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Inflicted skeletal trauma: The relationship of perpetrators to their victims^{☆,☆☆}

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Abstract

Objective: Although inflicted skeletal trauma is a very common presentation of child abuse, little is known about the perpetrators of inflicted skeletal injuries. Studies exist describing perpetrators of inflicted traumatic brain injury, but no study has examined characteristics of perpetrators of inflicted skeletal trauma.

Methods: All cases of suspected child physical abuse evaluated by the child abuse evaluation teams at Vanderbilt University Medical Center (January 1996 to August 2000) and at the Children's Hospital at Denver (January 1996 to December 1999) were reviewed for the presence of fractures. All children with inflicted fractures were entered into the study, and demographic data, investigative data, and identity of perpetrators were collected.

Results: There were a total of 630 fractures for 194 patients. The median number of fractures per patient was 2, and the maximum was 31. Sixty-three percent of children presented with at least one additional abusive injury other than the fracture(s). Perpetrators were identified in 79% of the cases. Nearly 68% of the perpetrators were male; 45% were the biological fathers. The median age of the children abused by males (4.5 months) significantly differed from the median age of those abused by females (10 months) ($p = .003$).

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Conclusion: In the cases where a perpetrator of inflicted fractures could be identified, the majority were men, most commonly the biological fathers. Children injured by men were younger than those injured by women.

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Introduction

Inflicted skeletal trauma is the second most common presentation of child abuse in the United States (Cramer, 1996). More than 30% of children evaluated in the emergency department for suspected child abuse have either acute or healing fractures (Hyden & Gallagher, 1992). Although general risk factors for child abuse have been identified (Brenner, Overpeck, Trumble, DerSimonian, & Berendes, 1999; Kotch, Browne, Dufort, & Winsor, 1999; Wolfner & Gelles, 1993), and studies have examined the types and locations of fractures associated with child abuse (Leventhal, Thomas, Rosenfield, & Markowitz, 1993; Loder & Bookout, 1991; Worlock, Stower, & Barbor, 1986), little is known about the perpetrators of skeletal injuries. Several studies exist regarding perpetrators of inflicted traumatic brain injury (ITBI) (Starling & Holden, 2000; Starling, Holden, & Jenny, 1995; Starling et al., 2004), but no study has examined characteristics of perpetrators of inflicted skeletal trauma.

In this study, we reviewed cases of inflicted skeletal trauma from two medical centers to determine if any group of caretakers is at a higher risk of causing fractures in children. We examined demographic characteristics of victims and perpetrators, types and locations of fractures sustained, and the relationship between perpetrators and victims.

Methods

All cases of suspected child physical abuse evaluated by the child abuse evaluation teams at Vanderbilt University Medical Center between January 1996 and August 2000 and at the Children's Hospital at Denver between January 1996 and December 1999 were reviewed. These cases included children for whom fractures were the presenting complaint as well as those cases in which the children may have presented with other injuries or illness. Institutional Review Board approval was obtained at each center. Reviewers identified the charts of all children with inflicted fractures for inclusion in this study. For each case, reviewers recorded information on the sex, race, and age of victim; the number of fractures per patient; fracture site(s); number and types of additional abusive injuries; and number and types of injuries indicative of prior abuse. Reviewers also recorded the following information on the known or suspected perpetrators associated with each case: sex, age, relationship to victim (e.g., biological parent, babysitter, etc.), and living situation. All cases of suspected child abuse had been reported to Child Protective Services or to law enforcement.

Perpetrators were identified by reviewing case records and, when available, information related to the investigation. Such information included the statements, admissions, or confessions made by the perpetrators to physicians or investigators. In some cases, the perpetrator confessed to the injuries, either during the initial medical evaluation or subsequently during the criminal investigation. In other cases, the perpetrator was the primary suspect in a criminal investigation. In the remaining cases

the perpetrator was suspected by the child abuse evaluation team based on such factors as a discrepant history of injury for fractures with known mechanisms of injury or having been alone with the child when the injury was known to have occurred. For analysis purposes, all groups of perpetrators were pooled. In some cases the relationship of the perpetrator to the child could not be determined.

