

Shoulder Rehabilitation: State of the Art 2006  
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Course Chair: George M. McCluskey III, MD

## Adolescent Throwing Injuries: Shoulder & Elbow

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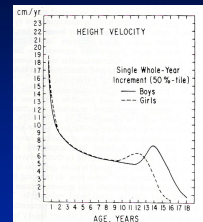
## OUTLINE

- Introduction
- Shoulder injuries
- Elbow injuries
- Conclusion



## INTRODUCTION

- Growth and development
  - Height increases ~3.5 X
  - Weight increase 20-25 X
  - Muscle mass increases 7 X
- Growth velocity
  - Declines with age, except
    - 10-14 years for females
    - 13-17 years for males



## INTRODUCTION

- Tissue in "transition"
  - Skeletally immature
  - Growth plates
  - Unique characteristics
- Tissue at "risk"
  - Healing capabilities

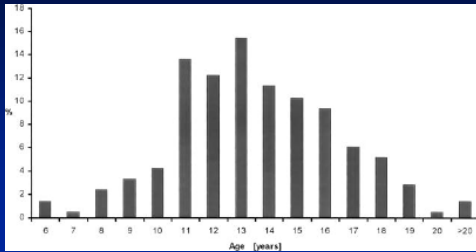


## INTRODUCTION

- Bone quality
  - More flexible
- Growth plate
  - Weak link
    - Adolescent growth spurt
  - Includes tendon attachment
    - Apophysis



## SPORTS INJURIES



Journal of Pediatric Orthopaedics, March/April 2001

## INTRODUCTION

- Overuse injuries
  - Repetitive stress
    - Microtrauma
    - Inflammatory response
  - Anatomic sites
    - Tendon-bone junction
    - Muscle-tendon junction
    - Growth plate

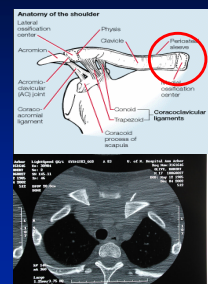


## SHOULDER INJURIES



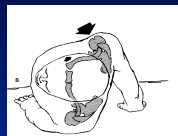
## Sternoclavicular Joint: Anatomy

- Medial clavicular physis
  - 70-80% of clavicle growth
  - Closes after age 20
- Ligament injury
- Physeal injury



## Sternoclavicular Joint: MOI

- Lateral blow to shoulder
- Levers clavicle
  - Posterior or anterior



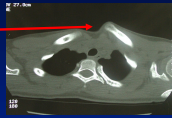
## Sternoclavicular Joint: Injury

- Acute injury
- Anterior chest pain
  - Dysphagia
  - Dyspnea



## Sternoclavicular Joint: Injury

- Anterior Displacement
  - Not as painful or dangerous
  - Requires sub-acute reduction
    - within a few days - up to 14 days
- Posterior Displacement
  - Higher risk to vital structures
  - Requires emergent reduction
  - Must have thoracic surgery backup



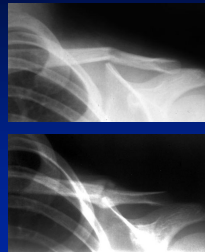
## Post-Reduction Care

- Most are Stable
  - Posterior - figure of eight
  - Anterior - sling
- Sling/brace - 6 weeks
- Contact Sports - 3-4 Months



## Clavicle Fractures

- Typically heal rapidly
  - Age-related
- Sport-related fractures
  - Nearly all treated non-operatively



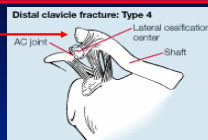
## Acromioclavicular Joint: Anatomy

- Lateral Clavicle Physis
  - 20-30% of clavicle growth
- Physis Closes at 20 Years



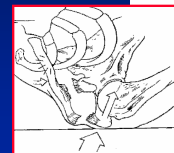
## Acromioclavicular Joint: Anatomy

- Physeal injuries
  - Many AC joint injuries
- Rare coracoid injury
  - Coracoid physis
    - closes at 20 years
  - if CC ligaments remain intact



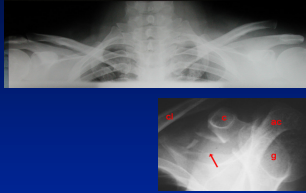
## Acromioclavicular Joint: MOI

- Direct Trauma
  - Anterolateral acromion
- Ligament Injury
- Physeal Injury
  - Children



