Symptoms and Time to Medical Care in Children With Accidental Extremity Fractures
Caitlin Farrell, David M. Rubin, Kevin Downes, John Dormans and Cindy W. Christian

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Symptoms and Time to Medical Care in Children With Accidental Extremity Fractures

WHAT’S KNOWN ON THIS SUBJECT: A delay in seeking medical care for children with significant injury often raises a concern about child abuse, but there are few data describing the range of responses children display after accidental fracture for providers to use in comparison.

WHAT THIS STUDY ADDS: This study presents the range of responses exhibited by children after accidental fractures and identifies factors associated with a delay in seeking medical care. No child was asymptomatic, although a minority did not manifest all expected responses after their injury.

abstract

BACKGROUND AND OBJECTIVE: Delay in seeking medical care is one criterion used to identify victims of abuse. However, typical symptoms of accidental fractures in young children and the time between injury and the seeking of medical care have not been reported. We describe patient and injury characteristics that influence the time from injury to medical care.

METHODS: Parental interviews were conducted for children <6 years old with accidental extremity fractures. Demographic characteristics, signs and symptoms of the injury, and fracture location and severity were described and examined for their association with a delay (>8 hours) in seeking medical care.

RESULTS: Among 206 children, 69% had upper extremity fractures. The median time to the first medical evaluation was 1 hour, but 21% were seen at >8 hours after injury. Although 91% of children cried after the injury, only 83% were irritable for >30 minutes. Parents observed no external sign of injury in 15% of children, and 12% used the injured extremity normally. However, all parents noted at least 1 sign or symptom. Minority children (odds ratio [OR]: 2.54 [95% confidence interval [CI]: 1.18–5.47]), those with lower extremity injuries (OR: 2.23 [95% CI: 1.01–4.90]), those without external signs of injury (OR: 3.40 [95% CI: 1.36–8.51]), and those with continued extremity use (OR: 3.26 [95% CI: 1.22–8.76]) were more likely to delay seeking medical care.

CONCLUSIONS: Although some children did not manifest all expected responses, no child with an accidental fracture was asymptomatic. Delay in seeking medical care was associated with more subtle signs of injury; however, delays identified in minority patients are unexplained.

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KEY WORDS: children, child abuse, extremity fractures, medical care, parental perception

ABBREVIATION
ED—emergency department

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Identifying physical abuse in young children is a challenge in pediatric practice. In 2009, physical abuse represented 18% of reported child maltreatment, accounting for ∼126,000 cases.\(^1\) Child maltreatment resulted in an estimated 1770 fatalities in 2009, disproportionately affecting young children, with 81% of fatalities in children <4 years old.\(^1\)

Despite its prevalence, physical abuse is difficult to diagnose. Suspicion for abuse increases when reported mechanisms of trauma or the child's development seem inconsistent with the injury, when caregivers of an injured child deny trauma, or when seeking medical care is unexpectedly delayed.\(^2\–5\) Inferences about delays in seeking medical care are guided rarely by evidence but instead by clinicians' expectations about a child's response to injury. It is commonly held that children who fracture a bone will respond by crying, guarding the injured body part, and demonstrating behavioral changes, in turn prompting parents to seek immediate medical attention. Perceived delays in seeking medical care may raise a concern of abuse. Recent guidelines regarding the medical evaluation of physical abuse recommend asking about the child's behaviors related to the injury.\(^4\) In addition, law enforcement and child welfare professionals investigating cases of suspected abuse often request medical opinions about a child's expected behavior after sustaining a fracture.

Despite these guidelines,\(^4\) insufficient data exist describing the range of responses children display after accidental fractures.\(^6\) It is unknown whether all children cry or change their behavior after breaking a bone and what factors influence parents' decisions to seek medical care. The goal of this study was to characterize the spectrum of responses of infants and young children to accidental fractures and to identify clinical features and family demographic characteristics that influence the timing of the decision to seek medical care.

