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Comparison of outcomes of closed reduction in pediatric both-bone forearm fractures performed by emergency physicians and orthopedic surgeons

Çocuklarda ön kol çift kırıklarının tedavisinde acil doktorları ve ortopedi uzmanlarının karşılaştırılması

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Abstract

Aim: The study aimed to compare the outcomes of closed reduction and splinting performed by emergency physicians and orthopedic surgeons in cases of both-bone forearm fractures.

Materials and Methods: This retrospective study included pediatric patients with both-bone forearm fractures. Surgical intervention, hospitalization, and discharge outcomes following closed reduction performed by emergency and orthopedic physicians were evaluated.

Results: A total of 91 patients were included, with a mean age of 9.97 ± 3.58 years, of whom 72.5% were male. Statistically significant differences were observed in surgical intervention rates (p=0.006) and hospitalization rates (p=0.001) between emergency physicians and orthopedic surgeons, while discharge outcomes showed no significant difference (p=0.590).

Conclusion: The comparable discharge rates between emergency physicians and orthopedic surgeons emphasize the value of emergency physicians' role in closed reduction. Emergency physicians can achieve high-quality reductions in pediatric both-bone forearm fractures with full functional recovery.

Keywords: both-bone forearm fracture; Pediatric; Closed reduction; Emergency physicians.

Öz

Amaç: Ön kol çift kırıklarında kapalı redüksiyon ile atele alınan olguların acil tıp uzmanları ile ortopedi doktorlarının sonuçlarının karşılaştırılması hedeflenmiştir.

Gereç ve Yöntem Bu retrospektif çalışmaya, ön kolun çift kırığı ile başvuran pediatrik hastalar dahil edilmiştir. Acil servis ve ortopedi uzmanları tarafından uygulanan kapalı redüksiyon girişimleri analiz edilerek, tedavi etkinliği ve sonuçları değerlendirilmiştir.

Bulgular: Çalışmaya 91 hasta dahil edildi. Yaş ortalaması 9,97±3,58 yıl ve %72,5'i erkek idi. ön kol çift kırığına kapalı redüksiyon sonrası opere edilme oranları (p=0,006) ile yatış durumları (p=0,001) istatistiksel olarak anlamlı fark gösterirken taburculukları bakımından fark yoktu (p=0,590).

Sonuç: Acil doktorlarının kapalı redüksiyondaki başarısı ile taburculuk bakımından ortopedistler arasında fark bulunmamıştır. Acil servislerde acil tıp uzmanları tarafından çocuk ön kol çift kırıklarının tam fonksiyonel iyileşme ile yüksek kalitede redüksiyonu sağlanabilmektedir.

Anahtar Kelimeler: Ön kol çift kırığı; Çocuk; Kapalı redüksiyon; Acil doktorları.

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Bu makale araştırma ve yayın etiğine uygun hazırlanmıştır.
intihal incelemesinden geçirilmiştir.

Introduction

One of the most common upper extremity fractures in children is forearm fractures. These fractures most frequently occur due to falls at home and school, traffic accidents, and sports injuries. The initial point of care is often the emergency department. Unlike adult fractures, the majority of pediatric forearm fractures can be treated conservatively. Closed reduction and cast immobilization are the standard treatment methods for pediatric forearm fractures. This reduction procedure is typically performed by orthopedic specialists. However, orthopedic specialists are not always immediately accessible in every location. This can result in delays in intervention, causing the patient to endure pain for a longer period. Additionally, such delays are not well-received by the patient's family. The advantages of initial traction and splinting include reducing bleeding and pain, preventing soft tissue injuries.[1]

When evaluating the outcomes of treating diaphyseal fractures of both-bones forearm in children in the emergency department, it has been demonstrated that high-quality reduction with full functional recovery can be achieved. In such fractures, good radiographic and clinical results obtained in emergency departments lead to a reduction in hospital admission rates.[2] Emergency physicians, who are the first to evaluate pediatric trauma patients in the emergency department, can also participate in orthopedic interventions. Emergency physicians are trained to perform orthopedic procedures under sedoanalgesia as part of their training programs.

This study aims to compare the outcomes of closed reduction and splinting performed by emergency medicine physicians and orthopedic specialists in cases of diaphyseal fractures of both the radius and ulna in pediatric patients.

