories and studies

- In a study by Andrews et al, it was shown that eccentric loading of the bicep during the deceleration phase of throwing resulted in the labrum physically being lifted off of the glenoid[2]
- In another study by Burkhart et al, it was noticed that in an ABD and max ER position, there is a rotational twist that occurs, transmitting a torsional force on the bicep anchor[20]
- Known as the "Peel Back Mechanism"
- Remember from earlier, any disruption of the bicep anchor results in compromised anterior stability

Atraumatic Labral Tears

- Factor 2: Anterior Instability
- In a study by Reinold et al, it was shown that excessive movement of the humeral head on the glenoid during the throwing motion results in microtrauma to the labrum, resulting in anterior instability[21]
- Remember that the roll of humerus is in the anterior directions in the ER position, so it just repetitively bumps into the anterior labrum
- Couple that with the "Peel Back Mechanism" and the twisting and disruption of the bicep anchor leading to more anterior instability ON TOP OF the anterior instability described by Rienold

Recipe for Disaster…

- It is the combination of these factors:
  - High eccentric loads on the shoulder that lift the labrum off the glenoid
  - Peel Back Mechanism causing a twisting and disruption of the bicep anchor
  - Repetitive activity in the ABD/Max ER Position
  - Retroversion of the humerus
- That results in the high prevalence of SLAP tears in pitchers[2]

Prevalence of SLAP Tears in Baseball

- Study by Andrews et al showed that 83% of pitchers had a SLAP tear in their throwing shoulder when evaluated arthroscopically[22]
- Study by Reinold et al showed that 91% of pitchers undergoing special clinical tests for GH instability had a positive exam for labral pathology[23]
- Basically ALL overhead athletes have some sort of labral pathology if we do imaging or clinical testing on the shoulder
- So if everyone has a SLAP tear, when does it become a problem?
  - When it becomes symptomatic!
  - Which is why it is CRITICAL to do daily screens for IR/ROM and have a good shoulder stability program for these athletes as a form of prevention to hopefully stop them from becoming symptomatic

You Get a SLAP Tear…

Signs and Symptoms of Labral Tears

- Difficult to differentiate SLAP tears because they have very similar findings to RTC pathology
- Remember, SLAP lesions are basically a worsened condition of internal impingement
- Study by Andrews et al showed that 73% of pitchers with labral pathology also had a RTC tear along with it[2]

Signs and Symptoms of Labral Tears[2]

- Mechanical Pain (Pain with overhead activity but not at rest)
- Described as a deep ache in the anterior shoulder (differentiate from bicep tendonitis, which his more superficial)
- Painful clicking or catching deep in the shoulder (differentiate from subluxing bicep tendon which is superficial)
- Loss of velocity and accuracy when pitching

Exam

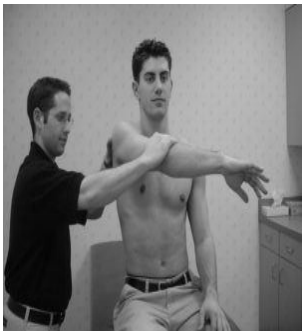
- I. ROM
  - Loss of IR
  - TROM greater than 5 degrees compared to non-throwing side
- II: Joint Mobility
  - Increased anterior laxity with A-P glide
  - (+) Apprehension test, especially in the max ER position
- Strength
  - Weak and painful MMT for RTC; weak with MMT scapular stabilizers
  - Weakness and/or pain with functional testing (stab in 90 degrees, PNF patterns)
- Looks exactly the same as the exam for internal impingement
- Special tests for the labrum may help differentiate

Special Tests for the Labrum

- O'Brien's (Active Compression Test)
- Bicep Load II Test

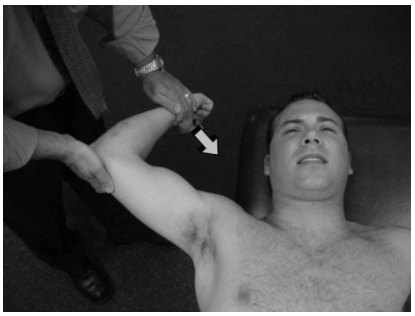
O'Brien's (Active Compression Test)[2]

