

# Arm Pain in Throwing Athletes

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- I have no potential conflicts of interest to declare.

# What's the Big Deal?

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- Between 26% and 35% of youth baseball pitchers will experience elbow or shoulder pain each year <sup>(4)</sup>
- 10-year prospective study shows 5% of pitchers aged 9 to 14 years will experience serious injury resulting in surgery or retirement from baseball <sup>(6)</sup>

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- Pitchers are 3.6 to 4.5 times as likely to experience an UE injury compared with position players <sup>(1)(2)</sup>
  - Youth baseball players experience elbow symptoms ranging from 17% to 26% <sup>(3)(4)</sup>
    - 7% of all pitching performances resulting in elbow symptoms
    - 9% of all pitching performances resulting in shoulder symptoms <sup>(5)</sup>

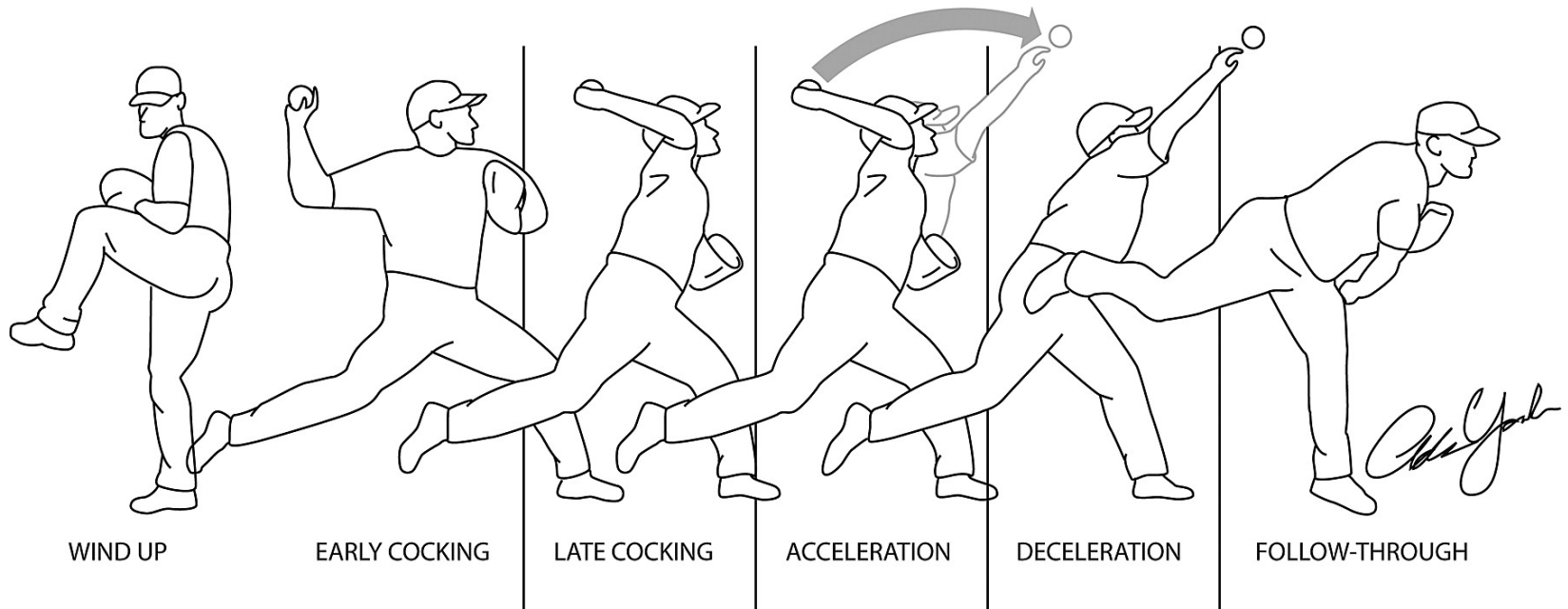
# Risk Factors

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- In Developing immature Youth
- Increased bone plasticity
- Ligamentous laxity
- Open epiphyseal growth plates
- Underdeveloped musculature (7)
- Regardless of Age
- Throwing mechanics
- Pitch count
- Pitching while fatigued (8)
- Type of pitch less important than velocity

\*\*There is speculation that throwing related injuries that manifest in high school or college are the result of microtrauma accumulated from throwing excessively during childhood(9)

# Anatomy of Throwing (Sports Performance Institute)



# Wind up and early cocking(10)

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## Minimal forces

- Creates linear velocity by maximizing the length of elastic components of the body
- Creates speed through stride and trunk rotation



# Late Cocking

- Rotation of pelvis and upper torso
- Energy transfer to throwing arm
- Shear force of 400N across shoulder
- Extreme valgus stress along the medial elbow as elbow has angular velocity of 3000 degrees/sec.





