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Inter-rater reliability of physical abuse determinations in young children with fractures



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ABSTRACT

As there is no “gold standard” in determining whether a fracture is caused by accident or abuse, agreement among medical providers is paramount. Using abstracted medical record data from 551 children < 36 months of age presenting to a pediatric emergency department, we examined the extent of agreement between specialists who evaluate children with fractures for suspected abuse. To simulate clinical scenarios, two pediatric orthopaedists and two child abuse pediatricians (CAPs) reviewed the full abstraction and imaging, whereas the two pediatric radiologists reviewed a brief history and imaging. Each physician independently rated each case using a 7-point ordinal scale designed to distinguish accidental from abusive injuries. For any discrepancy in independent ratings, the two specialists discussed the case and came to a joint rating. We analyzed 3 types of agreement: (1) within specialties using independent ratings, (2) between specialties using joint ratings, and (3) between clinicians (orthopaedists and CAPs) with more versus less experience. Agreement between pairs of raters was assessed using Cohen's weighted kappa. Orthopaedists ($\kappa = 0.78$) and CAPs ($\kappa = 0.67$) had substantial within-specialty agreement, while radiologists ($\kappa = 0.53$) had moderate agreement. Orthopaedists and CAPs had almost perfect between-specialty agreement ($\kappa = 0.81$), while agreement was much lower for orthopaedists and radiologists ($\kappa = 0.37$) and CAPs and radiologists ($\kappa = 0.42$). More-experienced clinicians had substantial between-specialty agreement ($\kappa = 0.80$) versus less-experienced clinicians who had moderate agreement ($\kappa = 0.60$). These findings suggest the level of clinical detail a physician receives and his/her experience in the field has an impact on the level of agreement when evaluating fractures in young children.

In the United States, medical professionals are responsible for reporting about 10% of the more than 3 million child abuse and neglect reports that are made yearly to Child Protective Services (CPS). Of the cases that are substantiated as maltreatment, 18% are due to physical abuse (U.S. Department of Health and Human Services, 2015). Fractures are one of the most common presentations of

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child abuse, second only to bruising (Kemp, Maguire, Nuttall, Collins, & Dunstan, 2014; McMahon, Grossman, Gaffney, & Stanitski, 1995).

It is of critical importance to the health and safety of children with fractures that these injuries are accurately determined to be either abusive or non-abusive; an erroneous determination in either direction has important negative implications for the child, family, and clinician. Mistakenly reporting an accidental incident to CPS may result in the child being removed from the home, while failing to report a case of suspected abuse may greatly increase the risk of further maltreatment or death (Moles & Asnes, 2014; Tilak & Pollock, 2013). In addition, failure to contact CPS can lead to criminal penalties for the physician (Christian, 2015; Moles & Asnes, 2014).

State laws mandate that clinicians report a case to CPS if there is a reasonable suspicion, not certainty, of maltreatment (Christian, 2015; Moles & Asnes, 2014). Reporting an abusive injury, however, is influenced by a clinician's ability to recognize injuries suspicious for abuse, the history of the clinician-family interactions, and a clinician's prior experience with CPS (Jones et al., 2008). The absence of a "gold standard" for evaluating injuries also adds a layer of subjectivity in the decision to report to CPS (Lindberg, Lindsell, & Shapiro, 2008). The complex and high-risk nature of diagnosing child abuse makes decision-making about the likelihood of abuse challenging.

Studies of decision-making concerning fractures in young children have been limited. A few studies have examined the frequency with which abusive fractures are missed on initial or subsequent physician examination due to difficulty distinguishing accidental from abusive fractures. In one study of 258 children < 3 years of age who presented to a pediatric emergency department, abuse was missed in one fifth of children with abuse-related fractures during the initial medical visit, particularly when the victim was a male child with an extremity fracture (Ravichandiran et al., 2010). Another study found that one third of pediatric patients with healing abusive fractures had a previous visit where the signs of abuse, such as bruising or swelling, were not recognized (Thorpe, Zuckerbraun, Wolford, & Berger, 2014).