- Shoulder is placed at 90 degrees of flexion and 30 degrees of horizontal ADD across the midline
- Resistance is applied using an isometric hold with both full shoulder IR followed by full shoulder ER
- Positive: Pain is reproduced in the IR position and typically relieved in the ER position
- 100% sensitive; 95% specific for labral pathology



Bicep Load II Test[2]

- Shoulder is placed in 120 degrees of ABD and max ER with the forearm SUPINATED
- Patient performs a bicep contraction against resistance
- Mimics the "Peel off Mechanism"
- Positive: Deep pain within the shoulder



Imaging[2]

- MRI-Arthrogram is 90% accurate in diagnosing SLAP Lesions
- Imaging can also help determine the prognosis with rehab based on the type of tear present
- 4 classifications of SLAP Tears

Types of Labral Tears[2]

- Type I: Isolated fraying of the superior labrum with firm attachment of the labrum to the glenoid
- Type II: Detachment of the superior labrum and the origin tendon tendon of the bicep-longhead from the glenoid resulting in instability of the bicep anchor
- Type III: Bucket-handle tear of the labrum with intact bicep insertion
- Type IV: Bucket-handle tear of the labrum that extends into the bicep and results in instability of the bicep anchor

Prognosis[2]

- Depends on the severity of the labral tear
- Type I can usually be treated with conservative rehab
- Type II: Results vary
- Type III and IV: Usually are the result of traumatic event and require surgery

Conservative Rehab

- Follow the same principles as internal impingement
- Focus on treating the causes of the condition:
  - Restore IR
  - Treat anterior instability
- Follow the same four phases as internal impingement as well:
  - Decrease pain/inflammation and restore IR
  - Baseline RTC/scap strengthening and begin stabilization in non-throwing position
  - Functional strengthening including stab in throwing, PNF, plyos and eccentrics
  - Return to play throwing program

Conservative Rehab Success Rates[24]

- In a study by Fedoriw, 68 professional baseball players (45 pitchers, 23 position players) were identified with SLAP lesions confirmed under MRI and underwent conservative rehab
- 21/45 pitchers (40%) returned to play with 10/45 (22%) returning to their previous performance level
- 10/23 position players (39%) returned to play with 6/23 (26%) returning to their previous performance level
- Study determined that return to play with conservative rehab had reasonable success rates

Surgical Repair

- Performed when conservative treatment has not improved the player's condition and they are unable to continue to pitch
- Performed with more severe labral tears and/or traumatic event

Section Summary

- If left untreated, often times internal impingement can progress to where tearing of the labrum can occur
- Labral tears can also be directly attributed to the changes that result from humeral retroversion
- When the posterior cuff is overly shortened and cannot eccentrically control the motion of the shoulder during the deceleration/follow through phase of throwing, compensation from the bicep occurs

Section Summary

- This eccentric contraction of the bicep physically lifts the labrum off of the glenoid, resulting in microtrauma to the labral
- In addition, there is a twisting of the bicep tendon that occurs in the ABD/max ER position known as the Peel Off mechanism that over time with repetitive throwing can disrupt the bicep anchor and results in greater anterior instability
- This resulting anterior instability, coupled with the already present anterior instability seen by retroversion of the humerus, causes the humeral head to move more on the glenoid, also resulting in microtrauma to the labrum in the process

Section Summary

- Labral tears are prevalent in the overhead population, in particularly baseball as it has been shown that up to 80-90% of all baseball players have some type of labral lesion (fraying to a bucket-handle tear)
- Most are asymptomatic, but it is critical to monitor these athlete's IR ROM on a daily basis and make sure that they are on a good shoulder stability program to help prevent them from becoming symptomatic

