

An investigation of extremity injuries in school-aged children presenting to the emergency department

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Abstract

Aim: It was aimed that various preventive measures should be taken with the demographic characteristics, trauma etiology, injury sites and radiological imaging results of school-age pediatric patients admitted to the emergency department after isolated extremity trauma.

Material and Methods: In our two-center study, 748 patients with isolated limb injuries aged 6-17 years were prospectively evaluated. Their gender, age, causes of trauma, requested radiological imaging in patients classified according to injury sites, treatments, requested consultations, hospitalization and discharge rates were examined.

Results: The mean age was 12.2 ± 3.2 years. The most common cause of injury (52.8%) was fall while playing. Fall while playing (FWP) and extremity injuries occurring during sport were more in males than females ($p = 0.020$). When injury sites were compared according to trauma etiologies, injuries were observed mostly in the left upper extremity in FWPs and mostly in the right upper extremity in school accidents ($p = 0.009$). An orthopedic consultation request was high in patients who underwent splinting and surgical treatment ($p = 0.000$). While fracture was detected in 136 (18.1%) patients included in the study, splint or Velpeau bandage treatments were applied to 314 (41.9%) patients.

Conclusion: In school-aged child injuries, the most common cause was observed to be "fall," which is a preventable cause. Protective measures that will be taken for the safety of children at home, playgrounds, and schools can reduce these injuries.

Keywords: Children; extremity; fall; injuries; trauma

INTRODUCTION

Childhood injuries are a primary and important health problem (1). Approximately 25% of all traumas experienced by people throughout their life are observed in childhood. Trauma mostly causes extremity fractures in children. Children's body mass is smaller than that of adults, and they are more vulnerable to injuries. This situation may cause more harm and significant morbidity (2, 3).

The incidence of extremity fractures after trauma in children is two times higher than in adults (4). Trauma mechanisms and trauma localizations also differ according to the age ranges of children (5). The causes of injuries also differ by age and gender besides geographical differences. Worldwide, around 90% of children aged 17 and below are injured as a result of various accidents every year (6). About one-third of all children experience an injury that results in at least one bone fracture before the age of 17 (7). However, the data and studies on the extremity injuries of this age group in Turkey are limited. Various studies on general body traumas or head traumas

have been usually performed on children who presented to emergency departments. Our study will complete this shortcoming that cannot find a place in emergency orthopedic traumas and pediatric emergencies. Our aim is to contribute to the literature with the data obtained from school age children 6-17 years after extremity injuries. After these data, it is necessary to learn which body localization is affected more and the radiological imaging results and various preventive measures should be taken.

MATERIAL and METHODS

This study was carried out after ethics committee approval numbered 80576354-050-99/75 and dated 26.02.2020 was received. Patients who presented to the emergency departments of Kafkas University Health Research and Practice Hospital and Malatya Training and Research Hospital between 1 March 2020 and 1 July 2020 were reviewed. The number of all trauma patients aged between 6-17 years who presented to the emergency department was 1572. Eight hundred twenty-four patients were removed after exclusion criteria. The remaining 748

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patients with only limb injuries were prospectively studied. Non-traumatic cases, electric shocks, burns, animal bites, non-extremity traumas, and patients with inadequate medical history were excluded from the study. All of our cases consisted of patients with the Glasgow Coma Scale (GCS) of 15 and who did not have death risk. Within the scope of the study, both patients and their parents were informed about the aim of the study. Systemic physical examinations of the patients who presented to the emergency department were performed. The patients were evaluated in terms of age, gender, trauma etiologies (FWP, school accidents, sports injuries, battery, traffic accidents, sharp object injuries), injury localizations (right upper, left upper, right lower, and left lower extremity), imaging methods, imaging results (normal or pathological appearance), consultation request status, and treatment. Imaging methods were preferred in cases with pain, swelling, tenderness, ecchymosis, or deformity as signs of injury. Depending on the trauma status, direct radiography (DR) or computed tomography (CT) was performed, or no radiological imaging was preferred. All patients with suspected radiography were primarily evaluated by an emergency medicine specialist using the hospital's Picture Archiving and Communication Systems (PACS) system. In simple injuries, suturing, dressing or bandage treatments were applied, and patients who did not need any procedures were only prescribed medications. The treatment type of fractures was determined as conservative treatment (splint, Velpeau bandage) and surgical treatment.

