PÆDIATRIC ORTHOPÆDIC CHALLENGES in the EMERGENCY DEPARTMENT

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OUTLINE

FRACTURE

ELBOW
• supracondylar humerus fracture with “nerve out”
• supracondylar humerus fracture with no pulse
• nursemaid elbow

HIP
• slipped capital femoral epiphysis

VASCULAR
• compartmental syndrome

LIMPING CHILD

INFECTION

NON-ACCIDENTAL TRAUMA

FRACUTURES

FRACTURES

routine imaging special imaging

articular fracture
physseal
metaphysseal diaphysseal

displacement < 2 mm. ORIF

displacement > 2 mm. accept

acceptable criteria:
age
location
plane of joint motion
special
**FRACTURES**

age – forearm

- bayonet apposition
- 20-30° < 10 yr.
- 10-20° > 10 yr.

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**FRACTURES**

location – proximal humerus

- 80% of growth
- multiplanar = compensatory
- accept ≤ 90°
  100% translation

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**FRACTURE – compound**

<table>
<thead>
<tr>
<th>small (puncture)</th>
<th>large (wound)</th>
</tr>
</thead>
<tbody>
<tr>
<td>“inside-out”</td>
<td>“outside-in”</td>
</tr>
<tr>
<td>agent: bone</td>
<td>agent: foreign</td>
</tr>
<tr>
<td>clean</td>
<td>dirty</td>
</tr>
<tr>
<td>tetanus toxoid</td>
<td></td>
</tr>
<tr>
<td>? antibiotics</td>
<td>antibiotics IV:</td>
</tr>
<tr>
<td></td>
<td>cephalosporin</td>
</tr>
<tr>
<td></td>
<td>aminoglycoside</td>
</tr>
<tr>
<td>local treatment</td>
<td>irrigation &amp; débridement</td>
</tr>
<tr>
<td>immobilize</td>
<td>ORIF</td>
</tr>
</tbody>
</table>

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**FRACTURE – compound**

urgent not emergent

- cover
- immobilize
- refer during “business” hours within 24 hr.

[Skaggs D. JPO 2000
Skaggs D. JBJS-A 2005]
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FRACTURE – neural

supracondylar humerus

• neurapraxia

[Cramer JPO 1993
Dormans J Hand Surg 1995
Campbell JPO 1995
Albright M POSNA 2004]

FRACTURE – neural

supracondylar humerus

• neurapraxia

[Cramer JPO 1993
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RECOVERY ≤ 100%

not an emergency

2 mo. 4 mo. 8 mo.

study/explore

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FRACTURE – vascular

supracondylar humerus

- vascular change: \( \leq \frac{1}{3} \)
- Volkmann contracture: < 1%

[Ottolenghi Clin Orthop 1971]
[Davis Clin Orthop 2000]

- mechanism: offense by proximal fragment entrapment in fracture site
- closed reduction: NO pre-reduction angiogramme
- explore if: ischaemia = ↓ capillary refill

[Shaw J Orthop Trauma 1990]
[Campbell JPO 1995]

vascular change

reduction

+ pulse + CR
- pulse + CR
- pulse - CR

normal observe +/- study explore

vascular change

reduction

+ pulse + CR
- pulse + CR
- pulse - CR

normal observe +/- study explore

emergency
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Nursemaid elbow

- not a dislocation
- röntgenogramme negative – utility?
- don’t be shy

Supination flexion?

Slipped Capital Femoral Epiphysis

- proximal femoral physeolysis leads to displacement of epiphysis relative to remainder of femur
- most frequently missed pediatric orthopaedic non-fracture emergency

[Skaggs D. JBJS Am. 2001]
Slipped Capital Femoral Epiphysis

- Puberty > 75%
- Skeletal age ≤ 20 mo. in 70%
- Somatotype: 2-3 X
- Bilateral: ≤ 40%
- Synchronous: 50%
- Non-synchronous: 80% ≤ 18 mo.

