Upper Extremity Injuries in Youth Baseball:

Causes and Prevention

Biomechanics

- Throwing a baseball is an unnatural movement
- Excessively high forces are generated at the elbow and shoulder
- Throwing requires flexibility, strength, coordination

Biomechanics

- Phases of throwing:
  - Windup
  - Cocking
  - Acceleration
  - Deceleration
  - Follow-through

Biomechanics

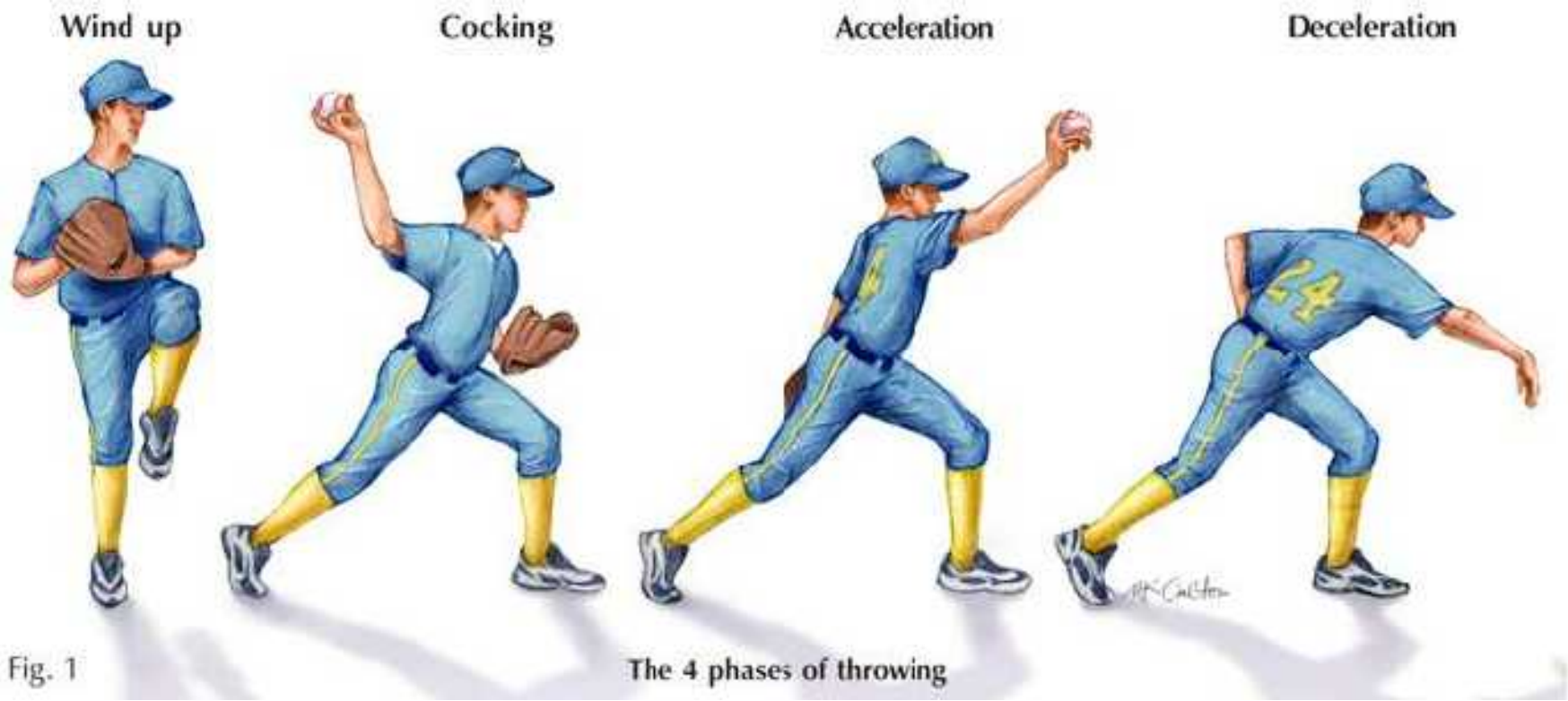


Fig. 1 The 4 phases of throwing

Biomechanics

- Windup
  - Body placed in good starting position
  - Gains momentum in forward direction
  - Lasts 0.5 to 1.0 seconds
  - Minimal muscle activity

Biomechanics

- Cocking
  - Begins with front foot contact
  - Ends with shoulder in maximal external rotation (MER)
  - Elbow flexed, forearm supinated
  - Lasts 0.1 to 0.15 seconds
  - Deltoid, rotator cuff, medial and lateral elbow musculature highly active during cocking phase

