The Athletic Shoulder Through The Lifespan – The Pediatric Years

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- Disclosures
- Objectives
  - Upon completion of this lecture, the attendee will:
    - Review common shoulder pathologies in the pediatric age group
    - Identify unique evaluation techniques to the youth athlete
    - Review clinical rehabilitation techniques based on the unique needs of the pediatric age group
    - Describe current decision making guidelines and outcomes for return to play
- Current State of Youth Athletics
  Statistics
    - High school athletes account for an estimated 2 million injuries, 500,000 doctor visits, and 30,000 hospitalizations each year.
    - More than 3.5 million kids under age 14 receive medical treatment for sports injuries each year.
    - Overuse injuries are responsible for nearly half of all sports injuries to middle and high school students
- Statistics
  - By age 13, 70% of kids drop out of youth sports.
  - The top three reasons:
    - Adults
    - Coaches
    - Parents
- Injury Rates in Throwers
  - 20% of children ages 8 to 12 and 45% of those ages 13 to 14 will have arm pain during a single youth baseball season.
  - 5 fold increase in the number of serious shoulder and elbow injuries among youth baseball and softball players since 2000.
- Common Pediatric Injuries
  - Clavicle Fractures
  - Can be medial as well
Little Leaguer’s Shoulder

- Biceps and SLAP Injuries
  - Associated with GIRD
- Instability
- Scapular Dyskinesis
  - Associated with other injuries
- Proximal Humerus Fractures

- A greater proportion of older children are treated for overuse injuries
  - Younger children more commonly diagnosed with fractures
  - Physeal
  - Apophysitis
  - OCD lesions

**Case Study**

- **History**
  - 9 y.o. RH dominant pitcher
  - Bigger body type
- **Hx of right shoulder pain x 6 weeks**
  - Threw ~100 pitches in 3 innings
  - Had “a really bad inning”
  - 2 days later tried to pitch again
  - Warmed up through soreness
  - Felt pain on second pitch
  - Has rested since

- **Case Study Examination**
  - **Palpation**
    - Tenderness at greater tuberosity, infraspinatus
  - **ROM:**
    - Right 90/90 ER/IR 130/50
    - Left 90/90 ER/IR 110/80
  - **MMT**
    - flexion 4/5, scaption 4/5, abduction 4+/5, IR 5/5, ER 5/5
    - rhomboid 4/5, middle trapezius 4/5, lower trapezius 4/5.
  - **Special Tests**
    - Limited posterior mobility, good inferior mobility

- **Subjective**
  - **Common Questions**
  - **Location of pain**
  - **When did it start**
  - **Aggravating factors**
  - **Improving factors**
  - **Changes in volume**
  - **Recent Growth spurt?**

- **Examination**
  - **Observation**
  - **Scapular positioning**
Repetitive motion  
Dynamic strength testing  
Scapular Assessment  
Strength  
Mobility  
Range of motion  
  - GIRD  
  - Total Arc  

Strength Assessment  
Balance and Coordination  

Treatment  
  - Rest  
  - Control Inflammation  
  - Modify Usage  
  - Treatment  
  - Medicine  
  - +/- Surgery  
  - Rehab  
  - Return to play  

Restore ROM  
Strengthen/Activate  
Rotator Cuff  
Scapular Stabilizers  
Core/Legs  
Functional Movements  
Interval Throwing Program  

Little Leaguer’s Shoulder  
  - Mainly occurs 11-13 years of age  
  - Microtrauma leading to stress fracture at the proximal humeral physis  
  - Physes has difficulty transmitting stress  
  - Bony stress reactions require time to heal  
  - Avg 3-8 months  

Instability  
  - Traumatic or Atraumatic  
  - Recurrence is common  
  - Atraumatic may be multidirectional  
  - Throwers (anterior)  
  - Swimmers  
  - Gymnasts  

