RESEARCH ARTICLE

How Much are Emergency Medicine Specialists' Decisions Reliable in the Diagnosis and Treatment of Pediatric Fractures?

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Abstract

Background: Considering the importance of an early diagnosis and proper decision-making in regards to the treatment of pediatric distal radius and elbow fractures, this study examines emergency medicine specialists' accuracy in the diagnosis and treatment of these patients.

Methods: From 2012 and 2013, children less than 14 years old who were referred to an academic hospital emergency department with elbow or distal radius fractures were enrolled. Initially, patients were examined by an emergency medicine specialist and then they were referred to an orthopedic surgeon. Type of fracture and the proposed treatment of two specialists were compared.

Results: In total, there were 108 patients (54 patients in each group) with a mean age of 8.1±3.3 years. Identical diagnosis in 48 cases (88.9%) of distal radius and 36 cases (66.7%) of elbow trauma were observed. We found a difference between diagnosis of the two specialists in diagnosing lateral condyle of the humerus fracture in the elbow group and growth plate fracture in the distal radius fracture group, but the differences were not significant. Among 108 patients, 70 patients (64.8%) received identical treatment.

Conclusion: Although the emergency medicine specialists responded similarly to the orthopedic specialists in the diagnosis of pediatric distal radius and elbow fractures, diagnosis of more complicated fractures such as lateral condylar humoral fractures, distal radius growth plate and for choosing the proper treatment option, merits further education.

Keywords: Distal radius fracture, Emergency medicine, Elbow fracture, Orthopedics, Pediatrics

Introduction

The pediatric musculoskeletal system is significantly different than that of adults. Although, the difference decreases as age increases, these fractures develop in a unique pattern, causing difficulty in diagnosis and treatment (1). Children's bones are highly cellular and porous compared with that of adult bones; this large amount of collagen leads into increased flexibility, thus preventing fractures. Distal radius fracture is the most common pediatric trauma, followed by elbow fracture (1-3). The diagnosis of distal radius fracture is easier than that of an elbow fracture. The anatomical complexity of the elbow joint, the probability of neurovascular complications and growth or developmental disorders of the traumatized zones in the elbow, are all issues highlighting the need for emergency intervention in the treatment of these traumas (4–6).

Most pediatric fractures have a non-surgical treatment and can be treated on an outpatient basis (7, 8). Emergency medicine specialists are the very first physicians to encounter traumatized children. Orthopedic residents may also visit the patient – that

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is if present – in the academic hospitals. In inner city hospitals, emergency medicine specialists have neither access to orthopedic specialists nor a radiologist to quickly provide them with a written report. Therefore, emergency medicine specialists often have greater responsible in accurately diagnosing and administering proper treatment as they are the front liners responsible to treat these patients. Hence, an emergency medicine specialist with diagnostic accuracy and proper decision making can avoid unnecessary referrals of the patient to orthopedic surgeons (6, 8).

Considering the importance of an early diagnosis based on proper decisions regarding the treatment of these patients, this study examines the emergency medicine specialist's accuracy in diagnosing and recommended treatment of pediatric distal radius and elbow fractures.

Materials and Methods

From 2012-2013, children under the age of 14, who were referred to the academic hospital emergency with elbow or distal radius fractures were enrolled into our study. Patients who did not have follow up referrals to the orthopedic clinic after being examined by the orthopedic specialist were eliminated from the study.

Patients were then divided into two groups: distal radius fractures and elbow fractures. Based on the previous study sample size with the alpha level of 95% and test power of 80% was determined to be 108 patients, 54 in each group (7).

Initially, patients were examined by an on-call emergency medicine specialist. X-rays of the traumatized area were requested. For each patient a questionnaire was completed, including patients' age, sex, mechanism of injury, type of fracture and proposed treatment by the emergency medicine specialist. Patients were then referred to an orthopedic specialist, where he filled in another copy of the questionnaire, defining the final diagnosis and treatment. Appropriate treatment for all patients was performed by the senior author (MMK).

