Trouble in Pediatric Elbow Fractures

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CASE #1

- 7 year old child fell jumping from couch
- Pain and swelling around elbow
- X-rays
- Where’s the trouble?
CASE #2

- 5 year old female fell off the monkey bars
- Pain at R elbow
- Ecchymosis of antecubital fossae
- Pink extremity, warm, no palpable pulse
- Trouble?
Case #2
Case #2
Supracondylar Fractures

- Peak age 5-8 years
- Males > Females (2:1)
- Left > Right (61% / 39%)
- Open Fractures (1%)
- Rare “floating elbow”
- Nerve injury 7% all fractures, up to 49% of type III fractures (Waters, et al)
Supracondylar Fractures

• Highest rate of complications of any pediatric fracture
  – Malunion
  – Neurovascular Impairment
  – Compartment Syndrome
Tip #1: Get the x-rays right

Lateral x-rays:
- ANTERIOR humeral line, “teardrop”

AP x-ray
- Baumann’s angle
  - 9-26 deg
  - Need true AP distal humerus 90deg beam
Tip #2: Know fracture type

- Direction of displacement:
  - extension type (98%)
    * posterior - medial
    * posterior - lateral
  - flexion type

- Amount of displacement / stability
  - Gartland Types I/II/III/IV

*** Floating Elbow
Type I

- Non-displaced
- Positive fat pad sign on lateral (posterior)
- Symmetric Baumann’s angle and humeral condylar line
- Stable
Type II

- Displaced with posterior cortex intact
- Requires reduction
  - Flexion/Hyperpronation
  - Not always
- Malunion risk
  - Lateral condyle fractures
  - Loss of function
  - Cubitus Varus
Type III / IV

TYPE III / IV

• III
  – Displaced with no cortical contact

• IV
  – Extension to flexion type

• High risk of complications
Flexion Type

• Different reduction maneuver
• Trouble is lack of extension and varus
Non-Op Closed Reduction

• < 120 deg flexion casting
  – Loss of reduction >50%
• (Millis CORR 1984)
  – Volkman’s ischemia
    (Kurer CORR 1990)
• Cast < 90 degs
  (Pirone JBJS 1988)

TROUBLE:
  – rotational deformity
  – coronal malalignment
  – significant extension
    (Spencer JPO 2012)
Percutaneous Pinning

- **History:**
  - Miller (1939), Swenson (1948)
- **Best results, rare complications**
  - (Flynn 1986)

- Minimal to no risk of physeal arrest
- Low rate of malunion
- Iatrogenic ulnar nerve injury with medial pin <3% (Royce 1991)
- Pin tract infection (0-7%)
Pin Placement

– 3 lateral entry pins
  • greatest combination of torsional and bending stiffness
  • With medial comminution, adding a medial pin increased torsional stiffness and bending stiffness (Silva, 2013)

– Spread and divergence

– Ulnar nerve iatrogenic injury - healthy debate
Open Reduction Pediatric Supracondylar Fractures

- Open fracture
- Neurovascular entrapment
  - Immediately remove pins
- Inability to obtain a closed reduction
- Incision
My Algorithm

• **Type I**
  - immobilization x 3 weeks
  - differential infection, synovitis
    - sclerosis/periosteum at f/u

• **Type II and III**
  - closed reduction, lateral
  - Pinning, 2.0 for shaft ~6-8yo

• **Type III and IV**
  - Milking, possible open exploration
Neurovascular Injury

- AIN most common
- Median and Radial
- Ulnar nerve flexion type/medial pin
- May require vascular repair
- “Pink pulseless” debate
Volkmann’s Ischemia

- Ischemia injury to the forearm
- Compartment Syndrome
- Severe functional implications
- Pediatric A’s
- Increased risk with nerve injury
- GO
CASE #3

• 4 yo tripped over backpack, fell onto left arm

• X-rays = 2mm displaced lateral condyle fracture

• Trouble?
Lateral condyle fractures

12 - 17% of all elbow fractures in children
Second most common elbow fracture
Usually ages 4 - 10 years
Mechanism of injury: varus stress imparted on extended elbow and supinated forearm
History of fall, trauma
Pain, swelling, limited elbow motion
Lateral condyle fractures

