FEMORAL SHAFT FRACTURES: AN ASSESSMENT IN CHILDREN YOUNGER THAN 3 YEARS OLD

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SUMMARY

This study consists of an orthopaedic and psychosocial re-evaluation of children who experienced femur fractures as young as 3 years old and aims to analyze potential causes and detect Child Abuse rates. Thirty-five children under the age of three years who experienced femoral shaft fractures received care at the Emergency Department of the Orthopaedics and Traumatology Service of Santa Casa de São Paulo within the period ranging from January, 1996 to August, 2002. Eighteen patients returned to the hospital for re-evaluation. The reported causes for fractures were: fall in 13 cases (72.2%), object fall on the limb in 2 cases (11.1%). Child abuse was suspected in 9 cases (physical abuse in 6 cases (33.3%), negligence in 3 cases (16.7%), pathological fracture in 4 cases (22.2%), accidental causes in 3 cases (16.7%), and other causes in 2 cases (11.1%). Child abuse constitutes an important cause that needs to be investigated in cases of femur fracture in children under the age of three years and this has possibly been the mechanism responsible for half of the fractures investigated in the current study.

Keywords: *Femoral fractures, Child abuse, Children.*

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INTRODUCTION

Caffey[1], in 1946, was the first to correlate long bones fractures with chronic subdural hematoma, but the mechanism of trauma of such injuries was still unknown. Only in 1962, the expression "Beaten Child Syndrome" was used for the first time by Kempe et al [2], for describing a clinical condition in children suffering physical abuse.

Long bones fractures in young children may represent one of the major evidences of high levels of physical abuse [3], with this femoral fracture being associated to the Physical Abuse Syndrome (PAS) in 30-36% of the cases involving children under the age of 3 [4], and in up to 85% children under the age of 1 year [5,6].

Identifying and characterizing a physical abuse condition is many times difficult [2,5,6] and it is suspected upon direct (signs and symptoms) and indirect signs (injury history), because the attacker rarely confess it. The non-identification may favor aggression recurrence and, if the child comes back to its home environment, it may experience severe psychomotor sequels or ultimately leading to death [7,8,9].

This retrospective study comprehends the orthopaedic and psychosocial reassessment of children who had femoral fractures as young as 3 years old, and targets the analysis of its probable causes and detection of evidences of PAS.

PATIENTS AND METHODS

Thirty-five children under the age of 3 suffered femoral shaft fractures and received care at the Emergency Room of the Orthopaedics and Traumatology Service at Santa Casa de São Paulo, within the period comprehending January 1996 to August 2002. Nineteen children and their caregivers were contacted by means of telephone calls and letters sent to the addresses collected from medical files, with 18 showing up for reassessment. The project was, at first, approved by the Committee on Ethics in Research of the Santa Casa de Misericórdia de São Paulo Sisterhood (Protocol n.242/02). Anamnesis data concerned to fracture history and other potential fractures or hospitalizations; time elapsed from fracture time to healthcare provided; history or presence of negligence signs and investigation about family's and/or caregivers' socio-economical status were re-collected by means of a previously prepared protocol. The physical examination consisted of clinical measurement of lower limbs. X-ray images of the involved limb were requested as a complement (anteroposterior and lateral planes) as well as a scanning of the lower limbs intending to verify fracture union and/ or changes on fractured limb's growth. The patients and their caregivers were also submitted to individual psychological evaluation, conducted by two psychologists

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of the Psychology Service at Santa Casa de São Paulo, aiming to find discrepant reports and/ or suspecting factors of physical abuse, such as: poorly structured families, previous familial history of abuse, undesired pregnancy, poor emotional bonds between parent and child, drug abuse, alcohol abuse, low education level, unemployment, psychiatric diseases, emotional and behavioral disorders. A detailed discussion was conducted in each reassessed case, correlating medical file information with data collected during the orthopaedic and psychological reassessment in order to identify the probable fractures' mechanism of occurrence.