**METHODS**

Parents of a consecutive sample of children <6 years of age with extremity fractures seen in a pediatric orthopedic practice at The Children's Hospital of Philadelphia between July and September 2008 were asked to complete a survey. Children were excluded if they had multiple fractures (excepting radius/ulna and tibia/fibula fractures, which often occur together), sustained a pathologic fracture, were involved in a motor vehicle crash, or had a condition limiting their ability to feel or express pain (neurologic or developmental disorders). Interpreters translated the interview for non–English-speaking parents.

To exclude children with possible inflicted fractures, those whose fractures raised any suspicion of abuse were not approached for participation. These children included cases in which a suspicion of abuse was raised by a clinician during the evaluation, a social work consult was ordered, child protective services were involved, or a skeletal survey was obtained.

The study was approved by the hospital's institutional review board, and written parental consent was obtained for each survey. The survey was conducted with the parent(s) who accompanied the child to the visit. Data collected included: demographic characteristics (age, gender, and ethnicity, defined as white, African American, Hispanic, or other [for analysis, “minority” was defined as all non-white children]); date, time, and mechanism of injury (fall from height, injury while walking/running, fall down stairs, injury while biking/skating, or injury while playing with others); child's response to his or her injury (presence and/or duration of irritability/crying for >30 minutes and limitations in use of the extremity after injury); physiologic signs of injury (yes or no, including bruising, redness, laceration, swelling, or deformity); and date, time, and location of initial presentation for medical care.

The parent(s) who brought the child to the orthopedic clinic completed a structured interview with a single member of the study team. The time from the injury to the presentation to medical care was obtained by parental interview, as was the duration of symptoms. Length of time was recorded to the nearest quarter hour. Most parents were present at the time of injury. If the injury occurred at day care, parents reported the information given to them. To assess for validity in reporting and to account for recall bias, available emergency department (ED) records were reviewed and compared with parental surveys.

Clinical data were obtained from the child's medical record and discussion with the orthopedist, and included the fractured bone (ultimately categorized as upper versus lower extremity), type (Salter-Harris, buckle, greenstick, supracondylar, transverse, oblique, spiral, or comminuted) and severity (stable or unstable) of fracture, and the need for surgical repair (yes or no). Stable fractures included Salter-Harris fractures, buckle fractures, greenstick fractures, and type I supracondylar fractures. Unstable fractures included types II and III supracondylar fractures; transverse, oblique, and spiral fractures; and those fractures that were comminuted or displaced.

Sample characteristics were described using means and SDs for continuous variables and frequency distributions for categorical variables. \(\chi^2\) tests were used to examine the association of independent variables with a delay of >8 hours in seeking medical care. This cutoff was considered clinically significant because it represents waiting an
entire workday or waiting overnight before a child was brought for medical evaluation. Injury characteristics were included in the multivariate models a priori because of a hypothesized relationship to the care-seeking behavior of parents. Other sociodemographic variables were included if univariate analysis revealed a trend (defined as $P < .2$) toward an association with delay in seeking care. Variables were subsequently removed from the multivariate model if they were not independently associated with a delay in seeking care.

### RESULTS

Of 225 identified children during the enrollment period, 19 were not enrolled. Two families declined participation, 1 child was excluded because of severe developmental delay, and 6 children sustained fractures during a motor vehicle crash. Three were excluded because of pathologic fractures, including osteopenia of prematurity, osteogenesis imperfecta, and rickets. Seven children sustained fractures of multiple bones. The study sample therefore included 206 children.

The majority of fractures involved the upper extremity, and most fractures were stable. A small percentage of fractures required surgical repair (Table 1). Patients’ mean ± SD age was $3.7 ± 1.6$ years; $20.4\%$ were <2 years old. The majority were male (60.2\%); $53.0\%$ were white, $32.4\%$ were African American, and $14.6\%$ were Hispanic, Asian, or other ethnicities (Table 2). Most (57.3\%) were from families with private insurance, whereas $42.7\%$ were enrolled in Medicaid or the Children’s Health Insurance Program or were uninsured. The mean time lapse between the occurrence of the injury and completing the study survey was 28.6 days, with $49\%$ of surveys completed within 14 days of the injury.

The most common mechanism of injury was a fall from a height, including beds and playground equipment (45\%). Other mechanisms included falls down stairs (13\%); injuries while running (12\%), biking/skating (11\%), or playing with others (10\%); or by other mechanisms (9\%).

