Common Elbow, Wrist, and Hand injuries in Youth Sports

Jamie Monica, MD
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I have no disclosures
Elbow injuries
Epidemiology

Sports participation, circa 2000
- >25 million school-sponsored
- >20 million extracurricular

Unique considerations in children/adolescents
- Skeletal immaturity
- Muscle strength, coordination
- Poor technique, mechanics
- Overuse, high intensity
Sports-Specialized Intensive Training and the Risk of Injury in Young Athletes: A Clinical Case-Control Study.

- 1200 youth athletes
- Early specialization in a single sport is one of the strongest predictors of injury
- Athletes in the study who specialized were 70% to 93% more likely to be injured than children who played multiple sports


Jayanthi NA¹, LaBella CR², Fischer D³, Pasulka J⁴, Dugas LR³
Recommendations

Medical and Safety Advisory Committee for USA Baseball

Pitches per game

- Age 8-10: 52 +/- 15
- Age 11-12: 68 +/- 18
- Age 13-14: 76 +/- 16
- Age 15-16: 91 +/- 16
- Age 17-18: 106 +/- 16
Anatomy

Skeletal considerations

- Children ≠ small adults
- Presence of secondary ossification centers
- Physeal stress injuries
- 50% stability

Medial ligaments

- Anterior bundle (1° <90°)
- Posterior bundle (1° >90°)
- Transverse ligament

Tensile forces medial, compressive lateral
Biomechanics of Pitching

6 phases of throwing

- Acceleration: 40-50msec, up to 600,000 deg/sec
- Deceleration: 50msec, up to 500,000 deg/sec
Biomechanics of Pitching

Adults

- Elbow valgus stress ~ 65 Nm, highest during cocking
- Shoulder tensile stress ~ 1,100 Nm, highest during release
Physical Examination

Inspection
• Swelling
• Ecchymosis

ROM
• Flexion-extension
• Pronation-supination

Palpation

Neurologic
• Motor
• Sensory
Physical Examination

Valgus instability

• Anterior bundle (A)
  – Elbow flexed 20-30°
  – Valgus stress

• Posterior bundle (B)
  – Elbow flexed 90°, forearm supinated
  – Pull outward on thumb
“Little Leaguer’s Elbow”


- Nonspecific term
- Applied to a number of different clinical entities

More specific diagnosis preferred
“Osteochondritis Dessicans”

Ages 10 – 14 years

Repetitive compression loading + vulnerable chondroepiphyseal blood supply → abnormalities in osteochondral surface

Presentation

• Pain, stiffness
• Loose bodies → catching, locking
“Osteochondritis Dessicans”

Diagnosis
- Radiographs
- MRI

Classification
- Multiple
- Radiographic, arthroscopic
- Defilice et al., 2001
- Keys: cartilage integrity, fragment stability

Table 1
Classification of OCD of the Capitellum

<table>
<thead>
<tr>
<th>Type</th>
<th>Intact/Unstable</th>
<th>Intact articular cartilage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ia</td>
<td>Intact/Stable</td>
<td>Intact articular cartilage</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No loss of subchondral stability</td>
</tr>
<tr>
<td>Ib</td>
<td>Intact/Unstable</td>
<td>Intact articular cartilage</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unstable subchondral bone with impending collapse</td>
</tr>
<tr>
<td>II</td>
<td>Open/Unstable</td>
<td>Cartilage fracture</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Collapse or partial displacement of subchondral bone</td>
</tr>
<tr>
<td>III</td>
<td>Detached</td>
<td>Loose cartilagenous fragments within joint</td>
</tr>
</tbody>
</table>
“Osteochondritis Dessicans”

Treatment

• Stable lesion
  – Rest, NSAIDs, PT
  – Drilling *in situ*

• Unstable lesion
  – Arthroscopy vs. arthrotomy
  – Debridement
  – Internal fixation
  – Loose body excision
  – Marrow stimulation
Panner’s Disease


<10 years of age

Fissuring $\rightarrow$ irregularity $\rightarrow$
fragmentation $\rightarrow$
reossification $\rightarrow$
remodeling, resolution of symptoms

Entire capitellar involvement

Self-limiting

“Perthes of the elbow”
Olecranon Apophysitis

Traction apophysitis due to repetitive forceful extension

Diagnosis: PE, XR

Treatment

- Nondisplaced: rest, PT
- Displaced: ORIF
Medial Epicondylitis

“Golfer’s elbow”

Pathophysiology

• Repetitive valgus stress → inflammation of flexor-pronator origin

Diagnosis

• PE, MRI

Treatment

• Rest, NSAIDs, bracing
• Injections?
• Debridement
Medial Epicondyle Fracture

In skeletally immature athletes, may have physeal injury/avulsion.