Biomechanics

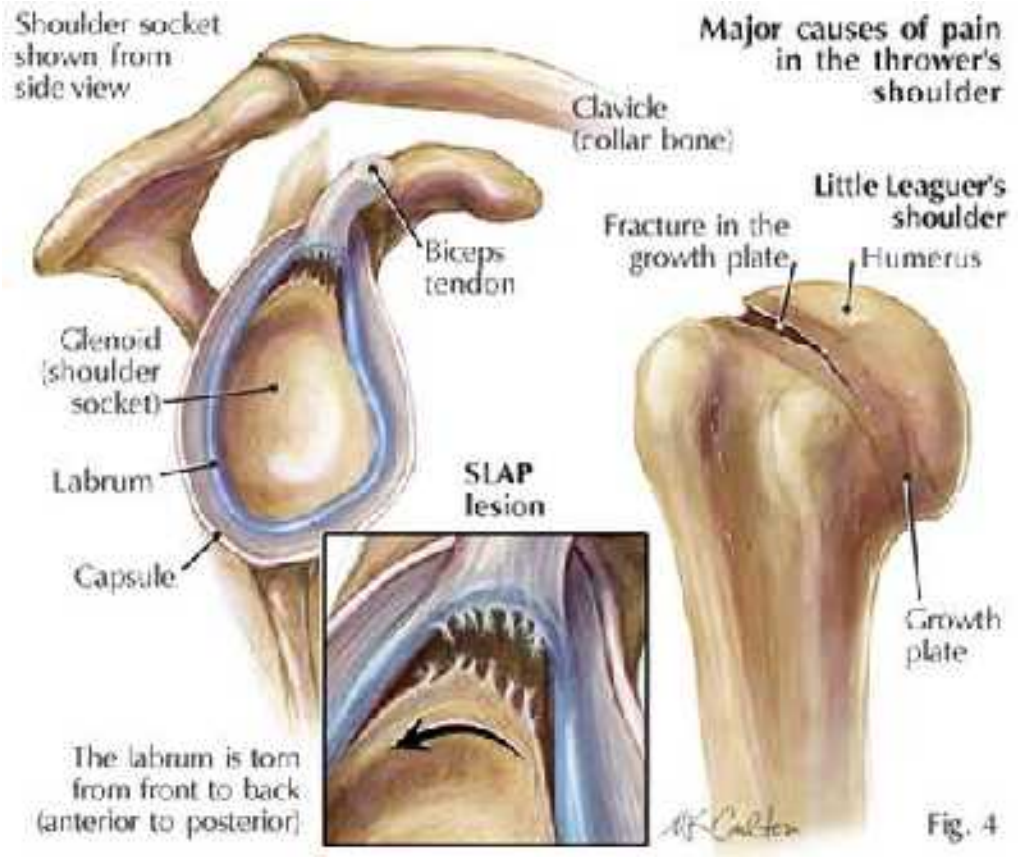
- Acceleration
  - Begins with MER
  - Ends with ball release
  - Arm moves to a position of internal rotation and adduction at the shoulder and extension at the elbow
  - Lasts a few hundredths of a second
  - Large valgus and extension forces generated at the elbow

Biomechanics

- Deceleration/Follow-through
  - Begins with maximal internal rotation (MIR)
  - Ends with foot contact
  - Follow-through is complete when pitcher achieves a balanced position and is ready to resume play

Shoulder Injuries

- Rotator cuff
- Instability
- Labral pathology
- Little Leaguer's shoulder



Rotator Cuff Injuries

- Primary impingement
  - Cuff impinging on coracoacromial arch
  - Rare in young athletes
- Secondary impingement
  - Due to underlying instability
  - Can result in a poor outcome if instability goes unrecognized

Rotator Cuff Injuries

- Tensile overload
  - Forces generated in cuff during pitching can cause tendinosis and collagen breakdown
- Internal impingement
  - Supraspinatus and infraspinatus contact posteriosuperior aspect of labrum during MER
  - Caused by chronic compressive damage
  - Results in partial undersurface cuff tear and labral fraying

Rotator Cuff Injuries - Evaluation

- History
  - Specific injury or insidious onset?
  - Pain during cocking usually impingement
  - Pain during deceleration commonly tensile failure
- Physical exam
  - AROM/PROM
  - Glenohumeral translation
  - Apprehension/relocation tests
  - ↓ strength due to pain, inhibition, fatigue – rarely full-thickness tear