Section Summary

- Signs/Symptoms of labral tears include mechanical pain, deep ache within the shoulder joint, popping or clicking deep within the joint and loss of velocity/accuracy when throwing or inability to throw at all
- Exam should include ROM measurements, joint mobility, strength testing, functional strength testing and clinical special tests for labral tears
- Labral tears present very similarly to RTC tears (most have a co-morbidity of RTC tears in addition to labral tears anyways) so differential diagnosis can be difficult, however both O'Brien's Test and the Bicep Load II test can help rule in the presence of a labral tear
- Conservative management is very similar to internal impingement, as goals include restoring IR and controlling anterior instability.
- If conservative rehab is unsuccessful in returning the athlete to play, surgery may be warranted

Surgical Management of SLAP Tears of the Shoulder

Surgical Repair of the Labrum[2]

- Surgical repair of the labrum is usually based on the type of labral tear is present
- Type I tears or labral fraying, is often time just debrided back to a stable labral rim with no repair necessary
- Type III tears (bucket handle tears) are often just excised, similar to the meniscus in the knee
- Type II and Type IV unstable tears that require repair using surgical anchors
- May also have to debride the RTC or bicep tendon or even perform a bicep tenodesis (Type IV) in addition to the labral debridement or repair

Case Study for this Presentation

- Rehab protocol for shoulder labral repairs will vary based on:
  - Debridement vs Repair
  - Number of anchors used in the repair (Typically 2-3 but have seen as many as 12)
  - Any additional procedures (RTC or bicep debridement or bicep tenodesis)
- For this case study, we are going to simplify things and just focus on the rehab of a pitcher who underwent a Type II SLAP repair with two surgical anchors used with no additional procedures (RTC or bicep debridement or bicep tenodesis)
- In these cases, you want to contact the surgeon for any contraindications and timelines
- Always want to use the most conservative protocol if two procedures are done:
  - Ex: Labral Repair with a bicep tenodesis, may have to go slower to protect the bicep

Rehab Phases of a Labral Repair

- Still want to follow the Four Phases of Rehab guidelines with these patients
- Phase I: Decrease pain/inflammation and restore ROM
- Phase II: Baseline Strengthening
- Phase III: Functional Strengthening
- Phase V: Return to Play Program

Phase I Rehab: Week 0-1

- Usually during the first week post-op after labral repair surgery, the surgeon's preference is to keep the shoulder quiet to allow for the inflammation to subside a bit
- Player will remain in their sling at all times except for when they come into the training room/clinic for rehab
- At this point, we are simply monitoring the incisions for signs of infection, performing passive ROM of the elbow/wrist/hand and using cryotherapy (Game Ready so not to get the incisions wet) to help control inflammation and pain
- No shoulder ROM, lower body strength/conditioning or core work at this time
- May start them on scapular retraction depending on how they feel

Phase I Rehab: Week 1-3

- After one week, the patient will remain in the sling at all times still with the exception of during physical therapy
- Can begin PASSIVE shoulder ROM with them at this time to their protocol limitations set by the surgeon:
  - Flexion is usually 0-90 degrees
  - ER is usually 0-30 degrees (check with surgeon, will change depending on severity)
- Can now begin some active scapular retractions exercises and very light isometric/stabilization exercises (supine with arm in neutral and elbow bent at 90 degrees)
- Still no lower body strengthening or conditioning at this time

Why these ROM Limitations?

- Not picked at random?
- Flexion 0-90 degrees: Avoid engaging the bicep past 90 degrees so as not to pull on the bicep anchor which attaches to a healing, inflamed labrum
- ER 0-30 degrees: Limit anterior roll of the humerus to avoid contact with the healing, inflamed labrum
- Speaking of the bicep…

Tricks of the Trade!