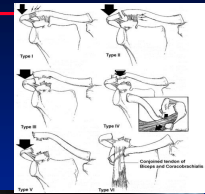
## Acromioclavicular Joint: Imaging

- Radiographs
  - Bilateral
- Beware
  - Clavicle fractures
  - Coracoid fractures



## Acromioclavicular Joint: Treatment

- Depends on displacement
- Ligament sprains
  - Nonoperative for I, II, III
  - Operative for IV, V, VI
- Fractures/Physeal Injury
  - Minimally Displaced
    - Non-operative
  - Widely Displaced
    - Surgical repair



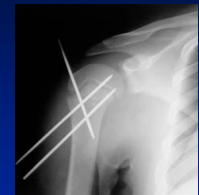
## Glenohumeral Joint: Anatomy

- Proximal humeral physis
  - 80% of humeral growth
- Physeal injuries are common
  - 20% of youth proximal humerus fractures from sports
  - Acute traumatic injuries
  - Chronic repetitive loading



## Displaced Proximal Humerus Fx

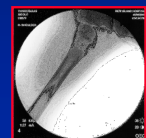
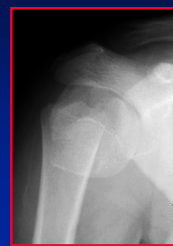
- Age and Displacement
- Age 1-5
  - 70° angulated, 100% displaced
- Age 5-12
  - 50° angulated, 50% displaced
- Age >12
  - 30% displaced



## Operative Case

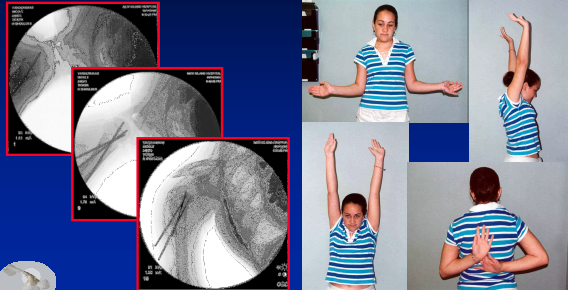


## Operative Case





## Operative Case



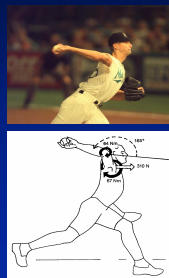
## "Little Leaguer's Shoulder"

- Shoulder pain
  - Proximal humeral physis
- Microtraumatic injury



## Throwing Kinematics

- Throwing optimizes ER
  - Speed of ball
    - Correlates with ER
  - Torque increased



## Throwing Kinematics

- Throwing optimizes ER
  - Speed of ball
    - Correlates with ER
  - Torque increased
- Asymmetric rotation
  - ER increased
  - IR decreased



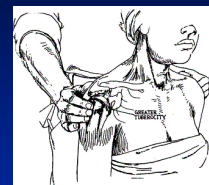
## Little Leaguer's Shoulder: Injury

- History of overuse
  - Increase in speed
  - # of pitches
  - No break in season
- Poor mechanics
- Pain with throwing
- Cocking/deceleration pain

TABLE 1 Risk factors for injury in the history
Position played (pitcher, catcher, outfield, third base, shortstop)
Higher than recommended maximum number of throws in a single week (based on age)
Nine to 12 months of play in a year
Poor pitching mechanics
Throwing pitches too advanced for age

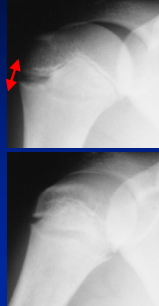
## Little Leaguer's Shoulder: Injury

- History of overuse
  - Increase in speed
  - # of pitches
  - No break in season
- Poor mechanics
- Pain with throwing
- Cocking/deceleration pain
- Tender proximal humerus



## Little Leaguer's Shoulder: Imaging

- Radiographs
- Widening of lateral physis
- MRI ?