For the purposes of fracture cause classification, we used the Thomas et al's modified scale [5,6]:

1. Confirmed physical abuse: confession provided by the child or his/her parents or caregivers; presence of multiple fractures not matching the story reported; presence of signs and symptoms such as unexplained ecchymoses, burns, bruises, and scratches; presence of severe behavioral changes.

2. Suspected physical abuse: discrepant stories reported by different people; inconsistent stories, insufficient for causing injuries, delay on seeking for health care after the occurrence of injury, presence of behavioral changes, child away of family environment and/or of some family member.

3. Negligence: lack of supervision and care on the child, leading to injuries that could be avoided.

4. Unknown cause: Incomplete and non-suspected story, insufficient information.

5. Pathological injury: presence of basal disease (imperfect osteogenesis, neoplasia, etc), with any suspected or confirmed physical abuse being ruled out.

6. Accident: unsuspected fracture, proven consistent and complete story.

7. Other: caregivers' lack of guidance regarding children basic care, with no suspected or confirmed PAS.

We also performed a search intending to identify the reason for the absence or inaccessibility of patients who could not be present at reassessment visit (n = 1) or could not be reached (n = 17) by contacting them according to their personal data, telephone calls and addresses described on medical files.

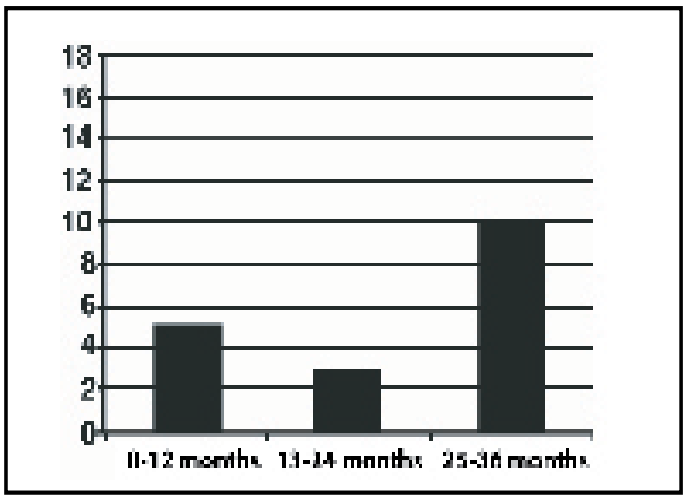
RESULTS

The mean age at the moment of fracture in the 18 reassessed patients was 20.0 ± 10.9 (0-34) months (Graph 1).

A prevalence of male patients was found (77.8%) among reassessed children (Males: 14, Females: 4). There was no prevalence concerning fracture side (R = 10, L = 8). The average follow-up time was 56.0 ± 21.7 months (24-104 months). At the moment of reassessment, the patients presented with a mean age of 76.1 ± 23.1 months (34 - 133 months). Caregivers sought for healthcare at the very injury day in 12 cases (66.7%), one day after injury in three cases (16.7%), two days after injury in two cases (11.1%), and one month after injury in one case (5.5%).

As reported causes of fractures we found: 13 fall cases (72.2%), three cases of objects falling on the limb (16.7%) and two cases of fractures secondary to birth delivery (11.1%). Among the 13 patients whose reported fracture cause was fall, these reported simple falls for three cases, falls from bed or mattress for two, falls from mother's arms for two, fall from a chair for one, fall from ladder for four, and cement slab for one of the cases (Table 1). Following orthopaedics and psychological reassessment, we verified suspected physical abuse in six cases (33.3), negligence in three cases (16.7%), pathological fracture in four cases (22.2%), accidental causes in three cases (16.7%), and other causes in two cases (11.1%) (Graph 2, Table 1). From the four children with pathological bone fracture (three due to imperfect osteogenesis and one to congenital short femur), three had reported previous episodes of femoral fracture: one patient had suffered three fractures, and two experienced two other fractures.