- During this phase, the player will often complain of anterior shoulder pain along the bicep
- Although normal at this time due to muscle guarding of the bicep, if the bicep is tensioned and pulling on the bicep anchor/labrum, it could be counterintuitive and keep the tissue inflamed.
- Good time to perform a distal bicep release using soft tissue techniques
  - Makes the patient way more comfortable
  - Takes tension off of the bicep and gives it a better chance to heal

Phase I: Weeks 3-6

- Player can now discontinue the sling with MD permission (may need to wear it longer for larger repairs, etc)
- Continue with unrestricted PROM progressing to AAROM and finally to AROM for all shoulder motions
- Begin using the UBE and continue with scapular retraction and light RTC isometrics/stabilization exercises at this time
- Can now begin riding the stationary bike and begin lower body (body weight only) exercises at this time

Tricks of the Trade!

- Gaining full ROM is essential for these athletes, so they need to get back to their max ER (beyond 90) so it's a good idea to take a pre-surgery measurement to know your goal if possible
- Absolutely critical to restore IR at this time!
- Trick of the Trade for ROM:
  - Never want to "crank" on them with aggressive stretching
  - Use combination of manual stretching, joint mobilization and soft tissue release
- Soft tissue ART/MRT works great during this phase to help regain motion and restore flexibility to guarded muscles
- Focus on:
  - Flexion: Teres Major and Latissimus Dorsi, Tricep, Distal Bicep
  - ER: Subscap, Teres Major and Pectoralis Major/Minor
  - IR: Infraspinatus, Teres Minor, Supraspinatus

Tricks of the Trade!

- This is also a great time to get an early start on glute strengthening since they cannot do much with the upper extremity at this time
- Remember:
- There is a relationship between the activation of the glute medius and the scapular muscles, which plays a big role in overhead athletes
- These athletes are in single stance while pitching, so glute med control is vital to help their performance
- Examples: Clam Shells, glute bridges, side-lying ABD, lateral band walk, single leg stance (if you trust them not to fall on an outstretched arm!)
- "I Like Big Butts and I Cannot Lie" –Sir Mix-A-Lot

Phase I Goals

- Pain-free at rest and with daily activities
- Minimal joint swelling
- Full active ROM

Phase II: Week 6-10

- Once full active ROM is achieved, can begin baseline strengthening
- Progress from isometric shoulder exercises to isotonic strengthening exercises
- Begin their thrower's 10 dumbbell exercises and tubing exercises
- Progress their stabilization exercises: Supine punch, side-lying ER
- Avoid the throwing position at this time
- Avoid forceful contraction of the bicep as well (don't want to pull on repair)
- Can now progress to full cardio (elliptical/running), lower body (weight vest)

Tricks of the Trades!

- Make sure that you continue to monitor and treat if necessary the player's IR. As you add more stress to the tissue with added strengthening, the tissues will have the tendency to tighten up as they gain tone, so keep a close eye on IR so you don't get to their throwing program and their tight and back in the same boat as before surgery
- Make sure you add a stabilization component when possible to their thrower's 10 and tubing programs because they need stability above and beyond what they had prior to surgery to help them succeed
- Also remember to add a glute/core component when possible to their thrower's 10 and tubing programs to keep "looking down the road" for these highly skilled athletes
- Also a good time to add a forearm strengthening program (no bicep) because it's critical for these athletes to have excellent forearm strength to protect their UCL once they return to throwing as well (again "looking down the road")

Phase II Exercise Menu

RTC/Scap Strengthening

- Thrower's 10 dumbbell Program
- Tubing: Squat to Row
- Tubing: Single arm row with SLS
- Tubing: ER at 30 degrees
- Tubing: ER with lateral band walk
- Wall push ups
- Scap clocks
- Serratus wall slides
- Scapular PNF Patterns

Stabilization Exercises

- Thrower's 10 with manual stab
- Tubing: ER at 30 degrees with manual stab
- Body blade: At side/ 90 flexion
- Supine punch with stab
- Side-lying ER with stab
- Wall circles with stab

Phase II Goals:

- Pain-free with daily activities and with exercises
- Maintaining IR
- 5/5 strength with MMT for RTC/scapular muscles
- Able to hold supine punch with manual stabilization for 30 seconds

Phase III: 10 Weeks-4 Months

- Begin functional strengthening
- Progress to eccentric and plyometric exercises
- Advance player's strengthening into the throwing position
- Continue with full cardio, full lower body (can begin holding weights) and begin upper body lift (more cautious with bicep)