Biceps/SLAP  
  - Most commonly seen in elite throwers  
  - MOI  
  - Peel back mechanism
- GIRD
- Coexists with other pathologies
- Recognize the role of scapular mechanics and stabilization

**Rehabilitation Implications**
- Implementing movement patterns that differ from the sport
- Integrative Neuromuscular training must be part of the annual program for children
- Gear towards preparatory conditioning and fun-based activities
- Enhancing movement profiles
  - Adding new patterns that are undercoached
- Accounting for growth spurts during training
- Monitor workloads in and out of season

**Balance and Coordination**
- Anti-rotation and core activities
- Mechanics
  - Landing
  - Jumping
- Unilateral and Bilateral LE situations
- Acceleration, Deceleration, and Reacceleration

**Role of Growth**

**Humeral Retrotorsion**
- Rotational difference between the position of the humeral head and the axis of the elbow
- Healthy adult population, dom arm 3 degrees
- Throwers = Inc GER, Dec GIR
- Bony and soft tissue adaptations
- Hibberd et al accounted for HR and GIR asymmetry remained unchanged across age groups
- Suggests Retrotorsion plays a role

**Age Related Changes of HR**

**Development of Retroversion**
- Does throwing activity affect retrotorsion development?
  - Yes
- Does the effect of HR on shoulder ROM vary with Age?
  - Probably
- Does a “Window of Opportunity Exist” for its development?
  - Unsure
- Is HR protective against injury?
  - More research needed

**Activity Modification**
- ASMI Guidelines
- Pitch Counts
- PEP Program for Throwers?

**Practice/Throwing Modifications**
- Cardiovascular Warm up
• Shoulder mobility exercises
• Practice/Throw
• Cuff Exercises
• Stretching
• Ice

• Risk Prone Activities
  • 13.2% reported pitching competitively > 8 mos/year
  • 5.7% year round
  • 45% pitch in leagues without limits or counts
  • 43.5% pitched at least once on consecutive days
  • 30.4% pitched on teams with overlapping seasons
  • 19% pitched more than one game in a day

• Outcomes
• Return to Sport Testing
• Psychosocial Aspects
• Long Term Development
  • Later Specialization:
  • Elite performance
  • Enhanced physical health
  • Enhanced enjoyment of the sport
  • Children participating in > 16 hrs/wk of sports activity need monitoring

References

• References
• Al Dajah SB. Soft tissue mobilization and PNF improve range of motion and minimize pain levels in shoulder impingement. J Phys Ther Sci. 2014; 26:1803-1805
The Athletic Shoulder Across the Lifespan - Collegiate Athletes
Wes Eberlin, PT, MPT, SCS, CSCS

- DISCLOSURE
  - Nothing to disclose

- OBJECTIVES
  - Identify and review shoulder pathologies common to the collegiate/young adult athlete
  - Present mechanisms and factors involved in injury
  - Outline rehabilitation specifics for various pathologies
  - Examine upper extremity functional testing and return to sport programs
  - Discuss special considerations when working with the collegiate/young athlete

- Shoulder Injuries – Contact Sports
  - Football – Kaplan et al 2005
  - Hockey – Agel et al 2007
  - Rugby – Heady et al 2007

- Shoulder Injuries – Overhead Sports
  - Laudner & Sipes 2009

- Conditions
  - AC Separation
  - Shoulder Dislocation
  - Rotator Cuff Impingement
  - SLAP

- AC Separation
  - 9% of shoulder girdle injuries
  - Men > women (5:1)

  - Mechanism
    - Direct – fall or blow onto lateral aspect of shoulder with arm adducted
    - Indirect (less common) – fall on outstretched hand

- AC Separation
  - Grade I
    - No visible deformity
    - AC ligament sprained but intact
    - Distal clavicle stable
    - AC Separation

  - Grade II
    - Slight upward displacement of clavicle
    - AC ligament torn
    - CC ligament sprained but intact
    - Distal clavicle unstable in horizontal plane
- AC Separation