Patients' and caregivers' social profiles are described on Table 2. Undesired pregnancy was reported for one case.



Source: *SAME of the Department of Orthopaedics and Traumatology, Santa Casa de Misericórdia de São Paulo.*

Graph 1- *Distribution of the 18 patients regarding age.*

n	*Reported case*	*Confirmed Case*	*Cause scale*
1	*fracture at birth*	*undetermined*	*other*
2	*fall during bath*	*undetermined*	*other*
3	*fall from mother's arms on the street*	*fall from parent's arms*	*accident*
4	*jumped from slab*	*fall from slab*	*negligence*
5	*slipped and the ironing board fell on the limb*	*object fell on limb*	*accident*
6	*slipped on wet ramp*	*simple fall*	*negligence*
7	*fall from bed with body over the leg while playing with an uncle*	*thrown from bed*	*suspected physical abuse*
8	*fall from chair*	*fall from chair*	*pathological injury*
9	*fracture at birth*	*fracture at birth*	*pathological injury*
10	*sprained by jumping on a mattress*	*simple fall*	*pathological injury*
11	*fall from ladder (h=1m)*	*fall from ladder*	*suspected physical abuse*
12	*fall when climbing a step*	*simple fall abuse*	*suspected physical*
13	*fall from ladder (h=1m)*	*fall from ladder*	*negligence*
14	*fall from mother's arms*	*fall from slab abuse*	*suspected physical*
15	*fall at children daycare*	*simple fall*	*suspected physical abuse*
16	*fall from chair and the chair hit the limb*	*trampling abuse*	*suspected physical*
17	*fall from ladder and the ladder hit the limb*	*object fell on limb*	*accident*
18	*fall from ladder*	*fall from ladder*	*pathological injury*

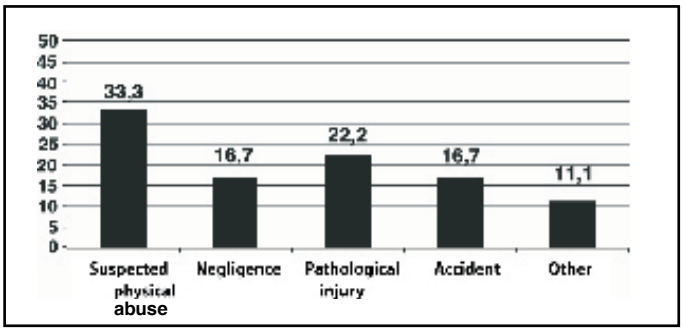
Source: *SAME of the Department of Orthopaedics and Traumatology, Santa Casa de Misericórdia de São Paulo.*

Table 1- *Table comparing fracture causes in the 18 children according to reported cause, confirmed cause and cause according to the criteria of the modified scale.*

	Parents' Status[A]	Nr brothers	Pregnancy[B]	Abortion attempts[C]	Family Violence history [d]	PSY. History[e]	Drugs abuse	Alcohol abuse	Family income/ r. of people (R$) [f]	Educ. Father[g]	Educ. Mother[g]	Domicile status[h]
1	D	3	D	N	N	N	N	N	150	BE	BE	OK
2	M	2	D	N	N	Y(mother)	N	N	175	BE inc	BE inc	OK
3	M	4	D	N	N	N	N	N	250	BE inc	BE inc	OK
4	M	2	D	N	N	N	N	N	100	BE inc	BE inc	OK
5	M	2	D	N	N	N	Y (father)	N	130	BE inc	BE inc	OK
6	D	2	D	N	Y (father)	N	N	Y (father)	200	IE	IE	OK
7	D	1	D	N	N	N	N	N	500	BE	BE	OK
8	D	2	D	N	N	N	N	N	215	BE	BE	OK
9	S	2	D	N	N	N	N	Y (father)	250	IE	BE inc	OK
10	D	1	D	N	Y (father)	N	N	N	130	BE inc	BE inc	OK
11	M	4	D	N	N	Y(grandmother)	Y(2 uncles)	N	86	BE inc	BE inc	OK
12	D	4	D	N	Y (father)	N	N	N	200	IE	IE	OK
13	D	3	D	N	N	Y(mother)	Y (mother)	N	240	BE	BE	OK
14	D	2	D	N	N	N	N	N	260	BE	BE	OK
15	D	2	U	N	Y (father)	N	N	N	260	BE inc	BE inc	OK
16	M	2	D	N	N	N	N	N	375	IE	CD	OK
17	M	3	D	N	N	N	Y (father)	Y (father)	140	IE	IE	OK
18	M	1	D	N	N	N	N	N	200	BE inc	BE inc	OK