Tricks of the Trade

- Continue to monitor IR as you add eccentric and plyometric components and treat as needed with soft tissue
- Make sure that you are working the player's stability in the max ER position
- It IS a more dangerous, extreme position to work the player in, but it is also where he will be most vulnerable when throwing, so it is this position that he will actually require the most strength in!
- Start with two-handed plyos and progress to one arm
- Continue to work stability exercises, glute exercises and forearm whenever possible (ie med ball tosses in SLS/foam, med ball tosses with lateral band walk, ball drops on exercise ball)

Phase III Exercise Menu

Stabilization Exercises

- Manual stabilization in multiple angle throwing positions, emphasizing max ER
- Body blade in throwing position

Eccentric and Plyometric Exercises

- D2/D1 PNF Patterns
- Eccentric side-lying ER
- Eccentric I/T/Y Rows-prone
- Two handed med ball toss
- Wall dribbles
- Ball drops: Side-lying ER
- Ball drops: T/Y/W prone
- Rebounder ball tosses: ER-side
- Rebounder ball tosses: "90-90"
- Deceleration ball tosses

Phase III Goals

- Pain-free with all daily activity and with all exercises
- Maintaining IR

- Good form, strength and endurance with D2 PNF pattern (24 reps)
- Able to hold in the max ER position vs manual stabilization (30 sec)

Phase IV: 4 Months-8-9 Months

- Begin gradual return to play throwing program

- Unrestricted in the weight room

Tricks of the Trade

- Pre-Throwing Towel Drills?
- Why Not:
- Towel weight less than a 5 oz baseball, so the player's arm will actually move through the motion faster than if he was holding a baseball which = MORE STRESS on the shoulder
- Player usually feels like they have to hear the "whip sound" so they "overthrow" so they can hear it, which again, they move faster through the throwing motion which = MORE STRESS on the shoulder
- Towel is held loosely in their hand. Problem: Does not engage their forearm flexors which are critical in dissipating force from the elbow, specifically the UCL, during throwing. Makes them more susceptible to UCL injury!!

Tricks of the Trade

- Solution: Sock Drills
- Can have the player hold a baseball and then wrap a sock over their hand.
- They can now throw and release the ball into the sock, so the ball doesn't go anywhere
- Because they are holding a baseball, the speed of the arm remains the same as throwing, they aren't listening for the "whip" and reduces the chances of them overthrowing and it engages their forearm flexors, so it reduces the risk on the UCL as well

Weighted Ball Debate

- Growing trend of throwing weighted baseballs to increase strength and increase velocity
- Drive Line heavily promoting this
- Study by Fleisig et al determined that weighted baseballs between 6 oz and 1 lb actually slow the arm's motion down when being thrown, thus reducing stress on the shoulder and elbow[3]
- Still needs to be more research done, but likely will see more of this in the future

Throwing Program Guidelines

- Player will initially begin their throwing program throwing 3x per week with a day off in between to allow for recovery
- Example Program: Throw on M/W/F with day off in between (two for the weekend)
- Pitch Type: Fastball only
- Volume: 25 throws at that distance (doesn't include warm-ups)
- Distance: Start at 60 feet and progress 15 feet per week as long as the player is pain-free, has good strength on their throws and maintains good mechanics (rely on pitching coach)
- Intensity: On a line but with a little bit of air under it

Intensity

- Hard for players to gage percentages of intensity
- If you say 50% intensity, they're likely to throw 75%
- Radar Guns?
- Problem: Intensity is too subjective and really cant be measured on the gun
- Example: Player who throws 100 mph is asked to throw at 50% intensity
- Is 50 mph really 50% of their effort level?
- Intensity will take care of itself as the player moves back in distance, they are gradually going to have to throw harder, so it's really a built in effort level program

