Elbow Anatomy, Growth and Physical Exam

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Contributing Factors to Elbow Injury

- The elbow is affected by upper core strength and mobility
- Shoulder weakness can put patients at risk for elbow problems
  - Particularly relevant to sports that sustain larger forces across elbow
- Elbow also vulnerable to improper technique
Growth and development

• Children grow from specific areas at the end of the bone

• Cartilage of growth plates not as strong as bone, tendon or ligament
  – More vulnerable to stresses
  – Prolonged stress to growth plate can cause stress injury
Histology of the Growth Plate

- Resting Zone
- Zone of Proliferation
- Zone of Hypertrophy
- Metaphysis
Growth and development of the arm

- Humerus:
  - Proximal growth plate – 80% of growth
Growth and development of the arm

- **Distal humerus**
  - 20% of growth
  - Multiple growth centers of elbow region make elbow vulnerable to injury

- **Radius and Ulna:**
  - Proximal growth plate
    - 30% of growth
  - Distal growth plate – 70% of growth
Immature Elbow

- Stress areas
  - Differ by
    - Age
    - Sport
- 6 growth areas in the immature elbow
Elbow Ligaments

• Medial
  – Collateral ligament
  – Arises from medial epicondyle

• Lateral
  – Ligament complex
  – Arises from lateral epicondyle
Medial ligaments

- Medial collateral ligament
  1. Anterior bundle
     - Most significant
  2. Posterior bundle
     - Fan-shaped
     - Weaker
  3. Transverse ligament
     - Ulna attachment only
Lateral ligaments

- Lateral complex
  1. Annular ligament
  2. Radial collateral
  3. Lateral ulnar collateral ligament
  4. Accessory lateral collateral ligament
Physical Examination

• Inspection
  – Carrying angle
    • Normal is 11-13 degrees
    • Always compare to contralateral side
  – Swelling or bruising
    • Normal x-rays in setting of significant swelling/bruising concerning
      – Worry about missed elbow dislocation
Physical Examination

• Range of motion
  – Normal is 0-145°
    • Many kids can have up to -15°
    • Always compare to contralateral elbow
  – Lack of extension worrisome
    • May indicate loose body
    • If chronic, often associated with unstable OCD
  – Lack of flexion also concerning
    • Often loose body, OCD
  – Also evaluate forearm rotation
Physical Examination

- Tenderness
  - Radiocapitellar joint
  - Radial head
  - Anterior capitellum
  - Medial epicondyle
  - Medial collateral ligament
  - Olecranon
  - Mobile wad
  - Flexor-pronator mass
Physical Examination

– Muscle strength
  • Biceps, brachialis, triceps
  • Pronation, supination
  • Wrist flexion, extension

– Evaluate for effusion
Physical Examination

• Ligamentous testing for instability
  – Varus/valgus stress
    • Usually done at 30°
      – Tests collateral ligaments
      – Best for medial instability (valgus stress)
  – Moving valgus stress test
    • Valgus stress during range of motion
      – Start flexed and quickly extend
      – Pain between 70° and 120°
  – Lateral pivot-shift
    • Elbow supinated in extension, apply valgus stress and axial compression while flexing
    • Evaluates posterolateral rotatory instability
      – Difficult to do on awake patient
Physical Examination

• Provocative tests for lateral instability
  – Table-top relocation test
    • One arm press-up, forearm in supination
      – Apprehension at $40^\circ$
      – Relieved by thumb pressure on radial head
  – Chair sign
    • Seated with elbows flexed $90^\circ$, forearms supinated
    • Push off of chair just with arms
    • Apprehension vs. dislocation
  – Active floor push-up sign
    • Like chair sign, only doing push-up
Physical Examination

- Provocative tests for medial instability
  - Milking maneuver
    - Opposite hand under elbow, grasp thumb and pull into valgus stress while elbow flexed past $90^\circ$
    - This produces pain localized to anterior bundle
  - VEO test
    - Valgus extension snap maneuver
    - Patient seated, valgus stress on elbow, palpate medial tip of olecranon, move from $30^\circ$ to $0^\circ$ reproduces pain
Physical Exam

• Careful examination of shoulder stabilizers and upper core
  – Often weakness here leads to use of elbow valgus to stabilize in extension during tumbling/vaulting

• Any treatment (nonoperative or operative) should include strengthening of shoulder stabilizers and upper core