A: Parents' status. **S:** single, **M:** married, **D:** divorced; **B:** Pregnancies. **D:** desired, **U:** undesired; **C:** Abortion Attempts. **N:** no, **Y:** yes; **D:** Family violence history. **N:** no, **Y:** yes; **E:** Psychiatric history. **N:** no, **Y:** yes; **F:** Monthly family income in R$ divided by the number of family members; **G:** Education level (father and mother). **BE:** basic education (junior high completed), **IE:** intermediate education (high school completed), **CD:** college degree, **BE:** inc: basic education incomplete; **H:** Domicile status. **OK:** brickwork house + electricity + piped sewer + potable water.

Table 2- *Socio-economical profile of the 18 children's families.*



Source:*SAME of the Department of Orthopaedics and Traumatology, Santa Casa de Misericórdia de São Paulo.*

Graph 2- *Distribution of the causes of femoral fractures in the 18 children, according to modified scale.*

We found four cases where the parents had previous history of family violence. Drug abuse was found in four families, and alcohol abuse in three. The monthly family income per person (total family income/ number of family members) ranged from R$ 86 to R$ 500. Eight fathers and nine months reported incomplete elementary education; only one mother report having university degree.

In all reassessed cases, fracture union was confirmed, upon simple X-ray imaging tests.

Regarding those patients who could not be contacted for reassessment (n = 17), we found nine cases of inexistent address and telephone number; in four cases, the address didn't match to the patient/ family/ acquaintances, and; in four cases, the families moved, not leaving the new address. One patient was contacted but never showed to reassessment visit because he was living in another state at the time. A search in government agencies for other recent hospitalizations and/ or deaths did not provide any additional data.

DISCUSSION

Physical abuse is defined, according to article 136 of the Brazilian Penal Code, as: "exposing people under your authority, safeguard or supervision for educational, teaching, treatment or custody to life- or health-threatening situations, either subjecting them to excessive or inappropriate work, or abusing of corrective or disciplinary measures"[10]. Kinds of abuse may include: physical, sexual, psychological or negligent abuse. Other known kinds are the Shaken Baby Syndrome, and Münchausen's Syndrome.

In Brazil, during the period of January 1998 to June 1999, 1,169 cases of domestic violence towards children and adolescents were reported, 22% only in children below the age of three years. The mother is indicated as the key aggressor in 52% of the cases, and the father in 27%. The main form of violence reported was physical (65% of the occurrences), overlapping forms of psychological violence (51%) and negligence (49%)[11].

Signs suggesting child abuse include the presence of multiple acute injuries (ecchymosis, bruises, scratches, bites, burns and soft parts edema), previous history of abuse, subdural bruise, behavioral change, presence of multiple fractures (especially femoral, tibial and humeral) and/ or fractures at various healing stages; however, isolated fractures occur frequently [12].

