Elbow Injuries in Throwing Athletes

Background
1. General information
   o Elbow injuries are common during throwing
   o Baseball
   o Softball
   o Football
   o Javelin
   o Tennis
2. Anatomy
   o Bones
     • Humerus: medial epicondyle, lateral epicondyle, capitellum, trochlea
     • Radius: radial head
     • Ulnar: olecranon
   o Ligaments
     • Ulnar collateral ligaments
     • Anterior: most common site of ligament injury
     • Posterior
     • Transverse
     • Radial collateral ligament
     • Annular ligament of radius
   o Articulations
     • Flexion/extension: ulnohumeral joint
     • Supination/pronation: radiohumeral, proximal radioulnar joints
   o Elbow illustrations

Pathophysiology
1. Pathophysiology
   o Biomechanics
     • History and Physical Exam of the Shoulder—Six phases of throwing
   o During throwing:
     • Arm moves from external rotation to internal rotation
       • Creates large valgus and extension forces
     • Medial aspect of elbow—distraction force
     • Lateral aspect of elbow—compression force
     • Posterior aspect of elbow—shear stress
     • Bony structures provide primary support during <20° and >120° elbow flexion
     • Soft tissues provide primary support from 20° to 120° elbow flexion
2. Risk factors
   o Common in throwing athletes—overuse injuries
   o Musculoskeletal immaturity
   o Improper throwing mechanics
   o Prolonged competitive throwing (>9 months)
   o Increased body height/weight
     • Higher pitch velocity
   o Decreased self-satisfaction/self-esteem
     • More likely to continue to throw with pain to prove themselves
Impact of throwing breaking pitches at young age is unclear

**Diagnostics**

1. Diagnostics
   - History
     - Age
       - Skeletal maturity in children
       - Arthritis in older athletes
     - Dominant hand
     - Mechanism of injury
       - Acute injury: trauma, pop, crack, or snap sensation
       - Chronic injury: Repetitive activity, weakness, decreased range of motion
     - Pain
       - Location, character, onset, duration, intensity, exacerbating/relieving factors
     - Medial elbow injury
       - 85% of athletes will experience pain during acceleration phase
       - 25% of athletes will experience pain during deceleration phase
     - Neurovascular complaints
       - Weakness, numbness, tingling, paresthesias
     - Instability/dislocation
     - Changes in velocity, accuracy, strength, stamina
     - Changes in training regimen
     - Work/daily activities - may exacerbate sport related condition
     - Medications
     - Past medical history
       - Prior elbow problems/injuries
     - Family history
     - Review of systems
     - Other joint injuries
     - Recent illness:
       - Viral/bacterial infection may cause arthritis
   - Physical exam
     - Elbow exam
     - Inspection
       - Gross deformity, asymmetry, muscle atrophy/hypertrophy, ecchymosis, edema, abrasion
       - Physiological cubitus valgus range
         - Up to 11° in men
         - Up to 13° in women
         - May be >15° in professional throwers
       - With forearm in 90° flexion, lateral epicondyle, medial epicondyle and olecranon process form an isosceles triangle
         - Absence suggests posterior dislocation
     - Palpation
       - Anterior
         - Biceps tendon at antecubital fossa
         - Absence of tendon-biceps tendon rupture
- Tenderness and ecchymosis-biceps tendon rupture
  - Posterior
    - Olecranon process, olecranon bursa, triceps brachii tendon
    - Focal swelling/tenderness-olecranon bursitis
    - Effusion with ecchymosis-consider olecranon fracture
    - Palpate for osteophytes/loose bodies
  - Medial
    - Medial epicondyle, ulnar collateral ligament, medial flexor-pronator
    - Bony tenderness-avulsion fracture or growth plate injury
    - Pain in medial flexor-pronator muscle-consider ligament laxity
  - Lateral: Lateral epicondyle, radial head, capitellum
    - Pain may indicate fracture, annular ligament injury, osteochondritis dissecans of capitellum

- Range of motion
  - Flexion/Extension
    - Normal range of motion 0°-150°
    - Adult throwers rarely hyperextend at elbow
    - Children may hyperextend to 10°-15°
  - Pronation/supination
    - Examine with elbow in 90° flexion
    - Normal range of motion 80° in each direction
  - Crepitus or pain may indicate chondral irregularity or loose body
  - End-feel range of motion testing
    - Normal end-feel sensation in extension is firm bone to bone
    - Normal end-feel sensation in flexion is soft muscle to muscle
    - Bony end-feel flexion may be due to osteophyte or loose body