Elbow fractures were categorized into the 8 following groups: sprain, growth plate fractures, supracondylar humerus fractures, lateral condyle of humerus fractures, radius head fractures, olecranon fractures, pulled elbow, and others. Types of distal radius fractures were divided into 6 groups: sprain, growth plate fractures, buckle fractures, green stick fractures, complete fractures, and others. Types of treatment were divided into: outpatient Treatment (splint, cast, brace and medication) and inpatient (non-surgical and surgical).

Finally, in order to assess the correlation, diagnosis and recommended treatment of the emergency medicine specialist were compared to those of the orthopedic specialist - which was considered the standard.

Project license was issued by the Institutional Review Board and parental informed consent was obtained from all patients. All the study's ethical principle procedures were formulated based on the Declaration of Helsinki (9).

Results

Totally there were 108 patients, 54 in each group (mean age: 8.1+3.28) consisting of 66 girls (61.1%) and 42 boys (38.9%). The youngest child was 18 months old and the oldest was 14 years old. The most common causes of injury were as observed: 62 falls (57.4%), 33 blunt traumas (30.6%), and 8 traffic accidents (4.7%).

Diagnoses

In distal radius fractures the most frequently diagnosed cases by emergency medicine specialists were respectively: sprain seen in 21 patients (38.9%); buckle fracture in 15 patients (27.8%); and complete fractures in 7 patients (13%). The most frequently diagnosed cases by orthopedic specialists were respectively: sprain and buckle fracture each in 15 patients (27.8%); and growth plate fracture in 11 patients (20.4%). In general, no significant differences were found between the diagnosis of types of distal radius fractures by emergency medicine specialists and orthopedic surgeons (P=0.051). Among the 54 patients with distal radius trauma, 48 cases (88.9%) had the same diagnosis given by the two specialists [Table 1]. From 21 cases of sprain that was diagnosed by emergency medicine specialists, 5 cases were classified as growth plate fractures by the orthopedic specialist.

The most common diagnoses in elbow fractures observed by emergency medicine specialists were supra condylar fractures in 18 (33.3%), and sprain in 16 (29.6%) patients. Supra condylar fractures in 16 (29.6%), and sprain in 14 (25.9%) patients were the most frequent diagnoses by the orthopedic specialist, as well. The diagnoses of elbow fractures by both emergency medicine specialists and orthopedic specialists had no significant difference

Table 1. Emergency medicine and orthopedic specialists' diagnoses given for distal radius fractures

Trauma type	Emergency Medicine		Orthopedic	
	Number	Percent	Number	Percent
Sprain	21	38.9	15	27.8
Growth plate fracture	6	11.1	11	20.4
Buckle fracture	15	27.8	15	27.8
Green Stick fracture	2	3.7	2	3.7
Complete fracture	7	13	7	13
Others	3	5.6	4	7.4
Total	54	100	54	100

Table 2. Emergency medicine and orthopedic specialists' diagnoses given for elbow fractures

Trauma type	Emergency Medicine		Orthopedic	
	Number	Percent	Number	Percent
Sprain	16	29.6	14	25.9
Growth plate fracture	3	5.6	5	9.3
Supracondylar fracture	18	33.3	16	29.6
Lateral Condylar fracture	1	1.9	5	9.3
Head Radial fracture	1	1.9	1	1.9
Olecranon fracture	3	5.6	1	1.9
Pulled elbow	8	14.8	8	14.8
Others	4	7.4	4	7.4
Total	54	100	54	100

(*P*=0.315). There were 36 cases (66.7%) of identical diagnosis among the 54 patients observed with elbow trauma. The most significant difference was observed in the diagnosis of lateral condylar fractures [Table 2].

Treatments

In distal radius fractures, emergency medicine specialists had administered outpatient treatment for 42 cases (77.8%) and inpatient treatment for 12 cases (22.2%), while orthopedic specialists performed outpatient treatment for 51 cases (94.4%) and inpatient treatment for only 3 cases (5.6%). A significant difference was observed between the overall treatment method choice of distal radius fractures by emergency medicine specialists and orthopedic specialists (*P*=0.004). Among 54 patients with distal radial trauma, there were 45 cases (83.3) of similar treatment.

