FEMORAL SHAFT FRACTURES IN CHILDREN AND ADOLESCENTS

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SUMMARY

Seventy one patients below the age of 16, with 72 shaft femur fractures occurred between January 1995 and December 1998, were evaluated. The purpose of the study was to understand the descriptive aspects of the fractures and appraise the employed treatment. Age was the key criterion for treatment choice, with those under 3 years old (Group I) being treated with immediate spica cast; those between 3 and 10 years (Group II) were treated with traction followed by spica cast, and those over 11 years old (Group III) with conservative or surgical therapy. Mean age was 6.3±3.8 years with a prevalence of males and closed fractures. Traffic accident was the most common injury cause. The fracture was in the middle third in 60.6% of the cases, in the proximal third in 23.9%, and in the distal third in 15.5%. Ninety three percent were simple trace fractures, 4.2% comminutive and 2.8% segmental. Associated injuries were identified in 35.2% of the patients. All fractures in Groups I, II and 60.0% of those in group III were treated conservatively. Complications seen until bone union were: discrepancy, infection at the wire path, vicious union and limited knee motion. The average time for union was 8.6±3.4 weeks, varying with age. We conclude that the studied fractures' characteristics were similar to those described by current literature and that the employed treatment showed good outcomes.

Keywords: Femoral fractures; Child; Adolescent.

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INTRODUCTION

Femoral shaft fractures in children are common and frequently lead to hospitalization and require anesthesia for performing an orthopaedic procedure [(1)].

Femoral shaft fractures treatment goals in children and adolescents are the following: achieving bone union with length, alignment and limb's function restoration, without losing movements of adjacent joints.

These fractures are historically treated by conservative approach, with reduction and early immobilization with plaster cast or preceded by skin or skeletal traction. This procedure is not exempted from complications, with reduction loss and the shortening of the affected limb being the most frequent ones [(2)]. In the last two decades, targeting the reduction of hospitalization time and the social damages to the patients and their relatives, some authors have recommended surgical treatment, especially in children above 10 years old [(2,3-8)]. The use of surgical methods is limited due to the level of morbidity imposed by its complications, such as infections and physeal injuries [(5,7,9)]. External fixation is indicated in open fractures, in limbs presenting extensive soft parts injuries, multiple-trauma patients, and in extensive comminution fractures [(4,8,10)].

Intending to know the treatment of those fractures in the premises of the Pediatric Orthopaedics Service of Hospital Maria Amélia Lins, a survey was conducted for detecting cases, aiming to identify:

- Patients' and fractures' characteristics regarding the following variables: age, gender, side, mechanism of injury, exposure, location, related injuries and fracture trait.
- Time for fractures union within each age group.
- Complications found in different treatment approaches employed.

Study conducted at the Learning and Research Nucleus, Hospital Maria Amélia Lins, in a partnership with the Department of Locomotive Apparatus, Medical College, UFMG.

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MATERIALS AND METHODS

This is a retrospective, cross-sectional study, approved by the Committee on Ethics in Research of this Institution.

Of the 112 children and adolescents, with ages ranging from 12 to 191 months, with femoral shaft fractures occurred during the period of 01/1995 to 12/1998, we could assess 71 patients carrying 72 fractures. Patients for whom insufficient data was available on medical files and those who presented no appropriate X-ray documentation for analysis were excluded from this study.

Data gathered from medical files were transferred to a research form, considering the following variables: name, registration, accident date, age, gender, side, location, exposure, mechanism of injury, related injuries, fracture trait, kind of treatment, complications, time for union, and clinical and X-ray review after union. The patients were divided into three groups, according to the treatment recommended by the service. In Group I, constituted of children in the age group below 3 years old, the treatment of choice is reduction and immediate plastered cast; in Group II, represented by children between 3 years and 10 years and 11 months, traction followed by plastered cast is usually employed, and; in Group III, comprised of children above the age of 11 years, surgical treatment is indicated. Following the criteria by Staheli[11], angles were regarded acceptable when below 10º at frontal plane, 30º at saggital plane, and with rotational dislocations below 10º.

All obtained data were entered in a record database of EPI-INFO 6.04 software, which was used for making statistical analyses, being assessed frequencies, central trend measurements and variability, as well as comparisons between proportions. The significance level for all analyses was 0.05.

