

# Orthopedic Injury: Accidental or Not?

**Matthew Oetgen, MD**  
**Department of Orthopedics**

**Tanya Hinds, MD**  
**Child and Adolescent Protection Center (CAPC)**

## Objectives

Highlight evaluation and management of pediatric fractures

Understand when fractures should raise concern for child abuse

Emphasize AAOS 2009 and AAP 2014 Clinical Practice Guidelines

Encourage partnership with Orthopedic Surgeons and Child Abuse Pediatricians

# Fractures in Hospitalized Children <36 Months

Leventhal et. al. Pediatrics 2008

Cause	% (N = 15 143)
Fall	50.42
Abuse	12.08
Other accident	11.60
Motor vehicle accident	11.40
Uncertain whether accidental or intentional	2.17
Bone abnormality	0.85
Metabolic abnormality	0.12
Birth trauma	0.05
No injury E-code	11.32
Total	100.01

# Abusive Fractures in Hospitalized Children

Leventhal et. al. Pediatrics 2008

Age, mo	Cases per 100 000 Children	
	KID (2003)	Welsh Study (1996–1998)
0–11	36.1 (31.0–41.2)	48.3 (30.2–77.3)
12–23	4.8 (3.8–5.7)	15.6 (6.9–35.1)

# Case Presentation

6 month old





# Case Presentation



# When Is a Fracture Suspicious?

*Flaherty et al. Pediatrics 2014 (AAP Clinical Report)*

No history of injury

History of injury not plausible (mechanism; energy load; severity)

Inconsistent or changing history

Fracture in a non-ambulatory child

Fracture with high specificity for abuse

Multiple fractures

Fractures of different ages

Other injuries suspicious for child abuse

Delay in seeking care for an injury

# When is a Fracture Suspicious?

*Flaherty et al. Pediatrics 2014 (AAP Clinical Report)*

## **High specificity**

- CMLs

- Rib fractures, especially posteromedial

- Scapular fractures

- Spinous process fractures

- Sternal fractures

## **Moderate specificity**

- Multiple fractures, especially bilateral

- Fractures of different ages

- Epiphyseal separations

- Vertebral body fractures and subluxations

- Digital fractures

- Complex skull fractures

## **Common, but low specificity**

- Subperiosteal new bone formation

- Clavicular fractures

- Long-bone shaft fractures

- Linear skull fractures



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## Updated analysis

Bone fracture/studies	Age range	Positive predictive value for suspected or confirmed abuse (95% CI)	2013
Femur/nine studies (confirmed or suspected): (36, 38, 53–59)	0–18 months	50.1% (CI 34.1–66.1)	
Femur/eight studies (confirmed or suspected abuse): (36, 38, 43, 54, 55, 57–59)	12–48 months	11.7% (CI 6.1–17.3)	
Humerus/five studies (confirmed or suspected abuse): (37, 40, 56, 58, 60)	0–18 months	43.8% (CI 27.6–59.9)	
Humerus/four studies (confirmed or suspected abuse): (37, 40, 58, 60)	18–48 months	1.8% (CI –0–3.9)	
Rib fractures/four studies (confirmed or suspected abuse): (35, 61–63)	0–48 months	66% (CI 42.5–89.7)	
Skull fractures/four studies (confirmed or suspected abuse): (35, 64–66)	0–48 months	20.1% (CI 13.3–26.9)	