Statistical analysis

The statistical analysis of the data obtained was performed using the IBM Statistical Package for the Social Sciences (SPSS) (version 20.0; Chicago, IL, USA) program. The numerical data obtained by measurement were presented as mean and standard deviation, and the categorical data obtained by counting were presented as number (n) and percentage (%). Pearson's chi-square test was used for the statistical analysis of categorical variables, and the Mann-Whitney U test was used for the analysis of non-normally distributed independent variables. In all

of the tests, a p-value lower than 0.05 was accepted as statistically significant.

RESULTS

A total of 748 patients were included in the study. Of these patients, 468 (62.6%) were male, and 280 (37.4%) were female. The mean age was found to be 12.2 ± 3.23 years. When the patients were classified according to their trauma etiologies, it was observed that there were 395 (52.80%) cases in FWP, 215 (28.74%) cases in injuries while doing sports, 106 (14.17%) cases in injuries due to school accidents, and 32 (4.27%) cases in other traumas (Table 1). In the other traumas group, there were 16 patients with injuries due to battery, 11 patients with sharp object injuries, and 5 patients with injuries due to traffic accidents (TAs). Males constituted 59.7% of patients with extremity injuries after FWP and 70.7% of extremity injuries that occurred while doing sports. Both rates were statistically significant ($p = 0.020$). However, there was no statistical significance between males and females in terms of extremity injuries that occurred after school accidents and other traumas. When the relationship between the results of radiological imaging and gender was examined, 71.4% of the fracture or dislocation images that were considered as pathological belonged to the male gender. This rate was found to be statistically significant ($p = 0.026$). When the relationship between injury sites and gender was analyzed, no statistically significant result was observed ($p = 0.167$). Again, there was no statistical significance between genders in terms of radiological imaging and treatment modalities ($p = 0.620$, $p = 0.112$).

When extremities were classified according to injury sites, 231 injuries in the right upper, 258 in the left upper, 153 in the right lower, and 106 in the left lower extremity were observed (Table 2). When injury sites were compared according to trauma etiologies, the injuries were mostly observed in the left upper extremity in FWPs ($p = 0.009$). The most common injuries that occurred due to school accidents were observed to be the right upper extremity injuries ($p = 0.009$).

Table 1. Examination of gender, trauma etiology, and injury localizations according to treatment modalities

	Treatment	Prescription n (%)	Splint n (%)	Dressing n (%)	Surgery n (%)	Total n (%)	P*
Gender	Male	226 (48.3)	210 (44.8)	26 (5.6)	6 (1.3)	468 (62.6)	0.112
	Female	159 (56.9)	101 (36.0)	17 (6.0)	3 (1.1)	280 (37.4)	
	FWP	177 (44.8)	197 (49.9)	13 (3.3)	8 (2.0)	395 (52.8)	
Trauma Etiology	School Accidents	68 (64.2)	32 (30.2)	6 (5.7)	0 (0.0)	106 (14.2)	0.000
	Sports Injuries	129 (60)	73 (34)	13 (6)	0 (0.0)	215 (28.7)	
	Other Injuries	11 (34.4)	9 (28.1)	11 (34.4)	1 (3.1)	32 (4.3)	
Injury Localization	Right Upper Extremity	110 (47.4)	108 (46.5)	12 (5.2)	2 (0.9)	232 (31.1)	0.001
	Left Upper Extremity	101 (44.9)	112 (49.8)	8 (3.6)	4 (1.8)	225 (30.1)	
	Right Lower Extremity	96 (63.6)	45 (29.8)	9 (6.0)	1 (0.7)	151 (20.2)	
	Left Lower Extremity	78 (56.1)	45 (32.4)	14 (10.1)	2 (1.4)	139 (18.6)	