# Acceleration Phase

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- Shoulder internal rotators and scapular stabilizers contract explosively creating IR velocity up to 7000 degrees/sec.
- Elbow reaches maximum velocity during mid-acceleration phase
- Ends with release of the ball

# Deceleration and Follow-through

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- Controlled by contraction of the shoulder girdle, teres minor has the highest activity.
- Lower extremity extension and trunk flexion help distribute the forces.
- Entire complex throwing motion takes 2 seconds



# Shoulder Injury

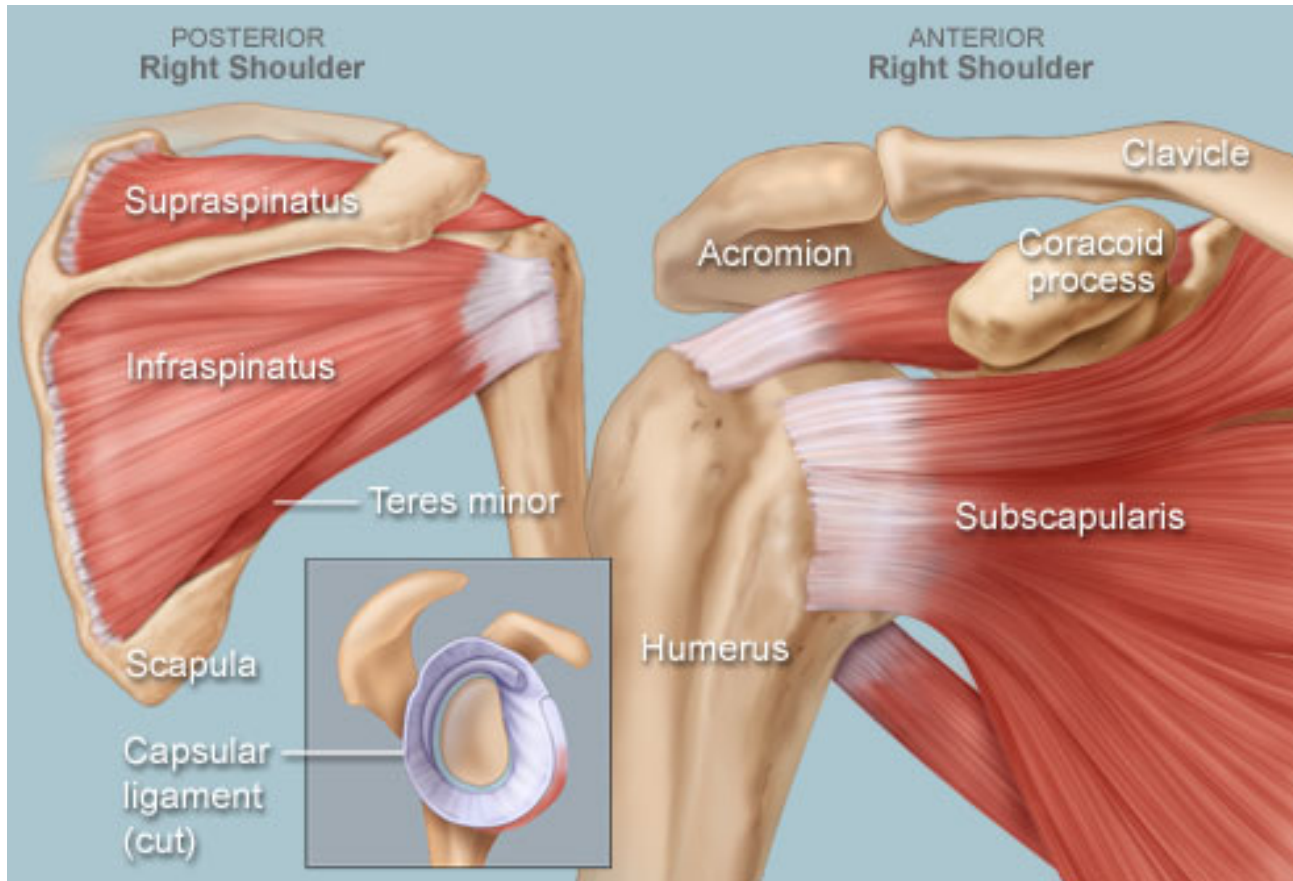
## (Its not always the rotator cuff)