Parents observed an external sign of injury (bruising, redness, laceration, swelling, or deformity) in $85.4\% (n = 176)$ of cases (Table 2). After injury, $91.0\% (n = 186)$ of children cried immediately, $17.0\% (n = 35)$ either did not cry at all or stopped crying within 30 minutes of the injury, and $83.0\% (n = 171)$ cried for >30 minutes. Parents observed that $87.9\%$ of children exhibited abnormal use of their injured extremity. Of the 64 children who sustained a lower extremity fracture, $59\% (n = 38)$ of parents observed a limp, and $30\% (n = 19)$ observed a complete refusal to bear weight. Among the 142 children with an upper extremity fracture, $84\% (n = 119)$ demonstrated abnormal use of the injured arm, either by exhibiting a preference for using the uninjured arm or by complete refusal to move the injured arm.

Although the majority of children exhibited signs or symptoms of the fracture immediately after injury, there was a significant minority of children without such findings. Parents did not observe external physical signs of injury in $14.6\% (n = 30)$ of children. Of these children, $17\% (n = 5)$ sustained severe or unstable fractures, and $3\%$

### TABLE 1 Characteristics of Fractures ($N = 206$)

<table>
<thead>
<tr>
<th>Fracture</th>
<th>All, %</th>
<th>No Delay, %</th>
<th>Delay &gt;8 Hours, %</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper extremity</td>
<td>69.00</td>
<td>67.0</td>
<td>12.0</td>
<td></td>
</tr>
<tr>
<td>Humerus</td>
<td>28.00</td>
<td>28.0</td>
<td>20.0</td>
<td></td>
</tr>
<tr>
<td>Radius/ulna</td>
<td>37.00</td>
<td>34.0</td>
<td>36.0</td>
<td></td>
</tr>
<tr>
<td>Clavicle</td>
<td>3.00</td>
<td>3.0</td>
<td>9.0</td>
<td></td>
</tr>
<tr>
<td>Hand/finger</td>
<td>0.06</td>
<td>0.0</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>Lower extremity</td>
<td>51.00</td>
<td>51.0</td>
<td>49.0</td>
<td></td>
</tr>
<tr>
<td>Femur</td>
<td>8.70</td>
<td>8.0</td>
<td>12.0</td>
<td></td>
</tr>
<tr>
<td>Tibia/fibula</td>
<td>22.50</td>
<td>23.0</td>
<td>17.0</td>
<td></td>
</tr>
<tr>
<td>Foot/toe</td>
<td>0.02</td>
<td>0.0</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>Stable</td>
<td>61.00</td>
<td>61.0</td>
<td>39.0</td>
<td></td>
</tr>
<tr>
<td>Unstable/displaced</td>
<td>39.00</td>
<td>39.0</td>
<td>61.0</td>
<td></td>
</tr>
<tr>
<td>Surgical repair</td>
<td>22.00</td>
<td>22.0</td>
<td>78.0</td>
<td></td>
</tr>
</tbody>
</table>

Stable fractures included Salter-Harris fractures, buckle fractures, and greenstick fractures. Unstable fractures included transverse, oblique, and spiral fractures and those that were comminuted or displaced. Surgical repair included open reduction, internal fixation, or percutaneous pinning.

Type 1 supracondylar fractures were included in the Stable fracture group. Types 2 and 3 supracondylar fractures were included in the Unstable/Displaced group.

CHIP: Children’s Health Insurance Program.
(n = 1) required surgery. The most common types of injuries in this group were toddler’s fractures in 30% (n = 9) and buckle fractures of the forearm in 17% (n = 5).

Nine percent (n = 19) of children did not cry after their injury, and an additional 8% (n = 16) of children resolved their irritability within 30 minutes of injury. Twelve percent (n = 25) of children continued to use their fractured limb normally. Normal use of the fractured limb was noted for 16% (n = 22) of upper extremity injuries and 5% (n = 3) of lower extremity injuries. Of the children with normal use of their fractured limb, 6 had a severe or unstable fracture, and 4 required surgery (3 displaced supracondylar fractures and 1 lateral condyle fracture). The remaining 19 children who used their fractured limb normally had stable fractures, including 9 with buckle fractures, 6 with a hand or finger fracture, and 1 with a toddler’s fracture of the tibia. No femur fractures were identified among children using their limbs normally.

