

Femur Fractures in Infants and Young Children

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Using an administrative database, we determined rates of femur fracture by year of age for children younger than 6 years and by month of age. The highest rate of femur fracture was in children younger than 1 year and in 2-year-olds; the greatest number of fractures occurred during the third month of life. While femur fractures in children are often due to accidental injury, the reasons for the peak in the first year and the subsequent decline are not clear. (*Am J Public Health*. 2004;94:558–560)

The incidence of femur fractures in children is believed to have 2 peaks, one at the age of 2 to 3 years and another during adolescence.¹ This view is based, however, on older studies from Scandinavia^{2–4} and a more recent study from Maryland⁵ and may not reflect the experience of the US population. Previous studies have also categorized children by year of age, which may be insufficiently precise for the infant or young child in whom rapid changes in size, physical ability, and behavior may affect the risk of fracture.

Although most femur fractures in children are caused by falls or other unintentional injuries, abuse is considered more likely in the child aged younger than 1 year or not yet able to walk. In this brief, we focus on this youngest group, reporting data on hospital discharges for femur fractures from a national database in which children were categorized by age in months.

METHODS

The 1997 Kids' Inpatient Database⁶ contains 1.9 million records of hospital discharges for children aged 18 or younger, rep-

resenting nearly a third of the estimated 6.7 million pediatric discharges during that year. Using *International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM)* codes for fracture of the proximal femur, femoral shaft, and distal femur (diagnosis codes 820–821.39), we identified 3308 records of children under the age of 6 discharged from a hospital with a diagnosis of femur fracture. Fractures occurring during childbirth were excluded.

Using population weights provided with the database, we calculated national estimates for the number of femur fractures in each 1-year age group. We determined fracture incidence rates by dividing the number of fractures by the estimated number of children in each age group, using population estimates for 1997 from the US Bureau of the Census. To examine the relationship between age and femur fractures more closely, we identified 2753 records for which the age in months was available. Because we lacked the population denominator to determine rates of fracture, we report the counts for this subset of patients.

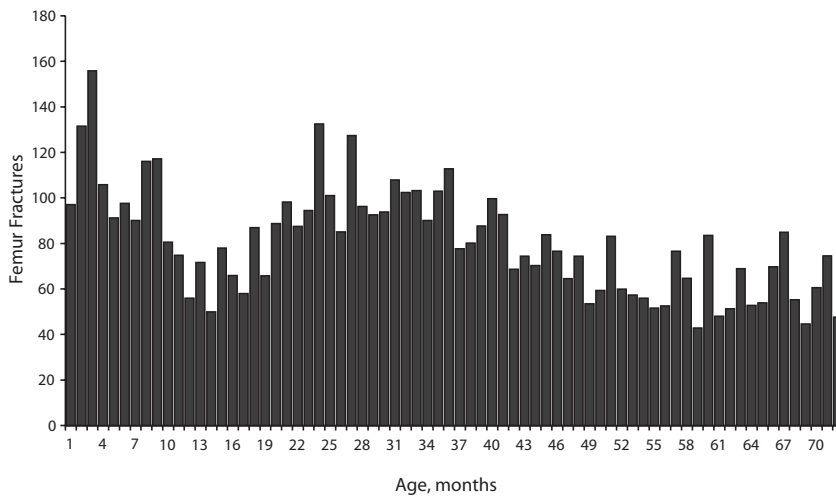
RESULTS

The rate of femur fracture was highest during the first year of life and in 2-year olds (Table 1). One-year-olds were less likely to sustain a fractured femur than those aged younger than 1 year. While the ratio of boys to girls was nearly equal in those aged younger than 1 year, all older age groups had more boys.

In children for whom the age in months was known, the greatest number of fractures occurred during the third month of life (Figure 1). There were slightly fewer fractures in children aged 4 to 11 months, and fewer still in children aged 12 to 20 months. After the first peak during infancy, there was a second peak in children aged 20 to 40 months. In children older than 40 months but younger than 72 months, the number of fractures was lower and relatively constant.

DISCUSSION

Previous studies of femur fractures in childhood have identified a peak in incidence at



Source. Kids' Inpatient Database, 1997.⁶

FIGURE 1—Estimated number of femur fractures among children in the United States, by month of age.

TABLE 1—US Population Estimates for Femur Fractures in Children, by Year of Age

Age, y	No. of Femur Fractures			Femur Fractures/100 000 (95% CI)		
	Male	Female	Total	Male	Female	Total
<1	849	763	1612	44 (39, 49)	41 (37, 46)	43 (39, 46)
1	759	485	1244	40 (35, 44)	26 (22, 30)	33 (30, 36)
2	1126	449	1575	58 (53, 63)	24 (21, 28)	42 (38, 45)
3	889	349	1238	45 (40, 50)	19 (15, 22)	32 (29, 35)
4	680	307	987	34 (29, 38)	16 (13, 19)	25 (23, 27)
5	622	342	964	30 (26, 34)	17 (14, 20)	24 (22, 26)

Note. CI = confidence interval.

Source. Kids' Inpatient Database, 1997.⁶

age 2 to 3 years. By contrast, femur fractures in children younger than 1 year of age are thought to be less common and, when they occur, to be highly suggestive of abuse.^{7,8} We found that femur fractures were as common in children younger than 1 year as in those aged 2 years and older, with the greatest number of fractures occurring during the third month of life. There are few plausible explanations for a femur fracture in this age group other than intentional injury. These data suggest that an infant has as great a chance of sustaining a femur fracture from physical abuse as an older child does from all causes.