Diagnosis: XR, MRI
- Physeal widening

Treatment
- Nondisplaced: rest, PT
- Displaced: ORIF?
Ulnar Neuropathy

Pathophysiology
• Traction, compression, mechanical irritation

Diagnosis
• PE: neuro, subluxation, elbow instability
• EMG/NCV (dynamic)

Treatment
• Rest, NSAIDs
• Decompression vs. transposition
  – Subcutaneous
  – Submuscular
• What is the main difference between Panner’s disease and OCD lesion of the elbow?

• A. Panner’s disease is associated with other comorbidities.
• B. OCD has a favorable prognosis.
• C. Panner’s disease occurs in patients under 10.
• D. Patients with Panner’s disease often do not have pain.
Wrist Injuries
Wrist injuries

Variable presentations

Sport-specific

Special considerations in competitive athletes
- Return to play
- Performance expectations
- Protective/assistive devices
- Psychosocial
- Financial
Epidemiology

Little information regarding incidence and prevalence

Torjussen et al, AJSM, 2005
• 12% wrist/hand injuries in elite snowboarders

Logan, BJSM, 2004
• 28% wrist/hand injuries in rock climbers

Jacobson et al, JOSPT, 2004
• 16% wrist/hand injuries in cheerleaders

Similar numbers in other sports
• Basketball
• Skating
• Soccer
• Gymnastics
Anatomy

Complex

Bony elements
• 5 metacarpals
• 8 carpal bones (SLTPTTCH)
• Radius, ulna
• 6 major articulations

Soft tissues
• Ligaments
• Cartilage
• Tendons
• Muscles
• Nerves
Anatomy

Don’t forget the DRUJ!
Anatomy

Ligamentous contribution to wrist stability, function

• Extrinsic ligaments
• Intrinsic ligaments
  – Scapholunate ligament
Physical examination: observation

- Deformity
- Swelling
- Ecchymosis
- Wounds
Physical examination

**ROM**
- Flexion-extension
- Pronation-supination
- Radial-ulnar deviation

**Grip strength**
- Different settings → different muscle groups

**Pinch strength**
Physical examination: palpation
Radiographic evaluation

Expedited diagnosis critical

Earlier utilization of radiographic imaging to guide treatment

Common modalities

• Plain radiographs
• Computed tomography (CT)
• Magnetic resonance imaging (MRI)
• Fluoroscopy
• Anesthetic arthrogram
Distal radial physeal injury

The “gymnast’s wrist”
• Sport-specific demands
• Wrist as weight-bearing joint
• Repetitive compressive and tensile loading
• Distal radial physeal arrest
• Abnormal biomechanics
Distal radial physeal injury

Axial loads at wrist

- 80% radiocarpal, 20% ulnocarpal
- 2mm ulnar positive variance -> 42% ulnocarpal load
- 2mm ulnar negative variance -> 4% ulnocarpal load
Distal radial physeal injury

Consequences:

- Abnormal wrist mechanics
- Ulnocarpal impaction
- TFCC tears
- DRUJ instability

Pain, functional limitations
Distal radial physeal injury

Treatment

- Wrist arthroscopy
- TFCC repair
- Ulnar shortening osteotomy
Scaphoid fractures

Most commonly fractured carpal bone

- Fall onto outstretched hand, wrist extended
- Pain, swelling
- Tenderness at anatomic snuffbox or scaphoid tubercle
Scaphoid fractures

Difficulties in radiographic diagnosis
- Complex shape of the scaphoid
- Proximal row kinematics with wrist motion
- “scaphoid view” with ulnar deviation of wrist
- “radiographically occult” fractures
Scaphoid fractures

Challenges:
• Difficult to diagnose
• Require long time for healing (2-3 months)
• Significant nonunion rate
• Risk of osteonecrosis
• Risk of arthrosis
Scaphoid fractures

Nondisplaced fractures

- Cast or Percutaneous screw fixation

Bond et al., JBJS, 2001

- Nondisplaced fractures
- Screw vs. cast
- Healing at 7 vs. 12 weeks
- Return to military duty at 8 vs. 15 weeks
Scaphoid fractures

Displaced fractures
• Risk of nonunion
• Risk of arthrosis
• Treatment: ORIF!