  - Grade III
    - Distal clavicle displaced superiorly
    - AC ligament torn
    - CC ligament torn
    - Distal clavicle unstable in horizontal and vertical planes

  - AC Separation
  - Grade IV
    - Posterior dislocation of distal clavicle
  - Grade V
    - Distal clavicle stripped of soft tissue attachments (deltotrapezial fascia)
    - More severe type III
    - Grade VI
    - Inferior dislocation of distal clavicle

- AC Separation Treatment
  - Grade I & II
    - Non-surgical
      - Sling, rest, NSAIDs, rehab, gradually resume activities
      - Injection for athletes?
  - AC Separation Treatment

- Grade IV, V, VI
  - Surgical
    - Reduce and stabilize joint, reconstruct ligaments
  - AC Separation Treatment

- Grade III
  - Debate
  - Goals? Occupation? Expectations?
  - Non-surgical – Adequate for most
  - Surgical – primarily for OH athletes and military
  - Overall satisfaction, time to return to activity, pain, ROM, and strength found to be similar

- AC Separation

- Rehab considerations

- Shoulder Dislocations
  - Shoulder most commonly dislocated joint
    - 45% of all dislocations

- Anterior Dislocation
  - 96-98% of shoulder dislocations
  - Incidence 11.2/100,000 population/year
  - Mechanism of Injury = abduction + external rotation
• Anterior Dislocation
  • Bankart tear
  • Hill Sachs lesion

• Anterior Dislocation
  • Men affected 3x more often than women
  • 9/10 are 21-30 years of age
  • Recurrence rate
    o Studies have shown up to 95% recurrence
    o Age related factors
      ▪ 1st time dislocator <20 y/o
        • 77% recurrence of instability within first year
        • Only 32% have stable shoulder 10 years later
      ▪ >40 y/o almost always tear cuff
  • Contact sports ➔ high risk of recurrence
  • Nerve injury frequent
    o De Laat et all found EMG evidence in 45% of cases

• Non-Op Treatment – Anterior Dislocation
• Immobilization
  o IR vs ER?
    ▪ IR
      • Conventional = sling x 3-6 weeks followed by rehab
      • Recurrence rate up to 95%
    ▪ ER
      • Itoi et al - MRI studies show ER increases tension on subscapularis and maintains the labrum and capsule in close contact with glenoid
      • Recurrence rate increases with time, becomes similar to conventional treatment
      • Adherence fair, position poorly tolerated
      • To date, there is no scientific proof that a specific immobilization position or duration is better over the others
    o Need for further studies

• Operative Treatment – Anterior Dislocation
• Handoll et al & Brophy et al –
  o Surgical stabilization is warranted for “young adults, usually male, engaged in highly demanding physical activities who have sustained their first acute traumatic shoulder dislocation”
  • Recurrence rates significantly lower after surgical stabilization
    o 68%-80% reduction in relative risk for recurrent instability
  • Bankart repair and/or capsular shift
  • Early repair of labrum and capsule improves healing
• Arthroscopy vs Open
  o Suture anchors
  o Treatment – Anterior Dislocation
- Depends on timing of injury, needs of athlete
- Sully brace to finish season

- Anterior Dislocation
- Rehab considerations

- Subacromial Impingement
  - Compression between the coraco-acromial arch and humerus
  - Supraspinatus, subacromial bursa, long biceps tendon
  - Occurs during active elevation of the arm

- Subacromial Impingement
- Structural Factors
- Functional Factors

- Clinical Presentation
  - Pain in anterior or lateral shoulder
  - Painful with active elevation of the arm
  - Activities performed below shoulder height are okay

- Internal Impingement
  - Compression between the posterosuperior labrum and greater tuberosity
  - Supraspinatus and infraspinatus
  - Occurs in overhead athletes when arm is abducted and externally rotated
  - Internal Impingement

