Clinical Evaluation of Impingement in the Overhead Athlete

How to navigate the examination and what works?

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Objectives

• Discuss various types of impingements mentioned in the literature

• Navigate common examination findings

• Identify risk factors associated with posterior internal impingement

• Discuss management strategies for internal impingement
Impingement Syndrome

• One of the most frequently described shoulder conditions in sports medicine and general practice.

• Irritation of the rotator cuff anatomy somewhere in the shoulder girdle complex?
  • Subacromial space
  • Postero-superior glenoid rim
  • Suprascapular notch
Impingement Syndrome

• Early literature considered this a pathology, or a diagnosis
  - Now considered a “cluster” of s/s
  - Not considered a true pathology
• Commonly used alongside terms such as “rotator cuff tendinopathy.”
• Recommendations to avoid the use of the term “subacromial impingement syndrome.”
Training Education (CAATE). The current minimum entry point into the profession of athletic training is the baccalaureate level, however it was recently decided by the AT Strategic Alliance that the minimum professional degree level will be a master’s, a change to be implemented within the next several years. More than 70 percent of athletic trainers hold at least a master's degree. Upon completion of a CAATE-accredited athletic training education program, students become eligible for national certification by successfully completing the Board of Certification, Inc. (BOC) examination.

Professional Education

Professional training education uses a competency-based approach in both the classroom and clinical settings. Using a medical-based education model, athletic training students are educated to provide comprehensive patient care in five domains of clinical practice: prevention; clinical evaluation and diagnosis; immediate and emergency care; treatment and rehabilitation; and organization and professional health and well-being. The educational requirements for CAATE-accredited athletic training education programs include acquisition of knowledge, skills and clinical abilities along with a broad scope of foundational behaviors of professional practice. Students complete an extensive clinical learning requirement that is embodied in the clinical integration proficiencies (professional, practice oriented outcomes) as identified in the Athletic Training Education Competencies (PDF).

Students must receive formal instruction in the following specific subject matter areas identified in the Competencies:

- Evidence-based practice
- Prevention and health promotion
- Clinical examination and diagnosis
- Acute care of injury and illness
- Therapeutic interventions
- Psychosocial strategies and referral
- Health care administration
- Professional development and responsibility

Continuing Education

PER THE BOARD OF CERTIFICATION

Continuing education requirements are intended to promote continued competence, development of current knowledge and skills and enhancement of professional skills and judgement. These activities must focus on increasing knowledge, skills and abilities related to the practice of athletic training.

As information continually changes, it is important for professionals to learn the latest about athletic training. Continuing education requirements are meant to ensure ATs continue to:
(7) “Practice of physical therapy” means:

(A) Examining and evaluating patients with mechanical, physiological, and developmental impairments, functional limitations, and disability or other health-related conditions in order to determine a physical therapy diagnosis, prognosis, and planned therapeutic intervention;

(B)(i) Alleviating impairments and functional limitations by designing, implementing, and modifying therapeutic interventions that include:

(a) Therapeutic exercise;

(b) Functional training in self-care as it relates to patient mobility and community access;

(c) Manual therapy techniques, including soft tissue massage, manual traction, connective tissue massage, therapeutic massage, and mobilization, i.e., passive movement accomplished within normal range of motion of the joint, but excluding spinal manipulation and adjustment;

(d) Assistive and adaptive devices and equipment as they relate to patient mobility and community access;
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• Recommendations to avoid the use of the term “subacromial impingement syndrome.”
Types of Impingement

- **Primary vs secondary Impingement**
- **External vs internal Impingement**
Types of Impingement

- **Primary Impingement**
  - Intrinsic degenerative narrowing of the subacromial space
  - Ie: AC arthropathy, osteophytes, subacromial swelling
  - Pts typically > 40 y/o
  - Limited IR ROM (< 50°) compared to non-involved side
  - General picture is one of hypomobility
Types of Impingement

- **Secondary Impingement**
- Result of previous underlying pathology that leads to impingement syndrome
- No structural obstruction, rather a functional problem
- Ie: scapular dyskinesia, GH instability, rotator cuff weakness, GIRD
- Both older & younger athletes, but usually < 35 y/o
- Limited IR, excessive ER, antero-superior HH migration
Types of Impingement

• External Impingement

• Impingement commonly known as “subacromial impingement”

• Encroachment of suprakinematic structures against subacromial roof (bursa, RTC tendons, LHB)

• Clinical Prediction Rule
  • (+) Hawkins – Kennedy test
  • (+) painful arc
  • (+) shoulder ER pain / weakness
Types of Impingement

• Internal Impingement
  • “Pathologic contact between the glenoid and the side of the rotator cuff that faces the articular surfaces of the shoulder.”

