Jeremy Onnen MD
Pediatric Orthopedic Surgery

ORTHOPEDIC MANIFESTATIONS OF CHILD ABUSE

Why do this conference?

- The number and rate of victims have fluctuated during the past 5 years. Comparing the national rounded number of victims from 2012 (656,000) to the national estimate of victims in 2016 (676,000) shows an increase of 3.0 percent

Exhibit 4–A Child Fatality Rates per 100,000 Children, 2012–2016

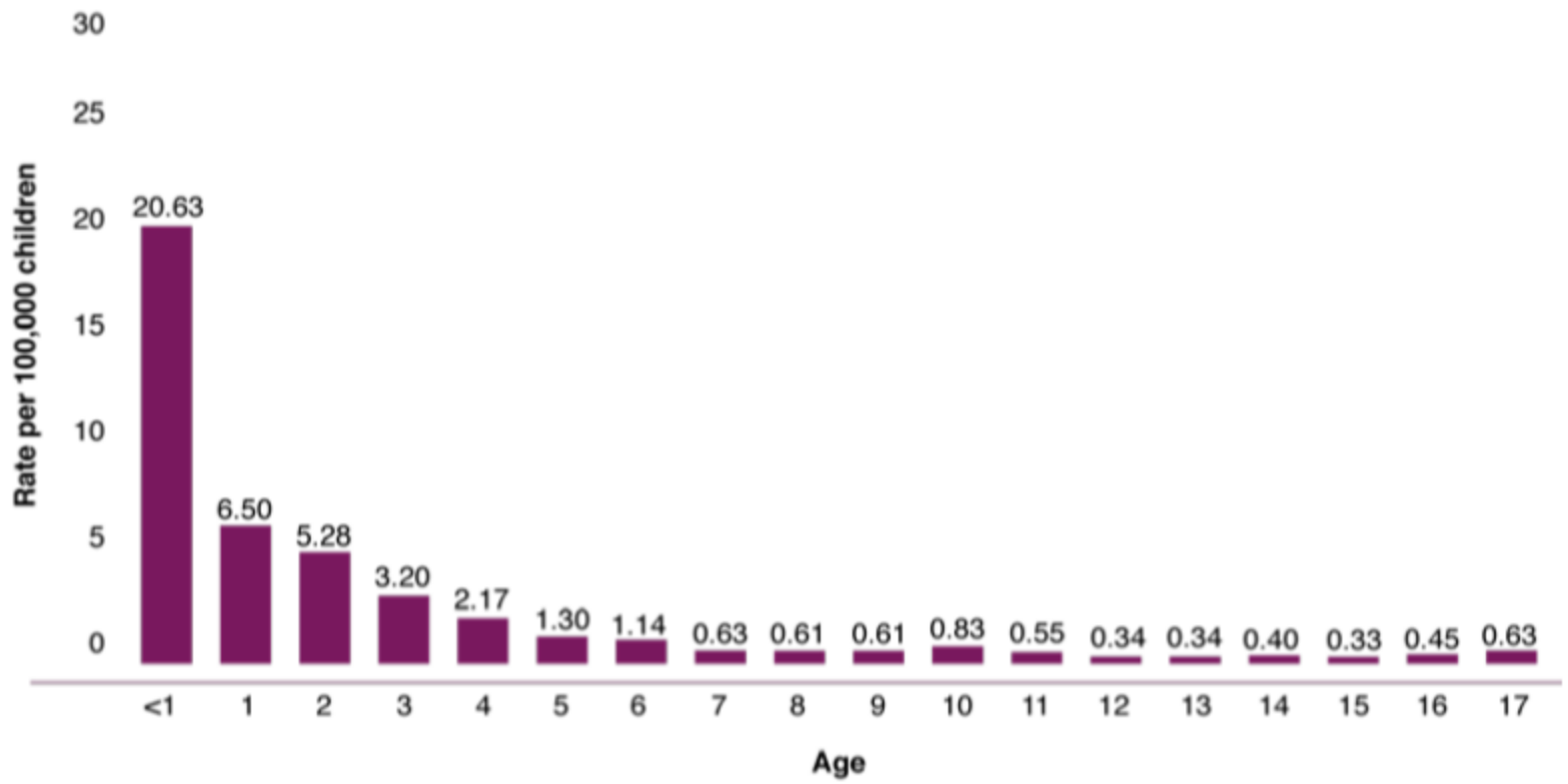
Year	Reporting States	Child Population of Reporting States	Child Fatalities from Reporting States	National Fatality Rate Per 100,000 Children	Child Population of all 52 States	National Estimate of Child Fatalities
2012	51	74,277,427	1,621	2.18	74,542,811	1,630
2013	51	74,121,591	1,551	2.09	74,383,731	1,550
2014	51	74,086,682	1,588	2.14	74,346,098	1,590
2015	49	70,416,380	1,589	2.26	74,349,174	1,680
2016	49	72,009,469	1,700	2.36	74,338,157	1,750

Data are from the Child File and Agency File. National fatality rates per 100,000 children were calculated by dividing the number of child fatalities by the population of reporting states and multiplying by 100,000.

If fewer than 52 states reported data, the national estimate of child fatalities was calculated by multiplying the national fatality rate by the child population of all 52 states and dividing by 100,000. The estimate was rounded to the nearest 10. If 52 states reported data, the national estimate of child fatalities was calculated by taking the number of reported child fatalities and rounding to the nearest 10. Because of the rounding rule, the national estimate could have more or fewer fatalities than the actual reported number of fatalities.

Exhibit 4–B Child Fatalities by Age, 2016

Children <1 year old died from abuse and neglect at three times the rate of children who were 1 year old.



Based on data from 44 states. See table 4–4.

What are the barriers to Diagnosis?

What is child abuse?

- Child abuse is when a parent or caregiver, whether through action or failing to act, causes injury, death, emotional harm or risk of serious harm to a child. There are many forms of child maltreatment, including neglect, physical abuse, sexual abuse, exploitation and emotional abuse.