Descriptive statistics were used to summarize the demographic characteristics of the victims and perpetrators. The Shapiro-Wilk test, histograms, and boxplots were used to assess the distributions of continuous variables. Non-normally distributed data were described using the median and interquartile range, while parametric data were described with means and standard deviations. Categorical variables were described using frequencies and relative frequencies. The χ^2 test was used to examine differences in proportions between groups. The Wilcoxon Rank-Sum test was used to examine differences in continuous, non-parametric data. Statistical analyses were performed with the SAS System for Windows, Release 8.01 (SAS Institute, Cary, NC).

Results

Of the 298 patients with fractures, 194 (65%) of the children were determined to have inflicted skeletal injury and therefore included in the study; 104 children whose fractures were the result of accidents or of indeterminate etiology were excluded. Of the 194 children included, the age ranged from 0 months to 13.9 years, with a median age of 6 months. The majority of the patients were White (66.5%), and the proportion of males (52.6%) and females (47.4%) was not significantly different.

There were a total of 630 fractures for 194 patients. The median number of fractures per patient was 2, and the maximum number of fractures sustained in a single patient was 31. Of the 630 fractures, the sites most commonly fractured were the ribs (50.2%), legs (21.8%), and arms (12.9%). Most of the children (63.4%) presented with at least one additional abusive injury in addition to the fracture(s). The details regarding the number and types of associated injuries are shown in [Figure 1](#). Although bruising was the most commonly associated injury, only 20.8% of the children had a bruise overlying a fracture. If scalp bruises and subgaleal hematomas associated with skull fractures are eliminated, only 9.3% of the children had bruises associated with their fractures. Additionally, 30% of the children at the time of their admission had injuries suggesting prior abuse, such as healed burns, fractures with evidence of healing, or chronic subdural hemorrhages.

The relationship of the perpetrator to the child was able to be determined in 79% ($n = 153$) of the cases. Demographic characteristics of perpetrators are listed in [Table 1](#). Nearly 68% of perpetrators were males, with biological fathers representing 45.1% of the 153 known perpetrators. Seventy-six percent of the perpetrators lived with their victims.

The data also were examined to determine whether there was a relationship between the sex of the victims and the sex of the perpetrator, and between the age of the victims and the sex of the perpetrator. The proportions of girls and boys abused did not differ significantly by the sex of the perpetrator ($p = .07$). However, the median age of the children abused by males (4.5 months) was significantly lower than the median age of those abused by females (10 months) ($p = .003$). There is a small spike in perpetration of fractures by both men and women in children at the age of 23–24 months ([Figure 2](#)).