  - Factors
    - Acquired anterior instability???
    - Humeral retroversion
    - Loss of internal rotation
    - Posture – SICK Scapula

- Clinical Presentation
  - Chronic, diffuse, posterior shoulder pain
  - Exacerbated by activities requiring abduction and external rotation
  - Performance (throwers)
    - Decreased velocity
    - Decreased control
    - “Dead arm”

- SLAP LESIONS
  - Superior Labrum from Anterior to Posterior
  - Andrews et al 1985
    - First to report on superior labral lesions in throwers
  - Snyder et al 1990
    - Coined term ‘SLAP’
- Reported 6% incidence in 2000 cases
- Presented classification system

- **CLASSIFICATION**
  - 4 types in Snyder’s Classification system
  - Has been expanded by later investigators
  - Classification beyond original 4 types has not been proven to influence understanding and treatment of

- **SLAP injuries**
  - **TYPE I**
    - Superior labral fraying with localized degeneration
    - Superior labral and biceps anchor attachments remain intact
    - Common in middle-aged persons
    - 11% of superior labral injuries (Snyder 1990)

  - **TYPE II**
    - Detachment of the superior labrum/biceps anchor from the glenoid
    - Most common clinically significant tears
    - 41% of superior labral injuries (Snyder 1990)

  - **TYPE III**
    - Bucket handle tear of the superior labrum with an intact biceps anchor
    - May displace into joint causing mechanical symptoms

  - **TYPE IV**
    - Bucket handle tear of the superior labrum with extension of the labral tear into the biceps tendon

- **MECHANISM OF INJURY**
  - Traction
    - Sudden anterior or inferior pull
  - Fall on outstretched hand (FOOSH)
  - Overuse – Overhead Athletes

- **SUBJECTIVE COMPLAINTS**
  - Pain
    - May be sharp or aching
    - Deep within shoulder
    - Posterior in throwers
    - During late cocking or early acceleration
  - Intermittent clicking or mechanical symptoms
  - Weakness
  - Performance (throwers)
    - Decreased velocity
    - Decreased control
    - “Dead arm”
• MECHANISM OF INJURY - THROWING
  • Biomechanical cascade
    o ↑’d ER
      ▪ Lengthening of anterior capsuloligamentous restraints
      ▪ Increased humeral retroversion
    o ↓’d IR
      ▪ Posterior capsule contracture (PIGHL)
      ▪ “Essential lesion”
  • Burkhart and Morgan 1998
    ▪ POSTERIOR CAPSULE CONTRACTURE

• HUMERAL SHIFT
• Cadaver Study (Grossman 2005)
  o Normal shoulder
    ▪ Humeral head shifts posterior/inferior in late cocking
  o Simulated posterior capsule contracture and anterior capsule stretch injury
    ▪ Humeral head shifts posterior/superior in maximal ER
    ▪ Loads the labrum while under excess tension with increased ER
    ▪ Labrum peels back and separates from glenoid rim attritionally

• PEEL BACK
• When shoulder is placed in a position of abduction and maximal external rotation, the rotation produces a twist at the base of the biceps, transmitting torsional force to the anchor
• Burkhart and Morgan 1998

• EXAMINATION
• ROM
  o GIRD
    o Kinetic chain mobility
  • Posture
    o SICK scapula
  • Strength/Motor Control
    o Dyskinesia
    o ER/IR
    o Core
  • Special Tests

• GIRD
• Glenohumeral
• Internal
• Rotation
• Deficit
• Loss of Internal Rotation compared to non-throwing shoulder
- GIRD
- Adaption in throwers
- Humeral retroversion
- Shoulder at risk = GIRD > 20 degrees
  - Of 39 pitchers presenting with GIRD in spring training 60% had injuries over the course of the season
  - Burkhart, Morgan, and Kibler 2003

