

The Incidence and Patterns of Injuries about the Elbow in Children

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Abstract Purpose : To investigate the incidence and the patterns of elbow injuries in children.

Methods : The records of the 445 in patient children treated for the elbow injuries for 5 years were reviewed retrospectively.

Results : The age of peak incidence was 5 years both in boys and girls. Fifty percent occurred in the age of 4-7 years. The overall incidence of fractures in boys versus girls was 1.95 : 1. The distribution changed with the age. The left side predominance was accentuated in girls after the age of 8 years. The seasonal variations was not noted in the age groups of 0-3 years and 12-16 years. The supracondylar fracture was 52% followed by the lateral condyle fracture(25%), olecranon, radial neck, medial epicondyle fractures. Other fractures were rare. Ninety eight percent of injuries were caused by the slight or moderate severity of the trauma. The causative trauma did not make a difference of the type of fractures. More than 84% of the children received open or closed reduction under the general anesthesia.

Conclusions : The incidence and patterns of fractures about the elbow were closely related with the geographic area, social system and social environment and also with the behavioral pattern during the causative trauma.

Introduction

Children tend to protect themselves with their outstretched arms when they fall, thus accounting for the vulnerability of the upper extremities to fractures. The upper extremity accounted for 65 to 75% of all the fractures sustained¹⁾³⁾⁵⁾. The injuries about the elbow are the most common area³⁾. They are children-specific fractures that are rare in adults. The treatment for them frequently needs more than

a simple immobilization and inevitable general anesthesia with hospitalization. They were the major cause of morbidity in children. The causative situations of injuries about the elbow ; falling down with outstretched arms, are similar¹⁾. It is interesting that the resulting fractures about the elbow could be varied. In order to develop preventive strategies, the patterns of these injuries should be analyzed.

The objective of this study was to analyze the overall patterns of injuries about the elbow in

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Fig. 1.
The incidence of elbow fractures changes with the age.

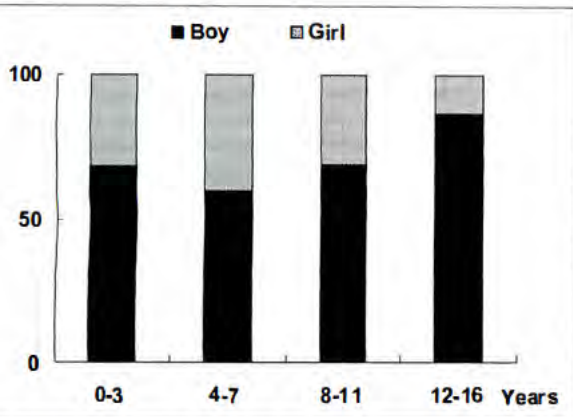
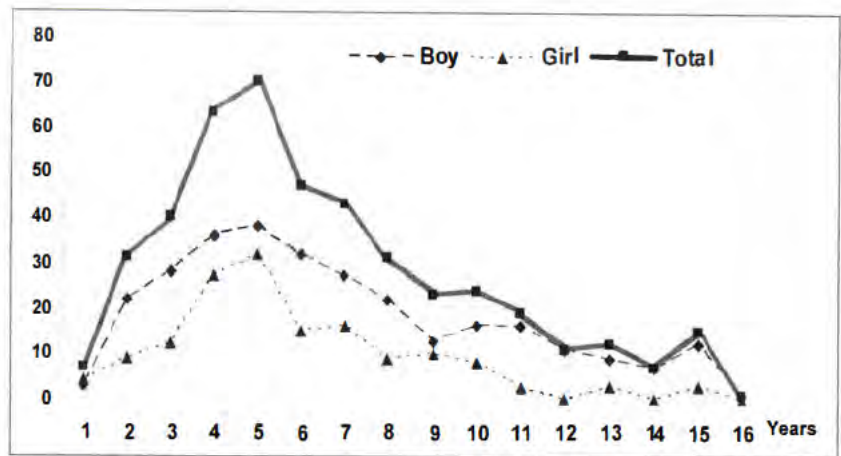


Fig. 2. The ratio of boys versus girls in elbow fractures changes with the age.

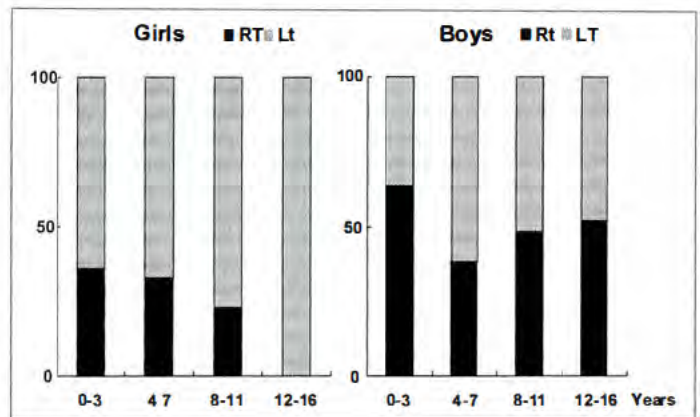


Fig. 3. The left side predominance according to the sex and the age group

children and also to investigate the relationship between the type of fracture and the severity of the trauma.