Nonunion, osteonecrosis
• ORIF with bone graft
• Vascularized bone graft
• Salvage procedures
Hook of hamate fractures

2-4% of carpal fractures
Common in baseball, golf, racquet sports
Acute: Pain, ecchymosis, limited grip strength
Late: ulnar nerve paresthesias, rupture of RF and SF flexor tendons
Hook of hamate fractures
Hook of hamate fractures

Treatment:
• **Acute**
  – Cast/splint immobilization
  – Excision
• **Chronic**
  – ORIF
  – Excision
• **Postop recovery**
  – ROM at 1 week
  – Sports at 6-8 weeks
  – Painful scar!
TFCC tears

What is the TFCC?

• Triangular fibrocartilage complex
• Multiple components
  – ECU subsheath
  – Ulnar collateral ligament
  – Meniscal homologue
  – Articular disk/ TFC
  – DRUL/ PRUL
  – UL/ UT ligaments
TFCC tears

Presentation
• Ulnar wrist pain
• Pain with forceful grip or ulnar deviation
• +/- DRUJ instability

Radiographic imaging
• Xrays for ulnar styloid fracture
• Arthrography
• MRI
TFCC tears

Why is this a problem?
• Pain
• Instability
• Hallmark of other problem

Treatment:
• Debride
• Repair
• Treat underlying cause!
Ulnar styloid fractures

Often associated with distal radius fractures
Present with painful nonunion

Treatment considerations
- Size of fragment
- TFCC tear
- DRUJ stability
Ulnar styloid fractures

Treatment

- Small fragment, stable DRUJ, no TFCC tear
  - excise

- Large fragment, unstable DRUJ or TFCC tear
  - ORIF
  - excision + repair of DRUJ or TFCC
SL ligament tears

Scapholunate ligament
• Critical in wrist kinematics, linking scaphoid to lunate
• Fall onto outstretched hand
• Tear $\rightarrow$ pain, instability
• Failure leads to predictable progression to early wrist arthritis
SL ligament tears

Radiographic evaluation

- Widening of SL interval (>3mm)
- Cortical ring sign
- Trapezoid shape of lunate
- Increased scapholunate angle (>60 degrees)
SL ligament tears
DRUJ instability

“The forgotten joint”
Complex; difficult to diagnose
Instability usually associated with distal radius or ulnar styloid fracture, TFCC injury
Pronation → ulna goes dorsally

Radiographic evaluation
• Plain radiographs
• CT (in multiple positions)
• +/- MRI
ECU tendinosis

Common wrist tendinosis in athletes

- Racquet sports
- Rowing

Ulnar wrist pain, swelling, tenderness

Check for ulnar styloid fracture

Treatment

- Splinting
- Rest
- NSAID’s
- Steroid injection
- Technique modification
ECU subluxation

Acute injury > overuse

Examination
- Ulnar deviation, supination, flexion
- Injection test

Acute treatment
- Casting in pronation and wrist extension

Surgical treatment
- Repair vs. reconstruction
What is the treatment for negative scaphoid x-rays in a patient with snuffbox tenderness?

A. ORIF  
B. Thumb spica cast or splint and referral to a hand specialist  
C. Immediate MRI  
D. Repeat x-rays in one day after immobilization
Hand Injuries
Epidemiology


- Review of 382 hand injuries over 8 months, urban pediatric ER
- Lacerations (30%), fractures (16%), infections (4%)
- <2 years: fingertip injuries
- 12-16 years: sports-related hand injuries
Epidemiology

Hastings & Simmons, *Clin Orthop*, 1984

• 354 pediatric hand fractures, 2 year follow-up

• Small percentage of injuries -> large percentage of complications and poor outcomes

• Malunion risks
  – Failure to obtain adequate x-rays
  – False assumptions about remodelling
Epidemiology
Epidemiology