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- Little Leaguers Shoulder
- Rotator cuff tendinitis and tears
- Biceps tendinitis and tears.
- SLAP tears(Superior Labrum Anterior to Posterior)
- Internal impingement
- Instability
- Glenohumeral Internal Rotation Deficit (GIRD)
- Scapular Rotation Dysfunction (SICK scapula)

# The Shoulder

(wedmd)



# Little Leaguer's Shoulder

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- Peak incidence in pitchers between 11-16 years old
- Complaints of progressive non-focal pain with throwing
- Diagnosis made with radiographs
- Widening of the proximal humeral physis which may need to be confirmed with comparison view



# Little Leaguers Shoulder

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- Structurally more resistant to tension and least resistant to torsion, the epiphyseal plate poorly tolerates the biomechanical stress imposed by throwing, particularly the rotational torque during external rotation of the cocking phase.
- Meister et al found that total range of motion decreased with age and with a remarkable decline between 13- and 14-year olds, just before the peak incidence of Little Leaguer's shoulder

# Treatment of Little Leaguers Shoulder

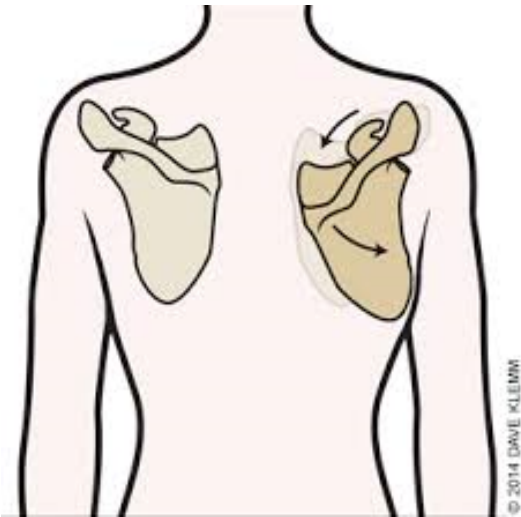
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- Rest until player is pain free for 2-3 months
- Physical therapy to improve strength with possible video throwing analysis
- Return to throw program



# SICK scapular syndrome and scapular dyskinesia

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- Key feature is asymmetric scapular positioning and motion
- Player usually complains of insidious onset of anterior shoulder pain typically at the coracoid process and posterior shoulder pain
- Scapula is usually lower with a more prominent inferior medial border than the unaffected side
- May be related to RC impingement and underlying labral pathology



# SICK scapula syndrome treatment

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- Rest from throwing
- Physical therapy to improve scapular stabilizer strength

# Rotator cuff tendonitis

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- Most common complaint
- RC muscles are the dynamic stabilizers of the shoulder during throwing
- Area of pain is lateral/posterior depending on muscles involved.
- Fatigue leads to instability
- More pressure on labrum leading to tears
- Repeated microtrauma leads to posterior impingement

# Treatment

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- Rest
- Physical therapy
- Return to throw program

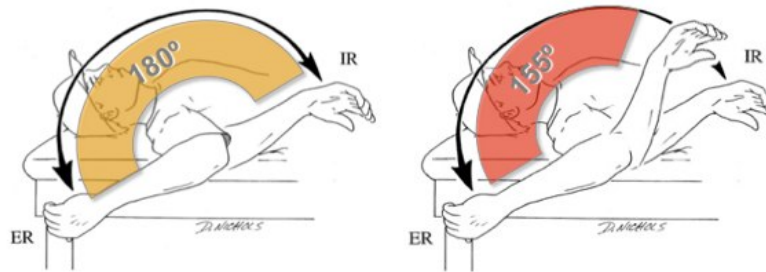
# Glenohumeral internal rotation deficiency (GIRD)