• Newest of impingement concept
  • 1991 paper by Walch et al.

• Posterior shoulder pain in overhead athletes
Internal Impingement
Internal Impingement
Internal Impingement
Internal Impingement
Examination of Internal Impingement

- **Subjective**
  - MOI -> Chronic / micro-traumatic / cumulative overload
- Insidious onset of *posterior* shoulder pain
- Increasing pain as season progresses
  - Intensity increases each successive year
- Pain is dull, aching, and poorly localized
- Denies numbness, pallor, or paresthesia in the arm
- Sense of “slipping” of the shoulder
Examination of Internal Impingement

• **Differential Diagnosis**
  • What can also cause posterior shoulder pain in overhead athletes that is *NOT* posterior internal impingement?

  • Cervical radiculopathy
  • Upper trap active trigger points
  • Multi-directional Instability
  • Systemic sources of shoulder pain
  • *Suprascapular nerve entrapment*
Suprascapular nerve entrapment

- Often mistaken as a RTC pathology or cervical radiculopathy
- Two sites of compression
  - Transverse scapular ligament
  - Spinoglenoid notch
- Pain is “more localized 4 cm MEDIAL to posterolateral corner of acromion”
- Pain with palpation at the spinoglenoid notch
Suprascapular nerve entrapment

- Can occur from an acute trauma
  - Forced external rotation of UE
  - Stretch on suprascapular nerve
- Complaints of micro-instability
- ROM does not often decrease
- Description of external rotation weakness
Suprascapular nerve entrapment

- Fossa atrophy
  - can be easily overlooked in well-developed individuals

- In chronic situations, teres minor and serratus anterior can compensate for infrapsinatus weakness to obtain near normal strength!

- Lidocaine anesthetic injections can help with diagnosis
Examination of Internal Impingement

• **Objective**

• Palpation / inspection

  (+) Infraspinatus fossa

  (+) Superior scapular angle

• **Range of Motion**

  • Typically full ROM

  • Dominant UE

  • 10° - 15° more ER @ 90/90

  • 10° - 15° less IR @ 90/90

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**Intraoperative Impingement**

- **Clinical Commentary**

  - In the setting of a subacromial decompression and reverse total shoulder arthroplasty, the surgeon must be mindful of the potential for intraoperative impingement. The presence of internal impingement can be identified by palpation of the infraspinatus fossa and superior scapular angle, as well as range of motion assessment. Full ROM is typically present, with dominant UE exhibiting 10° - 15° more ER and 10° - 15° less IR compared to the non-dominant side. The infraspinatus fossa is examined for tenderness and swelling, while the superior scapular angle is palpated for any abnormality.

  - **Surgical Interventions**

    - **Subacromial Decompression**
      - Indicated in cases of mild to moderate subacromial impingement, subacromial decompression involves the removal of the subacromial bursa and an anterior acromioplasty. This procedure aims to decrease the size of the acromion process, thereby reducing impingement and relieving pain. Postoperatively, patients are often advised to avoid overhead activities and use of the involved extremity for a period of 6-8 weeks. Rehabilitation begins with passive range of motion and progresses to active-assisted and then active-only exercises.

    - **Reverse Total Shoulder Arthroplasty**
      - Utilized for patients with end-stage rotator cuff disease, reverse total shoulder arthroplasty involves the insertion of a total shoulder prosthesis that allows for glenohumeral motion. This procedure is particularly useful in cases of complex rotator cuff injuries, where a standard total shoulder arthroplasty may not provide adequate stability. Postoperatively, patients are advised to avoid overhead activities for a period of 6-12 months, with gradual return to full activity guided by clinical and radiographic assessment.
Examination of Internal Impingement

• Objective

• Muscle Testing
  • Scapular retractor weakness
  • Rhomboids
  • Upward rotation force coupling
  • Test @ 90/90
  • Scapula must move towards retraction with throwing
    • Avoids impingement of shoulder

• Neurological screen: WNL
  • (-) ULTT median nerve
Examination of Internal Impingement

• **Objective**

• **Joint Play**
  - 1+ to 2+ anterior laxity
  - 2+ posterior laxity
  - Inferior laxity noted

• **AMA lig. laxity grading***
  - 1+ = 0-5 mm increased translation
  - 2+ = 6-10 mm
  - 3+ = > 10 mm

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*AMA lig. laxity grading:

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**Figure 1.** Laxity changes in the dominant arm of the throwing shoulder. Illustration shows a lesser tuberosity of the humerus.