"dystrophia adiposogenitalis"

Slipped Capital Femoral Epiphysis

- Trauma
  - Energy: SCFE → low, S-H → high
  - Profile: SCFE → dystrophia adiposogenitalis, S-H → non-specific
  - History: SCFE → antecedent symptoms, S-H → negative

Slipped Capital Femoral Epiphysis

Pain

- "A nerve that supplies a muscle that traverses a joint supplies that joint"
- Groin pain: 85%
- Anterior & medial knee pain: 15%

Law of Hilton

Slipped Capital Femoral Epiphysis

- ROM
  - Loss of hip medial rotation:
    - Inclination of proximal femoral physis
    - Obligate hip lateral rotation with flexion:
      - Proximal metaphysis abuts, and femur rolls along, anterior acetabular rim
  - LLLD
    - Affected limb shortened and laterally rotated
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**INEFCTION**

**NON-ACCIDENTAL TRAUMA**
COMPARTMENTAL SYNDROME

Normal state:

- arterial inflow = venous outflow

Abnormal state:

- ↑ arterial inflow = ↑ pressure
- ↑ pressure = ↓ venous outflow
- ↓ venous outflow = ↑↑ pressure = ↓ arterial inflow = ischemia

“5 p's”:

- pressure = tense limb
- pain out of proportion
- paræsthesias
- pulselessness
- pallor
**COMPARTMENTAL SYNDROME**

**time of ischæmia - adult**
- $\leq 6\text{hr}$ = 90% salvage
- $\leq 18\text{hr}$ = 50% salvage
- $> 36\text{hr}$ = risk of infection

**Rx**
- fasciotomy
- observation

**amputation > salvage**


**COMPARTMENTAL SYNDROME**

**time of ischæmia - child**
- injury time to operation
- full recovery
- significant loss

**Rx**
- ~ 20 hr.
- $\leq 40\text{hr}$
- $> 80\text{hr}$

[Flynn JM. *AAOS 2004*]

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**LIMPING CHILD**

frequency

transient synovitis
pyarthritis
osteomyelitis
trauma
Legg-Calvé-Perthes
rheumatoid arthritis
diskitis

fever
weight-bearing
WBC
ESR
CRP

5x

$\frac{1}{5}$x
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INFECTION

pathogenesis

frequency

INFECTION

hole in bone

central joint

peripheral joint

bone XR

I&D

serial aspiration

aspirate

50-150 mg/Kg/d cefazolin

hole in bone

central joint

peripheral joint

I&D

serial aspiration

INFECTION

hip

• non-weightbearing
• fever > 38.5 °C
• WBC > 12K
• ESR > 40 mm/hr.
• CRP > 10 mg/L

kip chance of infection

1 < 10%
2 ~ 40%
3 > 75%
4 > 90%
87% NPV, 50% PPV

[Keeler M. JBJS Am, 1999 & 2004
Flynn JM. JPO 2005]
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• prevalence:
  1982 1% 1.2 million
  1996 2.9 million


NON-ACCIDENTAL TRAUMA

• neglect 50%
• physical abuse 25%
• sexual abuse 10%
• other (e.g. emotional) 15%

[U.S. Dept. of Health and Human Services. Child Maltreatment 1999: Reports From the States to the National Child Abuse and Neglect Data System.]

NON-ACCIDENTAL TRAUMA

• fractures < 1 yr. = abuse: ½
• abuse fractures < 2yr.: ½
• fractures < 3 yr. = abuse: ½
• single fracture ½

[Loder R. J Orthop Trauma 1991]

• risk of repeat abuse (morbidity): 25%
• risk of subsequent death (mortality): 5%

NON-ACCIDENTAL TRAUMA

signs of injury

- remodelling
- fracture callus
- perioskeletal elevation
- soft tissue

wk

1 2 3 4 5 6 7 8


NON-ACCIDENTAL TRAUMA

differential diagnosis

- osteogenesis imperfecta  multiple >> single fractures
  (uninvolved: single = 2 X multiple)
  lower limb = 3 X upper limb
  (uninvolved: reverse ratio)

- infection
- tumor (e.g. leukemia → fracture + ecchymosis)
- metabolic disease + morbid fracture (e.g. rickets)
- Caffey disease
- congenital indifference to pain

Dent R, JPO 1991]

NON-ACCIDENTAL TRAUMA

| high probability | metaphyseal: “corner” or “bucket handle” |
|                 | posterior rib  |
|                 | scapula       |
|                 | spinous process|
|                 | femur fracture before walking: 80% |

| medium probability | different stages of healing |
|                   | multiple bilateral |

| low probability    | clavicle    |
|                   | long bone  |


NON-ACCIDENTAL TRAUMA

[Silverman FN. Am J Roentgenol 1953]
NON-ACCIDENTAL TRAUMA

corner fracture

soft tissue
- skin tells the story
- abuse > 80%
- accident < 1/3

[Sussman SJ. J Pediatr 1968]

(415) 710-0899

OTHER OBSCURA?

www.ucsf.edu/orthopaedics/faculty/diab.html