Materials and Methods

The study was carried out in the tertiary referral center. The department of orthopedic surgery and emergency department treated children with minor injuries and simple fractures as outpatients. Only fractures with displacement or complicated problems are admitted to the hospital for further treatment. Medical records of all children with fracture dislocation about the elbow who were admitted from Jan 1st 1995 to Dec. 31st 1999 were retrieved and analyzed retrospectively. This included the supracondylar fractures, lateral condyle fractures, medial condylar fractures, medial epicon-

dyle fractures of the humerus, entire distal humeral physis fracture separation, olecranon fractures, radial head and neck fractures and Monteggia fractures. Four hundreds fortyfive children younger than 16 years who were admitted as inpatients were gathered. The age and sex distribution, the fracture pattern, the seasonal changes, the severity of trauma, the treatment received were analyzed. The severity of trauma was classified as slight, moderate or severe.

Slight-falling on the same level, falling from less than 0.5 meter (from chair or bed) and most of sports injuries. *Moderate* falling from heights 0.5-3 meters, falling downstairs, from bicycle and from swings and slides or similar playing equipment. *Severe* falling from heights exceeding 3 meters, all traffic accidents.

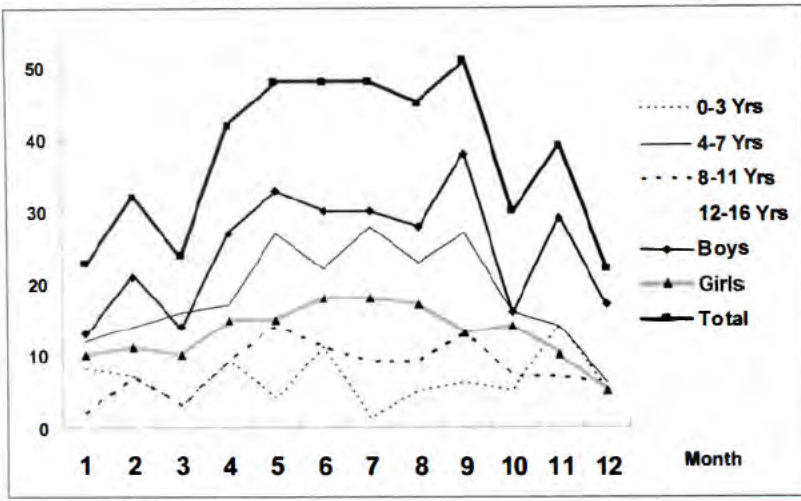


Fig. 4. Seasonal variations

For the age-specific fracture pattern, further break-down was performed into four arbitrary groups of 0 to 3-years age group (newborn and toddlers), the 4-7-years age group (young children), the 8-to 11-year age group (the older children) and the 12 to 16-year age group (the adolescents).

For the statistical analysis, Student t test and qui square test were performed. Significance was set at $P < 0.05$.

Results

The average age of 445 children was 6.7 years old. The incidence of fracture dislocation about elbow changed with the age. The age of peak incidence was 5 years both in boys and girls (Fig. 1). Two hundreds twenty three (50%) occurred in the 4-7 year group, followed by 22% in the 8-11 year group and 18% in the 0-3 year-group. Only 10% occurred in the 12-16 year group. After the age of 11 years, the elbow injuries in girl were a very rare occasion.

Among 445 children, there were 294 boys (66%) and 151 girls (34%). The overall incidence of fractures in boys versus girls was 1.95 : 1. The distribution changed with the age. The male predominant ratio was 1.48 : 1 in the age group of 4-7 years, 2.2 : 1 in the age group of 0-3 years and 8-11 years, and 6.7 : 1 in the

age group of 12-16 years (Fig. 2).

The left elbow (59.6%) demonstrated a significant predominance over the right elbow (40.4%). The ratio of left to right overall is 1.5 : 1. The ratio significantly varied with the age and the sex. It was greater in girls as 2.2 : 1, but lesser in boys as 1.2 : 1. In boys, the left predominance was noted only in the age group of 4-7 years as 1.6 : 1, but not in the other age groups. In girls, the ratio of left to right was 1.8 : 1, the least in the age group of 0-3 years, and accentuated as 2 : 1 in the age group of 4-7 years and 3.3 : 1 in the age group of 8-11 years. After the age of 12 years, all the girls had injuries of only left side (Fig. 3).

During the late spring, summer and autumn month, the significantly increased incidence was noted especially in boys. Seasonal variation was less conspicuous in girls. The age groups of 4-7 years and 8-11 years showed the similar seasonal variations, but the age groups of 0-3 years and 12-16 years did not show the seasonal trends (Fig. 4).

The most common fractures were the supracondylar fractures (52.3%), followed by the lateral condylar fractures (25.4%), olecranon fractures (5.3%), radial head or neck fractures (4.8%), medial epicondylar fractures (4.6%), entire distal humeral physis fracture-separa-

Table 1. Distribution and patterns of elbow injuries in children.