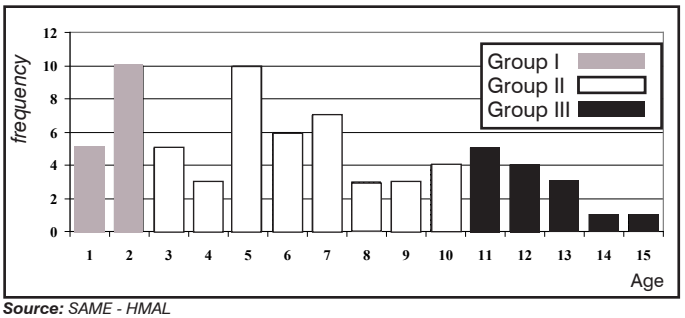
RESULTS

The mean age of the sample was 6.3±3.8 years, with the distribution of frequency for this variable being represented on Figure 1. There was a statistical prevalence ($p<0.001$) of patients in Group II (Figure 1).

Forty-eight patients (67.6%) were males and 23 (32.4%) females, at a ratio of 2.1:1. Table 1 shows the distribution of frequency and percentage regarding gender and evaluates the statistical prevalence.

Regarding affected side, 35 (49.3%) patients fractured the right side, 35 (49.3%) the left side, and one (1.4%) bilaterally.

The mechanism of injury was identified in 69 patients. The analysis of this variable by group showed a prevalence of traffic accidents for global sample and for Group II (Table 2).



Source: *SAME - HMAL*

Figure 1 – *Distribution of frequency, regarding age, of patients with femoral shaft fractures receiving care at the Hospital in the period of January 1995 to December 1998.*

Gender	Group I	Group II	Group III	Total
Male (1)	11 (73,3%)	24 (58,5%)	13 (86,7%)	48 (67,6%)
Female (2)	4 (26,7%)	17 (41,5%)	2 (13,3%)	23 (32,4%)
Total	15	41	15	71
p Value	0,010	0,122	<0,001	<0,001
	1>2	1=2	1>2	1>2

Source: *Hospital's SAME*

Table 1 - *Distribution o f patients' gender frequency and percentage by group.*

Mechanism	Group I	Group II	Group III	Total
Fall (1)	3 (21,4%)	6 (15,0%)	0	9 (13,1%)
Traffic (2)	2 (14,3%)	25 (62,5%)	10 (66,7%)	37 (53,6%)
Other (3)	9 (64,3%)	9 (22,5%)	5 (33,3%)	23 (33,3%)
Total	14	40	15	69
p Value	0,210	<0,001	0,067	<0,001
	1=2=3	2>3=1	2=3	2>3>1

Source: *Hospital's SAME*

Traffic *= Trampling, Car, motorcycle, bicycle accidents.*

Table 2 - *Distribution of frequency and percentage of mechanisms of injury in the assessed patients, by group.*

Four fractures were open, being one (2.4%) in Group II and three (20.0%) in Group III. Although open fractures are more frequent in Group III, this difference was not significant as compared to the other groups, in spite of having presented a strong trend ($p<0.051$). Open fractures were secondary to gun bullets and falls from berths, walls and ladders.

Regarding location, we found 43 (60.6%) fractures at medial third, 17 (23.9%) at proximal third, and 11 (15.5%) at distal third, with prevalence of the medial site ($p<0.001$). In the analysis by age groups, this finding was reproduced on stratus I ($p=0.003$) and II ($p<0.001$).

There was a prevalence of simple trait fractures for global sample and for each group; however, when considering the subdivision of simple fractures into transverse, short oblique, and long oblique, no statistical difference was found among the various traits. In Group I, 14 simple fractures occurred (eight transverse, four long oblique, and two short oblique), and one comminutive. Of the 42 fractures in Group II, 40 were simple (13 transverse, 14 short oblique, and 13 long oblique), and two segmental. In Group III, 13 fractures were simple (seven transverse and six short oblique), as well as two comminutive.