*: Pearson's chi-square

The number of patients in whom radiological imaging was not requested was 51 (6.82%), and the number of patients in whom it was requested was 697 (93.18%). While only DR was requested in 670 (89.6%) of the patients, both DR and CT were requested in 27 (3.6%) patients. The body region where DR was insufficient, and additionally, CT was requested was the lower extremity, and this result was found to be statistically significant ($p = 0.003$) (Table 2).

While the number of patients whose radiology image was evaluated as normal was 557 (74.5%), the number of patients considered pathological was 140 (18.7%) (Table 3). Of all patients, a consultation was not requested for 586 (78.34%) patients. The low consultation request rate (162 (21.66%)) is thought to be caused by the evaluation of all trauma patients by the emergency medicine specialist (Table 3). Within the requested 162 consultations, 121 patients had fractures or dislocations.

Table 2. Relationship between injury localizations and requesting radiological imaging

Injury Localizations n (%)		Right Upper Extremity	Left Upper Extremity	Right Lower Extremity	Left Lower Extremity	Total	p
Radiological Imaging Preferences	No Radiology		22 (9.5)	13 (5.8)	6 (4.0)	10 (7.2)	0.003
	Only DR		210 (90.5)	203 (90.2)	134 (88.7)	122 (87.8)	
Trauma Etiology	DR + CT		0 (0.0)	9 (4.0)	11 (7.3)	7 (5)	

Table 3. Examination of radiological imaging and consultation status according to trauma etiologies

Trauma Etiologies n (%)		FWP	School Accidents	Sports Injuries	Other Traumas	Total	p
Radiological Imaging Results	No	11 (2.8)	7 (6.6)	21 (9.8)	12 (37.5)	51 (6.8)	0.000
	Normal	278 (70.4)	91 (85.8)	173 (80.5)	15 (46.9)	557 (74.5)	
	Pathological	106 (26.8)	8 (7.5)	21 (9.8)	5 (15.6)	140 (18.7)	
Consultation	No	280 (70.9)	95 (89.6)	187 (87.0)	24 (75.0)	586 (78.4)	0.000
	Yes	115 (29.1)	11 (10.4)	28 (13.0)	8 (25.0)	162 (21.6)	

*: Pearson's chi-square, (Pathological: There is an image of fracture or dislocation)

Whether there was a relationship between requesting consultation and age distribution was examined. The median age of those for whom consultation was not requested was 13 years, and the median age of those for whom consultation was requested was 8 years. According to the Mann-Whitney U test, there was a statistically significant difference between these two groups ($p = 0.000$). While 111 (68.5%) orthopedic consultations were requested in males, 51 (31.5%) consultations were requested in females. There was no statistically significant difference between the consultation requests according to gender ($p = 0.077$). When consultations were examined according to treatments, the request for orthopedic consultation was significantly higher in patients undergoing splint treatment and surgical treatment ($p=0.000$).

When a total of 136 fractures were analyzed, 98 (72%) were male, and 38 (28%) were female. It was observed

that 104 (76.4%) of these fractures occurred while playing, 19 (14.0%) were sports injuries, 8 (5.9%) occurred due to school accidents, 4 (3.0%) occurred due to traffic accidents, and 1 (0.7%) was due to battery.

When these fractures were examined according to injury sites, 112 fractures were detected in the upper extremity, and 24 fractures were detected in the lower extremity. The distribution of the fractures is presented in Figure 1.