- 24 yo male boyfriend of the mother of the patient who has been very frustrated with work and his lack of sleep because of the 4 month old who wont stop crying while he is supposed to be napping is bring in the child because he shook him until he stopped crying.

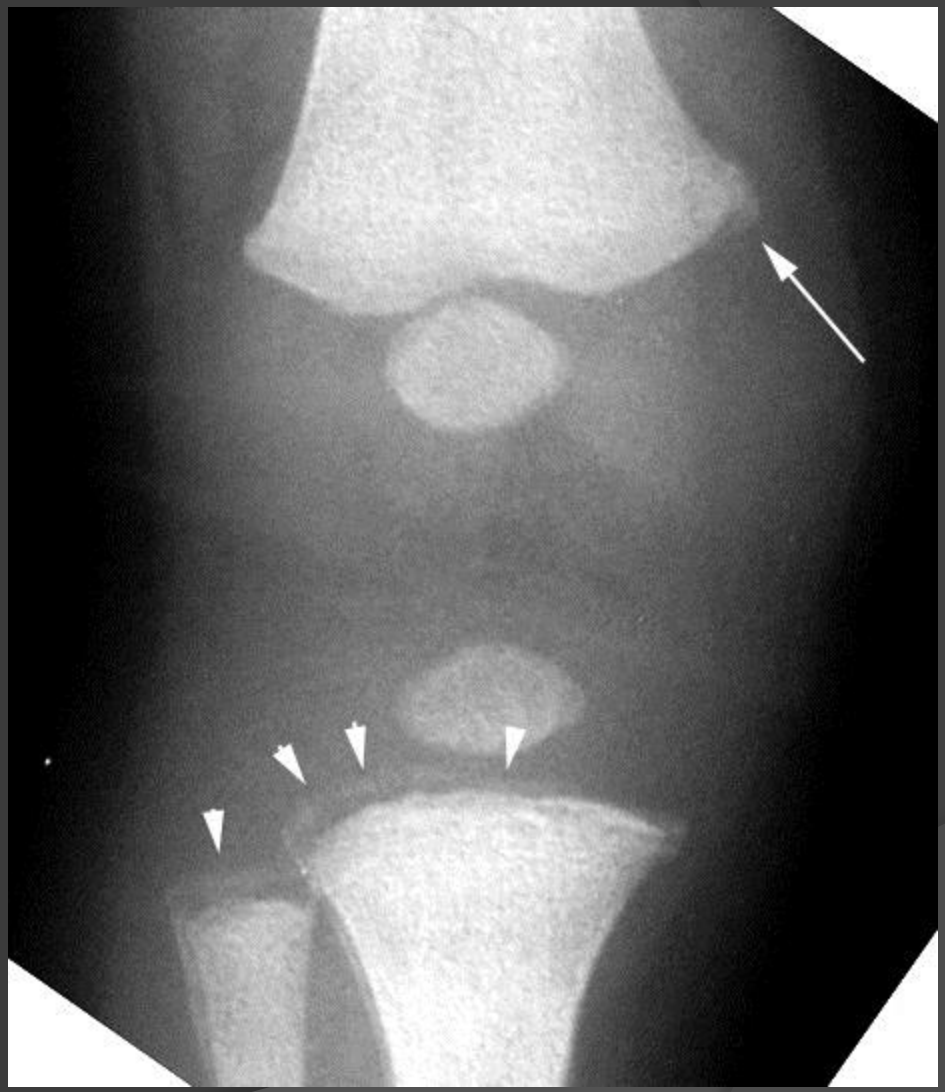
- Minority children >12 months old were 3 times more likely to be reported to Social services than their white counter parts.
- Minority children >12 months <3 yo were significantly more likely to receive a Skeletal survey

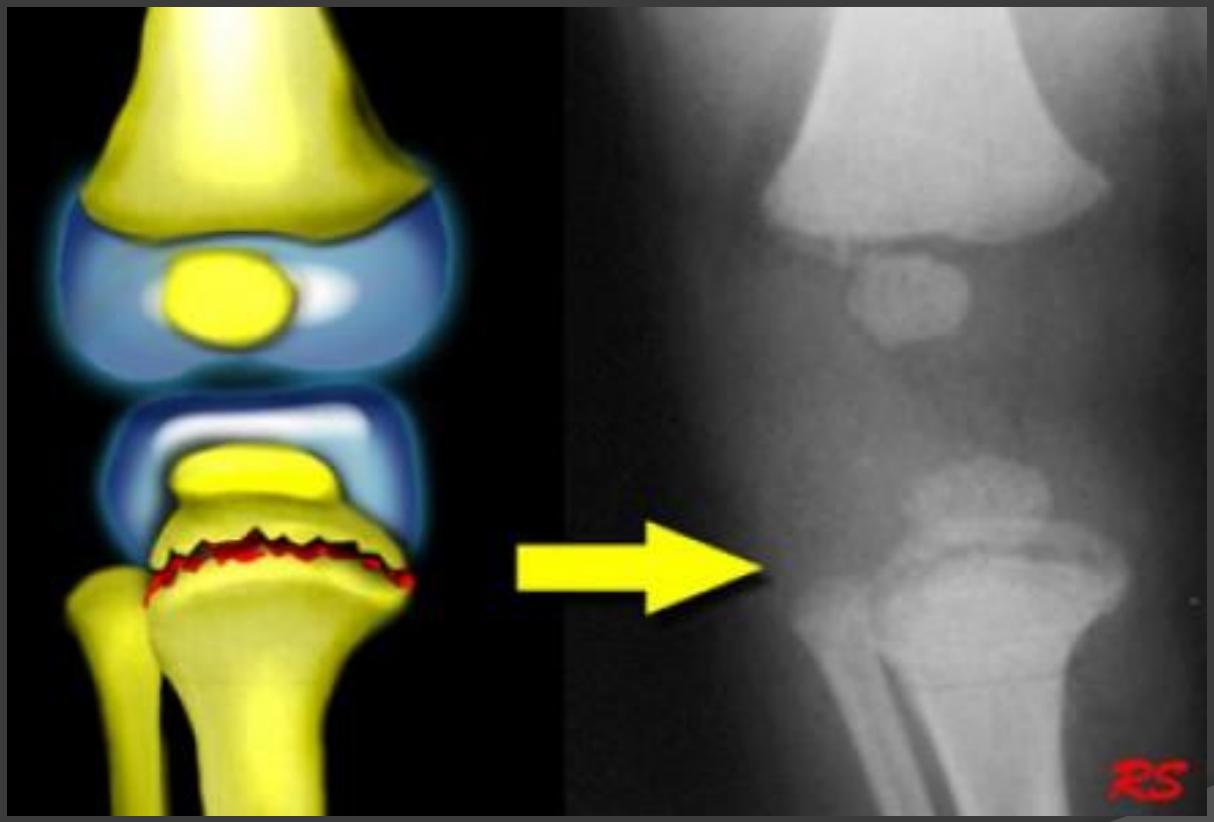
- The rate of African-American child fatalities (4.65 per 100,000 African-American children) is 2.2 times greater than the rate of White children (2.08 per 100,000 White children) and nearly 3 times greater than the rate of Hispanic children (1.58 per 100,000 Hispanic children).

