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Patterns of single segment non-physeal extremity fractures in children

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Abstract Five hundred and fifteen children with single segment non-physeal extremity fractures were retrospectively reviewed. The male to female ratio was 2.7:1. The average age of study group was 9.9 ± 4.7 years; 273 fractures (53 %) were on the left, 242 (47 %) were on the right. A fall was the main cause of the injury in most of the cases (80%). The forearm was the most commonly seen fracture site. Summer was the season when the fracture incidence was the highest. Highest surgical treatment rate (50%) was seen in supracondylar humerus fractures. It has been stated in the literature that non-physeal fractures are far more common than physeal fractures. We assume that this study not only will help understanding of the injury patterns of single segment non-physeal fractures in children but also, be a base for future studies in prevention and treatment of this type of fracture.

Résumé Travail portant sur 515 enfants ayant présenté une fracture mono-segmentaire non épiphysaire. La proportion garçons – filles était de 2,7 pour 1. L'âge moyen du groupe examiné était de $9,9 \pm 4,7$ ans. 273 fractures étaient du côté gauche (53 %) tandis que 242 étaient du côté droit (47 %). Le facteur étiologique principal (80 %) était une chute de l'enfant. Fracture survenant surtout l'été, atteignant l'avant-bras le plus souvent. La moitié des interventions chirurgicales ont concerné des fractures supra-condyliennes de l'humérus. D'après la littérature, les fractures n'atteignant pas le cartilage de conjugaison, sont beaucoup plus fréquentes que celles l'atteignant. Nous pensons que ce travail aidera à la compréhension des fractures n'atteignant pas le cartilage de conjugaison

et sera une base pour des études futures concernant la prévention et le traitement de ces lésions.

Introduction

Several authors have studied the fracture patterns in childhood [1–7,9,10]. While some of them studied with the populations at risk, others investigated the consecutive children's fractures seen in a health center [1–7,9,10]. The data of most of these studies included either physeal or both physeal and non-physeal fractures [1–7,9,10]. Also, some of them included multiple fractures in their study [3]. However, treatment and prognosis of fractures in children mainly depend on their location in bone. In other words, physeal fracture treatment and prognosis is different from metaphyseal or diaphyseal fracture treatment and prognosis. Also, treatment mostly changes in children with multiple injuries. Based on this idea, we conducted this study to show the single-segment non-physeal fracture patterns only in children.

Subjects and methods

We reviewed the records of the 515 children (1–18 years old) with a single segment non-physeal fractures seen at the Orthopaedic Surgery Emergency and Outpatient Clinics of Trakya University in Edirne, Turkey between January 1994 and December 1996. Children with multiple fractures and/or associated visceral injuries were excluded.

The records of these patients were reviewed to assess the age and sex of the patient, etiology, fracture type, site, localization, treatment as well as the season fracture occurred. Log-linear analysis test was used to assess the relations of sex, etiology, fracture type, upper/lower extremity involvement and treatment type. If any relation was found, then homogeneity analysis test was performed to analyze the differences between categories of the variables.

Results

Of the 515 children 376 (73 %) were male compared to 139 female (27 %). 273 fractures (53 %) were on the

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Fig. 1 The distribution of all of the fractures in age groups

left, 242 (47 %) were on the right. The average age was 9.9 ± 4.7 years. The most common fracture ages were 9, 6, and 10 years respectively (Fig. 1). Even though boys had very similar fracture frequencies with the overall study group, girls had their peak at the age of 6 followed by 8 and 9 years. The other feature seen in girls was the decrease of fracture frequencies with age (Fig. 1). Mean age in boys was 10.5 ± 4.7 years and was 8.2 ± 4.3 years in girls. When we compared the average ages of boys and girls with Student's *t*-test, the difference was statistically significant ($t=5.15$; $P<0.001$).

Summer was the season with highest fracture frequency in both female and male patients (Fig. 2). Statistical analysis of fracture frequencies revealed a significant difference in the seasons (chi square test $\chi^2=47.37$; $P<0.001$). There was no statistical difference in seasonal fracture distributions of boys and girls ($\chi^2=2.30$; $P>0.05$).

The fracture was caused by a fall in 412 patients (80 %); injury during sports activity in 49 (9.5 %), traffic accident in 52 (10.1 %), and violence in 2 (0.4 %). Of 515 fractures 397 (77 %) involved the upper extremity compared to 118 in the lower extremity. The most common fracture site was radius-ulna followed by radius, humerus and tibia-fibula (Table 1).

Fig. 2 Fracture frequencies in seasons

Log-linear statistical test showed the relation between etiology and upper/lower extremity involvement (L.R. $\chi^2=22.12$; $P<0.001$) and the relation between fracture type and etiology (L.R. $\chi^2=11.70$; $P<0.01$). Homogeneity analysis test showed the differences between categories of etiology and upper/lower extremity involvement and between categories of fracture type and etiology. In traffic accidents fractures occurred most often in the lower extremity, by fall in the upper extremity and by sport injury in both upper and lower extremity. With falls closed fractures are most often seen. In traffic accidents both open and closed fractures are seen and in sports-injury, though closed fractures are more commonly seen, both open and closed fractures may occur.