Pitch Type

- Get the question a lot about why not have them start out throwing change-ups because studies have shown that change-ups are less stressful on the shoulder
- Answer to that: The shoulder will gain strength based on the demands placed on it. In order to strengthen the shoulder, you are going to have to stress it while throwing, otherwise you're just babying it—might feel good and be asymptomatic with change-ups but also is not preparing the shoulder for it's true function of high intensity throwing

Volume

- Many throwing programs incorporate multiple sets of throwing (ie 2 sets of 25 throws, 3 sets of 25 throws)
- Good idea as a way to build up volume/strength/endurance
- Problem:
- Not functional (no throwing program for regular healthy players during workouts have breaks in throwing program).
- Get tight during their rest time (will build up rest time later on with up/down bullpens, but early on is not the time
- Get more sore and have more setbacks (remember, 3 sets of 25 throws is a lot…now add in the warm up throws to get out to that distance 3 times!)
- As their throwing distance increases through the program, the number of throws will naturally increase, so it's again a built in feature

Volume Continued…

- Another note, many programs also put numbers on warm up throws
- Example: For a player throwing out to max distance 90 feet for day
  - 5 throws at 60 feet
  - 10 throws at 75 feet
  - 25 throws at 90 feet
- Problem: Some guys take longer to warm up than others. Don't want to cap a guy and move him back if he's not properly warmed up and ready. Let them warm up at their own pace

Intensity, Pitch Type and Volume Opinions

- My personal observations after working with various throwing programs in the past 11 years; not fool-proof by any means and is a constantly changing work in progress from input from players, pitching coaches, ATCs and
- Some guys still progress just fine with multiple sets and volume, so I'm not saying don't use them
- Always best to work with your surgeon and if there is a protocol that he likes, stick to it
- But, if you have to make up your own, those are just a few things to consider

Throwing Program Template Post-SLAP Repair

- Week 1: 60 feet
- Week 2: 75 feet
- Week 3: 90 feet
- Week 4: 105 feet
- Week 5: 120 feet
- After the 120 feet phase at week 5, the player can now begin to throw 5x week with light easy catch (max 90 feet) on Tues/Thurs.
- Can also begin doing flat ground (10 throws) tacked on to their long throwing days
- Week 6: 135 feet
- Week 7: 150 feet

Mound Progression

- Once they complete the throwing program out to 150 feet, they can now progress to the mound
- Adding the flat ground drills in during the final two weeks helps prepare the player for the increased angle of the slope of the mound
- Still only fastball off of the mound, but the player can now begin to throw change-ups during normal catch
- Usually star the first week with the catcher up
- Give the pitcher two days in between pens (still play catch on the days in between or complete rest if needed) to help minimize fatigue and make their pens have a purpose

Mound Progression Template

- Bullpens will be on Tuesdays and Fridays
- Week 1: 20 pitches (Catcher up)
- Week 2: 25 pitches (Catcher down)
- Week 3: 30 pitches (Catcher down)
- Week 4: 35 pitches (Catcher down)

Mound Progression

- After the first month of FB only bullpens, can now start to add in change-ups during the next phase
- Begin Up/Down bullpens (break in between to simulate time on the bench between innings)
- Pitcher can now begin playing catch with his breaking ball (curveball, slider, etc) and will throw that for two weeks during catch before he throws it off of the mound
- Still give the pitcher two days rest in between pens

Up/Down Mound Progression Template

- Week 1: 15/15 (30 total)- FB and CH
- Week 2: 15/20 (35 total)- FB and CH
- Week 3: 20/20 (40 total) – All pitches (FB/CH/BB)
- Week 4: 20/20 (40 total)- All pitches (FB/CH/BB)

Live BP

- Once the pitcher has completed the Up/Down phase of the mound progression, begin to add live BP (live batting practice, facing live hitters)
- This should be on a 5 day rotation with a touch-feel (light) bullpen of 20 pitches in between
- Start with a 25 pitch live BP (maybe just fastball on the first one, consult with pitching coach) and add both up/down and 15 pitches with each live BP