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- Repeated throwing leads to repetitive stress on the posterior capsule leading to thickening
- Increased thickening forces the humeral head anterior and superiorly which results in impingement of the RC and superior labrum

# Exam

- Player is placed supine and shoulder and elbow at 90 degrees
- Total arc is the total IR to ER and compared to the opposite side
- Difference of more than 20 degrees is considered abnormal



# GIRD

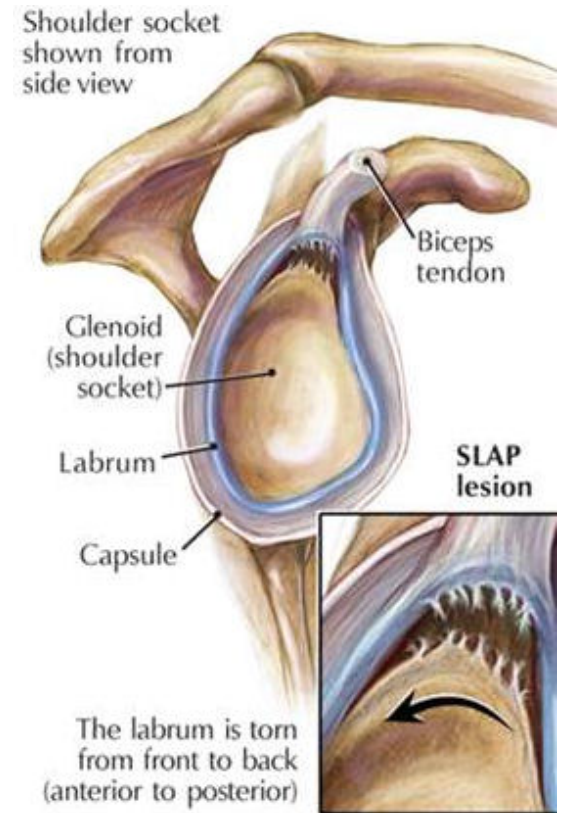
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- Player will complain of a deep pain in the posterior shoulder
- Unsure if GIRD increases the likelihood of more severe injury
- Treatment includes rest and PT in order to decrease the GIRD or increase the total arc.

# SLAP tears

## (Superior Labrum Anterior-Posterior)

- Most common labral tear
- Related to repeated shear forces
  - Fatigue and poor mechanics
- At late cocking the humerus is forced forward
- Deep pain
- Feels dead
- May lead to mechanical symptoms
- Treatment is surgery