Materials and Methods

Pediatric cases diagnosed with diaphyseal fractures of both the radius and ulna and treated with closed reduction and splinting under sedation and analgesia over one year were included. Sedation was individualized based on the patient's age, weight, clinical condition, and procedural needs. Ketamine was administered at a dose of 1–2 mg/kg IV or 4–5 mg/kg IM. It was frequently preferred because it provides dissociative sedation and preserves respiratory reflexes. Fasting time was assessed in all patients before sedation (≥2 hours for liquids, ≥6 hours for solids). During sedation, patients were monitored with pulse oximeters, cardiac monitors, and noninvasive blood pressure monitors, and oxygen supplementation was provided. Intubation equipment was readily available to ensure airway security. Sedation was performed by physicians experienced in pediatrics and emergency medicine. Reduction procedures were performed by emergency medicine specialists and orthopedic specialists. The decision to include diaphyseal fractures was based on their distance from the physis line. Variables such as age, gender, occupation, etiology, location of the incident, month of presentation, type of trauma, surgical intervention, and hospitalization were assessed. Retrospective data, including digital radiographs accessed through the PACS (Picture Archiving and Communication System), were analyzed

Patients were discharged once the radiographic angulation and displacement were reduced to acceptable levels. Follow-up examinations were conducted 5 to 7 days post-reduction, with subsequent monitoring for fracture displacement and complications. Healing progress was evaluated after six weeks.

Angulation of up to 15 degrees and rotational deformity up to 45 degrees in children under 10 years, and up to 10 degrees of angulation and 30 degrees of rotational deformity in children older than 10 years, were considered acceptable thresholds for reduction failure.[3]

For cases treated by emergency medicine physicians, pre- and post-reduction radiographs of hospitalized patients were reviewed via the PACS system. Orthopedic specialists assessed angulation and displacement before planning hospitalizations or discharges. Analyses were performed using SPSS 21 (IBM Inc, Armonk, NY, USA) software. Comparative analysis between the

treatment outcomes of emergency medicine physicians and orthopedic specialists was performed using Chi-Square Tests and Student's t-test.

Ethics committee approval

Approval was taken from the Ethical Board of the University of Health Sciences Adana City Training and Research Hospital the study was conducted in (Ethics committee approval number: 2025/13-494 and date: 08.05.2025) and written permission was taken from University. The study adhered to the principles of the Helsinki Declaration.

Results

The study included pediatric cases with diaphyseal radius and ulna forearm fractures who presented to the emergency department. Data from a total of 91 pediatric cases treated with closed reduction were analyzed. The average age of the cases was 9.97±3.58 years, and 72.5% (n=66) were male. Regarding occupational distribution, 79.1% were identified as students. When the etiology of fractures was examined, it was found that the vast majority, 92.3% (n=84), occurred as a result of falls, with the most common locations being schools (38.5%; n=35) and homes (27.5%; n=25).

An analysis of the time of the incidents over a year revealed the following distribution: January 6.6% (n=6), February 7.7% (n=7), March 5.5% (n=5), April 6.6% (n=6), May 1.1% (n=1), June 13.2% (n=12), July 11% (n=10), August 16.5% (n=15), September 15.4% (n=14), October 6.6% (n=6), November 3.3% (n=3), and December 6.6% (n=6).

Additionally, isolated trauma was the most common mechanism (92.3%), and the majority of the cases were not operated on (84.6%) and were discharged after outpatient treatment (76.9%). Comparisons between cases treated by emergency physicians and orthopedic surgeons showed that the age (p=0.442) and occupational (p=0.771) distributions of the cases were similar. It was also found that there was no statistically significant difference in the etiology of fractures (p=0.304), the location of the incidents (p=0.998), or the type of trauma (p=0.451) between cases treated by emergency physicians and orthopedic surgeons.

However, a statistically significant difference was observed in the rates of surgical intervention (p=0.006) and hospitalization (p=0.001) between the two groups. All demographic characteristics of the cases are presented in Table 1.

Table 1. Comparison of general characteristics of cases by emergency and orthopedic physicians.