CONCLUSIONS: One fifth of children with abuse-related fractures are missed during the initial medical visit. In particular, boys who present to a primary care or a general emergency department setting with an extremity fracture are at a particularly high risk for delayed diagnosis.

Classic BONE Signs of Abuse

- Bucket handle fractures
- Corner fractures
- Long bone fracture in non ambulatory infants
- Rib fractures

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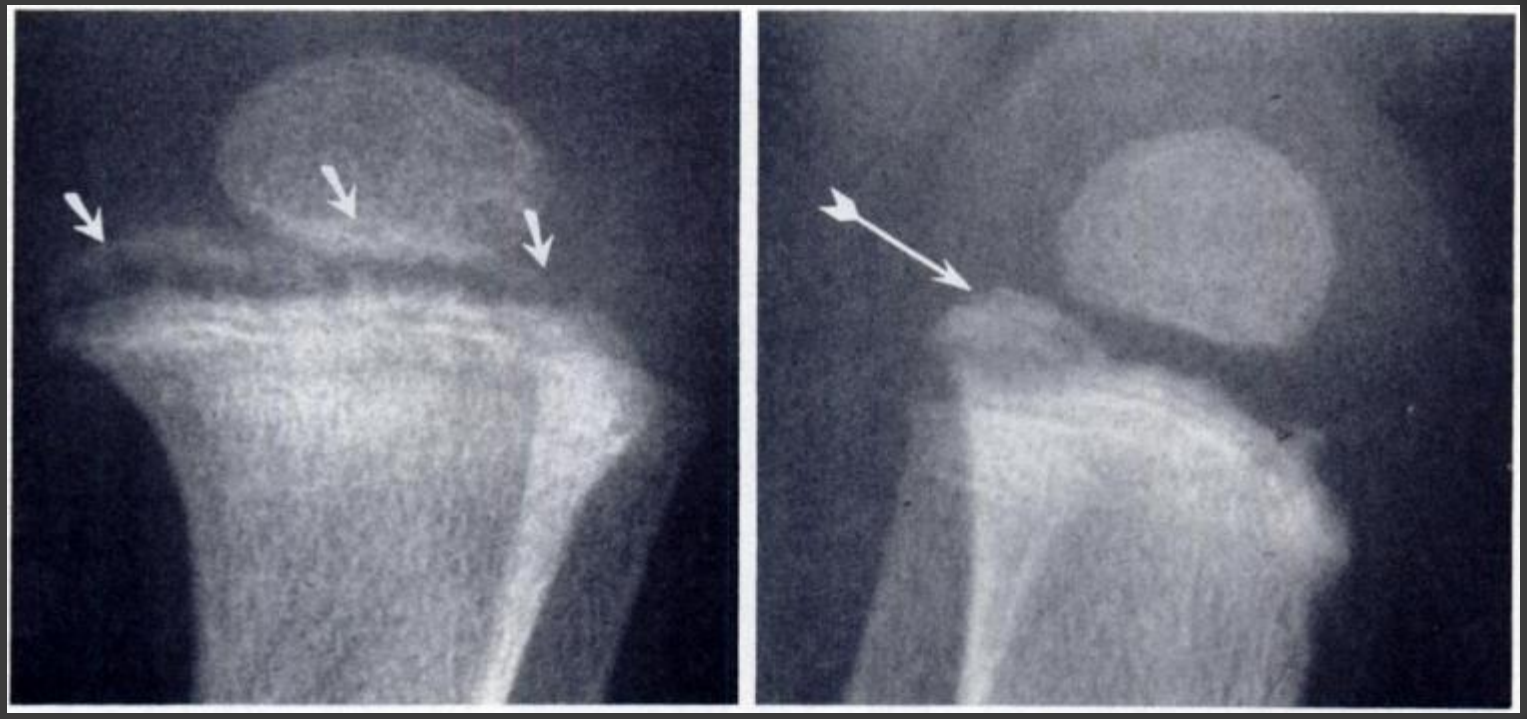