Live BP Template

- Day 1: Live BP (25 pitches)
- Day 2: Easy Catch
- Day 3: Touch/Feel Bullpen (20 pitches)
- Day 4: Easy Catch
- Day 5: Long-Toss or Easy Catch (player preference)
- Day 6: Live BP; 2 innings (40 pitches split 20/20)

Return to Play

- After this phase, the pitcher may return to play

Return to Play Rates Post-SLAP Repair[24]

- In a study by Fedoriw et al (2014), 68 professional baseball players (45 pitchers and 23 position players) were identified with SLAP lesions (Type II) confirmed under MRI imaging and all attempted conservative rehab
- 27 pitchers and 13 position players failed to return to play following conservative rehab and underwent surgical treatment
- 13/27 pitchers (48%) returned to play but only 2/27 pitchers (7%) returned to their previous performance level
- 11/13 position players (85%) returned to play with 7/13 (54%) returning to their previous performance level
- Authors concluded that the return after surgical repair was low for pitchers but higher for position players

Return to Play Rates After SLAP Repair[25]

- In a systematic review of the literature by Sciascia et al (2015), the researchers investigated the odds of overhead athletes returning to preparticipation levels after labral repair surgery
- In the end, 9 studies were included with 5 of the articles having baseball demographics
- Just looking at the articles involving baseball players, success rates varied from 84% (Morgan et al, 1998) to 38% (Park et al, 2003) with the other three studies in the 60-70% ranges
- Interesting outcome with this review was that overhead athletes who underwent isolated SLAP repair surgery were 28x more likely to return to their previous performance levels that those who underwent concurrent SLAP repair and soft tissue debridement

Return to Play Rates After SLAP Repair[26]

- In a study by Gilliam et al (2017), 133 baseball players (ranging from high school, college to professional levels) were identified with a SLAP lesion (Type II) under MRI and underwent SLAP repair surgery
- Of the 133 participants, 95 were pitcher and 38 were position players with a mean follow-up of 78 months (long term follow up)
- Overall, 85/133 (64%) returned to play at the same level or higher regardless of position
- 56/95 pitchers (59%) returned to play at the same level or higher
- 29/38 position players (76%) returned to play at the same level or higher

Overall

- Most studies show about a 50-70% success rate of return to play/previous performance level for baseball players following SLAP repair surgery
- Position players tend to have higher success rates than pitchers

Section Summary

- Surgical intervention for the labrum can range from a debridement of the tissue itself to placing surgical anchors into the labrum to re-attach it to the glenoid
- Depending on the type of surgery, number of anchors if used and if any other procedure was performed in addition to the labral surgery, the time frame and how quickly you can progress the patient will vary and you will want to communicate timeframes/contraindications with the surgeon
- Regardless of the severity of the procedure, you still will follow the four phases of rehab, just being mindful of timeframes

Section Summary

- During Phase I, your goal is to decrease pain/inflammation and progress the ROM per surgeon's protocol until full motion is achieved using ROM, stretching, joint mobilization, soft tissue etc
- Critical during this phase to restore normal TROM (ER and IR)
- Once full motion is achieved, you can progress the patient to Phase II, which is baseline RTC/scapular strengthening and light stabilization exercises
- Try to incorporate as much manual stabilization as possible, as well as incorporating core, glute and forearm exercises as a way of "looking forward" to what these athletes will require later on

Section Summary

- Once full strength (5/5) with manual muscle testing for the RTC and scap and the patient can hold a supine punch vs manual stabilization for 30 seconds, can progress the patient to Phase III
- Phase III focuses on functional strengthening, which means adding in functional PNF patterns, continuing with stabilization now in the throwing position (especially max ER) and adding eccentric and plyometric work
- Once the patient can perform 25 reps of D2 PNF pattern, hold vs manual resistance in the max ER throwing position for 30 seconds and is pain-free with all of his plyometric/eccentric work, he can move to phase IV

Section Summary

- Phase IV begins with a interval and progressive throwing program, starting with flat ground throwing and progressing to the mound and live BP prior to returning to game action
- Success rates for return to play post-SLAP repair are between 50-70%

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