Forty-six (64.8%) patients presented with femoral fracture as an isolated injury, and in 25 (35.2%) one or more related injuries were present. Table 3 shows the distribution of the most frequent related traumas. It is worthy to highlight that

Related injuries	Group I	Group II	Group III	Total
Fractures (1)	1 (25,0%)	6 (35,3%)	5 (55,6%)	12 (40,0%)
CET (2)	1 (25,0%)	7 (41,2%)	2 (22,2%)	10 (33,3%)
Other (3)	2 (50,0%)	4 (23,5%)	2 (22,2%)	8 (26,7%)
Total	4	17	9	30
p Value	1,000	0,724	0,333	0,592
	1=2=3	1=2=3	1=2=3	2=3=1

Source: *Hospital's SAME*

CET *= cranial-encephalic trauma*

Table 3 - *Distribution of related injuries found in the assessed patients, as frequency and percentage, by group.*

Conservative Treatment	Group I	Group II	Group III	Total
				66 (91,7%)
Early cast	7 (43,7%)	10 (23,8%)	2 (13,3%)	19 (27,8%)
Cast after TST	5 (33,3%)	31 (73,8%)	7 (46,7%)	43 (65,1%)
Cast after skin traction	3 (20,0%)	1 (2,4%)		4 (6,1%)
Surgical				6 (8,3%)
External fixator			2 (13,3%)	2 (33,3%)
Stiff nail			1 (6,7%)	1 (16,7%)
Plate			1 (6,7%)	1 (16,7%)
Flexible nail			2 (13,3%)	2 (33,3%)

Source: *Hospital's SAME*
***TST** = Trans-Skeletal Traction*

***Table 4** - Distribution, in frequency and percentage, of the employed treatment methods in each group.*

some patients had more than one related injury.
Sixty-six (91.7%) conservative and six (8.3%) surgical treatments were provided, those being in patients from Group III. The kinds of treatment are represented on Table 4.
Re-manipulation was required in five patients, being one from Group I, three from Group II, and one from Group III.
The children from Group I did not present early or late complications. Two patients from Group II and one from Group III developed infection at trans-skeletal traction wire's path. Changes on knee range of motion were reported in three patients, being two from Group II and one from Group III. The latter had his fracture treated, at first, by using a conservative approach, subsequently presenting a vicious union, when an external fixation was selected, resulting in a good deformity correction, but with knee flexion-extension restraint at the moment the fixator was removed. There was no angle or rotational displacement above established standard.
Regarding lower limbs' length discrepancy, measured by occasion of fracture union, two (13.3%) patients from Group I presented a shortening of 2cm and 3cm; 15 (35.7%) from Group II and five (37.7%) from Group III presented a mean discrepancy of 2.4±1.1cm and 1.6±0.6cm, respectively. In total, 22 (30.5%) children experienced shortening, with eight being lower than 2cm, 13 between 2-4 cm, and 1 higher than 4cm.
The average time for fractures union in the global sample was 8.6±3.4 weeks. In Group I, this time was 5.6±1.4 week, ranging from 4 to 9 weeks; in Group II, fractures union occurred within 8.4±2.6 weeks in average, ranging from 5 weeks to 16 weeks at most, and, in Group III, union occurred in average within12.1±4 weeks, ranging from 7 to 20 weeks.