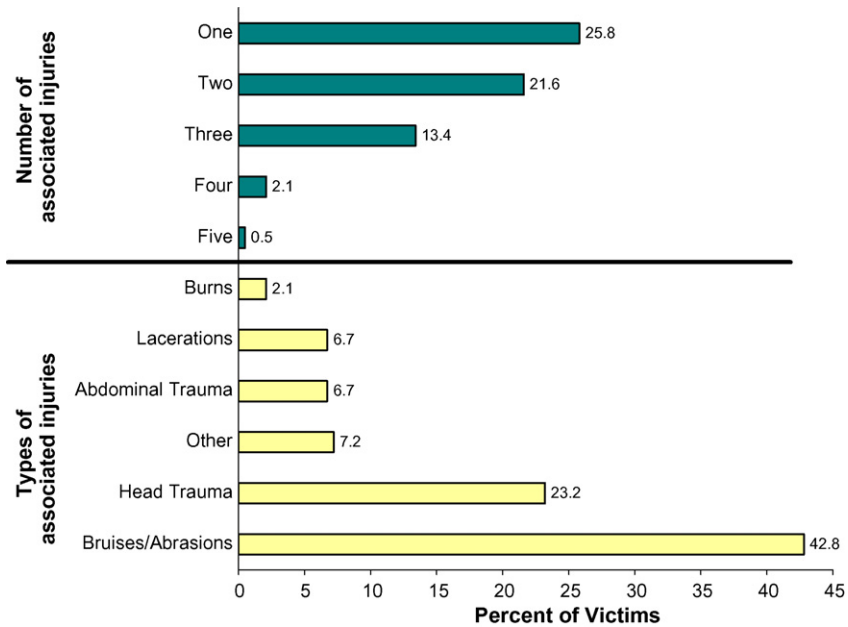


Figure 1. Number and types of additional abusive injuries diagnosed at the time of presentation for inflicted fracture ($n = 194$).

There were 44 children in the study group whose primary injury was inflicted traumatic brain injury, but who also had inflicted fractures. Since the age of victims of ITBI may differ from the age of fracture victims, these 44 cases were excluded, and the analysis repeated. With cases of co-existing ITBI excluded, the median age of the children abused by males (5 months) still was significantly lower than the median age of those abused by females (12 months) ($p = .004$).

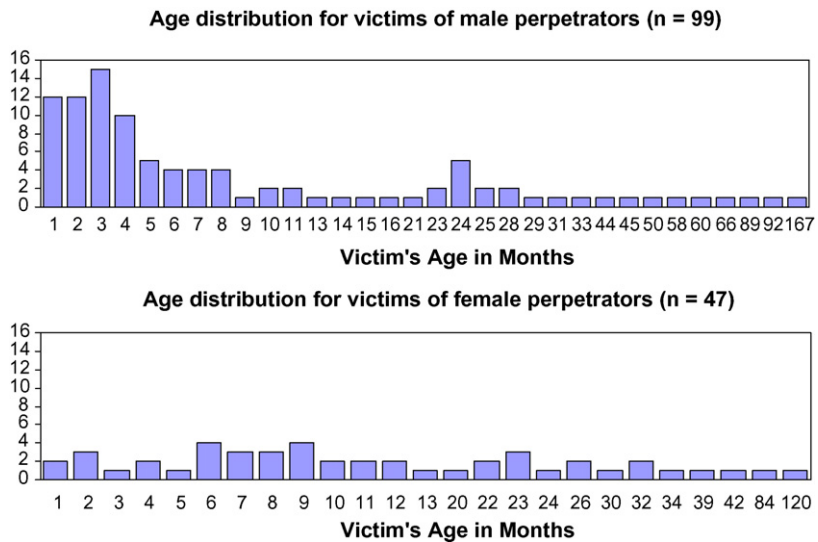


Figure 2. Age distribution for victims of male and female perpetrators.

Table 1
Demographics of known perpetrators ($N = 153$)

Characteristic	%
Sex ^a	
Male	67.8
Age ^b	
≥ 18 years	95.7
< 18 years	4.3
Relationship to victim ^c	
Biological father	45.1
Biological mother	17.0
Babysitter ^d	13.7
Mother's boyfriend	13.1
Other	5.9
Stepfather	3.3
Both biological parents	1.9
Perpetrator lived with victim ^c	
Yes	75.8
Level of suspicion ^e	
Primary suspect in investigation	26.8
Charged and convicted	26.8
Suspected by team	25.5
Confessed	20.8

^a $n = 146$.

^b $n = 92$.

^c $n = 153$.

^d One babysitter was male.

^e $n = 149$ (child may have had more than one identified perpetrator).

Discussion

This is the first study to examine the specific characteristics of perpetrators of inflicted skeletal trauma. We found that men are the most common perpetrators of skeletal trauma in children, with biological fathers and mothers' boyfriends accounting for 58.2% of fractures. Biological mothers were the second most common group of fracture perpetrators. The proportions of girls and boys abused did not differ significantly by the sex of the perpetrator; however, children injured by men were younger than those injured by women.