Rotator Cuff Injuries - Evaluation

- Radiology
  - Plain films – AP,Y, axillary
  - MRI

Rotator Cuff Injuries - Treatment

- Rest
- Rehab
  - Restore ROM
  - Strengthen cuff and scapular stabilizers
  - Maintain conditioning
  - Throwing program
- Anti-inflammatories
- Surgery

Instability

- Stability relies on ligaments and rotator cuff action
- Inferior glenohumeral ligament
  - Maximally stretched in external rotation
  - Chronic stretching can cause functional incompetence
  - Causes rotator cuff to work harder – can fatigue or tear

Instability - Evaluation

- H & P as above
- Symptoms due to cuff pain or instability? Signs may be subtle
- ↓ velocity and early fatigue frequent complaints
- Subjective subluxation rare
- May describe clicking or catching

Instability - Treatment

- Rest
- Rehab
  - As above, with stretching posterior capsule
- Surgical stabilization
  - EUA to determine direction & degree of laxity
  - Correct laxity without compromising motion
  - Subtle laxity → thermal capsulorrhaphy
  - Gross laxity → capsular shift

Labral Pathology

- Repetitive microtrauma results in fraying or tearing
- Disruption of biceps anchor causes pain and anterior-inferior translation of humeral head when completely detached
- Can occur alone, or with instability or cuff pathology

Labral Pathology - Evaluation

- H&P as above
  - Pain during acceleration
  - Loss of velocity
  - + O'Brien's test
- Radiology
  - MRI arthrogram most helpful
  - Dye leaks into tear

Labral Pathology - Treatment

- Rest
- Rehab
- Surgery
  - Labral repair
  - Labral debridement

Little Leaguer's Shoulder

- Symptoms
  - Gradual onset of pain in throwing shoulder
  - Localized to proximal humerus during throwing
  - Average age 14
  - Average duration of symptoms 8 months

Little Leaguer's Shoulder

- Mechanism
  - Appears to be caused by rotational stress applied to proximal humeral physis during act of throwing
  - Overuse inflammation of proximal humeral physis vs. stress fracture of physis
  - During throwing, shoulder is forcibly internally rotated and adducted from an externally rotated abducted position

Little Leaguer's Shoulder

- Radiology
  - Widening of the proximal humeral physis
  - Easily seen on bilateral AP internal and external rotation x-rays
  - Associated findings
    - Demineralization
    - Sclerosis
    - Fragmentation of lateral aspect of proximal humeral metaphysis

Little Leaguer's Shoulder - Treatment

- Rest until symptoms subside with pain-free ROM
- Gradual return to throwing when symptoms subside – remodeling on x-ray can take several months longer
- PT usually not beneficial – may have worse pain with strengthening exercises

Elbow Injuries

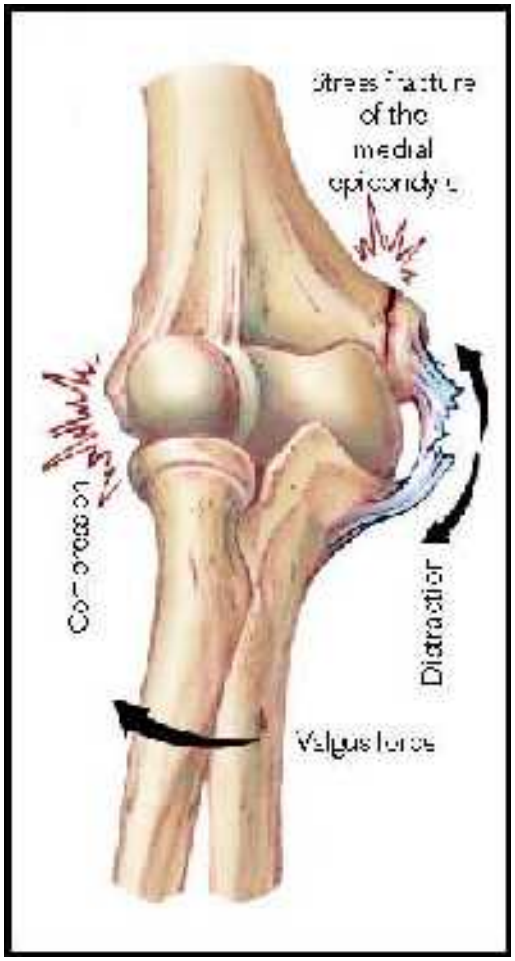
- Little Leaguer's elbow
- Ulnar collateral ligament injuries
- Loose bodies

Little Leaguer's Elbow

- With repetitive throwing, ligaments and tendons put tension on the end of the bone → causes inflammation of growth plate and ultimately stress fracture

- Activity-related pain, tenderness to palpation, decreased pitching effectiveness