**Figure 2.** Shoulder internal rotation deficit as demonstrated by a negative shift in the humeral head on the lesser tuberosity compared to the non-dominant side.
Examination of Internal Impingement

• Wait!
  • Remember….a “cluster” of s/s!!
  • **NOT** 1-2 special tests!

• Special Tests
  • Posterior impingement test
  • AKA “Meister” test
  • **Specificity** = 85%
  • **Sensitivity** = 94% with non-contact MOI
Examination of Internal Impingement

- Posterior impingement test
  - Pt supine
  - UE in scapular plane at 90° ABD
  - Passively rotate into max ER
  - Apply overpressure
  - (+) if reproduces s/s
Examination of Internal Impingement

• **Clinical reasoning algorithm**
  • External impingement
    • (+) Hawkins-Kennedy, empty can, Neer’s (ANT pain), apprehension, with **anterior** reported pain
    • Don’t forget Park et al CPR!
  • Internal impingement
    • (+) Neer’s (POST pain), apprehension, with **posterior** reported pain
    • (-) Hawkins-Kennedy, empty can

• **PLEASE DON’T FORGET THE REST OF THE EXAMINATION BEFORE THIS ALGORITHM!**
Risk Factors Associated with Internal Impingement
Risk Factors

- Pathomechanics
- Acquired Instability Overuse Syndrome (AIOS)
- Internal Rotation Deficit and the Implications
- Scapular Dyskinesia
Risk Factors

• **Pathomechanics**
  • Acquired Instability Overuse Syndrome (AIOS)
  • Internal Rotation Deficit and the Implications
  • Scapular Dyskinesia
Pathomechanics

• Arm Acceleration 7000-7500 degrees/sec
• Distractive forces at release are 1330N and average pitcher BW of 940N
• Max ER Anterior force=340N
  • Fleisig et al American J of Sports Med. 1999
Pathomechanics

- Arm Acceleration 7000-7500 degrees/sec
- Distractive forces at release are 1330N and average pitcher BW of 940N
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Pathomechanics
Etiology of Internal Impingement

Two Primary Causes

1. Excessive HH Translations
   a) Microinstability
   b) Internal Rotation Deficit (GIRD)

2. Abnormal Scapular Patterns
   a) Dyskinesia
   b) Retractor Deficiency (Hyperangulation)
Scapular positioning

Functional Instability

HH Translation

Posterior Internal Impingement

IR Deficit
Risk Factors

- Pathomechanics
- **Acquired Instability Overuse Syndrome (AIOS)**
  - Internal Rotation Deficit and the Implications
  - Scapular Dyskinesia
Microinstability

- Functional Instability or Acquired Instability Overuse Syndrome (AIOS)
  - Anterior capsule must be able to withstand significant tensile strain
  - Stress leads to gradual stretching of collagen
  - Compromise of static stability
  - Most commonly described—anterior instability
- Thrower’s-AIOS
  - ↑ ER=↑ Velo
Risk Factors

• Pathomechanics
• Acquired Instability Overuse Syndrome (AIOS)

• Internal Rotation Deficit and the Implications
• Scapular Dyskinesia
Internal Rotation Deficit

• Factors Impacting IR deficit
  • Osseous Adaptation (retardation of anteversion beginning as young as 8-10yro)
  • Posterior Capsule
    • IGHL laxity ("hammock Function")
    • Increases GH compression (axial load) @90° ABD
  • DeAngelis et al Ortho J of Sports Med 2015 (Cadaveric study)
    • Increases ant force @90° superior translation @100° -PROM study
  • Soft Tissue Adaptation-RC
  • Scapular Ant Tilt
IR Deficit-TROM

- Total Arc (TROM)
  - IR+ER=Total arc of motion
    - IR measured by coracoid stabilization
      - ICC Wilk .81 and Laudner .95
  - Norm 180°
  - GIRD classified by >12°-15° difference
    - Myers et al AJSM 2006. 19.7° Difference with PII
    - >5° difference in TROM 2.5x’s more likely to be injured
IR Deficit

• Reinold et al. Sports Health 2009 noted a 5º decrease in ROM after one throwing session

• Dwelly et al. JAT 2009 monitored over course of 1 season
  • No significant change in IR but increase of 11º ER
  • Suggest that those who develop >11º ER and lose >1-2º IR may be “atypical”