Beals and Tufts[13] reported that of the children below four years old who had experienced femoral fractures were physical abuse victims. In children below three years old, Dalton et al[4] found a rate of 31% of physical abuse occurrences. Anderson[7] reported a rate of 79% and 83% of suspected PAS as cause of femoral fractures in children under the age of two years and under the age of 13 months, respectively. Other studies point out to a PAS prevalence of 60-85% in children with femoral fractures and ages under one year [5,6]. Nevertheless, Blakemore et al[14], in 1996, in a study involving 42 children in the 1-5 years age group, reported only one case of child abuse, being the single finding in literature reporting such a low children's femoral fractures vs. physical abuse ratio. In our study, we found suggestive indications of PAS (physical abuse and negligence) in 50% of the reassessed children as triggering factors for femoral fractures, because

we saw discrepant, incomplete and inconsistent reports in nine cases (Table). However, this is just a partial rate, once there may be a higher number of suspected or even confirmed abuse cases among the 17 children who could not be reassessed due to no-show, and this may be the reason for which the parents did not answered to contacts or calls.

Children below one year old, not ambulating yet, are potentially the greatest abuse victims, while older children are more likely and able to escape from their aggressors [4,6]. Among reassessed children, we noticed a higher occurrence of suspected PAS between the ages of 25 to 36 months, which can be explained by the higher number of fractures within this age group in the studied population (Graph 1). The prevalence of accidental femoral fractures in male children can be explained by the fact that boys are more exposed to recreation activities [15].

Penal Code foresees a fine penalty to doctors, teachers or representatives responsible for healthcare practices or schools who fail to report suspected or confirmed physical abuse against children or adolescents to the relevant authorities [10]. Dalton et al[4] showed that an orthopaedic doctor is the key investigator (in absolute numbers) of physical abuse in children with femoral fractures, followed by the pediatrician. The investigation on PAS in a child with femoral fracture should be made immediately and must be performed by trained experts. Discrepant and inconsistent stories told by different people or mechanisms of trauma insufficient to an injury to occur are highly suggestive findings of child abuse. One fracture cause that is commonly mentioned by family members is fall from bed or other low structures, but, many times, these represent an insufficient mechanism of trauma for long bones fractures [16-19]. Hennrikus et al[16] assessed children reported to have fallen from bed or mattress, and they found that 50% of the children below one year old and 5% of the children in the age group of 1-5 years were potential victims of child abuse. In this context, controlled studies have been conducted confirming a direct relationship of "bed fall report" with child abuse [17-19]. Helfer et al [17] assessed 81 children under the age of 5 who suffered falls from bed while hospitalized, and found only one fracture case (1.2%). Similarly, Nimityongskul et al[18] and Lyons et al[19] reported the occurrence of two long-bone fractures (2.6 % and 1%, respectively) in hospitalized children who suffered bed falls. In our study, we saw two patients whose fracture cause was reported by their parents as a fall from bed or mattress, and we suspected of PAS in only one. Other 10 cases had simple falls as a reported cause of injury, falls from ramps, low ladders (up to 1 meter), chairs and mother's arms, with suspected PAS in 6 children (Table 1).

Investigating previous family history may also help on the identification of an injury cause. Charles and Shivas[20] made a survey in literature correlating pregnancy and illicit drugs, and they found that 40% of the reviewed articles (36/90) directly correlated drugs abuse during pregnancy and child abuse. In two other cases, we found that the father was a drug addicted; however, no direct correlation to PAS was noticed. Four of the reassessed patients in our study presented history of family violence (father), with two fracture cases being suspected of being inflicted by physical abuse, and one fracture case resulting from negligence.

Although our patients sample belongs to a low social layer, PAS has no direct correlation to socio-economical status. Studies conducted in developed countries comprising populations with better social status report a high PAS prevalence in children suffering long-bones fractures [12,13].

One of the major problems found regarding child abuse is the deleterious effect it causes to individual's growth and development, which may lead to a permanent cognitive and/ or neuromotor function deficit. Prasad et al[8] showed that children submitted to abuse presented with worse cognitive function ($p<0.05$), for motor abilities ($p<001$), language expression ($p<0.001$) and reception ($p<0.01$) during growth phases. Healthcare providers, therefore, have a social commitment with the detection of suspected PAS cases and must notify and be prepared for identifying these.