# Suspicious Injuries

Torn frenulum in a non-mobile child

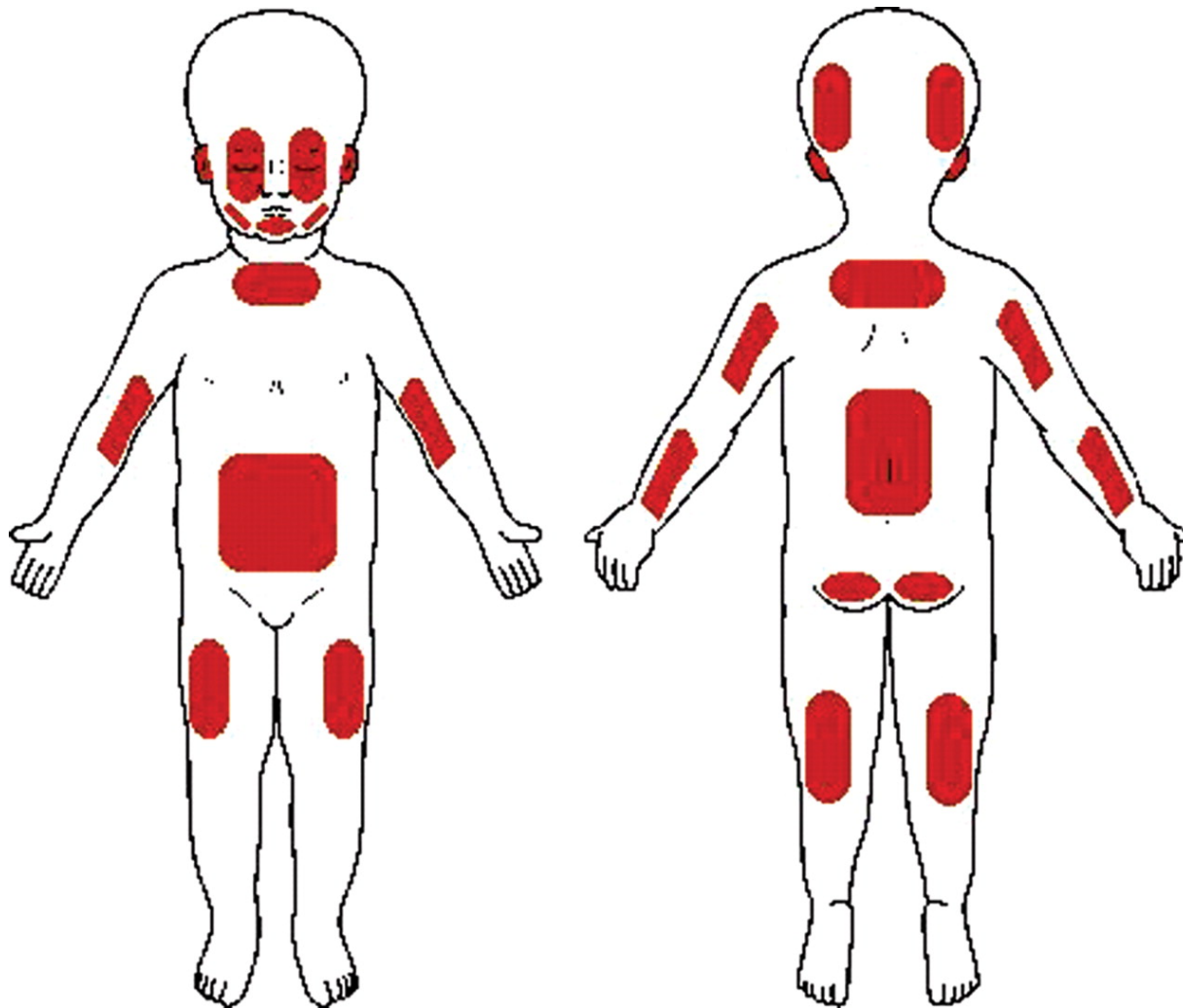


# Suspicious Injuries



compressed 27:1  
IM: 7

## Abusive bruising patterns.



Maguire S Arch Dis Child Educ Pract Ed 2010;95:170-177

## Suspicious Fracture(s)

Fracture(s) inconsistent with a child's motor development

Fracture (type) inconsistent with caregiver history

CPS REPORT

Unexplained fracture(s) in a child with normal bones

Fractures in different stages of healing in a child with normal bones

# Suspicion of Abuse

## Child Protective Services (CPS)

- **MANDATORY REPORT**
- Safety Assessments; Community Services
- Jurisdiction Specific Hotlines
  - 1 800 422 4453

- Child and Adolescent Protection Center (CAPC)
  - Recommended
  - Clinical Assessments
  - Service to Metropolitan Area
    - 202 476 4073 (Clinic)
    - 202 476 5000 (On-call MDs, SWs)

# Clinical Assessment

- Skeletal Survey - mandatory in all cases of suspected physical abuse in children < 2 yrs *AAP 2014 ACR 2009*
- Skeletal Survey - AP view of every bone in body, AP and lateral skull and spine, with bilateral oblique ribs (if < 2 yrs)
- 2 to 3 week limited follow-up survey can increase diagnostic yield *Harlan et. al. 2009*
- Non-contrast Head CT (if <1 yr or possible brain injury)



# Clinical Assessment

Calcium

Phosphorus

Alkaline Phosphatase

iPTH

25-hydroxy Vitamin D

DNA sequencing of COL1A1 and COL1A2

- AST, ALT, amylase, lipase, UA

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# Pitfalls

## Vitamin D Insufficiency *Schilling 2011*

- 20ng/cc to <30 ng/cc
- No difference in prevalence of fractures compared with healthy children

## Osteogenesis Imperfecta *Greeley 2013*

- Rib fractures occur in neonates and children but not infants
- 3 or more fractures at time of OI diagnosis is unusual

## Case Presentation

Initial forearm film: 3 fractures.

Skeletal survey: 34 acute and healing fractures.

No lab or XRAY indications of Vitamin D deficiency or Osteogenesis Imperfecta.

Biological father confesses to multiple episodes of abusive injury...