Fracture type	%	Boys/Girls	Lt/Rt	Age
Supracondylar	52	1.81	1.62	6.1
Lateral condyle	25	1.9	1.87	5.7
Olecranon	5.3	2.0	1.4	8.1
Radial neck	4.8	1.2	1.4	10.6 ^d
Medial epicondyle	4.6	4.25*	0.4*	12.4 ^d
Monteggia	2.2	2.3	1.5	7.4
Medial Condyle	1.1	4*	1.5	7.4
Elbow dislocation	0.8	B*	0.25*	8

*Inter gender difference, side difference, ^dage difference

tion(2.8%), Monteggia fractures(2.2%), medial condylar fractures(1.1%), elbow dislocations(0.8%). Among the four most common fractures, the supracondylar and lateral condyle fracture had the age specificity of 4-7 years and the seasonal trends of summer and autumn, but the incidence of the olecranon and the medial epicondyle fracture distributed throughout the ages and the season. The average age of radial head or neck fracture(10.6 years), medial epicondylar fractures(12.4 years) was higher than the age of other elbow fractures. The medial epicondylar fractures and elbow dislocation typically showed the right side and boy predominance(Table 1).

The severity of trauma causing injuries was slight in 57%, moderate in 41%. Only 2% was caused by severe trauma. The distribution of different degrees of trauma did not appear to differ among the varied fractures, except larger proportion of mild trauma in the medial epicondylar fracture and moderate trauma in the olecranon fractures. The modality of treatment was closed reduction and percutaneous pinning in 52%, open reduction in 32% and closed reduction and cast immobilization in 16%.

Discussion

Children with simple fractures treated as outpatients were not included in this study. This study might not reflect the true incidence. This study has the meaning of showing the

features of the clinically important cases needing more than a simple immobilization in management of elbow injuries in children.

The distribution of the age of 4-7 years was 50%, definitely suggesting that the elbow injuries have the age specificity. After the age of 12 years, the distribution was small both in boys and girls. The male predominance in the all the age group was the same as the many reports from other counties, but in contrast with the report from Denmark and San Diego⁴⁾⁶⁾, where the girls were more likely to sustain the elbow or the supracondylar fractures. This suggested that the relative amount of injury-prone activities between boys and girls could be affected by the social environment. The male predominant ratio was the lowest in the age group of 4-7 years, suggesting that the injury-prone activities of the girls in this age was matching the activities of the boys. The ratio was the accentuated after the age of 12 years, featuring of girls' injury-prone activities of much lesser amount than boys after that age.

The left side predominance of the elbow injuries was not consistent but variable with the sex and the age. Boys are assumed to use both upper extremities during the accidents to break the fall except the age group of 4-7 years. Girls frequently relied on the left extremities to break the fall. Especially in girls after the age of 8 years, the left side predominance was exaggerated.

gerated. This data suggested that girls' right arm more frequently embraced her body or tried to catch something in vain instead of being used to break the fall. This clearly showed the difference of the protective behavioral mechanism during the accident, according to the age and sex.

During the late spring, summer and autumn months of June through September, both the boys and girls showed a significant increase in the incidence of elbow injuries. This pattern is similar to other reports, but not the same. The September was the peak month in this study. This definitely reflects that in this periods the proper climate permitted children the largest amount of injury-prone activities. This trends was not clear in the age group of 0-3 years and 12-16 years. The children in the age of 0-3 years spent most of times at home and did not have the seasonal variation in the amount of outdoor activities. It is very interesting that the children at the age group of 12-16 years, who are presumed to have a lot of seasonal variations in the outdoor activities, did not show the seasonal variations. This can be explained that at this age group they had less opportunity to have physical activities because they spent lot of the time in the extracurricular class in our society.

The order of most common fractures was reported the supracondylar fractures followed by the lateral condyle, the proximal radius, and the medial epicondyle fractures in the Hong Kong children³⁾. The order was the supracondylar, proximal radius, the lateral condyle and medial epicondyle in the Sweden⁷⁾, and the supracondylar, the lateral condyle, olecranon and proximal radius in the Denmark⁶⁾. The order of most common fractures about the

elbow showed some difference from this study. The remarkable difference was noted in the incidence of the lateral condyle fractures. It was approaching half of the number of the supracondylar fractures in this study. Only 17%, 22% and 27% of the number of the supracondylar fractures was the number of the lateral condyle fractures in the other reports²⁾⁶⁾⁷⁾. These differences may reflect the true difference of incidence according to the different ethnic background, or may be the differences of selection of patients.

Ninety-eight percentage of injuries were caused by the slight or moderate severity of the trauma. This data suggested that most injuries developed during casual daily children' activities and play, not the special occasion or accident. The varied fracture about the elbow did not appear to be caused by the difference of the causative trauma.

More than 84% of the children was inevitable for the general anesthesia and any sort of surgery.

This was quite large in children's fractures. That was because most of the children transferred to my center had the severe injuries needing more than a simple immobilization.

Conclusion

This study has demonstrated the elbow fractures in children usually caused by the daily activities and during play. The causative trauma did not make a difference of the type of fractures. The incidence and patterns of fractures about the elbow were closely related with the geographic area, social system and social environment and also with the behavioral pattern during the causative trauma.

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