For elbow fractures, emergency medicine specialists recorded 31 cases (57.4%) of outpatient treatment and 23 cases (42.6%) of inpatient treatment; conversely orthopedic specialists had 47 cases (87.1%) of outpatient treatment and 7 cases (12.9%) of inpatient treatment. There was a significant difference observed between the overall treatment of elbow fractures by emergency medicine specialists and orthopedic specialists (*P*=0.006). Among 54 patients with elbow trauma, there were 42 cases (77.8%) of identical treatment. Orthopedic specialists sought hospitalization for just 2 of 29 patients, 27 of whom the emergency medicine specialists prescribed outpatient treatment. From 25 cases of recommended inpatient treatment, only 13 patients were hospitalized by the orthopedic specialist.

In terms of IN or OUT patient treatment for all types of fractures (108 patients), there was a significant difference between the recommendation of emergency medicine and orthopedic specialists (*P*=0.0001). Among the 108 patients in both groups, 87 cases (80.5%) received identical treatment.

There was a significant difference between the kind of treatment recommended by emergency medicine and orthopedic specialists for distal radius fractures as well as elbow fractures (*P*= 0.005 and *P*=0.027, respectively) as is shown in [Table 3].

There was a significant difference observed between the chosen types of treatment for all patients based on the diagnosis of emergency medical physicians and orthopedists (*P*=0.0001). Among 108 patients, 70 patients (64.8%) received identical treatment.

Discussion

Emergency room overcrowding, patients' waiting time and the related costs can impose a serious burden on the health care system. Reducing hospitalization period in the emergency department leads to higher performance and decreases related costs to improve patient's satisfaction. One way to reach such a goal is the manipulation of uncomplicated distal forearm fractures that is performed by the emergency medicine specialist, so avoiding the need for further measurements, time and monetary expense and so only needing the consultation of an orthopedic specialist (10, 11).

Our findings suggest that there is no difference regarding the diagnosis of distal radius fractures amongst emergency and orthopedic specialists. However, it is important to note that almost half of the children with growth plate fractures were missed by emergency medicine specialists and were considered as a sprain. This difference led to a significant difference in the recommended treatment for this group of patients.

The most often observed diagnoses of the distal radius traumas by the orthopedic specialist were sprain, followed by buckle fractures and then growth plate fractures and among emergency medicine specialists were sprain and buckle fractures as the two most common diagnoses. In Zomorrodi et al.'s study the most frequent diagnoses by emergency medicine specialists were growth plate fractures with 80 percent and other fractures with 10 percent. In 55 percent of cases, orthopedic specialists diagnosed growth plate fracture and in the other 23 percent they diagnosed other fractures, those of which having occurred the most frequently (7).

In the present study, the diagnoses suggested for elbow fractures by emergency medicine specialists and orthopedic specialists were respectively:

Table 3. Frequency distribution of the administrative treatments in terms of diagnoses of emergency medicine specialists and orthopedic specialists

Treatment Type	Distal radius fracture		Elbow Fracture	
	Emergency Medicine	Orthopedics	Emergency Medicine	Orthopedics
Splint - N (%)	27 (50)	26 (48.1)	22 (40.7)	23 (42.6)
Casting - N (%)	15 (27.8)	25 (46.3)	1 (1.9)	11 (20.4)
Brace - N (%)	-	-	1 (1.9)	5 (9.3)
Medication - N (%)	-	-	7 (13)	8 (14.8)
Inpatient,Non-surgical - N (%)	8 (14.8)	2 (3.7)	10 (18.5)	2 (3.7)
Inpatient,Surgical - N (%)	4 (7.4)	1 (1.9)	13 (24.1)	5 (9.3)

supracondylar, sprain, and pulled elbow. Therefore, the results of our study are comparable to the previous studies (1-3). In the present study it was noted that supracondylar fractures (55%), radial neck fractures (14%) and lateral condylar fractures (12%) were the three most common elbow fractures observed in children. Although diagnosing the type of damage in pediatric elbow trauma had no significant difference, 4 of 5 patients with lateral condylar fracture were missed by emergency medicine specialists. In a study performed by Shrader et al. the accuracy of the diagnosed radiographs of the elbow fracture by emergency medicine specialists was 53 percent, which was less than expected (8). This point is important because lateral condylar fracture is one of the most common children's orthopedic emergencies, with a definite need for hospitalization and it can lead to additional complications for the patient in cases of misdiagnosis (4).