A total of 314 (41.9%) patients underwent splint and/or Velpeau bandage treatment, while 87 (27.7%) patients underwent closed reduction. Furthermore, it was detected that 337 patients underwent suturing and/or dressing, 88 patients did not undergo any procedure, and 9 patients underwent surgical procedures. While a total of 733 patients were discharged, 15 patients were hospitalized or referred to an advanced center. Fourteen of these 15 patients (96.5%) were patients who came after FWP. There was no death among all patients.

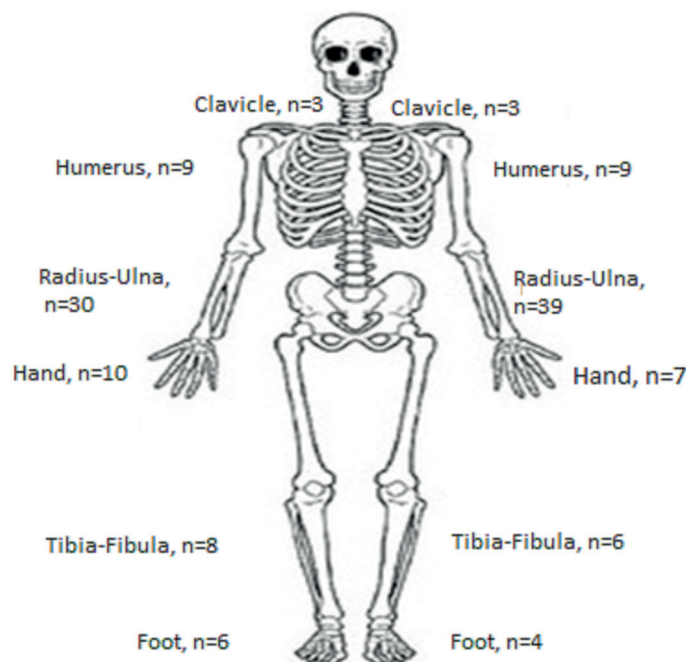


Figure 1. Distribution of fractures according to anatomical localization

DISCUSSION

This study is the first study describing the etiology of extremity injuries, trauma localizations, imaging method preferences, consultation request status, and treatments together in school-aged children. When the literature was reviewed, previous studies were determined to be performed on younger children, sports injuries, or only upper or lower extremity injuries (8, 9).

While there is no difference according to gender in extremity traumas in adults, it is more common in males in children (10). In the current study, in consistency with the literature, 62.6% of all traumas and 72% of fractures were found to occur in male children. In a study conducted in children aged between 0-10 years who were brought to the emergency department after trauma, 9% of those children were found to have fractures (11). In the present study, the age range was 6-17 years, which increased this rate to 18.1% since school-aged children between 6-17 years of age are physically more active. In another study, 500 general trauma patients aged between 6-12 years who presented to the emergency department corresponded to 2.12% of the total patient population (12). In this study, 1572 general trauma patients aged between 6 and 17 years who presented to the emergency department constituted 1.20% of the total patients. Furthermore, only patients with extremity injuries accounted for 47.5% of general trauma patients. Although trauma is the most important cause of morbidity in the child age group, most of them are preventable (13). Extremity injuries in children often occur during actions such as falling, walking, jumping, and running. In all age groups, falls come first among the reasons for presenting to emergency departments due to injuries (14). In the current study, the most common (52.8%) reason for applications due to injuries was found

to be "falls." According to the reasons for the formation of fractures, the most frequent reason was also observed to be "falls" with 47.4% (10).