• Pathologic vs “normal” alteration
Risk Factors

• Pathomechanics
• Acquired Instability Overuse Syndrome (AIOS)
• Internal Rotation Deficit and the Implications

• Scapular Dyskinesia
Scapular Dyskinesia

- What is normal for an overhead athlete
  - 2:1?
- How do we evaluate???
- If you can affect it, suspect it
  - SSMP
- Scapula is a link transferring large amounts of E from LE/Trunk to the arm
  - Global effect
Clinical Applications of a Symptoms and Systems based assessment

Apparent Scapula Dyskinesis observed

Potential interventions

Humeral Head Facilitation
Scapula Facilitation
External Rotation (static)
External Rotation (dynamic)
Single leg standing
Tip toe standing
Gym ball sitting

Reduction in symptoms

Incorporate into treatment plan

Figure 1. Potential symptom modification procedures.
Scapular Retraction

- Scapular musculature balance
  - OH athletes -protraction > retraction
  - Non-athletic populations have an = protraction:retraction

- Retraction necessary to avoid hyperangulation

- Axioscapular musculature provides base for ER
  - Rhomboid Major/minor
  - Middle Trapezius
  - Levator Scapulae
  - Serratus Anterior
Hyperangulation
Treatment Selection and Concepts
If humeral head or scapula facilitation makes a significant improvement.

Potential early exercises

If internal rotation in supine results in retraction of the shoulder girdle, the posterior cuff can be facilitated through external rotation in prone with support as necessary. Middle and lower fibres of trapezius and serratus anterior are moderately highly active in this position due to the need to counteract the destabilising forces of increased posterior rotator cuff activity.

Progression

Recruitment of the posterior cuff can be enhanced by facilitation through the kinetic chain. This can be used to improve the range of glenohumeral rotation or increase the complexity of the exercise.

If there is a favourable response to other forms of facilitation, they can be easily incorporated into rehabilitation programmes. Combining elements i.e., posterior cuff facilitation and kinetic chain recruitment can be effective. Isometric contraction of the humeral rotators removes the requirement of the scapular muscles to work in their dynamic stabilising role and can be utilised widely.

Potential early exercises

By gradually removing the support for the upper limb, the scapula and rotator cuff are required to work in both their stabilising and mobilising role increases. Adding load will further increase the demand.

Using grip increases output of the rotator cuff

A hand held dynamometer can give an objective marker for output in varying shoulder positions.
Treatment-AIOS

• Goals:
  • Emphasize Dynamic Stabilization and NM Control
    • Anterior Laxity has been associated with decrease in Proprioception
  • Integrate Local and Global Stabilization
  • Restore Muscular Imbalance
  • Restore Muscular Endurance
  • Institute Plyometric Program
ABSTRACT

Background: Due to the repetitive rotational and distractive forces exerted onto the posterior shoulder during the deceleration phase of the overhead throwing motion, limited glenohumeral (GH) range of motion (ROM) is a common trait found among baseball players, making them prone to a wide variety of shoulder injuries. Although utilization of instrument-assisted soft tissue mobilization (IASTM), such as the Graston® Technique, has proven effective for various injuries and disorders, there is currently no empirical data regarding the effectiveness of this treatment on posterior shoulder tightness.

Purpose: To determine the effectiveness of IASTM in improving acute passive GH horizontal adduction and internal rotation ROM in collegiate baseball players.

Methods: Thirty-five asymptomatic collegiate baseball players were randomly assigned to one of two groups. Seventeen participants received one application of IASTM to the posterior shoulder in between pretest and posttest measurements of passive GH horizontal adduction and internal rotation ROM. The remaining 18 participants did not receive a treatment intervention between tests, serving as the controls. Data were analyzed using separate 2×2 mixed-model analysis of variance, with treatment group as the between-subjects variable and time as the within-subjects variable.

Results: A significant group-by-time interaction was present for GH horizontal adduction ROM with the IASTM group showing greater improvements in ROM (11.1°) compared to the control group (-0.12°) (p<0.001). A significant group-by-time interaction was also present for GH internal rotation ROM with the IASTM group having greater improvements (4.8°) compared to the control group (-0.14°) (p<0.001).

Conclusions: The results of this study indicate that an application of IASTM to the posterior shoulder provides acute improvements in both GH horizontal adduction ROM and internal rotation ROM among baseball players.

