Improving the Rate of Follow-up Skeletal Survey (FUSS) Completion

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Disclosures

I have no actual or potential conflict of interest in relation to this presentation.

Objectives

- Describe the importance and utility of follow-up skeletal surveys (FUSS)
- Discuss barriers to completion and possible consequences of non-completion
- Summarize the quality project initiated at Upstate Golisano Children's Hospital to improve the rate of FUSS completion

What is the role of imaging in child abuse evaluation?

Concept of Child Abuse as a Medical Entity

- John Caffey, MD (pediatric radiologist)
- Henry Kempe, MD and colleagues – "battered child syndrome"

Caffey Disease

What is the role of imaging in child abuse?

- Identify the extent of physical injury when abuse is present or suspected
- Identify imaging findings that may point to an alternative diagnosis

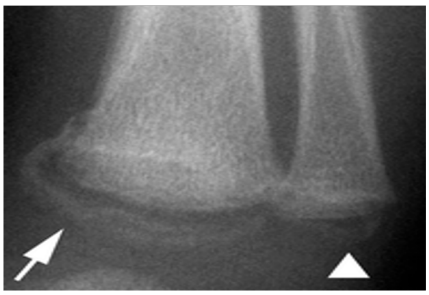
Skeletal Trauma in Child Abuse

- Skeletal injuries are often the strongest radiologic indicators of abuse.
- Certain patterns of injury can be diagnostic of child abuse.

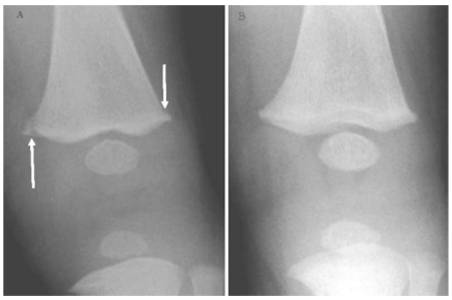
Fractures with High Specificity for Abuse

- Classic metaphyseal lesions (CMLs)
- Rib fractures
  - Especially posterior and 1st rib
- Scapular fractures
- Spinous process fractures
- Sternal fractures

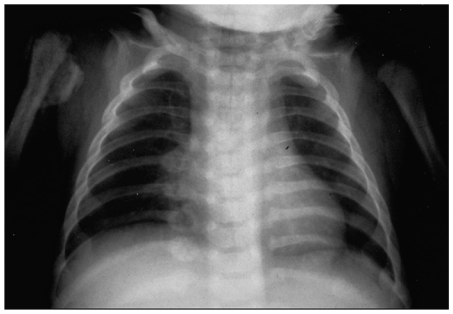
CMLs of Tibia and Fibula



Corner Fractures of Femur



Rib Fractures



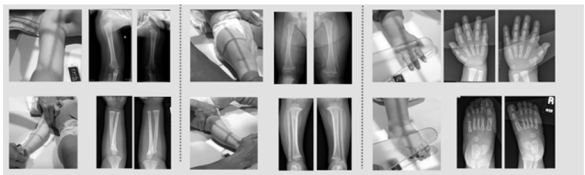
Spiral Fracture

Fractures Commonly Seen in Non-Abused Children

- Linear skull fractures
- Clavicular fractures
- Long bone shaft fractures

The Skeletal Survey (SS)

- Method of choice for global skeletal imaging
- American College of Radiology standards for SS imaging
  - High detail imaging systems to be used for suspected abuse in infancy



Points to Remember

1. *Proper technique*
   - *High resolution while optimizing dose*
2. *Positioning*
3. *Collimation*
4. *Image identification*
5. *Restraining methods*
6. *Patient shielding*

Department of Radiology and Imaging Science, IU working together to improve performance of skeletal surveys for suspected non accidental trauma

For any questions, please speak with one of our staff radiologists at Riley Tel- 317-948-6315

Riley Hospital for Children
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What about the risks of radiation in children?

- Imaging studies using ionizing radiation should be performed in accordance with ALARA (using an exposure as low as reasonably achievable) principle.

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Importance of SS

Young children are most at risk for missed abuse!

- SS is the standard screening tool for detecting clinically unsuspected fractures.
- Must image all children suspected to be victims of abuse.
- Be vigilant for sentinel injuries and follow appropriate work-up for them.

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Imaging Guidelines

- The AAP recommends initial SS for all children < 24 months old who are suspected to be victims of child abuse.
- SS to be done even when injuries may not be evident clinically.
- Imaging in children age 2-5 years is done on basis of clinical indicators of abuse.