When extremity injuries are grouped as upper and lower, and right and left, the response to trauma will also differ due to differences in localization. In the child age group, upper extremity fractures are frequently observed. Lower extremity fractures comprise approximately 20% of all fractures in children (15). Clavicle fractures in the upper extremity occur mostly in children due to falling on the shoulder, falling on an outstretched hand, or a direct blow to the clavicle (16). Likewise, in the present study, it was determined that clavicle fractures frequently occurred due to falling and constituted 5.8% of all fractures. Shoulder dislocations are rarely observed in children compared to adults (17). Similarly, there were only two shoulder dislocation cases in our study. Humerus body fractures make up approximately 2.5% of childhood fractures (18). In the present study, this rate was found to be 5.8%. Supracondylar humerus fractures, which are generally observed between the ages of 3-10 years and in males, constitute 16% of all childhood fractures (19). In our study, this rate was 7.3% among all fractures. As a result of a study performed according to the localization of fractures, distal radius fractures (23.5%) were mostly observed (10). Radius-ulna shaft fractures make up approximately 40% of long bone fractures in children (20). They usually occur due to falling on the outstretched hand or directly on the arm when the elbow is in extension (16). In our study, the number of long bone fractures was 102, the number of radius-ulna shaft fractures was 33, and its rate was 32.3%.

Radius-ulna distal end fractures are metaphyseal fractures that generally occur as a result of falling on an outstretched hand during the game or sports activity and contain the single cortex (21). In our study, these fractures occurred due to trauma etiologies similar to the literature. Tibial shaft fractures are mostly observed around the age of 8 years and in males (22). It was also similar in the present study to the literature in terms of age and gender. Foot fractures constitute 5-14% of all pediatric fractures (23). In our study, this rate was found to be 7.3%. The hand is the most frequently injured part of the body in the child and adolescent age group (24). Furthermore, in this study, 12.5% of the injuries with fractures and/or dislocations were in the hands. In pediatric fractures, knowing the order of imaging methods according to the status of trauma is important in terms of planning the diagnosis and treatment and determining the prognosis (25). In emergency departments, primarily direct radiographs are preferred to detect extremity fractures because of their being fast and practical. However, when it is difficult to detect fractures, CT is used.

In order to identify the severity in pediatric patients, easy trauma scoring systems with high predictive power are used, and the most preferred ones are the GCS and Pediatric Trauma Scale (PTS) (26). The GCS scores of all patients in this study were 15, and since their general

conditions were good, there was no need to use PTS scoring.

In the emergency department, mostly orthopedic consultations were needed in the diagnosis and treatment of some patients. Consultations were generally requested for dislocations that could not be reduced, injuries in which circulation was under pressure, open fractures, and injuries requiring surgical repair. In this study, the number of patients for whom orthopedic consultation was requested was 21.6%. While fractures existed in 121 of them, there were no fractures in 41 patients. However, they had other orthopedic problems, such as severe pain and movement restriction. As a result of the evaluation of all patients with a poor clinical picture by the emergency medicine specialist, orthopedics consultation was not required for fractures and subluxations that did not require closed reduction or surgical treatment. We believe that this situation reduced the consultation request.

In general, conservative treatment is the first option in the treatment of undissociated or minimally dissociated forearm fractures (21). In the treatment of pediatric age group fractures, closed reduction and splint methods are the most valid treatment methods (10). In this study, 41.9% of the patients were treated with a splint or Velpeau bandage, while 1.2% underwent surgical treatment.

Limitations

For most of the time interval during which the study was conducted, there was a curfew for people under the age of 18 and schools were closed in Turkey due to the COVID-19 pandemic, which caused a decrease in the diversity of traumas. Generally, accidents occurring at home were observed. In younger children, situations, such as fear, hiding from the family, or inability to express themselves clearly, caused incomplete information about the etiology of trauma.

CONCLUSION

At the end of the study, epidemiological features of school-age injuries were revealed in two different centers. It was observed that conservative treatment was often preferred in fractures, the presence of emergency medicine specialists reduced the need for consultation, and CT was used as an imaging method of the lower extremity. It was determined that extremity traumas in children were mostly caused by minor accidents due to carelessness, and the vast majority of these accidents may be prevented by simple measures to be taken by parents. Furthermore, there is a need to identify safety measures in detail with education programs for parents for the prevention of injuries in children. It is required to determine strategies related to protection methods from injuries, which are a preventable health problem.

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