It seems like emergency medicine specialists tend to hospitalizing patients more than orthopedic specialists, and tend less to prescribe outpatient casting. Of course, it is a good way to process patients since less will be missed; however, overtreatment incessantly poses more costs on both the patient and healthcare system (12, 13). In Zomorrodi et al.'s study the most common treatment applied by the emergency medicine specialists was a splint in 64 percent and among orthopedic specialists it was casting in 67 percent (7).

Five emergency medicine specialists were involved in this study and the results obtained from them are expressed in general. Due to the different abilities of these physicians in the diagnosis and treatment of studied traumas, it is possible that those differences seen between the diagnoses and treatments of emergency medicine specialists and orthopedic specialists are only related to one of the specialists. Studies with larger sample sizes that focus separately on each of these fractures are recommended for the future.

Although emergency medicine specialists act similarly to orthopedic specialists in diagnosing pediatric distal radius and elbow fractures, in diagnosing more complicated fractures such as lateral condylar humoral fractures, distal radius growth plate and allocating proper treatment for the patient, they still need further education.

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References

1. Park MS, Chung CY, Choi IH, Kim TW, Sung KH, Lee SY, et al. Incidence patterns of pediatric and adolescent orthopaedic fractures according to age groups and seasons in South Korea: a population-based study. Clin Orthop Surg. 2013; 5(3):161-6.
2. Randsborg PH, Gulbrandsen P, Saltyte Benth J, Sivertsen EA, Hammer OL, Fuglesang HF, et al. Fractures in children: epidemiology and activity-specific fracture rates. J Bone Joint Surg Am. 2013; 95(7):e42.
3. Rennie L, Court-Brown CM, Mok JY, Beattie TF. The epidemiology of fractures in children. Injury. 2007; 38(8):913-22.
4. Mounts J, Clingenpeel J, McGuire E, Byers E, Kireeva Y. Most frequently missed fractures in the emergency department. Clin Pediatr (Phila). 2011; 50(3):183-6.
5. Kachalia A, Gandhi TK, Puopolo AL, Yoon C, Thomas EJ, Griffey R, et al. Missed and delayed diagnoses

in the emergency department: a study of closed malpractice claims from 4 liability insurers. Ann Emerg Med. 2007; 49(2):196-205.
6. Hallas P, Ellingsen T. Errors in fracture diagnoses in the emergency department--characteristics of patients and diurnal variation. BMC Emerg Med. 2006; 6(1):4.
7. Zomorrodi A, Bennett JE, Attia MW, Loiselle J, Rogers KJ, Kruse R. Consistency between emergency department and orthopedic physicians in the diagnosis and treatment of distal fibular Salter Harris I fractures. Pediatr Emerg Care. 2011; 27(4):301-3.
8. Shrader MW, Campbell MD, Jacofsky DJ. Accuracy of emergency room physicians' interpretation of elbow fractures in children. Orthopedics. 2008; 31(12):34.
9. World medical association declaration of Helsinki. Ethical Principles for Medical Research Involving Human Subjects. Amended by 59th WMA General Assembly (Seoul): World Medical Association; 2008; Available from: http://www.wma.net/en/30publications/10policies/b3/.
10. Heidari K, Hatamabadi HR, Sabzghabaei A, Manouchehrifar M, Hanani K, Ahmadzadeh M, et al. The Efficacy of Closed Reduction of Distal Radius Fractures in Emergency Department. J Bas Appl Sci Res. 2013; 3(8):151-8.
11. Pershad J, Williams S, Wan J, Sawyer JR. Pediatric distal radial fractures treated by emergency physicians. J Emerg Med. 2009; 37(3):341-4.
12. Erthan ER, Kara PH, Oyar O, Unluer EE. Overlooked extremity fractures in the emergency department. Ulus Travma Acil Cerrahi Derg. 2013; 19(1):25-8.
13. Moradi A, Kachooei AR, Mudgal CS. Mallet fracture. J Hand Surg Am. 2014;39(10):2067-9.