The reason for the rise in incidence at age 2 to 3 years, and the subsequent fall, is less clear. Although most children are walking by age 15 months, femur fractures were infrequent at this age. The 2- to 3-year-old may be at increased risk of injury owing to changes in gait,⁹ increased mobility, greater climbing ability, and exposure to vehicular traffic. The decline in femur fractures after age 3 may be due to improvements in gait and judgment, as well as to increased bone strength. Although child abuse is thought to be a less common cause for femur fracture in children who are walking,¹⁰ there are widely varying estimates of its occurrence, reflecting

the difficulty of establishing the diagnosis of abuse with certainty.¹¹

Our study, based on an administrative database, lacks the clinical detail of a case series. The sample size is large, however, and the coding of femur fractures and age are likely to be accurate.¹² The rate of femur fracture in children younger than 2 years of age was 38.0 per 100 000; this is greater than the rate of 25.5 per 100 000 reported by Hinton and colleagues for femoral shaft fractures in this age group in Maryland.⁵ We included fractures of the proximal and distal femur, which may contribute to the higher rate we report.

We cannot determine how often fractures were due to abuse or neglect, but child abuse is thought to be common in children younger than 1 year old with femur fractures.^{7,8} Other possible causes include heritable disorders of connective tissue such as osteogenesis imperfecta¹³ and motor vehicle accidents. Short falls, as occur when a child rolls off a bed or table, are unlikely to cause a femur fracture in an infant.^{14,15} The equal number of boys and girls younger than age 1, and the predominance of boys among those older than 1 year, may signify a shift from intentional to accidental injury.

Although not as specific for abuse as the metaphyseal corner fracture or rib fracture, a single long-bone fracture may be the most common type of fracture due to abuse.¹⁶ Abuse should be suspected if caretakers provide inconsistent or implausible accounts of how a femur fracture occurred, or if there are additional unexplained injuries. A skeletal survey may provide evidence of occult injuries and may support a diagnosis of abuse. Efforts to prevent femur fractures in children should focus on preventing physical abuse in infants and accidental injury in the 2- and 3-year-old children at greatest risk. ■

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Contributors

D. Brown conceived the study, performed the analyses, and wrote the brief. E. Fisher assisted in the design of the study and statistical analyses and contributed to the design of the tables and the writing of the brief.

Human Participant Protection

Institutional review board approval was not required for this study.

References

1. Wilkins KE. The incidence of fractures in children. In: Rockwood CA, Wilkins KE, Beaty JH, eds. *Fractures in Children*. 4th ed. Philadelphia, Pa: Lippincott-Raven; 1996:3–17.
2. Hedlund R, Lindgren U. The incidence of femoral shaft fractures in children and adolescents. *J Pediatr Orthop*. 1986;6:47–50.
3. Nafei A, Teichert G, Mikkelsen SS, Hvid I. Femoral shaft fractures in children: an epidemiological study in a Danish urban population, 1977–86. *J Pediatr Orthop*. 1992;12:499–502.
4. Landin LA. Fracture patterns in children. Analysis of 8,682 fractures with special reference to incidence, etiology and secular changes in a Swedish urban population 1950–1979. *Acta Orthop Scand Suppl*. 1983; 202:1–109.
5. Hinton RY, Lincoln A, Crockett MM, Sponseller P, Smith G. Fractures of the femoral shaft in children. Incidence, mechanisms, and sociodemographic risk factors. *J Bone Joint Surg*. 1999;81:500–509.
6. Agency for Healthcare Research and Quality. 1997 Kids' Inpatient Database. Available at: <http://www.ahrq.gov/data/hcup/hcupkid.htm>. Accessed March 2, 2004.
7. Kocher MS, Kasser JR. Orthopaedic aspects of child abuse. *J Am Acad Orthop Surg*. 2000;8:10–20.
8. Nimkin K, Kleinman PK. Imaging of child abuse. *Radiol Clin North Am*. 2001;39:843–864.
9. Sutherland DH, Olshen R, Cooper L, Woo SL. The development of mature gait. *J Bone Joint Surg Am*. 1980;62:336–353.
10. Schwend RM, Werth C, Johnston A. Femur shaft fractures in toddlers and young children: rarely from child abuse. *J Pediatr Orthop*. 2000;20:475–481.
11. Blakemore LC, Loder RT, Hensinger RN. Role of intentional abuse in children 1 to 5 years old with isolated femoral shaft fractures. *J Pediatr Orthop*. 1996;16: 585–588.
12. Fisher ES, Baron JA, Malenka DJ, Barrett J, Bubolz TA. Overcoming potential pitfalls in the use of Medicare data for epidemiologic research. *Am J Public Health*. 1990;80:1487–1490.
13. Ablin DS, Sane SM. Non-accidental injury: confusion with temporary brittle bone disease and mild osteogenesis imperfecta. *Pediatr Radiol*. 1997;27: 111–113.
14. Tarantino CA, Dowd MD, Murdock TC. Short vertical falls in infants. *Pediatr Emerg Care*. 1999;15:5–8.
15. Nimityongsul P, Anderson LD. The likelihood of injuries when children fall out of bed. *J Pediatr Orthop*. 1987;7:184–186.
16. King J, Diefendorf D, Apthorp J, Negrete VF, Carlson M. Analysis of 429 fractures in 189 battered children. *J Pediatr Orthop*. 1988;8:585–589.