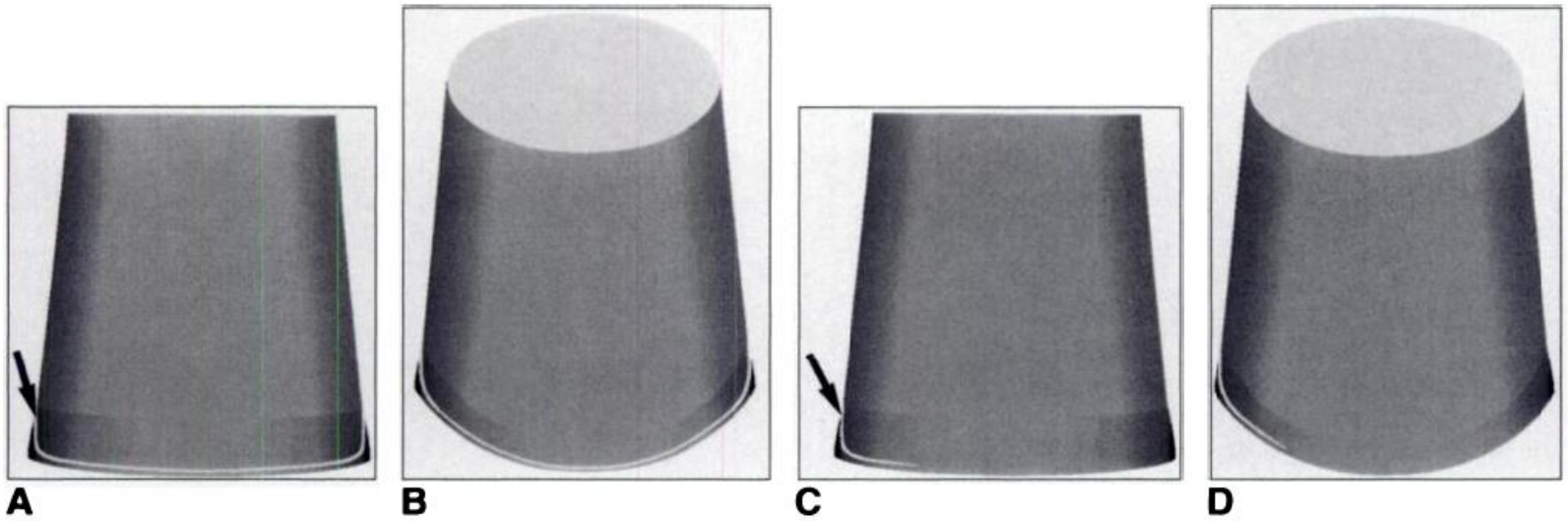
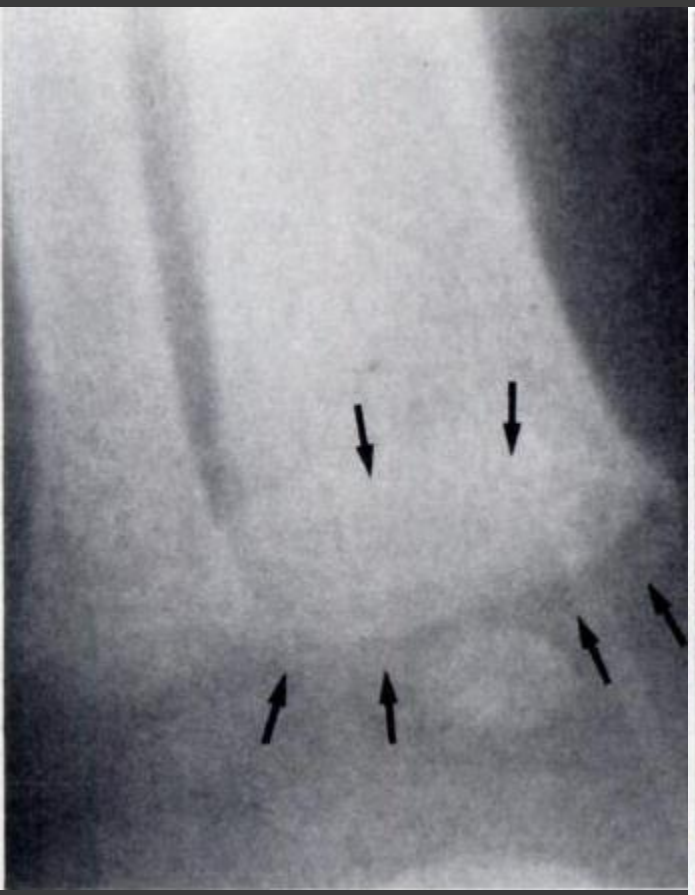
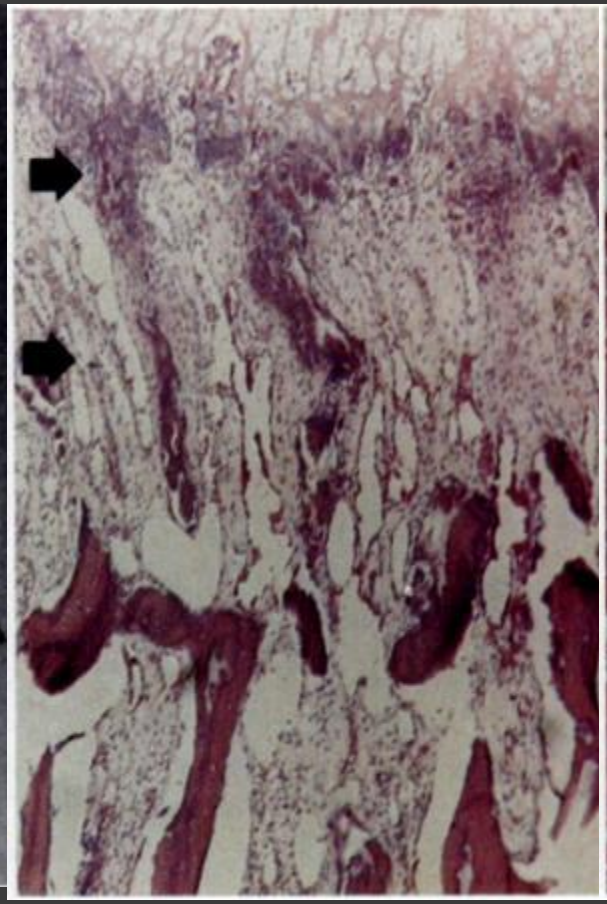