- Stability
  - Valgus stress test: ulnar collateral ligament
    - Performed in supinated position with elbow in 20° flexion to free olecranon process from fossa
  - Varus stress test: lateral collateral ligament
    - Performed in a pronated position with elbow in 20° flexion to free olecranon process from fossa
  - Normal laxity of elbow is usually within 0.5 mm of opposite elbow
  - No numerical value exists that accurately predicts elbow ligament injury
  - Lateral instability uncommon in throwers in absence of elbow dislocation

- Neurovascular exam
  - Gentle palpation of ulnar nerve should not cause discomfort
  - Check sensation in dermatome of median, radial, ulnar, musculocutaneous nerves
  - Evaluate strength
  - Check deep tendon reflexes
    - Biceps (C5), brachioradialis (C6), triceps (C7)
    - Check brachial, radial, ulnar pulses
  - Capillary refill
Neck and shoulder exam
- Pain from cervical radiculopathy or rotator cuff pathology may be referred to elbow

Diagnostic imaging
- Plain radiographs
  - AP, lateral, axial, and 2 oblique views
  - Oblique axial view with elbow in 110°
    - Best for olecranon osteophytes
  - Valgus stress radiography to assess instability
  - Calcific tendons suggest past injury
  - Avulsion or Salter-Harris fractures in children
  - May be helpful to image uninvolved elbow for comparison

Bone scan / CT scan
- Stress fracture, fracture line, or sclerotic bone reaction

MRI
- Soft tissues, occult fractures, and osteochondritis dissecans
- MRI arthrogram to evaluate ulnar collateral ligament tear

Differential Diagnosis
1. Key DDx
   - Ulnar collateral ligament tears
     - Persistent pain or instability from repetitive throwing
     - With acute injury-sharp popping sensation often felt
     - For pain relief
       - Brace/splint, NSAIDs, ice
     - May be treated non-surgically with rest/prolonged rehabilitation
     - If patient wishes to return to strenuous throwing activity, repair or replacement surgery is required
   - Ulnar neuropathy
   - Little League Elbow/medial epicondyle apophysitis/avulsion
   - Epicondylitis-medial and lateral
   - Posterior elbow dislocation
   - Radial head and neck fractures
   - Flexor-pronator muscle strain
   - Valgus extension overload syndrome with olecranon osteophytes
   - Olecranon bursitis
   - Olecranon fractures/Olecranon stress fractures
   - Osteochondritis dissecans of capitellum
   - Loose bodies

2. Extensive DDx
   - Anterior
     - Anterior capsule strain
     - Biceps tendinitis/rupture
     - Medical nerve compression syndrome
     - Radiculopathy (C5-6)
   - Posterior
     - Calcific tendinopathy
     - Olecranon impingement
     - Radiculopathy (C7, T1-2)
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- Triceps tendinitis or rupture
  - Medial
    - Medial epicondyle fracture
    - Radiculopathy (C8, T1)
  - Lateral
    - Musculocutaneous nerve entrapment
    - Panner's disease
    - Posterior interosseous nerve syndrome
  - Radial nerve syndrome
    - Radiculopathy (C5-6)

Prevention
1. Pre-screening physical examination and patient education
2. Proper throwing biomechanics
3. Close monitoring of pitch counts, pitch types, rotation schedule, number of innings per week and per season
4. Strengthening/flexibility conditioning during off-season
   - At least 6 weeks prior to beginning of season
5. Gradual functional progression in intensity and duration
6. Self-awareness and early referral to health provider

Patient Education
1. Little League-Pitch Count page:
   http://www.littleleague.org/Learn_More/rules/pitch_count_resource_page.htm
2. Throwing Injuries: http://www.throwinginjuries.com/

References
2. Chorley, J. Elbow injuries in the young athlete. UpToDate, 2008
11. http://www.littleleague.org/Little_League_Online.htm

Author: Richard Lee, MD, Penn State Hershey Medical Center, PA

Editor: Carol Scott, MD, University of Nevada Reno FPRP