Hastings & Simmons, *Clin Orthop*, 1984

- Problem fractures:
  - Open
  - Displaced articular
  - SH I of distal phalanx
  - Phalangeal neck

- **Key:** recognition of problematic injuries
Unique considerations

Challenges in examination

Presence of physis

Small size of musculo-skeletal structures

Need for more restrictive immobilization
Skeletal anatomy
Extensor tendons
Flexor tendons

FDP and FDS tendons

Camper’s chiasm

Vascular supply
• vinculae
Examination: observation

- Deformity
- Swelling
- Ecchymosis
- Wounds
Examination: observation

Digital cascade to assess rotation
Tenodesis effect
Examination: flexor tendons

FDP tendon -> DIP joint flexion
FDS tendon -> PIP joint flexion
• Immobilize other digits to eliminate FDP muscle belly
Examination: extensor tendons

Terminal tendon -> DIP

Central slip -> PIP

Sagittal bands -> MCP

Intrinsic muscles ->
  • MCP flexion
  • IP extension
Examination: nerves

Digital nerves (Radial and ulnar)
• 2-point discrimination
• Threshold testing
• Warm immersion testing

Median
• Opposition, finger flexion

Ulnar
• Pinch, crossing fingers

Radial
• Finger extension
Examination: arterial
Fractures

- Non-physeal (64%)
- Non-displaced (55%)
- Closed (95%)

Salter-Harris classification of physeal fractures
Mallet injuries

Axial load, hyperflexion
Closed treatment: splint in extension
In skeletally immature, physeal separation, may require open treatment
Joint must be reduced
Mallet injuries
Seymour’s fracture*

Physeal fracture of distal phalanx with nailbed laceration

• Incarceration of germinal matrix

High index of suspicion

Requires nail removal, I&D, nailbed repair, fracture reduction
Phalangeal neck fractures*

Common

“Doorjamb” injury

X-rays findings subtle

Closed treatment -> little remodelling, poor flexion

Requires surgery
Phalangeal neck fractures*
Intercondylar phalangeal fracture

Any displacement in any joint of the hand is indication for hand surgery consultation

“Flake” of bone in joint is osteochondral fragment until proven otherwise
Phalangeal shaft fracture

Assess for rotational malalignment!

Most amenable to closed reduction, immobilization

Unstable, irreducible injuries require surgical stabilization
Phalangeal physeal fractures

Salter-Harris II of small finger most common
  • “extra-octave” fracture
  • Usually amenable to closed reduction
  • Check x-rays after buddy taping
  • Cast immobilization
Metacarpal neck fractures

“Boxer’s fracture”
Proximal to MC head, usually of small finger
Axial load
Excellent remodelling potential
Usually treated non-operatively
Metacarpal shaft fractures

Check angulation and rotation
Usually treated non-operatively
Higher risk of malunion
- Multiple MC fractures
Irreducible or malaligned fractures -> surgery
Salter-Harris III of thumb P1

Pediatric equivalent to adult “gamekeeper’s”
May require surgical treatment
Base of thumb metacarpal fracture

Excellent remodelling potential

Treated with thumb spica cast immobilization
Hyperextension injury
X-rays: small fleck of bone proximal aspect of middle phalanx
Excessive immobilization leads to joint stiffness
• Buddy tape to adjacent finger, early motion
IP joint dislocations

Usually dorsal
Splint in flexion after reduction
Refer for early follow-up with hand surgeon
MCP joint dislocations

Simple
• Easily reduced
• Splint immobilization
• Early follow-up

Complex – Irreducible
• Soft-tissue interposition
• Bayonet deformity typical
• Require surgical reduction
Closed tendon injuries*

“Jersey finger”
- FDP avulsion off P3 +/- bony fragment
- Ring finger most common
- Diagnose, splint, early follow-up
- Delayed treatment -> complications
Summary

Thorough examination critical
- Tenodesis/digital cascade
- Neurovascular status
- Appropriate x-rays

Joint displacement unacceptable
Avoid overtreatment of volar plate injuries
Close all wounds loosely (absorbable sutures)
How soon should a “Jersey” finger be referred to a hand specialist?
A. Never— I can take care of that, I practice in Jersey.
B. I should refer them to the ED.
C. Within one week
D. Within 2 weeks
Thank You