Information of the number, male to female ratio, average age, peak age, left/right ratio, peak season, etiology, numbers treated surgically for each individual bone is given in the Table 1.

All the radial fractures were closed. Most radial fractures (78 of 88) were in distal, 3 in proximal and 7 in diaphyses. The ulnar fracture group consisted of 2 fractures of the Monteggia-type, 5 in the olecranon, 3 in the distal ulna and 6 fractures of the shaft.

Of the humeral fractures, 12 were located in the proximal humerus, 8 in the shaft, 54 in the supracondylar region, 4 in the medial epicondyle, 7 in the lateral epicondyle.

Table 1 Distribution and properties of the fractures in study group

Bone	Number of fractures	Male: female ratio	Average age	Peak age	Left: right ratio	Peak season	Etiology				Number treated surgically
							Fall	Traffic accident	Sport injury	Violence	
Radius-ulna	125	3.63	9.49 ± 4.15	6	1.08	Summer	112	5	8	0	4
Radius	88	3.63	10.94 ± 4.04	14	1.10	Spring	79	4	5	0	2
Humerus	85	1.74	8.14 ± 4.39	9	1.74	Summer	74	7	3	1	42
Tibia-fibula	65	2.61	10.51 ± 4.93	6	0.97	Summer	42	18	5	0	10
Clavicula	41	2.73	9.76 ± 5.23	14	1.16	Summer	33	7	1	0	0
Hand	41	3.56	14.05 ± 4.03	18	0.95	Spring and summer	21	3	17	0	1
Femur	38	1.92	7.47 ± 5.89	1	0.73	Summer	29	7	2	0	10
Ulna	16	0.78	9.31 ± 4.08	7	1.29	Winter	16	0	0	0	4
Foot	14	6	12.79 ± 3.42	14	1.33	Spring	6	0	7	1	0
Scapula	1	1/0	17	17	0/1	Spring	0	1	0	0	0
Patella	1	1/0	17	17	0/1	Summer	0	0	1	0	0

Of the supracondylar fractures the highest frequency was seen between ages 3 and 10; 28 of 54 patients were male and 27 patients with supracondylar fractures were treated surgically.

Even though the fracture of the tibia-fibula was more often seen during summer, the second most common season was autumn contrary to spring being the second most common season in almost all other bone fractures.

Discussion

Peclet et al. [8] reported on 3472 cases treated in their regional trauma center during a 34-month period to show the injury patterns in children. Iqbal [3] also examined 291 cases treated in their hospital to study the long bone fractures of children in Malaysia. We reviewed the records of the 515 consecutive patients aged 1-18 years to demonstrate patterns of the single segment fractures in children.

The male/female ratio in our study group (2.7:1) is similar to the reports of Cheng and Shen [1] and Demirsoy et al. [2].

Worlock and Stower [10] from Nottingham, UK encountered the fractures as more common during summer in their study of childhood fractures. Reed [9] had similar results in his evaluation of childhood extremity fractures and dislocations in Winnipeg, Canada. However, Landin [5] observed the lowest incidence of children fractures in June and July. He attributed this to the leave of the families for summer vacation in Mölme, Sweden. In our study group, the fracture frequency was highest in summer followed by spring.

Demirsoy et al. [2] studied 250 childhood fractures and found that falls caused most of the fractures. Worlock and Stower [10] also reported that fall was the main etiologic factor in the fractures. Simple fall was also the etiologic factor in 80% of cases in our study. Iqbal [3] reported 87% upper extremity and 13% lower extremity involvement, 44% of cases being forearm fractures. Worlock and Stower observed radius the most common fracture site. Of our cases 77% were in upper extremity 23% in the lower extremity. The most commonly fractured bone was radius-ulna with 24% and a fracture in forearm was found in 45% of cases. Our findings were similar to what is in the literature. Surgical treatment rate in supracondylar humerus fractures (50%) was higher than any

other fracture in our series. The physicians facing the supracondylar humerus fractures should remember the greater necessity for surgical treatment.

Peclet et al. [8] stated that understanding of the patterns of childhood injury was important in planning emergency response protocols. Our study revealed the patterns of injuries. This data could be used in the training programs of emergency and orthopedic physicians. The most frequent fractures should take priority in training and should be taught more comprehensively because the physicians will face these fractures more often.

Even though several studies were on either physeal or both physeal and non-physeal fractures, Mizuta et al. [7] reported that the physis was injured in 18% of the fractures. Since the non-physeal fractures outnumber the physeal fractures, it is important to understand injury patterns of non-physeal fractures to be able to provide better care. It is also important to perform studies showing the fracture patterns in different geographic regions. We assume that our study describing patterns of non-physeal fractures in children may be a base for future studies in prevention and care of fractures in children.

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