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Risk Factors and Complications Associated with Elbow Fractures in Children

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Abstract: Background and Aim: Children are at increased risk of elbow injuries, where fractures enrolled 14% of all fractures. Elbow injuries turn out to produce a rich pathology to the pediatric emergency unit.

Methods: Our study recorded clinical and surgical data of 94 pediatric fracture patients in hospitals in Baghdad, Iraq, between January 2024 and January 2025. Patient data were divided into two groups according to the type of surgery. The first group represented 47 pediatric patients who underwent open reduction. The second group represented 47 pediatric patients who underwent closed reduction and percutaneous pinning. For post-procedure outcomes, we recorded patient parameters, including complications, risk factors, functional recovery, and quality of life assessment.

Results: A comprehensive review of the medical records of 94 children was conducted in this study. The study demonstrated that 68.09% of the male patients and 31.91% of the female patients exhibited obesity, and supracondylar fractures had 45.74% of the total patients. In regard to the surgical outcomes, the surgical time was found to be 84.34 ± 9.57 minutes, with a length of stay in the hospital of 2.7 ± 0.1 days; postoperative complications were observed in 12.77% of cases, and 51.06% of patients in the open reduction group demonstrated functional recovery of mobility. In contrast, surgical time was found to be 35.11 ± 4.91 minutes, length of stay in the hospital was 0.9 ± 0.1 days, and postoperative complications were observed in 6.38% of cases, and functional recovery of mobility was observed in 78.72% of patients. The physical function score was 73.4 ± 9.4, and the psychological function score was 74.66 ± 4.6 in the open reduction group. In contrast, the physical function score group was 87.5 ± 6.6, and the psychological function score was 85.4 ± 6.0 in the closed reduction and percutaneous pinning.

Conclusion: The present study indicates that both closed and open reduction procedures are equally effective in restoring functional recovery in pediatric patients, with closed reduction and percutaneous pinning being preferable.

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Key words: Elbow fracture; Children; Symptoms; Fractures Mechanism; Complications; and Risk factors.

Introduction

Elbow injuries are common to the pediatric population, constituting 5% to 10% of all fractures in children ***[1].*** More common in males, the majority are due to falls with the arm in extension. Elbow injuries are one of the most common complaints referred by parents ***[2].*** Frequently, elbow injuries will prompt radiographic testing to rule out possible fractures. Almost 15% of all fractures sustained during childhood are related to the elbow ***[3].*** On plain radiographs, the posterior fat pad, which is normally contained within the olecranon fossa, is raised when there is effusion in the elbow joint. Elevation of this pad serves as a sensitive indicator for elbow fracture in cases of trauma ***[4].*** Upper limb fractures account for about sixty-five to seventy percent of all pediatric fractures, while elbow fractures account for about 8 to 10 percent ***[5].*** A trauma hospital treating pediatric elbow fractures is involved here, as they pose a serious challenge. Most injuries are a result of falling onto an outstretched arm ***[6].*** The etiology is important because the activities of children vary greatly between countries. ***[7, 8]***

Patients and Methods

I. Study Design

We conducted a cross-sectional study of 94 pediatric patients with fractures aged 3–14 years. All examinations and treatments for these fracture patients were performed at hospitals in Baghdad, Iraq, between January 2024 and January 2025. Demographic and clinical parameters of the pediatric patients were recorded, including age, sex, body mass index (BMI), fracture severity, other associated comorbidities, and the socioeconomic status of the parents.

II. X–ray Diagnostic Examinations

All patients underwent X–ray technique diagnostics, which assessed the location (right, left, or both sides) and fracture type (supracondylar, lateral condylar, or medial epicondyle) and determined the fracture mechanisms associated with the fractures in children.

III. Surgical Interventions

All patients underwent fracture surgery, and the two procedures were compared. Patients were divided into two groups based on the type of surgery. Both groups underwent surgical interventions at hospitals in Baghdad, Iraq, between January 2024 and January 2025. The first group represented 47 pediatric patients who underwent open reduction. The second group represented 47 pediatric patients who underwent closed reduction and percutaneous pinning. Surgical parameters included surgical time, length of hospital stay, admission to the intensive care unit, and patient pain and satisfaction rates during the postoperative hospital stay.

IV. Postoperative Procedure: Comparison of the Two Surgical Procedures

Both pediatric patients underwent postoperative clinical examinations, which identified parameters associated with a negative impact on the quality of life in pediatric patients after surgical interventions. This study recorded postoperative clinical parameters, including complications, pain rates, and satisfaction rates during the postoperative hospital stay. We performed univariate analysis on the patients to identify risk factors affecting quality of life after surgery. Furthermore, we assessed the functional recovery of pediatric patients by evaluating motor performance using the Mayo Elbow Performance Score (MESS), which ranges from 0 to 100, with 0 representing minimal functional recovery and 100 representing maximum functional recovery. The general health of pediatric patients after surgery was also assessed using the SF-36 questionnaire, which ranges from 0 to 100, with 100 representing optimal health.

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Results

A total of 94 children's data were enrolled in our study. Current outcomes shown males were in 68.09%, and females were 31.91%, obesity patients were 40.43%, where 36.17% had severity fractures with grade III.