		Emergency Physician (n=41) |	Orthopedist (n=50)	*p*
	Mean±SD / n (%)	**Mean±SD / n (%)**	**Mean±SD / n (%)**	
Age (years)	9.97±3.58	10.22±3.84	9.76±3.37	0.442
Gender				
Male	66 (72.5)	34 (82.9)	32 (64)	0.044
Famale	25 (27.5)	7 (17.1)	18 (36)	
Occupation				
Student	72 (79.1)	33 (80.5)	39 (78)	0.771
Non-Student	19 (20.9)	8 (19.5)	11 (22)	
Etiology				
Fall	84 (92.3)	36 (87.8)	48 (96)	0.304
Sports injury	6 (6.6)	4 (9.8)	2 (4)	
Bicycle fall	1 (1.1)	1 (2.4)	-	
Location of the Incident				
School	35 (38.5)	16 (39)	19 (38)	0.998
Home	25 (27.5)	12 (29.3)	13 (26)	
Garden	15 (16.5)	6 (14.6)	9 (18)	
Street	8 (8.8)	4 (9.8)	4 (8)	
Playground	8 (8.8)	3 (7.3)	5 (10)	
Type of Trauma				
Isolated	84 (92.3)	39 (95.1)	45 (90)	0.451
Multitrauma	7 (7.7)	2 (4.9)	5 (10)	
Operation				
No	77 (84.6)	30 (73.2)	47 (94)	0.006
Yes	14 (15.4)	11 (26.8)	3 (6)	

Hospitalization				
Discharged	70 (76.9)	25 (61)	45 (90)	0.001
Yes	21 (23.1)	16 (39)	5 (10)	

When examining the cases treated by emergency physicians, it was observed that 4% of the discharged cases underwent surgery, while 62.5% of the hospitalized cases underwent surgery. The rates of surgical intervention between discharged and hospitalized cases showed a statistically significant difference (p<0.001).

When examining the cases treated by orthopedic surgeons, it was observed that 2.2% of the discharged cases underwent surgery, while 40% of the hospitalized cases underwent surgery. The rates of surgical intervention between discharged and hospitalized cases showed a statistically significant difference (p=0.023). Although emergency physicians had significantly higher rates of surgery and hospitalization, both groups of doctors showed significant internal differences in these aspects. There was no statistically significant difference between emergency physicians and orthopedic surgeons regarding discharge rates (Table 2).

Table 2. Comparison of discharges between orthopedic and emergency physician.

Hospitalization		**Operation**		**Total(%)**
		No (%)	**Yes (%)**	
Discharged	Emergency Physician	24 (34.3)	1 (1.4)	25 (35.7)
	Orthopedic	44 (62.9)	1 (1.4)	45 (64.3)
Total		68 (97.1)	2 (2.9)	70 (100)
Hospitalization	Emergency Physician	6 (28.6)	10 (47.6)	16 (76.2)
	Orthopedic	3 (14.3)	2 (9.5)	5 (23.8)
Total		9 (42.9)	12 (57.1)	21 (100)

(p=0.590)

A multivariate logistic regression analysis was conducted to examine the effects of age, gender, and trauma type on [insert name of the dependent variable]. The age variable showed a statistically significant positive effect on the outcome (B = 0.035, p = .001) (Table 3).

Table 3. Multivariate regression analyses examining the effects of age, gender, and trauma type.

Variable	**B (Coefficient)**	**Std. Error**	**Wald**	**p (Significance)**	**O.R. (Exp(B))**	**95% CI Lower**	**95% CI Upper**
Age	0.035	0.011	10.16	.001	1.036	1.013	1.060
Gender	-0.149	0.088	2.87	.090	0.861	0.723	1.026
Trauma Type	-0.063	0.148	0.18	.670	0.939	0.699	1.261

Discussion

The most common cause of forearm fractures in children is falls[4]. Sports injuries and bicycle accidents are the second most common causes of forearm fractures after falls.[5] Forearm fractures occur in 34% of cases at playgrounds (schoolyards), 19.7% at sports fields, 17.9% in running areas, and 15.3% during activities involving non-motorized vehicles such as bicycles.[6] In our study, similar to the literature, forearm fractures were most commonly observed as isolated injuries resulting from falls at school, home, gardens, and then on streets and parks.

Fractures observed in children also show seasonal variations. Fractures are most common in the summer months (35%), particularly in July.[1] There are also studies showing that fractures are common between May and August.[5] In our study, consistent with other research, fractures were frequent during the summer months (40%), with more than half of the cases occurring in August, followed by September, June, and July. There are studies indicating that the average age of pediatric fractures is 8.5 years, with 63% of the cases involving male children.[3] The incidence of fractures increases 2.4 times in boys and 2.1 times in girls during primary school, and 2.2 times in boys and 2.9 times in girls during middle school. This increase in girls has been associated with their growing interest in sports activities.[7] Children aged 8 represent the

highest incidence of pediatric forearm fractures.[3] Many studies have shown that the risk of fractures is higher between the ages of 10 and 14, with boys being more affected than girls.[8-10] There are also studies indicating that the highest incidence of fractures occurs at age 14 in boys and at age 11 in girls.[11] In our study, forearm fractures most commonly affected children aged 7–11 years (45.1%), followed by 12–18 years (35.2%), and children up to 6 years old (19.8%). The high fracture risk between ages 9 and 13, with the peak incidence at age 9, demonstrates that our findings are consistent with the literature.