Level of Evidence: 2b

Keywords: Manual therapy, rehabilitation, shoulder, throwing athlete

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TREATMENT-IR DEFICIT

• Goals:
  • Tissue Pliability
  • Normal HH Translation

• Methods:
  • Scapular Facilitation
  • IASTM/Cupping
  • Mobilization with Movement
  • Post Capsule Stretching
  • “Sleeper/Modified Sleeper”, Cross Body stretch
Sleeper Stretch—To perform or not?

The Acute Effects of Sleeper Stretches on Shoulder Range of Motion

Kevin G. Laudner, PhD, ATC; Robert C. Sipes, ATC, CSCS; James T. Wilson, ATC, CSCS

The deceleration phase of the throwing motion creates large distraction forces at the shoulder, which may result in posterior shoulder tightness and ensuing alterations in shoulder range of motion (ROM) and may result in an increased risk of shoulder injury. Researchers have hypothesized that various stretching options increase this motion, but few data on the effectiveness of treating such tightness are available.

Objective: To evaluate the acute effects of “sleeper stretch” on shoulder ROM.

Setting: Biomechanics laboratory and 2 separate collegiate baseball facilities.

Patients or Other Participants: Thirty-three National Collegiate Athletic Association Division I baseball players (15 pitchers, 18 position players) volunteered for the study. The players had a mean age of 19.8 years, height of 184.7 cm, mass of 83.4 kg, and 33 physically active male college students (age of 3 sets of 30-second passive sleeper stretches among the dominant shoulder were assessed before and after completion participation (within 5 years) in overhead athletic activities.

Intervention(s): Range-of-motion measurements of the dominant shoulder were assessed before and after completion of 3 sets of 30-second passive sleeper stretches among the baseball players. The ROM measurements in the nonthrower group were taken using identical methods as those in the baseball group, but this group did not perform any stretch or movement between measurements.

Main Outcome Measure(s): Internal and external glenohumeral range of motion (GHRM) and posterior shoulder motion (GHRM horizontal adduction).

Results: In the baseball group, posterior shoulder tightness, internal rotation ROM, and external rotation ROM were significantly increased after the stretches. No other differences were observed in the baseball group, and no differences were noted in the nonthrower group in the range of motion (ROM) of the dominant shoulder.

Conclusions: Based on our results, the sleeper stretches produced a statistically significant acute increase in posterior shoulder flexibility. However, this change in range of motion may not be clinically significant.

Key Words: feasibility, soft tissue, throwing athlete.

Key Points

- Sleeper stretches acutely increased posterior shoulder motion and internal shoulder rotation in the dominant arm of baseball players.
- External shoulder rotation was not different after the stretches.
- The statistically significant acute increases in shoulder range of motion may be clinically insignificant.

Research1–7 have extensively examined alterations in the range of motion (ROM) of the dominant shoulder of throwing athletes, such as decreased internal rotation, increased external rotation, and increased posterior shoulder tightness (limited glenohumeral [GH] horizontal adduction). Such alterations have been linked anatomically to bone2–4 and soft tissue5–8 adaptations that result from the large rotator cuff and shoulder forces acting on the GH joint during the throwing motion.9–11

Bone adaptations among throwing athletes often appear as increased humeral retroversion. This increase has been reported to decrease shoulder internal rotation12–13 and increase external rotation12–13, leaving the total arc of motion (sum of total internal and external rotation) relatively unchanged.12–13 Furthermore, investigators5,9,11 have hypothesized that the deceleration phase of the throwing motion is a major contributor to the development of posterior shoulder soft tissue tightness, resulting in alterations of shoulder ROM similar to those of bony adaptations. As the humerus internally rotates during the follow-through phase of the throwing motion, the posterior inferior capsule may be placed in a primary location to resist the deceleration forces, becoming a direct restraint against these loads. Accumulation of such forces may result in tightness of the posterior capsule and other dynamic restraints (posterior deltoid, infraspinatus, teres minor, and latissimus dorsi), which causes altered ROM.9–11

Because throwing athletes often endure large forces and large numbers of repetitions, such athletes routinely participate in a variety of shoulder stretching exercises before and after a bout of throwing. They use these stretches to attempt to lengthen soft tissue restraints so that they can increase throwing velocity and control and can limit the incidence of injury and muscle soreness. Techniques typically involve both passive and ballistic stretches.

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TRAIN • RECOVER • MOVE

SHOULDER CENTER OF ARKANSAS
Treatment-Scapular Dyskinesia

• System Based Approach
• Understanding deficiency and treat accordingly
• SSMP
• Emphasize Dynamic Stabilization and NM Control
• Integrate Local and Global Stabilization
• Restore Muscular Imbalance
• Restore Muscular Endurance
• Institute Plyometric Program
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