Despite a significant minority of children without an external sign of injury or with normal use of the extremity after injury, only 1% (n = 2) of children exhibited both together. Both of these children, a 4-year-old and a 1-year-old, sustained forearm buckle fractures. The 4-year-old experienced a delay to medical care of 19 hours, and the younger child was brought for evaluation 1 hour after his injury. These 2 otherwise asymptomatic children both cried after their injury. Every child enrolled in our study exhibited at least 1 symptomatic demonstration of his or her fracture (crying, external signs of injury, or abnormal use of the limb).

Most parents (91%) brought their child to the ED for an initial evaluation. The median time to the first medical evaluation was 1 hour (interquartile range: 0.5–4 hours), although 21% were seen at >8 hours after injury (8% of whom were seen >24 hours after the injury). Children who were delayed in seeking medical care were more likely to be a minority, to have a lower extremity fracture, to lack external signs of injury, or to use the extremity normally (Table 2). These factors remained significant in a multivariate model. Minority status remained independently associated with delay in seeking care, even after controlling for clinical factors (Table 3). The age of the child, gender, the presence or absence of crying or fussiness, the severity of the fracture, and family insurance status were not associated with a delay in seeking medical care.

Of the 206 children in the study, 96 were cared for in our hospital’s ED and had data from the initial assessment available to compare with the survey responses. ED records did not include all data that were obtained by the survey of the parent; for example, 77% (n = 74) of ED records did not comment on the presence or lack of crying, 20% (n = 19) did not comment on deformity, 2% (n = 2) did not include a mechanism of injury, and 17% (n = 16) had no data on time of injury.

When ED data were available to compare with survey data, parental survey results often matched the ED data. For example, when crying was noted in the ED records, it was reported on 88% (n = 23) of parental surveys. When the mechanism of injury was reported in ED records, 94% (n = 91) of parental surveys and ED records matched. When the time between injury and ED arrival was available (83%; n = 80), there was no notable difference from parental survey reports.

**DISCUSSION**

The majority of young children with an accidental fracture follow an expected pattern of behavior by crying, demonstrating abnormal use of the injured limb, and exhibiting an external sign of injury visible to parents. Most parents bring their child to medical attention promptly, almost uniformly seeking care in the ED. However, our data demonstrate that a notable minority of children do not follow the pattern of expected behaviors. This finding is highlighted by the 9% of children who did not cry initially, 12% who continued normal use of their injured limb, and 15% who had no external sign of injury. Children with more subtle signs were less likely to present for medical care quickly. In fact, 13% of parents sought care for their children >8 hours after the injury, and an additional 8% sought care >24 hours after injury.

Although there was notable and surprising variability in the children’s responses to accidental fractures, such variability was reduced when considering behaviors in combination. All children demonstrated at least 1 sign or behavior that prompted their parent to seek medical attention. All parents noted at least 1 of the following responses: (1) the presence of external signs of injury, (2) abnormal use of the extremity, or (3) crying or fussiness for >30 minutes. No child was completely asymptomatic or without signs of injury, even in those who experienced a delay in receiving care. Although clinicians must acknowledge a range of behaviors in young children and infants with fractures, they must also

**TABLE 3 Multivariable Analysis of Clinical and Demographic Characteristics Associated With a Delay in Seeking Medical Care (≥8 Hours) for Accidental Extremity Fractures**

<table>
<thead>
<tr>
<th>Factor</th>
<th>Odds Ratio</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male gender</td>
<td>0.49</td>
<td>0.23–1.03</td>
</tr>
<tr>
<td>Minority race</td>
<td>2.54</td>
<td>1.18–5.47</td>
</tr>
<tr>
<td>No external sign</td>
<td>3.40</td>
<td>1.58–8.51</td>
</tr>
<tr>
<td>Normal use of extremity</td>
<td>3.26</td>
<td>1.22–8.76</td>
</tr>
<tr>
<td>Lower extremity injury</td>
<td>2.23</td>
<td>1.01–4.90</td>
</tr>
</tbody>
</table>

a Comparisons are female gender, nonminority race, presence of external signs, abnormal use of fractured extremity, and upper extremity injury.
maintain a high index of suspicion for possible abuse in children with fractures for whom none of these responses is reported.