## Little Leaguer's Shoulder: Treatment

- Rest
- Strengthening
- Progressive throwing program

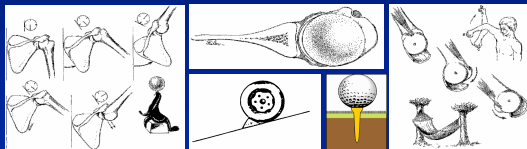
TABLE 3

### Guidelines for a return to throwing

Full, painless range of motion  
Full strength  
No apprehension or discomfort in the cocking phase of throwing

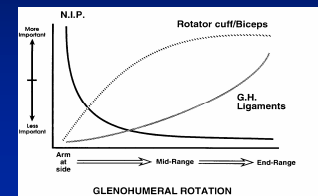
## Glenohumeral Instability

- Epidemiology
  - 1-5% of dislocations occur in skeletally immature
- Anatomy



## Glenohumeral Instability

- Epidemiology
  - 1-5% of dislocations occur in skeletally immature
- Anatomy
- Stability



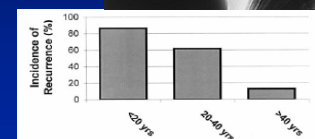
## Glenohumeral Instability: History

- Traumatic vs atraumatic
- Recurrence
- Age of patient
- Severity
  - Subluxation vs. dislocation
- Position of instability
  - Abduction ER
  - Adduction IR
  - More neutral position



## Glenohumeral Instability: Treatment

- Dependent upon
  - Age
  - Timing
  - Direction
  - Severity
- Most non-operative
  - First-time



## Posterior Glenohumeral Instability

- Traumatic
- Microtraumatic
- Voluntary
  - Demonstrable
  - Positional
  - Volitional
    - May be common



## Multidirectional Instability

- Definition is unclear
  - More than one direction
  - Collagen disorder
- Traumatic
- Atraumatic
  - Adolescent
  - Female
  - Generalized ligament laxity
  - Instability in mid range



## Rotator Cuff Injury

- Unusual in child athlete
- Typically acute strain
- Adolescents can get overuse tendinitis
- Secondary impingement
  - Secondary to pathologic laxity
  - Primary GH instability with secondary impingement



## ELBOW INJURIES



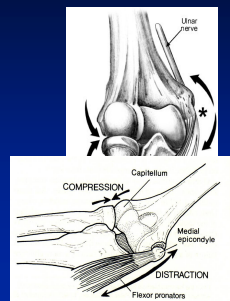
## Little Leaguer's Elbow

- Thrower's elbow
  - Valgus stress
  - Tensile force to medial side



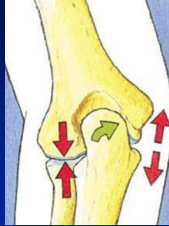
## Little Leaguer's Elbow

- Thrower's elbow
  - Valgus stress
  - Tensile force to medial side
- Structures at risk medially
  - Medial epicondyle injury
  - Flexor/pronator injury
  - Ulnar collateral ligament
  - Ulnar nerve



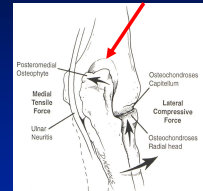
## Little Leaguer's Elbow

- Thrower's elbow
  - Valgus stress
  - Tensile force to medial side
  - Compressive force lateral side
- Structures at risk laterally
  - Radiocapitellar joint
  - Lateral epicondyle



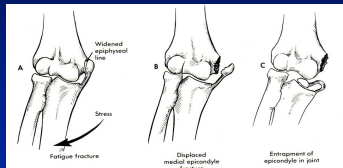
## Little Leaguer's Elbow

- Thrower's elbow
  - Valgus stress
  - Tensile force to medial side
  - Compressive force lateral side
  - Shear/compress posteromedial
- Structures at risk posteriorly
  - Olecranon fossa



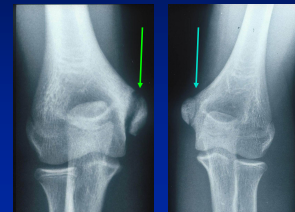
## Medial Epicondylar Injury

- Repeated medial tensile stress
  - F-P M-T
  - UCL
- Stress reaction
- Inflammation
- Avulsion



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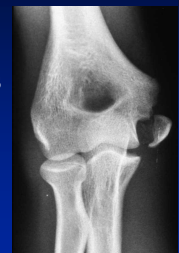
## Medial Epicondylar Avulsion

- Most common fracture in skeletally immature thrower
- 11% of distal humerus fractures
- Non-op vs. operative
  - Controversial



## Medial Epicondylar Avulsion

- Most common fracture in skeletally immature thrower
- 11% of distal humerus fractures
- Non-op vs. operative
  - Controversial
  - How much displaced
    - 2-5mm non-op



