

My Response

A normal baby with normal bones will not get a fracture from the physical examination of the legs!

The acute transverse right femur fracture is a high energy fracture and could not have been sustained by any movement of a 14 day-old baby on his own. This is an inflicted injury raising a serious concern for child maltreatment.

How often does child abuse involve skeletal injuries?

- Fractures account for 10%-25% of childhood injuries.
- About 25% of fractures in children less than 1 year old are attributed to abuse.
- The percent diminishes with increasing age of the child.

Proportion of Hospitalized Fractures Due to Abuse

TABLE 2 Causes of Injuries in Children <36 Months of Age With Fractures in the 2003 KID (Weighted N = 15 143)

Cause	Proportion, %
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

From Leventhal JM, Martin KD, Asnes AG: Incidence of fractures attributable to abuse in young hospitalized children: results from analysis of a United States database. *Pediatrics* 2008;122:602.

Rates of Abusive Fractures According to Age Group

TABLE 3 Weighted Rates of Abusive Fractures, According to Age Group, in the 2003 KID

Age, mo	Weighted No. of Fractures	Incidence of Fractures, Estimate (95% CI), Cases per 100 000 ^a	Incidence of Abusive Fractures, Estimate (95% CI), Cases per 100 000 ^b	Proportion of Abuse, %
0-11	5850	145.0 (131.3-158.7)	36.1 (31.0-41.2)	24.9
12-23	2677	67.1 (59.8-74.4)	4.8 (3.8-5.9)	7.2
24-35	6616	163.8 (136.5-191.1)	4.8 (3.4-6.1)	2.9
Total	15 143	125.5 (112.5-138.6)	15.3 (13.2-17.3)	12.1

^aWeighted incidence of fractures per 100 000 children in age group.

^bWeighted incidence of fractures attributable to abuse per 100 000 children in age group.

Adapted from Leventhal JM, Martin KD, Asnes AG: Incidence of fractures attributable to abuse in young hospitalized children: results from analysis of a United States database. *Pediatrics* 2008;122:602.

What proportions of various types of fractures are abuse related in different age groups?

Table 32-5 -- Weighted Proportions of Abusive Fractures Attributable to Abuse, According to Age and Bone, in the 2003 KID

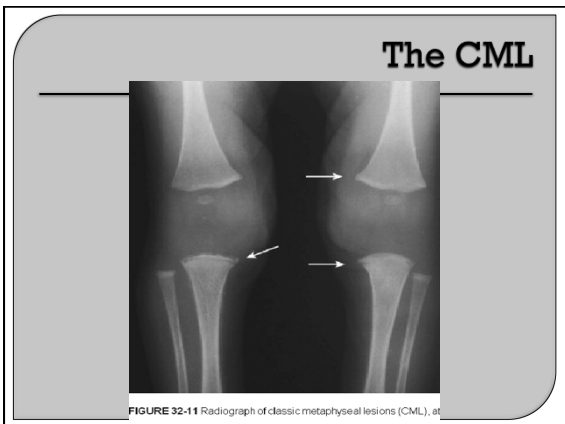
	0-11 mo		12-23 mo		24-35 mo		0-35 mo					
	No.	Proportion from Abuse %	No.	Proportion from Abuse %	No.	Proportion from Abuse %	No.	Proportion from Abuse %				
Ribs	809	89.4	561	96	28.5	27	96	27.6	26	1001	61.4	615
Radius/ulna	261	62.1	162	103	19.8	20	293	4.7	14	657	29.8	196
Tibia/fibula	493	58	286	192	16.1	31	384	4.7	18	1069	31.1	332
Humerus	518	43.1	223	545	6.8	37	2108	1.6	34	31729	3	295
Femur	1257	30.5	383	761	4.8	36	3006	2.5	75	4028	11.7	471
Clavicle	227	28.1	64	65	16.7	11	95	6	6	398	20.7	80
Skull	3363	17.1	675	948	8	81	1575	3.7	58	5886	12.1	712

Adapted from Leventhal JM, Martin KD, Asnes AG: Incidence of fractures attributable to abuse in young hospitalized children: results from analysis of a United States database. *Pediatrics* 2008;122:602.

Specificity of Specific Fracture Types

- Box 2-1**
Specificity of Radiologic Findings
- High specificity**
- Classic metaphyseal lesions
 - Rib fractures, especially anterior
 - Scapular fractures
 - Scissored forearm 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
- Relative specificity applies to infants.