# Elbow injury

## (Its not always the UCL)

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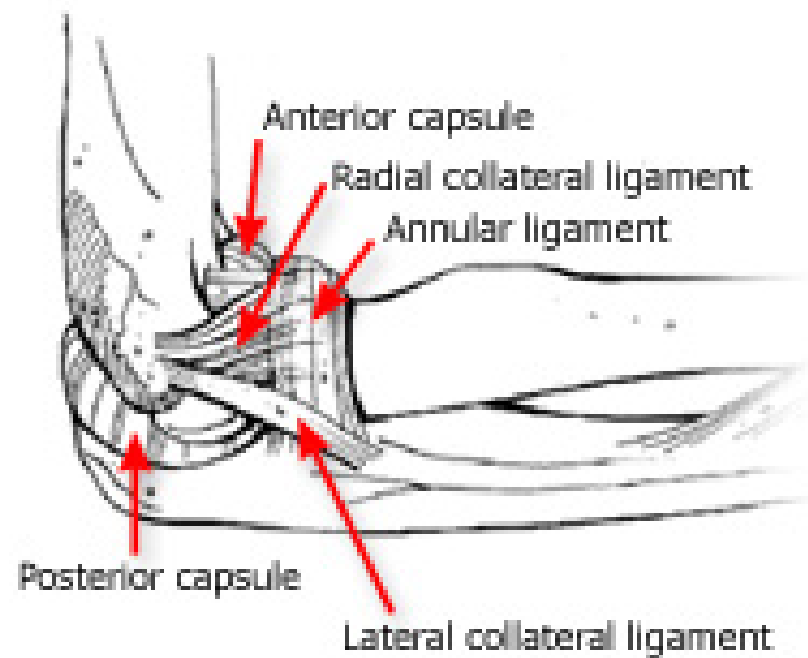
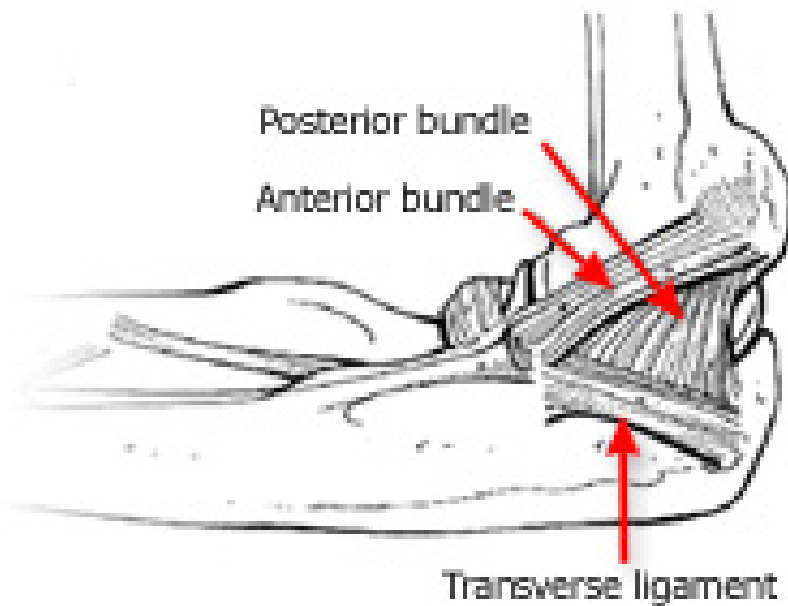
- UCL injury
- Little League Elbow (ulnar apophysitis)
- Valgus extension overload (VEO)
- Flexor tendonitis
- Olecranon Stress Fractures
- Ulnar neuritis
- Biceps tendonitis
- Triceps tendonitis



# The elbow

([orthoinfo.aaos.org](http://orthoinfo.aaos.org))

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# UCL tears

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- Important risk factors include pitching a high velocity (>80 mph), insufficient recovery time and overuse
- Other factors include poor throwing mechanics, late trunk rotation, reduced shoulder rotation arc, use of sidearm delivery and decreased shoulder flexion.
- Typical complaint is medial elbow pain during the acceleration phase.

# UCL tears

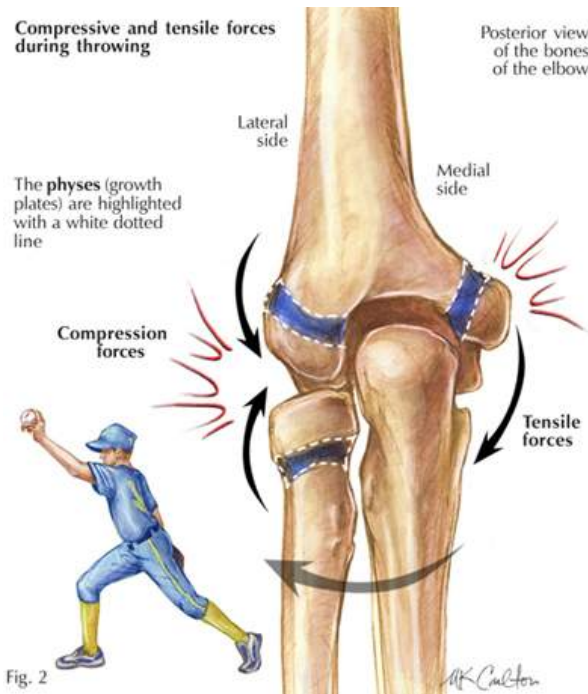
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- Usually occurs in older, high level throwers but increasing number of high-school aged players.
- In youth players UCL is much less common due to forces created.
- Chronic repetitive stress increases the likelihood of elbow injury and may be responsible for the increasing number of UCL surgeries among youth.
- Muscle fatigue increases the force transmitted on the UCL
- MR arthrogram is the test of choice for confirmation

# Little Leaguers elbow

## Medial apophysitis or avulsion fracture

- Most common in 9-14 year olds
- Kids age 12-14 (peak of adolescent growth spurt) may sustain avulsion fractures versus apophysitis
- During the cocking and acceleration phases the elbow experiences valgus and distraction forces, this repetitive stress leads to microtrauma.