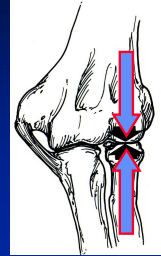
## Medial Epicondylar Avulsion

- Most common fracture in skeletally immature thrower
- 11% of distal humerus fractures
- Non-op vs. operative
  - Controversial
  - How much displaced
    - 2-5mm non-op
  - Repair



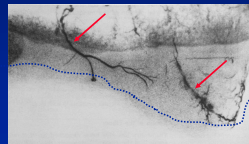
## Lateral Elbow Pain: Adolescent

- Osteochondritis dessicans (OCD)
- Panner's disease
- Radial head hypertrophy
- Lateral epicondylar avulsion
- Lateral epicondylitis



## OCD: Etiology

- Repetitive Compressive Stress
- Vascular
  - Injury to subchondral end arterioles
  - Osteonecrosis
- Trauma
  - Stress fracture
  - Hard radial head
  - Soft capitellum
- Genetics



Haraldsson 1959



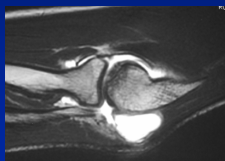
## OCD: Imaging

- Radiographs
  - Irregular or flattening
  - Subchondral sclerosis



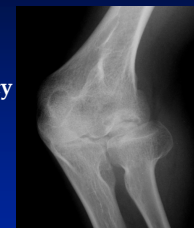
## OCD: Imaging

- Radiographs
  - Irregular or flattening
  - Subchondral sclerosis
- MRI



## OCD: Natural History

- Unpredictable
- Healing
  - Usually by skeletal maturity
- No healing
  - Shear / Microtrauma
  - Loss Support
  - Loose Bodies
  - DJD





## OCD: Treatment

### Articular Cartilage: Intact

- Relative Rest
  - Splint if Acute symptoms
- Rehabilitation
- NSAID's ?
- Surgery
  - Not healed by 6 months
- Return to sports
  - No symptoms, healed on x-ray



## OCD: Treatment

### Articular Cartilage: Partially intact, non-displaced

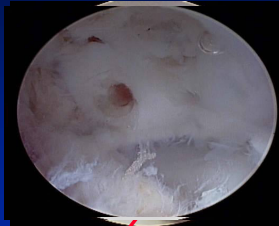
- Fix in place



## OCD: Treatment

### Articular Cartilage: Not intact, in situ

- Debride bed
- Fix in place



## OCD: Treatment

### Articular Cartilage: Not intact, loose body

- Excise & debride
- Excise & transfer cartilage
- Debride, fix & bone graft



## OCD: Treatment

### Post-Operative Care

- Early ROM
- Strengthening at 6 - 12 wks
- Advise against pitching



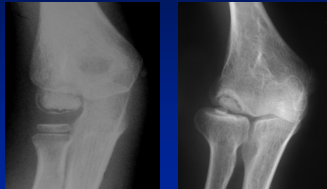
## Panner's Disease

- Most common cause of lateral elbow pain in children
  - ? Vascular
- Younger - Ages 4-10
- Non-operative treatment
  - Similar to OCD
- May take 3 years to heal



## Panner's vs OCD

- Younger Age Group
- Same Location
- Better Prognosis



## Olecranon Apophysitis

- Repetitive extension
- Triceps contraction
- Throwing motion
  - Acceleration & follow through phases



## Olecranon Apophysitis

- Repetitive extension
- Triceps contraction
- Throwing motion
  - Acceleration & follow through phases
- Widening on x-ray



## Olecranon Apophysitis

- Repetitive extension
- Triceps contraction
- Throwing motion
  - Acceleration & follow through phases
- Widening on x-ray
- Precursor to avulsion



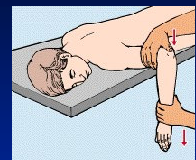
## Elbow Dislocation

- 6 - 8% of all elbow injuries in children
  - Sports most common cause
- Most commonly dislocated joint in children
  - High assoc w/ fractures



## Elbow Dislocation

- 6 - 8% of all elbow injuries in children
  - Sports most common cause
- Most commonly dislocated joint in children
  - High assoc w/ fractures
- Reduction



## CONCLUSION

- The shoulder and elbow are at risk in the adolescent athlete
- Some conditions are similar to adults
- Many conditions are specific to the adolescent
- Goal is always a normal shoulder or elbow and safe return to play
- Kids should not play thru pain



# THANK YOU

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