Radiographs with fracture line across lateral condyle
- **Oblique** views helpful
- Jakob Classification
Fixation Configuration
Algorithm

- <2 mm displacement cast
- >2mm displacement but not malrotated open vs closed arthrogram, pinning
- displaced, rotated open reduction, pins, configuration vs. screws
Complications

- Lateral “bump”
- Delayed union
- Nonunion
  (Flynn JBJS 1971)
- Nonunion treatment controversial: in situ vs. corrective osteotomy
CASE #4

- 12 year old gymnast hears a pop during a vault.
- Pain and swelling of the medial elbow
- Mild tingling in ring and small finger
- Trouble?
CASE # 5

- 15 yo male fell jumping over wall.
- Seen at outside hospital, reduced, splinted.
Incarcerated Medial Epicondyle

- CT Scan outside hospital
- Ulnar nerve may be inside fracture or tethered
- Reduction Maneuver
  - Patterson
Case # 4 and 5 - ORIF
Medial epicondyle fractures

Apophyseal avulsion injury

@ 11% of elbow fractures

Older children, ages 10-14 years

Associated with elbow dislocations
Medial epicondyle fractures

Non- or minimally-displaced
• Cast, early ROM

Associated elbow dislocation & fragment incarcerated in joint
• ORIF
Medial epicondyle fractures

Displaced fracture, no incarceration

• *Controversial!*

• Non-operative vs. operative?
  – Prone

• Considerations
  – Hand dominance
  – Demands
  – Ulnar nerve function
Medial epicondyle fractures

• 42 pts followed 45 yrs
• Equally good results with non-operative vs surgical treatment 5 - 15mm displacement
• Poor results fragment excision
CASE # 6

- 8 yo female fell on top of her friend in the bouncy house at a birthday party
- Seen in outside ER and splinted
- TROUBLE?
Pediatric Monteggia Fractures

• Radial head ossifies ~ age 4

• Classification
  – Type I: most common, anterior dislocation
  – Type II: posterior dislocation of the radial head
  – Type III: lateral dislocation of radial head w/ ulnar metaphyseal fracture, usually a greenstick
    • assoc w/ radial nerve injuries & is 2nd most common type
  – Type IV: anterior radial head dislocation and fractures of both the proximal radius and ulna

• Monteggia equivalent = fracture of proximal radius or physeal injury
Pediatric Monteggia Fractures

• Treatment
  – MOST closed, close follow up
    • Type I, III, and IV Monteggia injuries
      – immobilize elbow in 100 deg of flexion w/ forearm fully supinated for 6 weeks
    • Type II injuries, immobilize w/ elbow extended for four weeks
  
• If unable to achieve reduction;
  – improper position of elbow ( < 110 deg of flexion)
  – infolded annular ligament; PIN
  – radial head buttonholed thru capsule/brachialis

• Open reduction
  – is indicated if it is necessary to reduce radial head
  – if reduction of radial head is not maintained
  – IM fixation of ulna fracture usually enough
  – PIN loss after closed reduction
Missed Monteggia

• Often devastating
• Require ulnar osteotomy and/or annular ligament reconstruction
• Long term range of motion issues
• 200% surgical complication rate reported
Advances in Planning

Surgicase

Materialise
CASE #7

- 10 year old fell off a merry go round
Radial neck fractures

Typically physeal or metaphyseal fractures
Ages 8 - 12 years
Mechanism: fall with valgus moment
Associated with posterior elbow dislocations, medial epicondyle fractures
Radial neck fractures

Non-operative treatment:
- <30° angulation
- <3mm translation

Greater angulation or displacement
- CR
- Percutaneous reduction
- Metazieau technique
- ORIF
Métaizeau
Radial neck fractures

Complications

• Loss of forearm rotation
• Malunion
• Osteonecrosis of radial head
• Growth arrest
• Nonunion
• Radioulnar synostosis
Thank You