Imaging Guidelines (cont'd)

- Imaging of twin infant (and siblings)
- Imaging of sexual abuse victims based on clinical indications
- Hospitalization (or other safe haven placement) pending SS
- SS in critically ill children should be done in timely manner

FUSS

- The AAP and ACR also recommend a FUSS in two weeks.
- FUSS detects:
  - Acute fractures missed on initial survey
  - Evidence of ongoing trauma
  - More precise determination of age of injuries
  - Clarify indeterminate findings

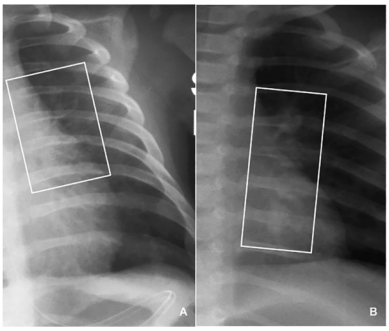
Imaging Signs of Fracture Healing in Young Children

TABLE 1: Time Since Injury When the Radiologic Signs of Fracture Healing Are Present as Proposed in Radiology Textbooks and Primary Scientific Studies

	Radiology Textbooks				Scientific Studies		
	O'Connor and Cohen [2]			Offiah and Hall [3]			
Radiologic Feature	Early	Peak	Late		Islam et al. [5]	Yeo and Reed [6]	Cumming [7]
Soft-tissue swelling				< 7–10 d			
Resolution of soft tissues	2–5 d	4–10 d	10–21 d				
Fracture gap widening				> 7 d	4–6 wk [56%] (2–8 wk)		
Periosteal reaction presence (stage I)	4–10 d	10–14 d	14–21 d	7–10 d	4–7 wk [100%] (≥ 2 wk)	1.6 wk (1–3 wk)	9–10 d (7–11 d)
Marginal sclerosis					4–6 wk [85%] (2–11 wk)		
First callus	10–14 d	14–21 d		1–6 wk	4–7 wk [100%] (≥ 2 wk)		
Callus density > cortex	14–21 d	21–42 d	42–90 d		13 wk [90%] (≥ 4 wk)		
Bridging (stage II)					13 wk [50%] (≥ 3 wk)	2.6 wk (1.5–3.7 wk)	
Periosteal incorporation					14 wk (≥ 7 wk)		
Remodeling (stage III)	3 mo	1 y	≥ 2 y		9 wk [50%] (≥ 4 wk)	8 wk (5–11 wk)	

Note—Data in brackets refer to the percentage of patients in study with feature during that peak period or at that time point and data in parentheses refer to range.

Prosser I, et al., 2012.



Infant who presented with unexplained bruise. Initial survey normal (A), but FUSS shows healing rib fractures (B). Bajaj and Offiah, 2015.

FUSS (cont'd)

- FUSS can affect the determined likelihood of abuse.
- FUSS should be considered in cases with lower initial levels of concern for abuse.

Improving the rate of FUSS completion: A quality improvement initiative

Goals

- To identify barriers for non-completion of FUSS in suspected child abuse in order to improve upon the follow-up rate.

Methodology

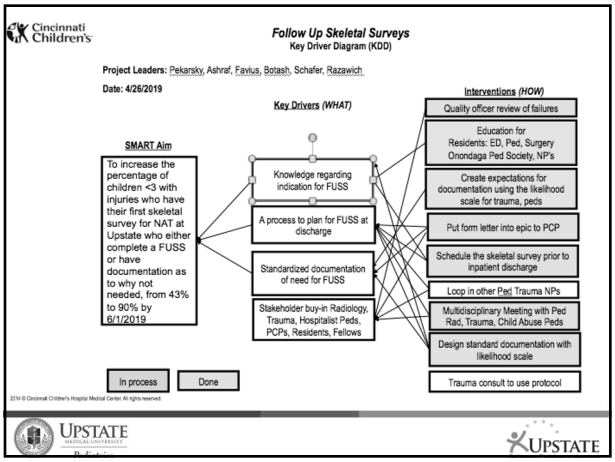
- QI conducted at SUNY Upstate University Hospital.
- Medical records of children who had initial skeletal survey between 06/01/17 and 05/31/18 were reviewed to determine if a follow-up was performed *or* documentation was provided as to why it was not needed.

How did our hospital do?

- 80 children had skeletal surveys performed over the course of the designated period.
- Only 34 (43 %) had a FUSS or had documentation as to why it was not needed.