# Little Leaguers Elbow

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- Pain is usually insidious
- Tenderness is medial and pain is elicited with valgus stress of the elbow
- Radiographic studies are often normal but comparison views may be obtained.

# Valgus extension overload syndrome (VEO)

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- Term refers to compression injuries of the posteromedial ulnohumeral articulation
- Excessive valgus force and UCL laxity predispose
- Typically tenderness over the posterior or posteromedial olecranon
- Pain in posterior elbow when ball is released
- Pain with valgus stress applied from 30 degrees flexion to end extension

# Olecranon stress fracture

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- May be transverse stress fracture (due to triceps stress) or oblique fracture (due to valgus loads)
- Pain is posterior and worse with resisted extension but not tender over the triceps
- May lack full extension
- Posterior pain when olecranon is engaged in the fossa (90 flexion or less)



# Common flexor tendon sprain

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- Pain is insidious in onset
- Tenderness is anterior and lateral to the medial epicondyle rather than over the UCL
- Pain with resisted wrist flexion and pronation
- No increase in pain with valgus stress of the elbow



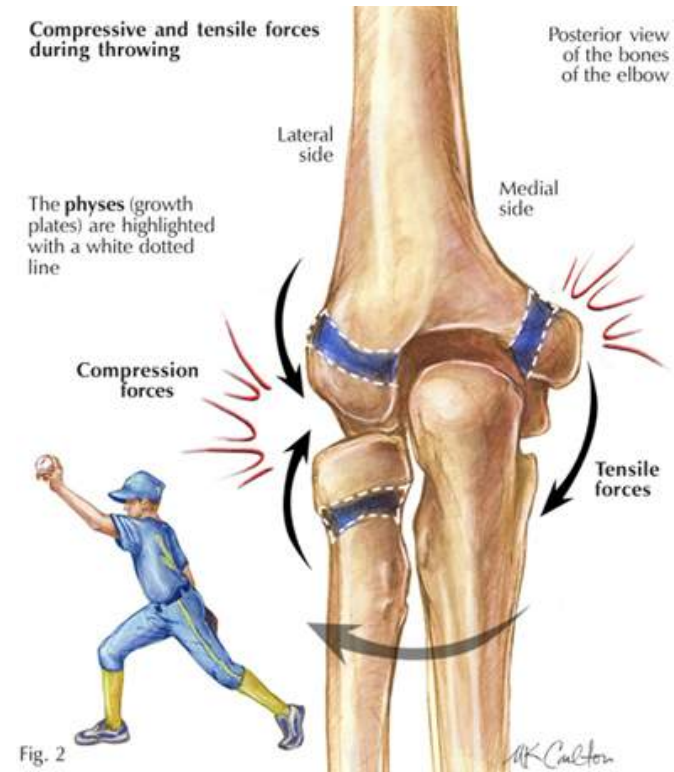
# Triceps tendinopathy

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- Pain is typically insidious with progressive worsening of pain with number of pitches.
- Tenderness is over the tendon or its insertion
- Pain is worse with resisted elbow extension

# Osteochondrosis of the elbow (Panniers disease)

- Most common cause of lateral elbow pain of young throwers (7- to 12-year olds)
- Focal lesion of the subchondral bone of the capitellum and cartilage
- Patients present with a swollen elbow and dull achy pain aggravated by throwing
- Radiographs show a fragmented capitellar ossification center



# Osteochondral defect of the elbow

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- Typically presents in 13- to 16 year olds.
- Pain is lateral elbow pain with throwing and may have episodes of locking
- Common findings include crepitus, joint effusion, and tenderness of the radiocapitellar joint.
- Diagnosis with plain radiographs and MRI used to stage the lesion

# Preventing Injury

## Proper Mechanics

(Fleisig GS, Andrews JR et al)

- Research has shown few differences between the biomechanics of youth pitchers and the mechanics of successful collegiate and professional pitchers
- Major difference is less force and torque and less consistent mechanics pitch-to-pitch
- Davis et al. (12) found that youth pitchers with better mechanics generated lower torques and loads on the throwing shoulder

