



Research article

Understanding forearm fractures in young children: Abuse or not abuse?



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ABSTRACT

This retrospective study describes the characteristics and mechanisms of forearm fractures in children <18 months adding to the evidence-base about forearm fractures. It also examines which features of forearm fractures in young children may help discriminate between abusive and noninflicted injuries. Electronic medical records were reviewed for eligible patients evaluated between September 1, 2007 and January 1, 2012 at two children's hospitals in Chicago, IL. The main outcome measures were the type of fracture and the etiology of the fracture (abuse versus not abuse). The 135 included patients sustained 216 forearm fractures. Most were buckle (57%) or transverse (26%). Child protection teams evaluated 47 (35%) of the patients and diagnosed 11 (23%) as having fractures caused by abuse. Children with abusive versus non-inflicted injuries had significant differences in age (median age 7 versus 12 months), race, and presence of additional injuries. Children with abusive forearm fractures often presented without an explanation or a changing history for the injury. Children with non-inflicted forearm fractures often presented after a fall. No particular type of forearm fracture was specific for child abuse. Any forearm fracture in a young child should be evaluated with special attention to the details of the history and the presence of other injuries. Young age, additional injuries, and an absent or inconsistent explanation should increase concern that the fracture was caused by child abuse.

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Introduction

Fractures are common childhood injuries (Sibert, Maddocks, & Brown, 1981; Spady, Saunders, Schopflocher, & Svenson, 2004). Although the risk of fractures increases with age, fractures also occur in young children, with an incidence of approximately 0.5% among children less than 1 year of age and 1.7% among children between 1 and 2 years of age (Hansoti & Beattie, 2008). The radius and ulna are the long bones most commonly injured and represent approximately 30–40% of limb fractures in children less than 3 years of age (Hansoti & Beattie, 2008; Taitz, Moran, & O'Meara, 2004).

Fractures are also a common injury resulting from child physical abuse, second only to bruises (Loder & Feinberg, 2007). Child physical abuse affects 12,500 children annually (U.S. Department of Health and Human Services Administration for Children Youth and Families, 2015). Young children are disproportionately affected; a quarter of abused and neglected

Abbreviations: CML, classic metaphyseal lesion; CPT, child protection team.

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children are less than three years of age (U.S. Department of Health and Human Services Administration for Children Youth and Families, 2015) and 80% of the fractures caused by abuse occur in children less than 18 months of age (Worlock, Stower, & Barbor, 1986). Recognizing abusive injuries is critical to preventing further injury and even death of the child (Jenny, Hymel, Ritzen, Reinert, & Hay, 1999). Unfortunately, distinguishing between non-inflicted fractures and those caused by abuse can be difficult, particularly in young non-verbal children.

No study to date has examined in detail the characteristics and mechanisms of forearm fractures in young children. Identifying which fractures occur most commonly and the circumstances under which they occur is information that would help to identify injuries caused by abuse (Pierce, Kaczor, Lohr, Richter, & Starling, 2012). This study examined a large cohort of children at two hospitals and assessed child age, other demographic factors, level of development, type of fracture, and history provided for the fractures. It also analyzed separately a subsample of children evaluated systematically by the hospital child protection teams (CPTs) for possible physical abuse to determine if certain characteristics can discriminate between fractures caused by abuse and non-inflicted forearm fractures.

Patients and Methods

Study Design

This study is a descriptive, retrospective review of the medical records of all patients less than 18 months of age who were treated at Children's Memorial Hospital (now Ann & Robert H. Lurie Children's Hospital of Chicago, IL) and John H. Stroger, Jr. Hospital (Chicago, IL) for radius and/or ulna fractures between September 1, 2007 and January 1, 2012. September 2007 was chosen because electronic medical records were available then at both hospitals. Patients were identified by searching for ICD-9 codes 813 (fractures of radius and ulna), 818 (ill-defined fractures of upper limb), 819 (multiple fractures involving both upper limbs and upper limb with rib[s] and sternum), and 829 (fracture of unspecified bone). Identified patients had a thorough chart review by an author from each institution (E.R. and N.R.) who had access to clinical notes, radiological images, and radiology reports. Fractures were coded according to the final read by a radiologist. Only patients with definite forearm fractures were included in the study.

Children with medical conditions that could predispose to bone injuries (extreme prematurity defined as a gestational age of <28 weeks, osteogenesis imperfecta, rickets, osteopenia, or steroid therapy) and infants who sustained their fractures as a result of birth trauma or motor vehicle collision were excluded. Patients whose only forearm fracture was a classic metaphyseal lesion (CML) were also excluded, because CMLs have been well studied and are recognized to be highly specific for child abuse (Kleinman, Marks, & Blackburne, 1986; Kleinman, Perez-Rossello, Newton, Feldman, & Kleinman, 2011). If patients with forearm fractures also had a CML, the CML was listed as an additional fracture.

The study received IRB approval from both participating hospitals.

Data Collection

Demographic information was collected from the medical chart, including age in months at the time of injury, gender, race/ethnicity (coded as white, black, Hispanic, or other based on the parent's self-report in the hospital's electronic medical record), and insurance status (public or private) as a marker for socioeconomic status. The child's level of development was recorded when available.

The location and type of fracture(s) were recorded. Fractures were categorized as: buckle, greenstick, transverse, oblique, spiral, and other including fracture type not specified. For patient level analysis, if a patient had radius and ulna fractures of the same arm, the patient was coded as having the fracture type that was identified for the radius. The specific fracture type was used for fracture level analysis.

The histories provided by the caregiver, including the reason for presentation, were briefly summarized. The histories were categorized as: *fall from child's standing height* (for example, the patient tripped while walking or fell over while trying to stand); *fall from sofa or bed* (reported heights were generally 1.5–3 feet); *fall from a distance higher than a sofa or a bed* (for example, the patient fell out of the parent's arms or out of a high chair); *fall down stairs*; *fall not specified* (no description of the fall was recorded); and *crush injury* (for example, someone stepped on the patient's arm or a sibling fell on the patient). If the caregiver(s) could not provide an explanation for the injury, it was categorized as "no history of trauma." If multiple caregivers provided conflicting information or if the explanation from a single caregiver changed significantly or completely upon retelling, the history was categorized as "changing history". If no information about the cause of the injury was recorded in the medical record, the history was listed as "missing."

If the child was evaluated by the hospital child protection team (CPT), the team's final opinion about the cause of the injury (*abuse, not abuse, or indeterminate*) was documented. Both participating hospitals have multidisciplinary CPTs composed of board-certified child abuse pediatricians and social workers with experience evaluating child abuse. The CPTs use information from the medical evaluation, any child protective service investigation, and any law enforcement investigation to formulate a final opinion about the cause of the injury. Although data regarding specific testing for other abusive injuries was not collected, both CPTs follow recommended guidelines for skeletal surveys and abdominal trauma screening (Coant, Kornberg,

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