Our results on fracture perpetrators are similar to previous studies of ITBI perpetrators (Starling & Holden, 2000; Starling et al., 1995). These earlier studies revealed biological fathers as the most common perpetrator of head injuries, and our data show that fathers also are the most common perpetrator of inflicted fractures. Biological mothers, who are among the least common group of perpetrators of head injury in our previous studies (Starling & Holden, 2000; Starling et al., 1995) are the second most common group of perpetrators in cases of skeletal trauma. We speculate that skeletal trauma and traumatic brain injury may have different triggers. Whereas crying in infants may trigger extreme irritation in an inexperienced caregiver leading to a shaking episode, fractures in infants and children may be more related to the frustrations of everyday parenting, thus accounting for the increase in perpetration by mothers.

Studies of victims of both inflicted head trauma and abdominal trauma (Cooper et al., 1988; Starling & Holden, 2000; Starling et al., 1995) find that boys are victimized more often than girls, but in this study of skeletal trauma the rate of victimization is similar for both boys and girls (52.6% vs. 47.4%). We did, however, find that children injured by men were younger than those injured by women. It is often suggested that great strength is required to fracture a child's bones; however, if the ability to fracture a bone depended on the size or strength of the perpetrator, one would expect that women would more commonly injure the more fragile younger children, and men would more commonly injure the sturdier older children. In this study the opposite was true. This preponderance of younger children injured by men may reflect some men's frustration and discomfort with parenting of very small children. Men may be less experienced in handling infants, may not understand normal infant crying patterns, or may be more uncomfortable changing soiled diapers. In addition, men may be less familiar with normal developmental levels of infants and children and may have unreasonable expectations regarding their abilities.

There is a small spike in the perpetration of fractures by both men and women in children at the age of 23–24 months. It is possible that as children gain more mobility and more independence that they become targets of more abusive behaviors. Additionally, this is a common age for toilet training and toddler negativism, which could provoke abusive behaviors from parents. Effective child abuse prevention measures should be explored for caretakers of toddlers in this age range.

If prevention efforts remain targeted primarily at women, a large proportion of perpetrators will not be reached. Alternate prevention methods that target males must be sought. Courses taught in prenatal parenting classes and in high school health classes could provide participants with an understanding of normal infant and child development and appropriate care of infants and toddlers, including strategies to deal with the stress of parenting. Education should include patterns of infant crying, child temperament, and basic information about developmental abilities of infants and young children. More detailed and explicit education about aggressive handling, such as the dangers of pulling or twisting extremities and squeezing, could potentially prevent a majority of inflicted fractures. Home visitation services have been suggested as a means to prevent child abuse, and have met with some success, resulting in fewer child abuse reports involving the mother as perpetrator (Eckenrode et al., 2000). However, given that the majority of fractures are perpetrated by men and that almost a quarter of perpetrators in our study did not live in the home, the potential benefits of in-home services as a prevention measure may be limited.

Our data also illustrate the high frequency of associated injuries with the fractures. More than 63% of children had an additional injury other than their fracture(s). This finding suggests that screening for associated injuries in children with fractures is warranted. Analysis of the additional injuries sustained by these children revealed a lack of association between fractures and bruising. When skull fractures were excluded, less than 10% of children had bruises associated with their fractures. Our findings confirm that of Mathew, Ramamohan, and Bennet (1998), who found that only 9% of fractures in children demonstrated bruises at the time of presentation. Their small study did not specify the sites of fractures or method of determining bruises. The association between fractures and bruising should be explored further.

Conclusion

The majority of the identified perpetrators of inflicted fractures were men, most often fathers, who tended to injure younger children. Mothers were the second most common perpetrator of fractures.

Early targeting of parents and other caregivers, particularly men, with information regarding appropriate expectations for infants and children may aid in the prevention of inflicted fractures.

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