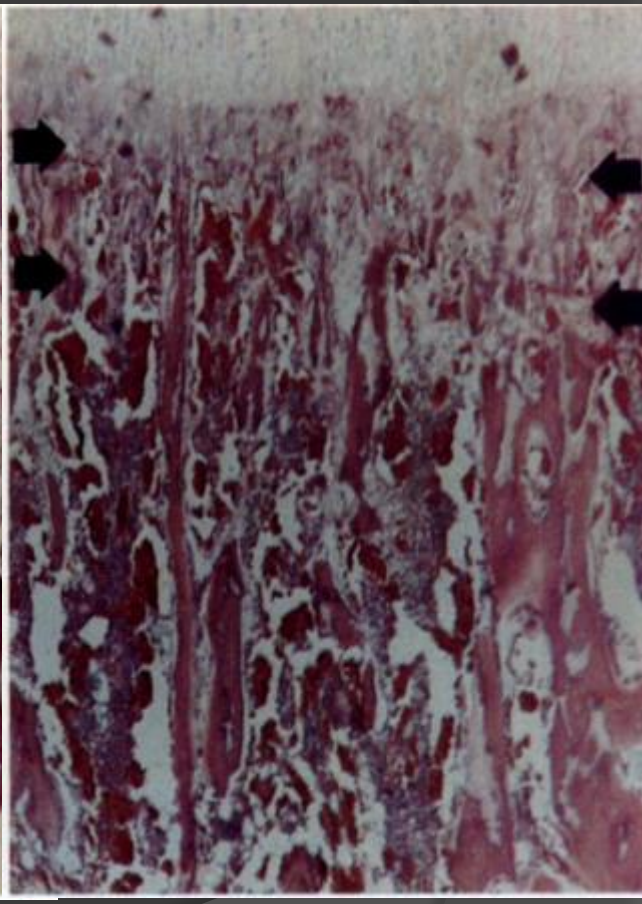
Fig. 5.—Diagrams of corner-fracture and bucket-handle patterns of classic metaphyseal lesions (CML) in distal tibia. Fractures (*arrows* in *A* and *C*) extend adjacent to chondro-osseous junction and then veer proximally to undercut larger peripheral segment that encompasses subperiosteal bone collar. When physis is viewed tangentially, CML appears as corner-fracture pattern (*A* and *C*). When view is obtained with beam angulation, a bucket-handle pattern results (*B* and *D*).

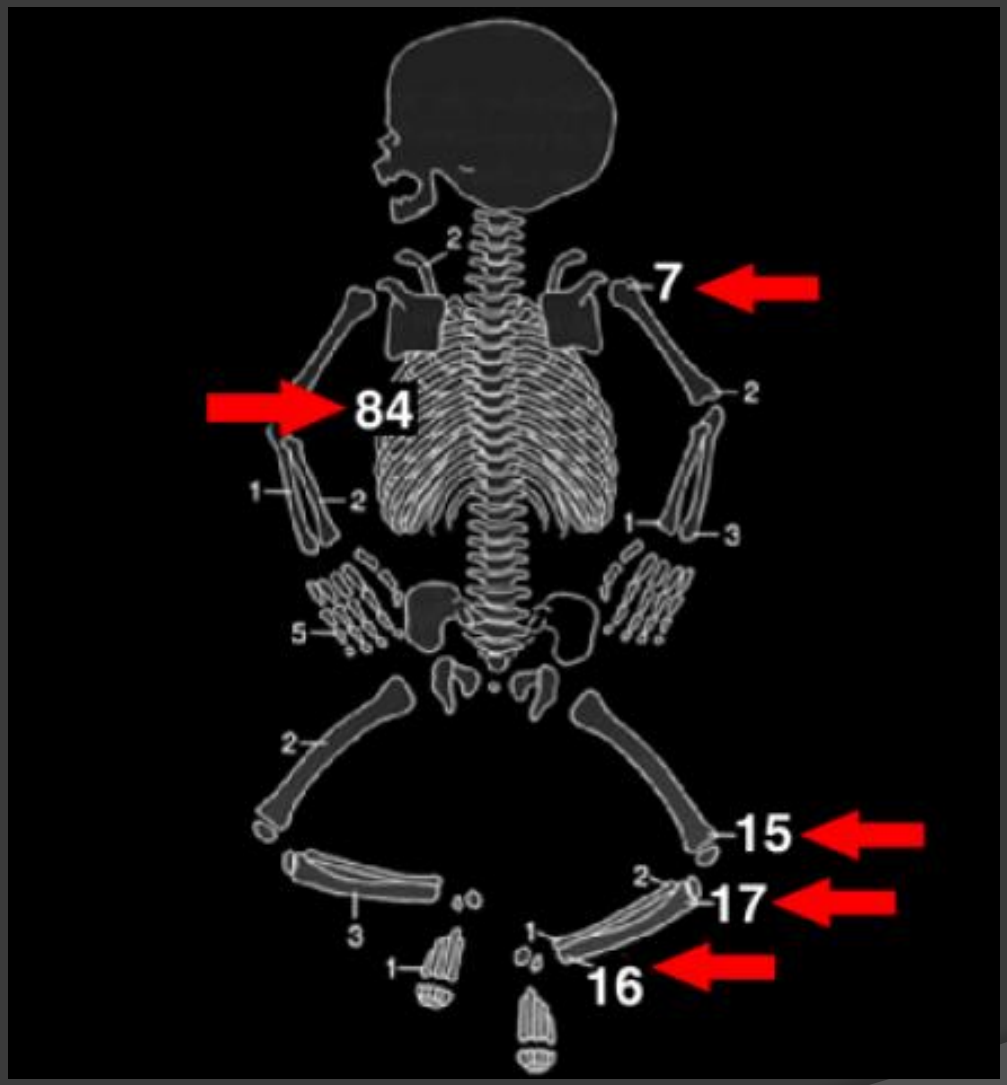
A and *B*, Diffuse forms.

C and *D*, Localized forms.