Other studies have examined bias in decision-making about the likelihood of abuse and the effects of race and socioeconomic status (SES) on the clinician's evaluation of pediatric fractures. One study, using chart abstractions of 414 children < 3 years of age, compared demographic data, including race/ethnicity, age, and insurance status, to the outcome measures of obtaining a skeletal survey and filing a CPS report. When controlling for likelihood of an abusive injury, it was found that children of minority race/ethnicity were evaluated and reported for suspected abuse more often than those of white race, especially if the child was at least 12 months of age (Lane, Rubin, Monteith, & Christian, 2002).

It is recommended as the standard of care to use a multidisciplinary team approach to abuse cases involving any level of uncertainty (Akbarnia & Akbarnia, 1976; Christian, 2015; Lindberg et al., 2008; Moles & Asnes, 2014; Wallace, Makoroff, Malott, & Shapiro, 2007). These teams may consist of child abuse physicians, other physicians (e.g., pediatric radiologists or pediatric emergency medicine physicians), nurses, social workers, and, if necessary, ethics and legal experts (Gonzalez & Deans, 2017; Teeuw et al., 2017). These teams enhance the decision-making process of abuse cases through the sharing of information and education of members, and can result in better protection of children, avoidance of unnecessary CPS investigations, and improved outcomes (Jones et al., 1998; Wallace et al., 2007).

Although previous studies of fractures in young children have sometimes relied on agreement between different types of specialists in defining abusive versus accidental injuries (Leventhal, Thomas, Rosenfield, & Markowitz, 1993; Thomas, Rosenfield, Leventhal, & Markowitz, 1991), no prior study has focused on the degree of agreement on the likelihood an injury is due to abuse among specialists who evaluate fractures in young children. Therefore, the purpose of this study was to examine the agreement of the likelihood of abuse ratings among three specialties whose role on the multidisciplinary teams is in the recognition and assessment of injuries suspicious for abuse: pediatric orthopaedists, child abuse pediatricians (CAPs), and pediatric radiologists. We also aimed to better understand the nature of disagreements among the specialties.

1. Methods

Children < 36 months of age who presented to a level 1 pediatric emergency department with one or more fractures (ICD-9 codes 800–829) between 2007–2010 were screened for inclusion in the study. Subjects were excluded if the participating radiologists detected no fracture, if there was an underlying metabolic or congenital bone disease, if the evaluation was not acute, or if the patient information and/or radiographs were not obtainable.

The following data were abstracted: age; race; type of insurance (as a proxy for socioeconomic status); fracture characteristics; reported mechanism of injury; imaging and radiology reports; presence of non-bony injuries; clinical notes from the child abuse team, if applicable, and social worker; whether or not a report was made to CPS; and other outcomes (e.g., child placed in foster care). To simulate a clinical scenario, clinicians (defined as pediatric orthopaedists and CAPs) were provided with the full data abstraction. The pediatric radiologists were given abstractions simulating the amount of information given to radiologists, which included the child's age, a brief summary of the event, and the imaging studies.

Six physicians – two pediatric orthopaedists, two CAPs, and two pediatric radiologists participated in the study. Attending physicians from each specialty were selected based on convenience and availability to complete the study. Each pair of specialists included one male and one female rater. The pediatric orthopaedic surgeon and CAP pairings had a more experienced individual (33–36 years in practice, mean 34.5 years) and a less experienced individual (5–10 years in practice, mean 7.5 years). Each pediatric radiologist had less than 10 years in practice.

The specialists used a rating scale to rate the likelihood of abuse. Clinicians used a previously described (Thomas et al., 1991) 7-point ordinal scale that ranged from definite abuse (rating of 1) to definite accident (rating of 7) with specific criteria listed for each

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