CONCLUSION

Physical abuse constitutes an important cause to be investigated in cases of femoral fractures in children under the age of 3 years, being the probable mechanism responsible for half of the fractures studied here. Suspected family history and the identification of mechanisms of trauma as reported by the family insufficient for an injury to occur represent findings that are highly suggestive of abuse.

REFERENCES

1. Caffey J. Multiple fractures in the long bones of infants suffering from chronic subdural hematoma. Am J Roentgenol 1946; 56: 163-73.
2. Kempe CH, Silverman FN, Steele BF, Droegemueller W, Silver HK. The battered child syndrome. JAMA 1962; 181: 105-112.
3. Rex C, Orth MS, Orth DNB, Orth MCh, Orth FRCS, Kay PR. Features of femoral fractures in nonaccidental injury. J Pediatr Orthop 2000; 20: 411-413.
4. Dalton HJ, Slovis T, Helfer RE, Comstock J, Scheurer S, Riolo S. Undiagnosed abuse in children younger than 3 years with femoral fracture. Am J Dis Child 1990; 144: 875-878.
5. Thomas SA, Rosenfield NS, Leventhal JM, Markowitz RI. Long-bone fractures in young children: distinguishing accidental injuries from child abuse. Pediatrics 1991; 88 (3): 471-476.
6. 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.
7. Anderson WA. The significance of femoral fractures in children. Ann Emerg Med 1982; 11: 174.
8. Prasad MR, Kramer LA, Ewing-Cobbs L. Cognitive and neuroimaging findings in physically abused preschoolers. Arch Dis Child; 90: 82-85, 2005.
9. Loughrey CM, Preece MA, Green A. Sudden unexpected death in infancy (SUDI). J Clin Pathol; 58: 20-21, 2005.
10. Brasil. Presidência da República. Casa civil. Subchefia para Assuntos Jurídicos. Decreto-Lei 2848, de 07 de setembro de 1940. Disponível em: http://www.presidencia.gov.br/ccivil_03/Decreto-Lei/Del2848compilado.htm. Acessadoem 2006 (Fev).
11. Associação Brasileira Multiprofissional de Proteção à Infância e à Adolescência (ABRAPIA). Disponível em: http://www.abrapia.org.br/homepage/dados_sobre_violencia/dados_sobre_violencia_domestica.html
12. Santos LM, Stewart G, Meert K, Rosenberg NM. Soft tissue swelling with fractures: abuse versus nointentional. Pediatric Emergency Care 1995; 11 (4): 215-216.
13. Beals RK, Tufts E. Fractured femur in infancy: the role of child abuse. J Pediatr Orthop 1983; 3:197.
14. Blackmore 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.
15. Kotzias Neto A, Pierri CA, Schneider A, Camisão GB, Oliver O. Avaliação dos resultados do tratamento das fraturas da diáfise femoral em crianças. Rev Bras Ortop 1998; 33 (1): 25-30.
16. Hennrikus WL, Shaw BA, Gerardi JÁ. Injuries when children reportedly fall from a bed or coach. Clinical Orthopaedics and Related Research; 407: 148-51, 2003.
17. Helfer RE, Slovis TL, Black M. Injuries resulting when small children fall out of bed. Pediatrics; 60: 533-35, 1977.
18. Nimityongskul P, Anderson LD. The likelihood of injuries when children fall out of bed. J Pediatr Orthop; 7: 184-86, 1987.
19. Lyons TJ, Oates RK. Falling out of bed: a relatively benign occurrence. Pediatrics; 92: 125-27, 1993.
20. Charles S, Shivas T. Mothers in the media: blamed and celebrated – an examination of drug abuse and multiple births. Pediatric Nursing, 28 (2): 142-145; March-April 2002.