- TOTAL ARC OF MOTION CONCEPT
- ER + IR = Total Motion
- Total rotational motion is equal bilaterally (within 5 degrees)
- Pitchers with GIRD 2x as likely to be injured as those without
- Pitchers with total rotational motion deficit greater than 5 degrees had a higher rate of injury

- SICK Scapula
- Scapular malposition
- Inferior medial border prominence
- Coracoid pain and malposition
- dysKinesis of scapular movement
- SCAPULAR DYKINESIA

- Rehab
  - Acute Phase
    - Decrease pain and inflammation
    - Normalize ROM
    - Re-establish dynamic stability and muscular balance
    - Improve posture
    - Avoid aggravating activities

- Rehab
  - Intermediate Phase
    - Normalize arthrokinematics of shoulder complex
    - Normalize strength
    - Enhance dynamic stability
    - Increase activities

- Rehab
  - Advanced Phase
    - Aggressive strengthening
    - Progress neuromuscular control
    - Improve strength, power, and endurance
    - Maintain flexibility, ROM, postural correction

- Rehab
  - Return to Sport Phase
    - Initiate interval sport program
- Maintenance exercise program
- Return to competition

- Return to Sports Criteria
- Pain free
- Full ROM
- Appropriate rehab progression
- Adequate strength and dynamic stability
  - Isokinetic testing
    - ER peak torque/body weight of 18-23%
    - ER/IR ratio of 66-76%
    - ER/abduction ratio 67-75% at 180°/sec

- Return to Sports
- Functional Testing
  - Y-balance
  - CKCUEST
  - Single Arm Shot Put Test
  - Push Up Test
  - Modified Pull-up Test
  - Return to Sports

- Interval sports programs
  - Throwing
  - Swimming
  - Tennis

- Special Considerations
  - People involved during the rehab process
    - Admin/front office
    - Coaches
    - Physical Therapist
    - Athletic Trainers
    - Strength and Conditioning Coaches
    - Special Considerations

- Sports psychology
  - Athlete expectations/fears
  - Expectations on athlete
  - Athlete identity
  - Motivation
  - Support System

References


The Athletic Shoulder Across the Lifespan: The Master’s Athlete

Mitch Salsbery, PT, SCS
Coordinator, Upper Extremity PT Fellowship
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- Objectives
  - Discuss examination specific to the master’s athlete’s shoulder
  - Review physiological changes of aging
  - Identify and discuss common shoulder pathologies in master’s athletes
  - Explore rehabilitation considerations specifically for the masters level athlete
  - Identify current literature in regards to return to sport

- Case Study
  - Previous Injuries
  - Current Complaints
  - Case as a Master’s Athlete

- Examination
  - 1987: 2500 participants Senior Games
    - 2011: 10,100 participants
  - Shoulder most mobile joint in body
    - Necessary for athletic events
      - Problem: Shoulder motion declines with age and with long-term sports participation (Kibler. Shoulder ROM in elite tennis. AJSM 1996)
  - Shoulder requires muscular balance to optimize strength and function
    - Aging leads to increased RTC tear rate (Templehof. JSES 1999)
  - Osteoarthritis
    - Gradual
    - Worst with activity and/or at night
    - Crepitus
    - Decreased ROM (rotation then flexion)
    - Decreased weight bearing
    - Strength may decrease
    - Special Testing Benefit?
  - Tissue Quality
    - Decrease in lean body mass
    - Decrease anabolics
    - Increase in catabolics
  - Decrease in Type I and II muscle fibers
    - Primarily Type II
    - Normal or Disuse atrophy???
- Rotator Cuff
  - Chronic vs acute
  - 44% Type I slow twitch in older adults (Lovering, JOSPT 2008)
  - Type II likely injured in eccentric actions
  - Strengthen Type II with rehab
- Muscle fiber types do NOT change when training is similar (coggan, J Apply Phys 1992)