Barriers to Non-completion

- Lack of education of relevant providers
- Patients lost to follow-up

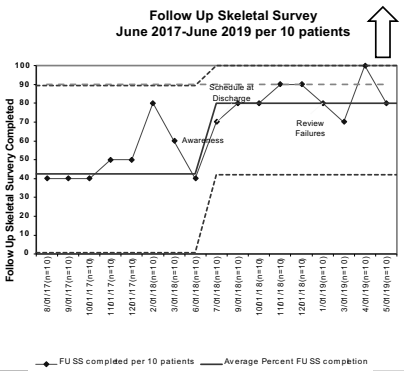


Interventions

- Education for pediatric, emergency medicine and trauma surgery teams
  - Lectures
  - Meetings
  - Written form
- Education materials for primary care providers to highlight the importance of FUSS
  - PCP letter
- Implementation of FUSS protocols to ensure outpatient follow-up after discharge
  - FUSS scheduled before discharge
  - OR standardized documentation as to why FUSS is not needed
  - PCP letter
  - Using a likelihood of abuse scale in documentation

Results (cont'd)

- After implementing our interventions, FUSS rate improved to 80% by the goal date.
- We can attribute the improvement to our interventions.



Likelihood of Abuse Scale

- **Definitely not inflicted injury**
  Significant, independently verifiable mechanism. Disinterested witness. Mimic.
- **No concern for inflicted injury**
  Mechanism explains all injuries, consistent history.
- **Mildly concerning for inflicted injury**
  Somewhat concerning injuries with no offered history. Otherwise unconcerning injury with past suspicious injury and same caregiver.
- **Intermediately concerning for inflicted injury**
  Insufficient information to offer opinion. Sequence of events clear, but uncertain whether they constitute abuse. Necessary laboratory tests/consultation pending. Concerning injury in the setting of bone fragility/bleeding diathesis.
- **Very concerning for inflicted injury**
  Given history unlikely to produce documented injuries. Concerning injury with no history of trauma.
- **Substantial evidence of inflicted injury**
  Severe injury with no offered history in a child incapable of inflicting the injury on himself or herself. History inconsistent with identified injuries. Serious injury with changing history or history inconsistent between caregivers. Inappropriate delay in seeking care. Multiple severe injuries of different age without plausible explanation. Pattern bruises/burns.
- **Definite inflicted injury**
  Unexplained posterior rib fractures, metaphyseal fractures, characteristic retinal hemorrhages. Highly suspicious injury with definite subsequent abuse. Reliable eyewitness of abuse. Suspicious injury and concurrently abused sibling. Obvious injury with significant, unexplained delay in seeking care.


PCP Letter Template

- Explain why their patient is admitted.
- Explain the reasoning for NAT workup and why initial SS was done. (Provide education in general and how this has been applied to their patient.)
- State the level of concern for abuse.
- Give recommendation for FUSS and explain why.
- Other information: evaluation of siblings/other children in same residence.


Conclusions

- FUSS is important, but there are challenges to following recommendations.
- We initially found a low rate of FUSS (43%).
- Barriers included lack of education about skeletal surveys amongst the relevant providers and children being lost to follow-up.
- Interventions in place to address these issues (provider education and FUSS protocols).
- Our interventions improved the FUSS completion rate to 80% by the goal date.


References

1. American Academy of Pediatrics. 2009. Diagnostic imaging of child abuse. *Pediatrics*. 123 (5):1430-1435.
2. Wood JN, Fakeye O, Feudtner C, Mondestin V, Localio R, Rubin DM. 2014. Development of guidelines for skeletal survey in young children with fractures. *Pediatrics*. 134(1): 45-53.
3. Duffy SO, Squires J, Fromkin JB, Berger RP. 2011. Use of skeletal surveys to evaluate for physical abuse: Analysis of 703 consecutive skeletal surveys. *Pediatrics.* 127(1):e47–e52.
4. Prosser I, et al. 2012. A timetable for the radiologic features of fracture healing in young children. *American Journal of Roentgenology*. 198: 1014-1020.
5. Kleinman PK, et al. 1996. Follow-up skeletal surveys in suspected child abuse. *American Journal of Roentgenology*. 167(4): 893-896.

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6. Harlan SR, Nixon GW, Campbell KA, Hansen K, Prince JS. 2009. Follow-up skeletal surveys for nonaccidental trauma: Can a more limited survey be performed?. *Pediatric Radiology*. 39(9): 962-968.
7. Gan T, Draus JM. 2018. Improving follow-up skeletal survey compliance in suspected nonaccidental trauma patients: What's the FUSS about?. *Pediatric Quality & Safety*. 3(4):e094.
8. Bennett BL, Chua MS, Care M, Kacheimeyer A, Mahabee-Gittens M. 2011. Retrospective review to determine the utility of follow-up skeletal surveys in child abuse evaluations when the initial skeletal survey is normal. *BMC Research Notes*. 4(354).
9. Harper NS, Eddleman S, Lindberg DM. 2013. The utility of follow-up skeletal surveys in child abuse. *Pediatrics*. 131(3): e672-e678.
10. Lindberg DM, Lindsell CJ, Shapiro RA. 2008. Variability in expert assessments of child physical abuse likelihood. *Pediatrics*. 121(4): e945-e953.

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