



Research article

Follow-up skeletal survey use by child abuse pediatricians[☆]

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ABSTRACT

Skeletal survey is frequently used to identify occult fractures in young children with concern for physical abuse. Because skeletal survey is relatively insensitive for some abusive fractures, a follow-up skeletal survey (FUSS) may be undertaken at least 10–14 days after the initial skeletal survey to improve sensitivity for healing fractures. This was a prospectively planned secondary analysis of a prospective, observational study of 2,890 children who underwent subspecialty evaluation for suspected child physical abuse at 1 of 19 centers. Our objective was to determine variability between sites in rates of FUSS recommendation, completion and fracture identification among the 2,049 participants who had an initial SS. Among children with an initial skeletal survey, the rate of FUSS recommendation for sites ranged from 20% to 97%; the rate of FUSS completion ranged from 10% to 100%. Among sites completing at least 10 FUSS, rates of new fracture identification ranged from 8% to 28%. Among completed FUSS, new fractures were more likely to be identified in younger children, children with higher initial level of concern for abuse, and those with a fracture or cutaneous injury identified in the initial evaluation. The current variability in FUSS utilization is not explained by variability in occult fracture prevalence. Specific guidelines for FUSS utilization are needed.

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Introduction

Child physical abuse is an important source of morbidity and mortality and carries profound costs for the child's family, the abuse perpetrator and for society at large (Fang, Brown, Florence, & Mercy, 2012; Florence, Brown, Fang, & Thompson, 2013; Russo, Hambrick, & Owens, 2008; Sedlak et al., 2010; US Department of Health and Human Services Administration for Children and Families, 2013). The radiographic skeletal survey (SS) is widely used to improve recognition of abuse by

Abbreviations: CML, classic metaphyseal lesions; FUSS, follow-up skeletal survey; SS, skeletal survey.

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identifying additional occult fractures (Kleinman et al., 2009). In several cohorts of children with concerns for abuse, the SS has been shown to identify additional fractures in 10–34% of cases in which it is obtained (Barber, Perez-Rossello, Wilson, & Kleinman, 2014; Belfer, Klein, & Orr, 2001; Duffy, Squires, Fromkin, & Berger, 2011; Karmazyn, Lewis, Jennings, Hibbard, & Hicks, 2011; Lindberg et al., 2014; Merten, Radkowski, & Leonidas, 1983). For this reason, SS is considered “mandatory” by the American Academy of Pediatrics (AAP) for any child less than two years old with concern for physical abuse (Christian & Committee On Child, & Neglect, 2015; Kleinman et al., 2009). However, in the acute phase of injury, SS has limited sensitivity for some fractures that are highly specific for abuse, including rib fractures and classic metaphyseal lesions (Harper, Eddleman, Lindberg, & for the ExSTRA Investigators, 2013; Zimmerman, Makoroff, Care, Thomas, & Shapiro, 2005). A follow-up SS (FUSS) obtained at least 10–14 days after the initial SS can identify additional fractures missed by the initial SS, clarify the importance of indeterminate findings on the initial SS, and affect the perceived likelihood of abuse (Christian et al., 2015; Harper et al., 2013; Kleinman et al., 1996; Singh, Squires, Fromkin, & Berger, 2012; Zimmerman et al., 2005).

Currently, guidelines about when FUSS should be recommended allow substantial discretion based on the perceived likelihood of abuse. Different guidelines from the AAP and American College of Radiology state that FUSS should be obtained for “high risk cases”; “equivocal cases”; when abuse is “strongly suspected” or “when abnormal or equivocal findings are found on the initial study and when abuse is suspected on clinical grounds”; the terms “high risk”, “suspected”, and “strongly suspected” are not further defined (American College of Radiology, 2012; Christian et al., 2015; Flaherty, Perez-Rossello, Levine, Hennrikus, & American Academy of Pediatrics and Society for Pediatric Radiology, 2014; Kleinman et al., 2009). Two series have demonstrated that FUSS can identify additional fractures and change the perceived likelihood of abuse, even when the initial SS is negative, or when the perceived likelihood of abuse is moderate (Bennett, Chua, Care, Kachelmeyer, & Mahabee-Gittens, 2011; Harper et al., 2013). Even in cases in which there are likely to be occult fractures, child abuse pediatricians (CAPs) may omit FUSS based on the child’s clinical condition or if the recognition of additional fractures is unlikely to affect the ultimate diagnosis or management.

Completing recommended FUSS may require substantial effort by child protective services workers and primary pediatricians in the face of reluctance from families or caregivers. This absence of clear, objective guidelines may lead to variability in FUSS recommendations, which could, in turn, decrease compliance. Our objective was to measure the variability in FUSS recommendation, completion, and injury identification for children who underwent subspecialty evaluation with concern for physical abuse at centers with child protection teams.

Methods

This was a prospectively planned, secondary analysis of the Examining Siblings To Recognize Abuse (ExSTRA) research network. The methods and results of the parent study have been published previously (Lindberg et al., 2012). Briefly, the ExSTRA research network was a prospective, observational study of 20 United States child abuse teams that included all children less than ten years of age who underwent subspecialty evaluation for concerns of physical abuse between January 15, 2010 and April 30, 2011. One center was excluded from this analysis because none of its nine participants received an initial SS. Each participating center included at least one member of the Ray E. Helfer Society, an honorary society for physicians who evaluate children who may have been victims of child abuse and neglect. The number of physical abuse consultations performed by each center during the data enrollment period ranged from 28 to 396.

While the parent study involved household contacts such as siblings or children who shared a daycare with the index child, this analysis includes data only from index children. All participating centers and the data coordinating center obtained approval for the parent study with waiver of informed consent from their local institutional review board. Each IRB also determined that secondary analyses of previously collected data that had been purged of all identifiers did not constitute human subjects research and were exempt from further review.

CAPs recorded whether an initial SS was obtained, whether a FUSS was recommended and ultimately completed, and any results. The perceived likelihood of abuse for each case was recorded both before and after FUSS results were available. Physicians recorded initial level of concern on a seven-point scale (1 – Definitely Not Inflicted Injury; 7 – Definitely Inflicted Injury). Data were entered prospectively into a secure, web-based data entry form (Quickbase, Intuit, Waltham, MA). Participating centers conducted skeletal surveys according to published guidelines from the AAP and/or American College of Radiology (Kleinman et al., 2009). Views of the skull are routinely excluded from FUSS because the membranous bones of the skull do not exhibit callus in the healing process and fractures do not become more apparent over time (Kleinman, 1998). In addition, six participating centers routinely excluded views of the spine and five of these centers also excluded views of the pelvis based on prior data suggesting that these views are unlikely to identify additional fractures (Harlan, Nixon, Campbell, Hansen, & Prince, 2009). All skeletal surveys (initial or follow-up) were interpreted as usual by experienced pediatric radiologists. In cases where findings were unclear, or when there was disagreement among specialists, the attending CAP made the ultimate determination on the presence of a fracture after review of available testing, clinical information and subspecialty consultation. In determining the presence of a fracture, CAPs were instructed to use the standard of whether they would include the presence of the fracture in the medical record, or testify to its presence in court. A fracture was considered to be newly identified by the FUSS if it had not previously been demonstrated to this standard.

For these analyses, we report the proportion of participants with an initial SS in which FUSS was recommended, completed, and the proportion that identified a new fracture. Next, we conducted logistic regression analysis to assess whether demographic or clinical information predicted whether a FUSS was (a) recommended, (b) completed, and (c) associated

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