## Avoid overthrowing

- Watch for signs of fatigue
- No overhead throwing of any kind for at least 2-3 months (4 preferred) per year.
- No pitching for 4 months per year
- Do not pitch >100 innings per year
- Avoid pitching on multiple teams
- Avoid radar guns
- A pitcher should not catch in the same game
- Pitch Counts

# Pitch Counts

## USAB-MSAC/ASMI

| Age                  | 2006 USA Baseball Guidelines        | 2010 Little League Baseball Regulations   |
|----------------------|-------------------------------------|---|
| <i>Daily Limits</i>  |                                     |   |
| 17-18                | N/A                                 | 105/day   |
| 15-16                | N/A                                 | 95/day  |
| 13-14                | 75/game                             | 95/day  |
| 11-12                | 75/game                             | 85/day  |
| 9-10                 | 50/game                             | 75/day  |
| 7-8                  | N/A                                 | 50/day  |
| <i>Weekly Limits</i> |                                     |   |
| 15-18                | N/A                                 | 31-45 pitches = 1 day rest<br>46-60 pitches = 2 days rest<br>61-75 pitches = 3 days rest<br>76+ pitches = 4 days rest |
| 13-14                | 125/week; 1000/season;<br>3000/year | 21-35 pitches = 1 day rest<br>36-50 pitches = 2 days rest<br>51-65 pitches = 3 days rest<br>66+ pitches = 4 days rest |
| 11-12                | 100/week; 1000/season;<br>3000/year |   |
| 9-10                 | 75/week; 1000/season;<br>2000/year  |   |
| 7-8                  | N/A                                 |   |

# Pitch Counts are great and all but..

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- An internet based survey of coaches conducted by Fazarale et al (11)
  - 73% reported that they follow the recommendations however only 43% of the questions were answered correctly
  - Coaches of 9- to 10-year old group answered 62% correct,
  - Coaches 11- to 12-year old group 35% correct
  - Coaches 13- to 14-year old group 42% correct

# Return to Throwing Program

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- Multiple different programs.
- Helps players return safely to the game.
- Progressively increases the distance of throwing with a minimum of one day off between each step
- Usually between 12-15 steps with pitchers taking longer.
- Should be guided by trainer, therapist or physician