DISCUSSION

The approach employed by this service for treating femoral shaft fractures in children and adolescents is similar to the one recommended by many authors, and depends, most of times, on patient age [5,8,9,11,12].
In the assessed sample, there were two incidence peaks regarding age, one at 2 and the other at 5 years. Schwend et al[13], when studying fractures in children below 4 years old, found a peak at 2 years. Staheli[11] found in children and adolescents a peak of femoral shaft fractures occurring during childhood, when spinal cord channel is wider, and an additional peak during adolescence, an effect of an increased number of traffic accidents. In the present study, there was a prevalence of patients in Group II, which differs from literature, where the highest reported incidence is during adolescence. This finding is regarded as secondary to current trend of providing surgical treatment to teenagers, a procedure performed in a higher number of services, because it requires a shorter hospitalization time and enables higher profits for the hospital and the team.
The prevalence of fractures in males is also reported by other authors [3,4,7-9,11-16]. In the small sample presented by Santili[6] no difference was detected regarding gender. Silva et al.[2], when studying fractures conservatively treated, noticed a prevalence of females. In the cases studied here, male prevalence was not found only in children from Group II. This may be explained by the high incidence of traffic accidents in this Group, and because this kind of trauma affects both genders uniformly.
The homogenous distribution of fractures concerning fractured side was also reported by Silva et al[2], Linhart and Roposch[4], Stans et al[7] and Volpon et al[8], Casas et al[9].
The rate of open fractures (5%) was close to the one found by Cramer et al[3] (3,5%), Ferguson and Nicol[14] (3%), Hutchins et al[15] (4%) and Linhart and Roposch[4] (5,8%).
Fractures at other regions and cranial-encephalic traumas are the related injuries most frequently reported by literature [3]. The 35.2% rate of related injuries found in this study was higher than the 26.7% reported by Buechsenschuetz et al[12] and than the 22.3% by Silva et al[2], who assessed samples within similar age groups. This suggests a higher severity in the patients assessed in the present study. Cramer et al[3], who studied only surgical cases, found a rate of 73.0% of related injuries. This high related injuries rate, alone, is suggestive of an increased number of surgical indications.
In surveyed literature, there is no standardization regarding fractures trait presentation. Buechsenschuetz et al[12], in 2002, found 35.2% of oblique fractures, 35.2% of transverse fractures, 16.9% of spiral fractures, and 12.6% comminutive fractures. Volpon et al[8] reported 39.8% transverse fractures, 33.2% spiral fractures, 13.7% short oblique fractures, 9.0% segmental-comminutive, and 3.8% long oblique. Data from the sample studied here are closer to those reported by Silva et al[2], who found 69.6% of oblique or spiral fractures, 35.8% of transverse fractures, and 4.4% of comminutive fractures.
The prevalence of involvement of femoral medial third was reported by Casas et al[9] (85.3%), Cramer et al[3] (70.1%), Ferguson and Nicol(14) (75%), Linhart and Roposch(4) (70.5%) and Staheli et al(11) (73%). Fractures in this study show the same prevalence, at a proportion similar to the one described by Volpon et al[8] (61.1%).
Literature also reports traffic accidents as the most frequent mechanism, except for children under the age of 3 [3,8,9,12,15]. Nork et al[17] report the so-called "other mechanisms" as the most common causative agent within that age group, a fact also noticed in the current study.
Many publications determine the treatment method according to age. Silva et al[2], Volpon et al[8], Casas et al[9] and Sahin et al[16] recommend conservative treatment as of choice for femoral shaft fractures in children. But Cramer et al[3], Linhart and Roposch[4] and Santili et al[6] advocate surgical treatment in children based on the justification that this is an indication enabling a fast recovery and presenting

a small number of complications. Sanders et al[5] conducted a survey about the U.S. Society of Pediatric Orthopaedics member's preferences in treating femoral fractures in children and adolescents, and they found that surgical treatment was indicated only for patients above 6 years old.

The complications found in cases treated at HMAL repeat the most reported ones by literature, i.e., reduction loss and shortening [2]. The latter could not be definitively assessed, because the research design considered only the measurement immediately after union, and the publications surveyed studied shortening immediately after fracture (14) or the discrepancy at the end of growth period. Stans et al(7), in a sample of 85 fractures treated both conservatively and surgically, identified end shortening greater or equal to 1 cm in 11 cases (12.9%). Silva et al(2), studying conservative treatment in 67 patients, found a discrepancy lower than 1 cm in 27 (40.3%), and of 1-2 cm in 16 (23.9%). By union occasion, the cases studied here showed 22 (30.5%) children with shortening, being 8 smaller than 2 cm, 13 between 2-4 cm, and 1 greater than 4 cm.

Infection at traction pin was another complication found, and it should be prevented by an improved introduction technique and local care. Sanders et al(5) also mentioned infection on wires' path as one of the complications. The patient who presented with restrained knee range of motion had an uncommon evolution, being initially treated conservatively, evolving to vicious union, until the use of an external fixator was indicated.

The average time for union of the studied fractures was consistent to literature data. Staheli et al[11] noticed that, in breastfeeding infants, fractures usually showed union within 4 weeks; in 2 year-olds, 6 weeks; in 3-10 year-olds, 6-8 weeks, and; above 10 years old, 8-12 weeks. Nork et al[17], in children as old as 2 years, found an average union time of 5.6 weeks. Casas et al[9] reported an average time for union of 9.7 weeks in children aged 4-10, conservatively treated. Silva et al[2] found an average union time of 8 weeks in children aged 3-13 years.

CONCLUSIONS

- The descriptive characteristics of the studied fractures are consistent to those presented by other authors.
- The conservative method is effective in treating femoral shaft fractures in children.
- The time for union found in the studied sample is comparable to reports of other studies.

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