2
7
84
2
1
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17
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1
16

TABLE 5. Odds Ratios for Comparing Subsets of Children With Given Injuries for Membership in the Abuse Group Versus the Control Group in Patients Less Than 18 mo Old and Greater Than 18 mo Old

Injury	Odds Ratio for Abuse < 18 mo (95% CI)	*P*	Odds Ratio for Abuse > 18 mo (95% CI)	*P*
Rib fractures	23.7 (9.5-59.2)	< 0.001*	9.1 (3.3-25.0)	< 0.001*
Tibia/fibula fracture	12.8 (5.1-32.6)	< 0.001*	2.1 (0.7-6.2)	0.172
Humerus fracture	2.3 (1.3-4.1)	0.004*	0.29 (0.1-0.7)	0.005*
Femur fracture	1.8 (1.2-2.7)	0.005*	0.30 (0.1-0.7)	0.003*

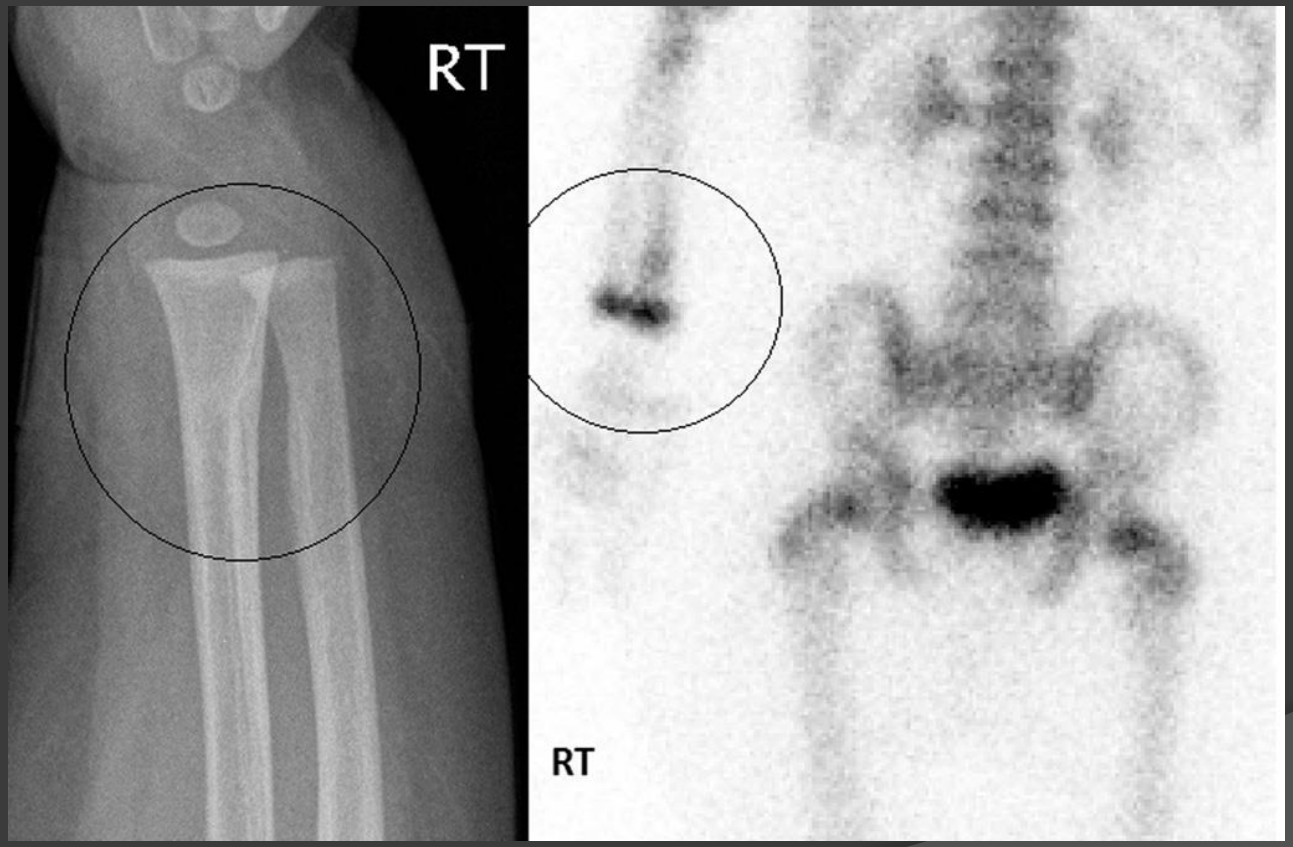
*Statistically significant.

Age and sex-adjusted odds ratios calculated using binary logistic regression, without eliminating variables for lack of significance (enter method).

CI indicates confidence interval.

- The skeletal survey with oblique views of the ribs still remains the gold standard for evaluating occult skeletal trauma.

