Common Abusive Skeletal Injuries

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Specificity of Radiologic Findings

High Specificity
- Classic metaphyseal lesions
- Rib fractures, especially posterior medial
- Scapular fractures
- Spinal process fractures
- Sternal fractures

Moderate Specificity
- Multiple fractures, especially bilateral
- Fractures of different ages
- Epiphysial 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


Ribs 51%
CMLs 39%
History

Silverman F. The roentgen manifestations of unrecognized skeletal trauma in infants. *Am J Roentgenol (AJR)* 1953; 69:413-427

Normal Anatomy
Subperiosteal bone collar

- Ring of LaCroix
- Bone bark
- Perichondrial ring
“Historically, metaphyseal fractures have been thought of as strong predictors of abuse, but we could not find comparative studies to support this hypothesis.”


Prevalence of the Classic Metaphyseal Lesion in Infants at Low versus High Risk for Abuse

Kleinman PK et al. AJR 2011

Case Material and Methods

Low risk for infant abuse

1. History of a fall
2. No significant intracranial injury (except focal extra-axial blood underlying fx)
3. No red flags/risk factors for abuse (changing history, previous child protective services involvement, and other cutaneous injuries)

Results

Classic Metaphyseal Lesions - Prevalence

<table>
<thead>
<tr>
<th>Low-risk</th>
<th>High-risk</th>
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<tbody>
<tr>
<td>Infants with CMLs 0/42</td>
<td>9/18 (50%)</td>
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(CI = 0-8%, 29-76%) p<0.0001

Adjusted for sex and age: p<0.0001
CML-The Evidence
• The CML is often inconspicuous initially
• Frequently bilateral, symmetric
• Periosteal reaction is uncommon
• Overlying bruising is usually lacking
• Rare with household falls

Specificity of Radiologic Findings

- **High Specificity**
  - Classic metaphyseal lesions
  - 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 near bone formation
  - Clavicular fractures
  - Long bone shaft fractures
  - Linear skull fractures

31 Abuse fatalities
Whole Body MRI
Rib fractures-The Evidence

- Rib fractures are highly specific for abuse absent an overt traumatic or organic cause (Kemp BMJ 2008)
- Posteromedial fracture are most common pathologically but require rigorous technique clinically
- Posteromedial fractures are consistent with anteroposterior compression

Multiple fractures are more common after physical abuse than after non-abusive traumatic injury
Specificity of Radiologic Findings

**High Specificity**
- Classic metaphyseal lesions
- Rib fractures, especially posterior
- Scapular fractures
- Epiphyseal separations
- Spinal fractures
- Sternal fractures

**Moderate Specificity**
- Multiple fractures, especially bilateral
- Fractures of different ages
- Vertebral body fractures and subluxations
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- Complex skull fractures

**Common, but Low Specificity**
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**Long bone shaft fractures - the evidence**
(Kemp BJM 2008)

- Most femoral shaft fractures are accidental, but abuse is more common in the non-ambulatory child
- No difference in the distribution of spiral, transverse and oblique femoral fractures between abuse and non-abuse
- In the young child mid-shaft humeral fractures are more commonly abusive, but supracondylar fxs are usually accidental
Skull fractures: The evidence

- Linear parietal fractures are the most common skull fracture pattern in abuse and non-abuse cases (Kemp 2008)
- According to Kemp et al (2008) an infant or toddler with a linear skull fracture has a 1/3 chance of abuse (the figure is probably lower, based on study by Wood et al, Ped. 2009)
- Complex fracture patterns are generally seen with higher energy events than linear fractures

Bilateral skull fractures do not always mean 2 impacts