- Mature Pathologies
  - Rotator Cuff
    - Etiology
      - Intrinsic
        - Decreased tensile strength of tendons
        - Intrinsic tendon degeneration
        - Presents as articularsided injury
      - Extrinsic
        - Compression against adjacent structures
        - NSAIDS may slow healing of chronic tendinopathies (mehallo CJS 2006)
  - 141 Senior Olympiads
  - Msk US of dominant shoulder Supraspinatus
  - 30% Pain with Positive Findings
- Pain
  - Positive predictor of RTC injury, worse function
  - Pain, DASH, ASES
- Aysymptomatic Tear: decrease in patient-based shoulder function measures and ROM
- Partial Thickness Tears Normal?
  - 80% turn into full thickness over 2 years (matsumoto 1994)
- Surgical outcomes:
  - Weber: good or excellent in 31of 33 partical thickness repairs
  - Hannafin: 98% patient satisfaction in 41 patinet with full repair or partial repair
  - Malearny: 12% retear rate when tear completed and repair
- Recreational pitchers:
  - 59 yr avg
  - 100% returned to sport
  - 92% of original function
- Tennis
  - 42 of 51 returned to sport
    - Avg of 9.8 months
  - Osteoarthritis
- Most common bone & joint disease
- Male > Female
- Degeneration most common cause – not associated with athletic activity
- Increases with PMH:
  - Rotator Cuff Arthropathy
  - Instability
  - Postsurgical
  - Fracture
  - Glenoid Retroversion (posterior wear pattern)

  - **Total Shoulder Arthroplasty**
    - 75% return to previous sports of golf, tennis, swimming
      - Spend TWICE as much time as before surgery
    - However, less than 50% of those playing softball, bowling, weight lifting returned
      - McCarty AJSM 2008. Sports Participation after TSA
    - Golf: 96% returned to recreational golf
    - Improved performance of 5 strokes
  - Younger TSA:
    - Under 50 years old
    - Less than 50% had unsatisfactory result (Sperling, JSES 2004
    - 62.5% survival rate at 10 years (denard JESE 2013)

- **Rehab Considerations**
  - What we CAN effect
    - Kinetic Chain mobility
    - Strength preservation
    - Posture
    - Biomechanics
    - Motivation
    - Knowledge
    - Overall health
  - What we CAN’T effect
    - Rotator cuff healing
    - Arthritis
    - Cartilage degeneration

  - More rapid deconditioning than younger
    - (Galloway, Aging successfully: the importance of physical activity in maintaining health and function. J AM Acad Orthop Surg. 2008
  - Maximize ROM
    - Loss of ROM leads to compression
      - Increases in OA and/or symptoms
- Posture
  - Daily
  - Sport Specific
- Mobility
  - Thoracic Cage and Spine
  - Cervical Spine
  - Scapula
  - Posterior Shoulder
  - GH Joint
  - Soft tissue
- Strength
  - Core
  - RTC
  - Periscapular
  - Postural Control
- Stability
- Power
- Return to Sport

References – Masters Athlete

The Athletic Shoulder Across the Lifespan: End-Stage Rehab and Performance Enhancement
Daniel Lorenz, DPT, PT, ATC/L, CSCS
Director of Clinical Operations, Specialists in Sports and Orthopedic Rehabilitation (SSOR)

- Thinking beyond the rotator cuff and scapula
  - Thoracic spine mobility
  - LE strength/balance
  - What performance characteristics determine elite baseball performance?
  - Core stability and the overhead athlete
    - “Try shooting a cannon from a canoe if you don’t think core stability is important” – Rob Panariello

- Components of a Needs Analysis
- Training for Strength, Power, Speed
  - Strength – key component is deceleration/eccentric strength
    - Eccentric/decel strength
    - Starting strength
    - Elastic/reactive Strength
  - Power or explosive strength
  - Speed
- Pediatric Programming
  - Biological v. Training Age
  - Critical components of a comprehensive pediatric program
- Collegiate Considerations/Programming
- Masters Athlete Considerations/Programming

REFERENCES