- 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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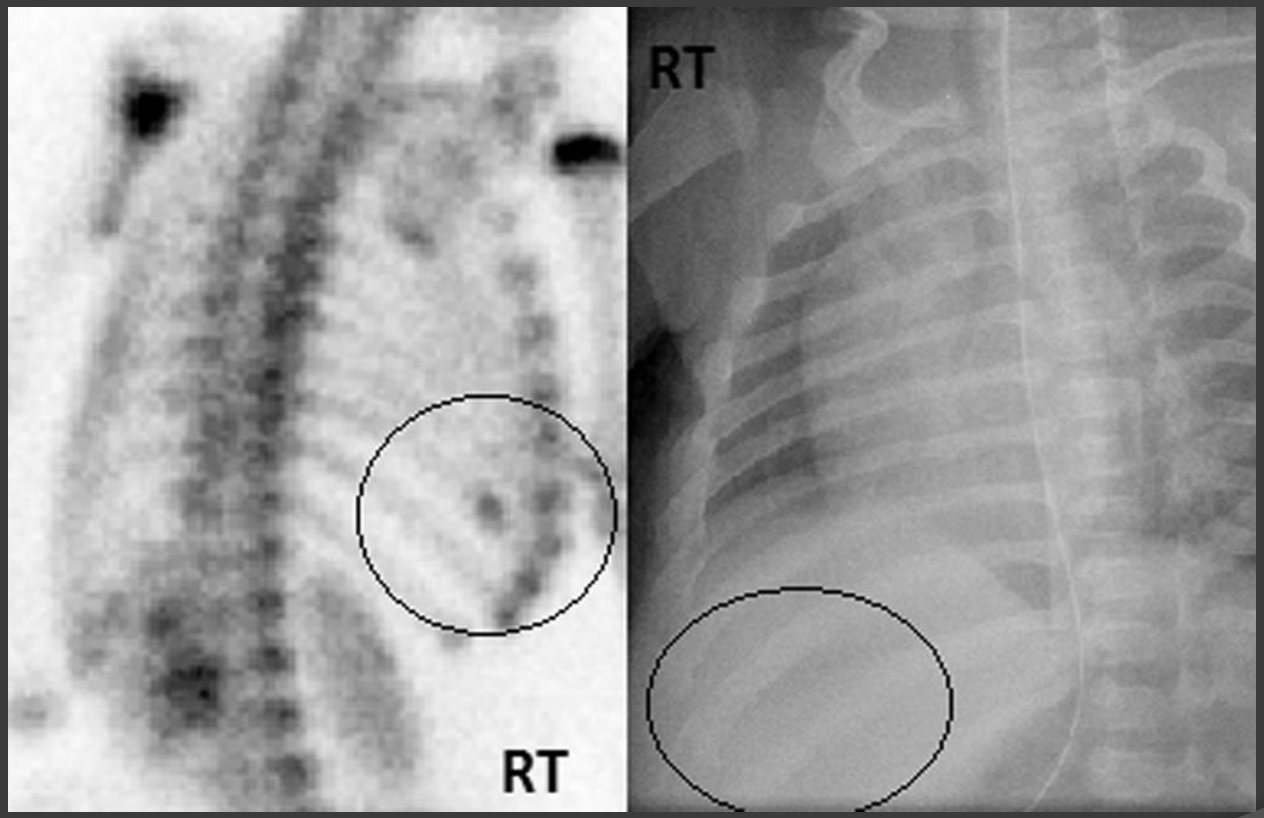
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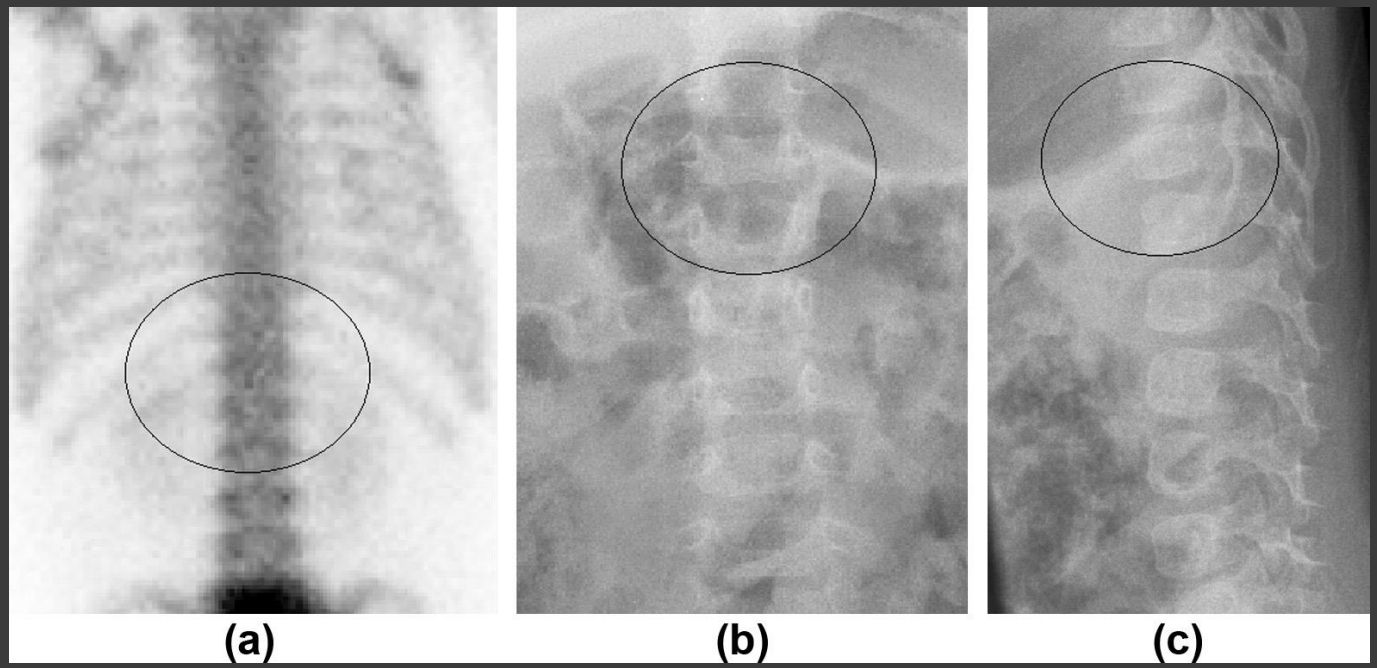

(a)
(b)
(c)