The primary treatment for pediatric fractures is closed reduction and splinting. Approximately 84% of pediatric fractures are treated conservatively in emergency departments.[1] Studies comparing the success of emergency physicians in closed reduction and splinting have increased in recent years, and this success rate is approximately 80%.[2] The success rate of closed reduction is 89.7% in single-bone fractures but decreases to 75.2% in both-bone fractures.[6] In our study, emergency physicians were found to prevent surgery in 73.2% of forearm both-bone fractures. The lack of a difference in discharge rates between emergency physicians and orthopedic surgeons in cases of forearm both-bone fractures further supports this finding.

Many studies have been published comparing the performance of emergency physicians and orthopedic surgeons in the management of pediatric forearm fractures with closed reduction and splinting.[12-14] Some studies have found that emergency physicians are more successful than orthopedic surgeons in managing forearm fractures.[8,13,15-17] In some studies, no difference was found between emergency physicians and orthopedic surgeons in terms of the success of initial reduction.[14] Similarly, in the comparative studies by Khan and Pershad and their colleagues on emergency physicians and orthopedic surgeons, no significant differences were identified in the successful reduction of forearm fractures or in the follow-up of complications.[8,16] It has been observed that the remanipulation rate of forearm fractures by emergency physicians is similar to that of orthopedic surgeons,[12] although some studies have shown worse outcomes.[14] Emergency physicians' initial interventions in the emergency department have significantly reduced emergency waiting times.[8,14] Additionally, interventions performed in the emergency department have resulted in substantial reductions in billing costs compared to orthopedic surgeons.[10] It is reported that there is a small overall cost savings due to the significantly shorter hospital stay associated with reduction procedures performed by emergency physicians.[14] The increasing number of emergency physicians, along with their enhanced skills and experience in sedation, contributes significantly to treatment. This helps prevent delays in reduction and reduces costs. Their success in conservative treatment has been clearly demonstrated.[10] Among discharged patients, the outcomes of successful reduction and complication rates were found to be similar to the findings of Christine and Özel's studies,[18,19] as in our study, showing no significant differences between emergency physicians and orthopedic surgeons.

It is noteworthy that emergency physicians and orthopedic surgeons demonstrate similar success rates among patients discharged after reduction and splinting of fractures. In recent years, emergency physicians have increasingly played a significant role in orthopedic interventions. Early splinting and intervention help reduce secondary injuries and the risk of failed reductions. Protective mechanisms of early splinting include limiting movement, tissue protection, pain control, prevention of reflex muscle spasm, control of edema, reduction of tissue pressure, stabilization, anatomic protection before reduction, and prevention of secondary injuries. The advantage of emergency physicians in these interventions lies in their role as the first-contact doctor. Early intervention can prevent prolonged pain for the patient and alleviate the concerns of their relatives. Additionally, it helps reduce unnecessary overcrowding in the emergency department and associated costs.

Limitation of the study

The single-center design and the limited number of cases can be considered limitations of the study.

Conclusion

When evaluating the outcomes of the treatment of forearm both-bone fractures performed in the emergency department, it has been demonstrated that emergency physicians can achieve high-quality reductions with complete functional recovery. In situations where orthopedic surgeons are unavailable or inaccessible, such as in high-casualty incidents, earthquakes, or other natural disasters, emergency physicians can serve as an alternative for initial closed reduction and splinting of fractures.

Ethics Committee Approval

Approval was taken from the Ethical Board of the University of Health Sciences Adana City Training and Research Hospital the study was conducted in (Ethics committee approval number: 2025/13-494 and date: 08.05.2025) and written permission was taken from University. The study was conducted in accordance with the Helsinki declaration principles.

Author Contributions

Idea, design, collection of resources, analysis and interpretation of results and literature, written and critical: HÜ, AA, OÇ, AKE.

Conflict of Interest

There is no conflict of interest to declare

Financial Disclosure

There is no person/organization supporting this study financially.

Peer-review

Externally peer-reviewed.

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