# RTT protocol

www.orthonc.com

| 80' Phase  |   | 80' Phase         |   | 80' Phase        |   | 100' Phase  |  |
|--|---|-------------------|---|------------------|---|---|--|
| Step 1   | A) Warm-up Throwing<br>B) 80' (25 Throws)<br>C) Hand 5-10 min<br>D) Warm-up Throwing<br>E) 80' (25 Throws)  | Step 3            | A) Warm-up Throwing<br>B) 80' (25 Throws)<br>C) Hand 5-10 min<br>D) Warm-up Throwing<br>E) 80' (25 Throws)  | Step 5           | A) Warm-up Throwing<br>B) 80' (25 Throws)<br>C) Hand 5-10 min<br>D) Warm-up Throwing<br>E) 80' (25 Throws)  | Step 7  | A) Warm-up Throwing<br>B) 100' (25 Throws)<br>C) Hand 5-10 min<br>D) Warm-up Throwing<br>E) 100' (25 Throws)   |
| Step 2   | A) Warm-up Throwing<br>B) 80' (25 Throws)<br>C) Hand 5-10 min<br>D) Warm-up Throwing<br>E) 40' (25 Throws)<br>F) Hand 5-10 min<br>G) Warm-up Throwing<br>H) 40' (25 Throws)   | Step 4            | A) Warm-up Throwing<br>B) 80' (25 Throws)<br>C) Hand 5-10 min<br>D) Warm-up Throwing<br>E) 80' (25 Throws)<br>F) Hand 5-10 min<br>G) Warm-up Throwing<br>H) 80' (25 Throws)   | Step 6           | A) Warm-up Throwing<br>B) 80' (25 Throws)<br>C) Hand 5-10 min<br>D) Warm-up Throwing<br>E) 80' (25 Throws)<br>F) Hand 5-10 min<br>G) Warm-up Throwing<br>H) 80' (25 Throws)   | Step 8  | A) Warm-up Throwing<br>B) 100' (25 Throws)<br>C) Hand 5-10 min<br>D) Warm-up Throwing<br>E) 100' (25 Throws)<br>F) Hand 5-10 min<br>G) Warm-up Throwing<br>H) 100' (25 Throws) |
| <b>80' Phase</b>                                     |   | <b>100' Phase</b> |   | <b>80' Phase</b> |   | <b>100' Phase</b>   |  |
| Step 9   | A) Warm-up Throwing<br>B) 80' (25 Throws)<br>C) Hand 5-10 min<br>D) Warm-up Throwing<br>E) 80' (25 Throws)  | Step 11           | A) Warm-up Throwing<br>B) 80' (25 Throws)<br>C) Hand 5-10 min<br>D) Warm-up Throwing<br>E) 80' (25 Throws)  | Step 13          | A) Warm-up Throwing<br>B) 80' (25 Throws)<br>C) Hand 5-10 min<br>D) Warm-up Throwing<br>E) 80' (25 Throws)<br>F) Hand 5-10 min<br>G) Warm-up Throwing<br>H) 80' (25 Throws)   | <p>80' throws should be on an eye with a one-up</p> <p>Warm-up throws consist of 10-20 throws at approximately 10 feet</p> <p>Throwing Program should be performed every other day, 3 times per week unless otherwise specified by your physician or rehabilitation specialist.</p> <p>Perform each step 3 times before progressing to next step.</p> |  |
| Step 10  | A) Warm-up Throwing<br>B) 80' (25 Throws)<br>C) Hand 5-10 min<br>D) Warm-up Throwing<br>E) 100' (25 Throws)<br>F) Hand 5-10 min<br>G) Warm-up Throwing<br>H) 100' (25 Throws) | Step 12           | A) Warm-up Throwing<br>B) 80' (25 Throws)<br>C) Hand 5-10 min<br>D) Warm-up Throwing<br>E) 100' (25 Throws)<br>F) Hand 5-10 min<br>G) Warm-up Throwing<br>H) 100' (25 Throws) | Step 14          | A) Warm-up Throwing<br>B) 80' (25 Throws)<br>C) Hand 5-10 min<br>D) Warm-up Throwing<br>E) 100' (25 Throws)<br>F) Hand 5-10 min<br>G) Warm-up Throwing<br>H) 100' (25 Throws) |   |  |
| <b>Flat Ground Throwing for Baseball Pitchers</b>    |   |                   |   |                  |   |   |  |
| <b>Step 14</b>                                       |   | <b>Step 15</b>    |   | <b>Step 16</b>   |   |   |  |
| A)   | Warm-up Throwing  | A)                | Warm-up Throwing  | A)               | Warm-up Throwing  |   |  |
| B)   | Throw 80' B (10-15 Throws)  | B)                | Throw 80' B (10-15 Throws)  | B)               | Throw 80' B (10-15 Throws)  |   |  |
| C)   | Throw 80' B (10-15 Throws)  | C)                | Throw 80' B (10-15 Throws)  | C)               | Throw 80' B (10-15 Throws)  |   |  |
| D)   | Throw 100' B (10-15 Throws)   | D)                | Throw 100' B (10-15 Throws)   | D)               | Throw 100' B (10-15 Throws)   |   |  |
| E)   | Throw 80' B (flat ground using pitcher's mechanics) (10-15 Throws)  | E)                | Throw 80' B (flat ground using pitcher's mechanics) (10-15 Throws)  | E)               | Throw 80' B (flat ground using pitcher's mechanics) (10-15 Throws)  |   |  |
|  |   |                   |   | F)               | Throw 80' B (10-15 Throws)  |   |  |
|  |   |                   |   | G)               | Throw 80' B (flat ground using pitcher's mechanics) (10-15 Throws)  |   |  |
| <b>Progress to Phase II - Throwing Off the Mound</b> |   |                   |   |                  |   |   |  |

- 80' feet = 13.7 meters
- 80' feet = 15.2 meters
- 80' feet = 27.4 meters
- 100' feet = 30.5 meters
- 100' feet = 45.7 meters
- 100' feet = 54.9 meters



# What do we have to do?

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- Pitch counts!!!
  - I believe that it is our responsibility to educate the coaches, parents and kids.
- Proper Mechanics
  - Reduces stress on the arm
  - Increases number of strikes
  - Reduces the total number of pitches

# Thank you!

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Questions?

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