Pediatric Femur Fracture

Femur Shaft Fractures in Toddlers and Young Children: Rarely from Child Abuse

- *Misperception 1: Toddlers rarely break their femurs*

Femur Shaft Fractures in Toddlers and Young Children: Rarely from Child Abuse

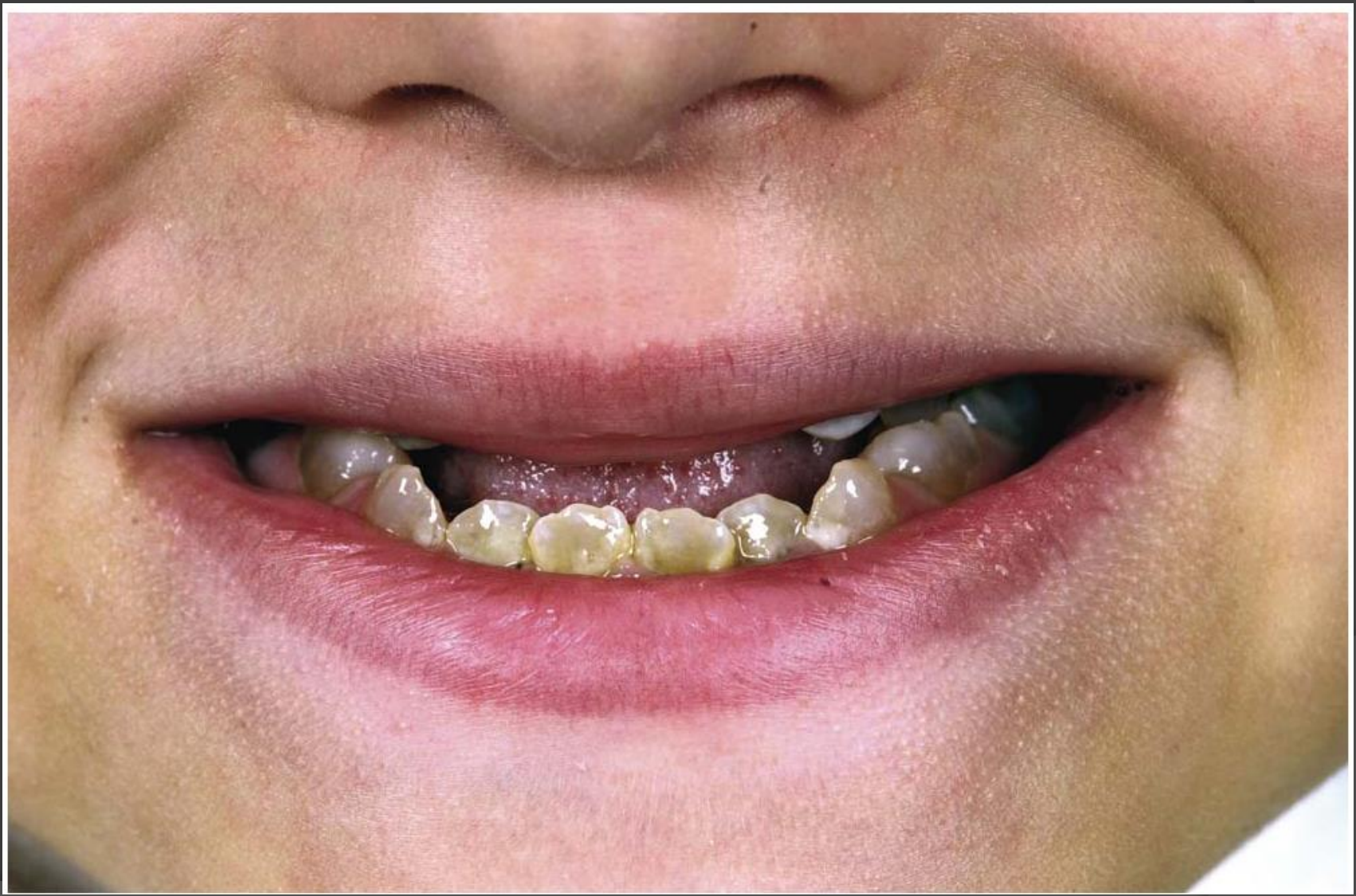
- *Misperception 1: Toddlers rarely break their femurs*
- *Misperception 2: Lots of force is required to break the femur*

Femur Shaft Fractures in Toddlers and Young Children: Rarely from Child Abuse

- *Misperception 1: Toddlers rarely break their femurs*
- *Misperception 2: Lots of force is required to break the femur*
- *Misperception 3: There is a high risk of abuse if a child has a femur fracture*

Femur Shaft Fractures in Toddlers and Young Children: Rarely from Child Abuse

- *Misperception 1: Toddlers rarely break their femurs*
- *Misperception 2: Lots of force is required to break the femur*
- *Misperception 3: There is a high risk of abuse if a child has a femur fracture*
- *Misperception 4: If unsure, report the incident, it can't hurt*



References in order of slides

- U.S. Department of Health & Human Services Administration for Children and Families Administration on Children, Youth and Families Children's Bureau 2016 report
- Racial differences in the evaluation of pediatric fractures for physical abuse. Lane WG[1], Rubin DM, Monteith R, Christian CW. JAMA. 2002 Oct 2;288(13):1603-9.
- Delayed identification of pediatric abuse-related fractures.
  Ravichandiran N[1], Schuh S, Bejuk M, Al-Harthy N, Shouldice M, Au H, Boutis K. Pediatrics. 2010 Jan;125(1):60-6. doi: 10.1542/peds.2008-3794. Epub 2009 Nov 30.
- The role of diagnostic imaging in the evaluation of child abuse
  Nita Jain, MD, FRCPC bc medical journal vol. 57 no. 8, october 2015 **bcmj.org**
- Diagnostic Imaging in Infant Abuse
  Paul K. Kleinman AJR:155, October 1990
- Child Abuse and Orthopaedic Injury Patterns: Analysis at a Level I Pediatric Trauma Center
  Nirav K. Pandya, MD, Keith Baldwin, MD, MPH, MSPT, Hayley Wolfgruber, BA, Cindy W. Christian, MD, Denis S. Drummond, MD, and Harish S. Hosalkar, MD, MBMS (Ortho), FCPS (Ortho), DNB (Ortho)
  J Pediatr Orthop Volume 29, Number 6, September 2009
- Should bone scintigraphy be used as a routine adjunct to skeletal survey in the imaging of non-accidental injury? A 10 year review of reports in a single centre
  J.K. Bainbridge, B. M. Huey, S.K. Harrison
  Clinical Radiology 70 (2015) e83-e89
- Femur Shaft Fractures in Toddlers and Young Children: Rarely from Child Abuse
  Schwend, Richard M. M.D.; Werth, Chris B.A.; Johnston, Andrew M.D.
  Journal of Pediatric Orthopaedics: July-August 2000 - Volume 20 - Issue 4 - p 475-481