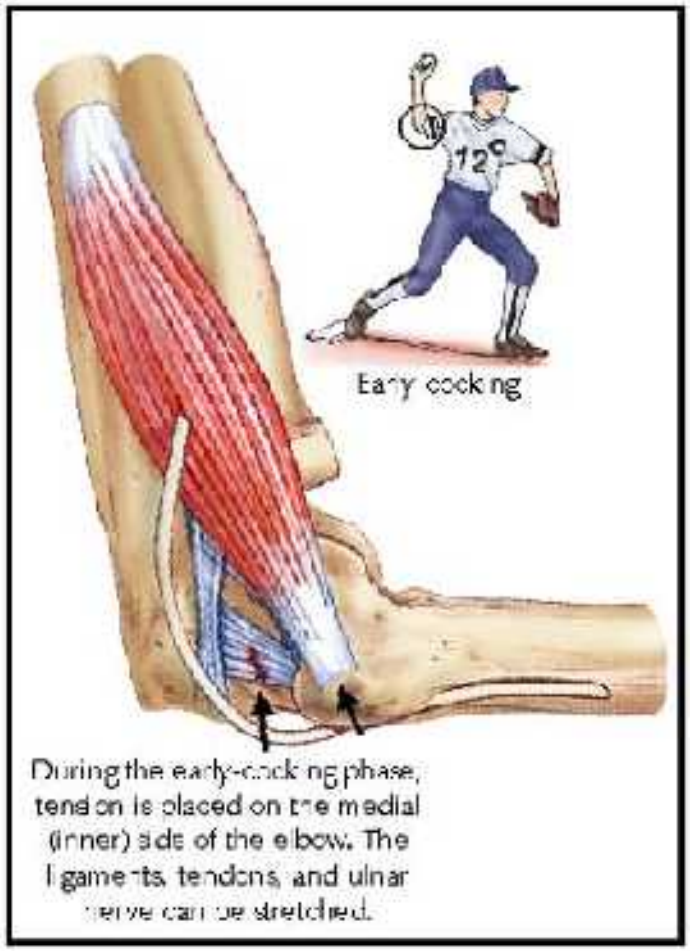
Little Leaguer's Elbow



- Treatment
  - Rest for several weeks until symptoms resolve

Ulnar Collateral Ligament Injuries

- Chronic valgus stress places ligament at risk for laxity or tearing
- Pitchers at highest risk



UCL Injuries - Evaluation

- Medial pain during late cocking, acceleration or deceleration is hallmark
- Pain with valgus testing more reliable than laxity
- Laxity on valgus testing at 30° minimal unless tear is complete
- MRI with contrast – fluid leakage outside of joint represents complete tear

UCL Injuries - Treatment

- Rest
- Physical therapy
- NSAIDs
- Return to throwing when pain-free
- Surgery → autologous tendon secured in tunnels in humerus and ulna in figure-of-eight fashion, ulnar nerve transposed

Loose Bodies

- Mechanism
  - Repetitive throwing causes fragmented cartilage within joint
  - Directly relates to amount and intensity of throwing

Loose Bodies

- Symptoms
  - Acute activity-related pain
  - Tenderness in outer portion of elbow
  - Decreased ROM
  - Locking or catching in joint
- Treatment
  - Rest until symptoms subside
  - Throwing program
  - Continued symptoms → surgery

The Solution…

- PITCH LIMIT!!!
- Prevents injuries and prolongs careers
- “Throwing is not dangerous to a pitcher’s arm. Throwing while tired is dangerous to a pitcher’s arm.” Rany Jazayerli (baseball writer).

Pitch Limit

- American Sports Medicine Institute recommends pitches per week:
  - Ages 8-10: 52 pitches
  - Ages 11-12: 68 pitches
  - Ages 13-14: 76 pitches
  - Ages 15-16: 91 pitches
  - Ages 17-18: 106 pitches

  - Practice and recreational pitching add to this strain

Pitch Types

- Pitch *type* should also be limited to reduce injury
- Before age 10, only fast ball and change-up should be permitted
- Curveball, slider, knuckleball and screwball may be introduced with increasing age

Pitching Mechanics

- Curveball and slider related to joint pain in young pitchers
- These pitches place high loads on shoulder and elbow
- Curveball requires new set of mechanics
- Adolescents more susceptible to injury because growth plates still open

Youth Baseball Recommendations

- No curveball or slider between 9 and 14
- Fastball and change-ups only
- Age-appropriate pitch limit per game

- By adhering to the above recommendations, we can expect the occurrence of shoulder and elbow pain in young throwers to decrease.

Questions?