Evidence Base for Child Abuse Fractures

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No Disclosures
Childhood Fractures

• Fractures are a common childhood injury
• Consider history, age and developmental stage of child, fracture type and associated mechanism, as well as identification of other injuries
• In infants and toddlers, physical abuse is the cause of 12-20% of fractures (1)
• Any fracture can be caused by child abuse
History

• HPI: Details important

• Children able should be interviewed apart and by a professional skilled in forensic interviewing

• One study showed caregivers either provided no history or a history of a low-energy event in cases of abuse, whereas 29% of caregivers of those with accidental injury provided a high-energy event (2)

• PMH, FH, PE and lab evaluation important in consideration of differential diagnosis
Age

• 80% of all fractures from abuse were seen in children under 18 months in large review (3)
• In children <1yo, 25% fractures caused by child abuse (4)
Developmental Stage

- Children who are not yet mobile are more likely to have fractures caused by abuse (1)
- In nonambulatory patients, physical abuse is the more likely cause of humeral and femoral fractures than those who are walking (2)
- % of fractures caused by abuse declines sharply after child begins to walk (1)
*High Specificity
- CMLs
- Rib Fractures
- Scapular Fractures
- Spinous Process Fractures
- Sternal Fractures

Moderate Specificity
- Multiple Fractures
- Vertebral Body Fractures
- Epiphyseal Separations
- Fractures Differing Ages
- Digit Fractures
- Complex Skull Fractures

Low Specificity
- Subperiosteal New Bone Formation
- Clavicle Fractures
- Long-bone Shaft Fractures
- Linear Skull Fractures

*Highest Specificity in Infants

Classic Metaphyseal Lesion

- Planar fracture through primary spongiosa of the metaphysis (6)
- Corner or bucket handle appearance
- Most common in distal femur, proximal and distal tibia, and proximal humeri
- Acute fractures difficult to visualize and commonly heal without new subperiosteal bone formation or sclerosis (7)
- Heal quickly and undetectable in up to 4 weeks (7)
Classic Metaphyseal Lesion

- High specificity for physical abuse, particularly in the first year of life (6,8)
- Mechanism: Torsional and tractional shearing strains applied across metaphysis as in pulling or twisting of an extremity (7)
  - Supported by similar lesions in breech and armling obstetric deliveries (9)
- CMLs are the most common long bone fracture found in infants who die of inflicted injury (10)
Classic Metaphyseal Lesions
Classic Metaphyseal Lesions
Rib Fractures

• Rib fractures, particularly posterior rib fractures, in young children are highly specific for abuse (3,5)

• Positive predictive value of rib fractures for child abuse in children <3yo has been reported up to 95% (11)

• A child with multiple rib fractures has a 7 in 10 chance of having been abused (3)
Rib Fractures

• Mechanism: Most caused by anterior-posterior compression as in an infant who is held around the chest, squeezed, and shaken (12)
Posterior Rib Fractures
Posterior Rib Fractures
CT Chest in 70 do Female
CT Chest in 70 do Female
Long-bone Shaft Fractures

• Low specificity but important as the single long bone diaphyseal fracture is the most common fracture pattern identified in abused children (4)
• Fracture pattern itself cannot clearly distinguish between abuse and nonabuse (2)
• Important for injury mechanism described by caregiver to match the extent and type of load required (13)
Long Bone Fracture Mechanism

- Transverse fracture
- Bending load applied perpendicular to bone
Long Bone Fracture Mechanism

- Spiral fracture
- Torsion or twisting of bone along its long axis
- Accidental spiral femur fracture reported in stairway falls with specific circumstances (14)
Long Bone Fracture Mechanism

- Oblique fracture
- Bending and torsion combination
- Accidental oblique femur fracture reported in stationary activity center as in an Exersaucer (15)
Long Bone Fracture Mechanism

- Buckle/impacted fracture
- Axial loading along length of bone
- Accidental buckle femur fractures reported in short fall to the knee (13)
Femoral Shaft Fractures

• A child with a femoral fractures has a 1 in 3-4 chance of having been abused (3)

• Key discriminator is the motor developmental level of the child

• Femoral fractures resulting from abuse are more commonly seen in children who are not yet walking
Humeral Shaft Fractures

- In a child less than 18 mo, humeral shaft fractures have a high likelihood of abuse (3)
- Supracondylar fractures are more likely to have non-abusive causes
- Case reported of infant rolling from prone to supine while child’s arm was extended causing a spiral-oblique midshaft humerus fracture (16)
Skull Fractures

• Majority of linear skull fractures are not inflicted (17)
• A short fall from several feet onto a hard surface can cause a linear, nondiastatic skull fracture (18, 19)
• Complex or bilateral skull fractures are typical of NAT (5)
3D Skull Reformats: 6 mo female
3D Skull Reformats: 21 mo male
Skeletal Survey

• ACR imaging recommendations available by age and presentation
• Child <24mo with suspicion for abuse should have skeletal survey (20)
• Additional fractures are found in 10%, with higher rates in infants (21)
• 2 week follow up skeletal survey provides additional information in up to one third of patients (20)
When is a Fracture Suspicious for Child Abuse?

- No history of injury
- Mechanism provided not consistent with type of fracture
- Inconsistent or changing histories
- Fracture in nonambulatory child
- Fracture of high specificity for abuse
- Multiple fractures
- Fractures of different ages
- Other injuries suspicious for abuse
- Delay in seeking care for an injury

References


Thank You