## Questions?

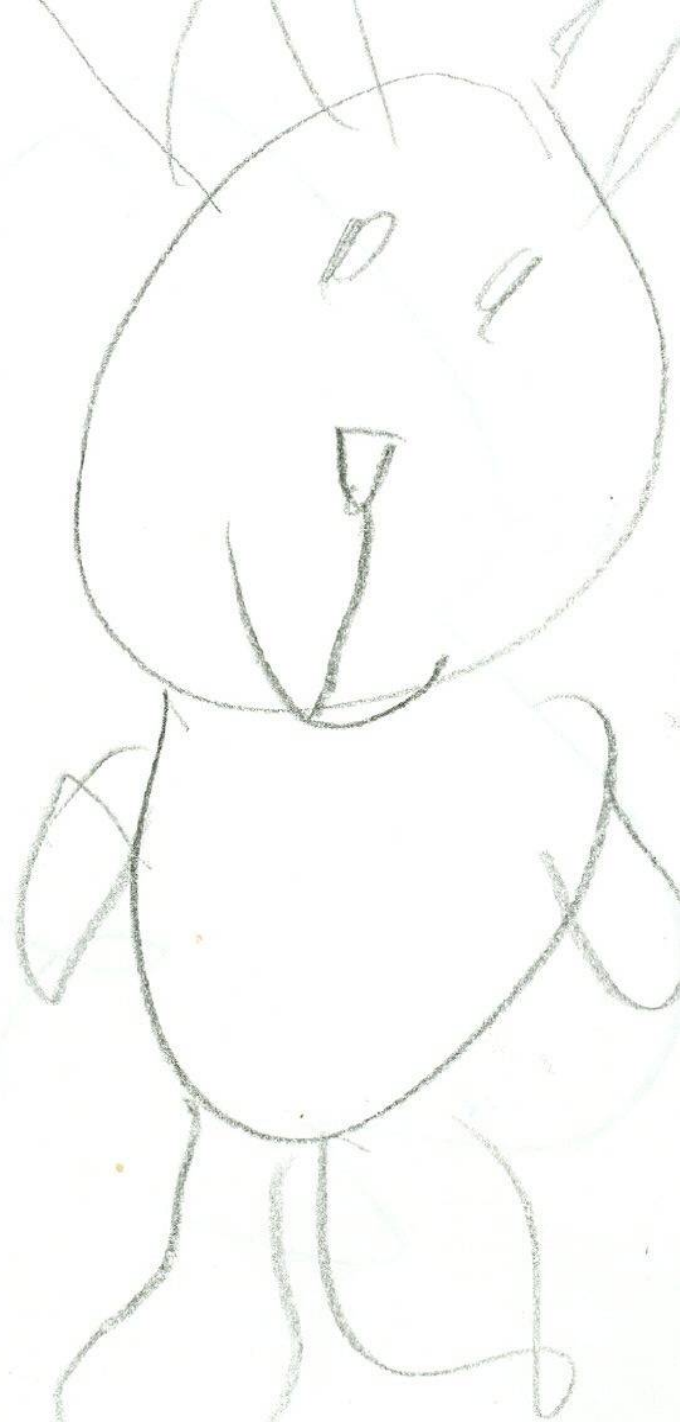
Matthew Oetgen  
Dept of Orthopaedics

Tanya Hinds  
Child Abuse Pediatrician  
Child and Adolescent Protection  
Center

[thinds@childrensnational.org](mailto:thinds@childrensnational.org)

202 476 6716

Thank  
you



## Additional Resources

Jenny, C (2011). *Child Abuse and Neglect: Diagnosis, Treatment and Evidence*. St. Louis: Elsevier.

Bilo, R (2010). *Forensic Aspects of Paediatric Fractures: Differentiating Accidental Trauma from Child Abuse*. Heidelberg: Springer.

<http://www2.aap.org/sections/childabuseneglect/>

- 2014 AAP Statement: Evaluating Children With Fractures for Child Physical Abuse
- Link to Child Abuse Specialists (by State)
- Online Child Maltreatment Courses
- Upcoming Conferences



# CPS Hotlines

Verified 5/22/2014

National Child Abuse Hotline: 1-800-4- A CHILD (422 4453)

Washington, D.C Hotline: 202-671-SAFE (7233)

Virginia Commonwealth Hotline: 1-800-552-7096

- Fairfax County 703-324-7500
- Loudoun County 703-777-0353
- Arlington County 703-228-1550

State of Maryland Hotline: 1-800-332-6347

- Prince George's County 301-909-2450
- Montgomery County 240-777-4417
- Anne Arundel 410-421-8400
- Charles County 301-392-6739
- Calvert County 443-550-6969

***Report to jurisdiction of occurrence.***

***Report to jurisdiction in which patient resides if jurisdiction of occurrence is unknown.***