Kleinman
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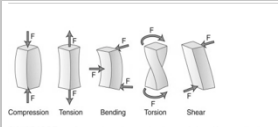
Description of Fracture is Key!

- **The specific fracture location along the bone (e.g., epiphyseal, diaphyseal, metaphyseal)**
- **The fracture type (e.g., transverse, oblique, spiral, buckle, CML)**
- **Whether there is displacement, separation, or comminution of the fracture**
- **Whether the fracture is open or closed**
- **Whether there is more than one fracture along the bone**
- **The extent of callus formation, if present**

Types of loading leads to predictable fracture patterns

Adapted from *Child Abuse and Neglect: Diagnosis, Treatment and Evidence*, editor Carole Jenny, MD
Chapter on Abusive Fractures by Kim Kacsor MS and Mary Clyde Pierce, MD

Types of loading leads to predictable fracture patterns



Biomechanical Condition	Fracture Type
Torsion	Spiral/Long Oblique
Bending	Transverse/Short Oblique
Compressive	Buckle/Impaction
Tension and/or Shear	CML
High Energy	Open and/or comminuted

Adapted from Child Abuse and Neglect: Diagnosis, Treatment and Evidence, editor Carole Jenny, MD
Chapter on Fracture Biomechanics, Gina Bertocci, PhD

ORIGINAL ARTICLE

Transverse Fracture of the Distal Femoral Metadiaphysis *A Plausible Accidental Mechanism*

Suzanne B. Haney, MD,† Stephen C. Boos, MD,‡ Timothy J. Kutz, MD,§||
and Suzanne P. Starling, MD***

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Learning Points

- Fractures can happen from delivery, including femur fractures.
- C-section is not necessarily protective!
- Presentation of parturitional femur fracture might be delayed.
- Even good doctors can miss things.
- Use all sources of information available to put the puzzle pieces together – in this case, the family’s photo and video clip were essential.

References

- Morris, et. al. Birth associate femoral fractures: incidence and outcome, *Journal of Pediatric Orthopedics*, (2002) 22: 27-30.
- Shigeki Matsubara, et. al. Femur fracture during abdominal breech delivery. *Arch Gynecol Obstet* (2008) 278:195–197.
- Cebesoy, et. al. Bilateral femur fracture in a newborn: extreme complication of cesarean delivery. *Arch Gynecol Obstet* (2009) 279:73–74.

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Femur Fractures Resulting From Stair Falls Among Children: An Injury Plausibility Model
 Mary Clyde Pierce, Gina E. Bertocci, Janine E. Jamosky, Fernando Aguel, Ernest Deemer, Morey Moreland, Danielle K. B. Boal, Sylvia Garcia, Sandra Herr, Noel Zuckerbraun and Eva Vogeley
Pediatrics 2005;115:1712-1722
 DOI: 10.1542/peds.2004-0614

TABLE 2. Criteria for Determining Biomechanical and Fracture Type Compatibility (Biomechanical Match)

Biomechanical Conditions ¹⁵	Fracture Types	Biodynamic History Examples
Torsional loading	Spiral/long oblique	Twisting or rotation of leg as child slips and leg folds underneath body
Bending load	Transverse/short oblique	Perpendicular impact of leg such as leg caught between stair and caretaker
Compressive loading	Buckle/impaction	Knee impacts along longitudinal axis of femur as child falls down stairs
Tension and/or shear loading	CML	Pulling or yanking of leg
High-energy event (any loading condition)	Open and/or comminuted	Pedestrian leg impacted by fast-moving vehicle

Fracture Assessment and Injury Plausibility

- ◉ Possible is not the same as plausible; must consider all features of the history.
- ◉ What is the particular type and magnitude of loading required for the particular type of fracture?
- ◉ Is the history described in a clear and consistent fashion with details?
- ◉ What was the child's response, symptoms, etc.
- ◉ Was there an appropriate caretaker response or was there a delay in seeking medical care?

Conclusions

- ◉ Children who have been physically abused often sustain bony fractures.
- ◉ Different fracture types have been described as having a high probability for abuse while others are more nonspecific.
- ◉ No one fracture *in isolation* is diagnostic for physical abuse.
- ◉ The details are in the history!