To the best of our knowledge, prior to this work, data regarding child behaviors after accidental fractures were lacking. Delay in seeking treatment is frequently cited as behavior that may signal an abusive injury, but no specific definition of “delay” is provided.4,8–10 In studying abusive fractures, previous researchers have described incomplete documentation in medical charts of children’s behaviors after injury.10,11 Our study quantified the range of signs and symptoms identified after the occurrence of extremity fractures in young children. We identified an association between lack of signs of injury and delay in seeking medical care. This finding allows clinicians to understand how these responses affect a parent’s decision to bring a child for medical evaluation.

An important finding in this study was the significant number of families that exhibited a delay in seeking medical care, which has been emphasized previously as a suspicious finding in abusive injury cases.10 In our study, the factors associated with a delay in seeking care included the physiologic response of the child, the location of the injury, and the race/ethnicity of the child. Although the absence of physical manifestations (use of limb and/or physical deformity or bruising) was associated with a delay in seeking care, there was no relationship between a child’s irritability or crying after injury and such a delay. Although a notable minority of children did not cry after injury, a lack of crying and fussiness was not associated with a delay in seeking medical care.

The identification of minority race as a predictor of a delay in seeking medical care is thought-provoking; we cannot determine the cause of this finding. Cultural differences in parenting styles or children’s play, as well as physical differences in observable signs, may play a role in this phenomenon. Yet, there is an important history of racial discrepancies in the reporting of child abuse that cannot be ignored.12 Clinical judgment is used to decide what an appropriate parental response entails. This assessment is subjective and therefore dependent on the clinician’s personal biases and previous experience. It is possible that parents’ previous experiences with the medical establishment shape their willingness to seek medical care when their child sustains an accidental injury. In addition, there is a well-documented history of unequal access to health care for minority patients, which may play a role in the delayed time to evaluation for minority children’s injuries.13–15 Our data would suggest that this delay cannot be explained by health insurance status alone (Table 2).

Our data are not without limitations, the most obvious of which was recall bias, as our survey relied on parental report of the child’s behavior and was conducted after the injury. Our major outcomes, including time from injury to seeking medical care and child behaviors after injury, relied solely on parental recollection. However, we had access to almost half of the ED records for participants in the study and found no significant discrepancies in ED and survey reports, suggesting that recall bias was minimal.

It is possible that we might have misclassified injuries in this study. We did, however, go to significant lengths to avoid misclassification of truly abusive injuries as accidental by excluding not only children with confirmed child abuse but also any child for whom a social work consult or skeletal survey was ordered. Although it remains possible that a child with an abusive injury might have been included in this study, we also may have falsely excluded cases of accidental injury from our study sample given our conservative exclusion criteria. If those cases were more likely to exhibit unusual patterns of behavior or a delay to care, then we might have systematically underestimated the prevalence of these findings in our study. The precise number of children excluded for issues related to suspected abuse is unknown, as these parents were not approached for participation in this study. However, during the study period, the Child Protection Team at the hospital saw 9 children who would have otherwise met inclusion criteria. The majority of these children were brought to medical care in <8 hours. Twenty-two percent (n = 2) experienced a delay in seeking care beyond 8 hours, consistent with our study population. Only 1 child underwent a child abuse evaluation specifically due to his delayed presentation to medical care.

CONCLUSIONS

Although the majority of infants and young children with accidental fractures are symptomatic at the time of an injury and present promptly for medical care, a significant minority use their extremity after an injury, show no significant physical signs of injury, or exhibit little irritability after the injury. When a delay in seeking medical care occurs, it is more likely related to the absence of physical signs of injury than a child’s crying or irritability. Additional delays in seeking care in minority families may have social, rather than biological, causes.
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