Table 1: Frequency distribution of demographic characteristics over all patients.

Variables	Children {n = 94}	Percentage {%}
Age		
3 – 6	21	22.34%
7 – 10	25	26.6%
11 – 14	48	51.06%
Gender		
Male	64	68.09%
Female	30	31.91%
Body mass index, {kg/m2}		
Underweight	3	3.19%
Normal weight	33	35.11%
Overweight	20	21.28%
Obesity	38	40.43%
Fracture classification according to severity		
I	25	26.60%
II	34	36.17%
III	21	22.34%
IV	14	14.89%
Illness related		
No	56	59.57%
Yes	38	40.43%
Diabetes	7	7.45%
Obesity	38	40.43%
Asthma	10	10.64%
Others	5	5.32%
Socioeconomic status of parents		
Lower–class	17	18.09%
Middle–class	52	55.32%
High–class	25	26.60%

Here, we observed that half of the patients had injured with sports-related injuries with 53.19%, followed by falls with 25.53%. Fracture type classified into supracondylar (45.74%), lateral condyle (32.98%), and medial epicondyle (21.28%); laterality fractures were right (61.7%), left (38.3%).

Table 2: Mechanisms of injury.

Mechanisms of injuries	Children {n = 94}	Percentage {%}
Falls	24	25.53%
Sports-related	50	53.19%
Trauma	14	14.89%
Others	6	6.38%

Table 3: Fracture type classification.

Items	Children {n = 94}	Percentage {%}
Supracondylar	43	45.74%
Lateral condyle	31	32.98%
Medial epicondyle	20	21.28%

Table 4: Laterality fractures.

Laterality	Children {n = 94}	Percentage {%}
Right	58	61.7%
Left	36	38.3%

In surgical outcomes, we divided children with fractures into two groups, where 47 children undergone open reduction procedure, closed reduction, and percutaneous pinning procedure (47). In according to open reduction, the open reduction procedure was a longer time with 84.34 ± 9.57 minutes, ICU admission got 0 cases, the length of stay in the hospital had longer with 1 – 3 days, pain scores was 6.6 ± 1.7, and 57.45% of children had satisfied. Based on the closed reduction and percutaneous pinning procedure, the closed reduction and percutaneous pinning procedure was a shorter time with 35.11 ± 4.91 minutes, ICU admission got 0 cases, length of stay in hospital had longer with 0.9 ± 0.1 days, pain scores was 3.2 ± 0.6, and 76.60% children had satisfied.

Table 5: Surgical outcomes.

	Open reduction {n = 47}		Closed reduction and percutaneous pinning {n = 47}	
Variables	**N**	**%**	**N**	**%**
Surgical time, min	84.34 ± 9.57		35.11 ± 4.91	
ICU admission	0	0%	0	0%
Length of stay in hospital, days	2.7 ± 0.1		0.9 ± 0.1	
Pain scores	6.6 ± 1.7		3.2 ± 0.6	
Satisfaction rate				
Excellent	27	57.45%	36	76.60%
Moderate	13	27.66%	9	19.15%
Poor	7	14.89%	2	4.26%

In comparison between open reduction and closed reduction and percutaneous pinning procedures, this study showed that 12.77% of complications were in the open reduction group, while 6.38% of complications were in the closed reduction and percutaneous pinning group, where most items complications were common in our outcomes, including infection, delayed healing, and lateral spurs.

Table 6: Postoperative complications.

Complications	Open reduction {n = 47}		Closed reduction and percutaneous pinning {n = 47}	
	N	**%**	**N**	**%**
Infection	1	2.13%	1	2.13%
Postoperative bleeding	0	0%	0	0%
Delayed healing	2	4.26%	2	4.26%
Avascular necrosis	0	0%	0	0%
Nonunion	1	2.13%	0	0%

Fishtail deformity	1	2.13%	0	0%
Lateral spurs	2	2.13%	0	0%
Total	**7**	**12.77%**	**3**	**6.38%**

Table 7: Determining risk factors of fracture in post-procedure intervention.

Univariate analysis	**OR {CI 95%}**		
	Open reduction	**Closed reduction and percutaneous pinning**	**P – value**
Illness-related {Obesity}	2.4 {1.1 – 3.5}	1.8 {1.0 – 3.7}	0.042
Fractures severity {II}	2.0 {0.7 – 3.0}	2.5 {2.0 – 2.8}	0.066
Cause {Sports-related}	1.7 {1.3 – 2.6}	1.4 {1.1 – 2.0}	0.058
Fracture type {Supracondylar}	3.2 {2.5 – 4.0}	2.7 {1.7 – 3.5}	0.064
Laterality fractures {Both}	2.4 {1.6 – 2.9}	2.3 {2.0 – 2.9}	0.025
Surgical parameters {Length of stay in hospital, Surgical time}	2.9 {2.0 – 3.8}	1.3 {0.2 – 5.0}	0.071
Postoperative complications {Infection, Delayed healing}	2.5 – {2.4 – 3.0}	2.0 {1.3 – 4.8}	0.032

In the evaluation of mobility performance, it is observed that almost of 78.72% of the closed reduction and percutaneous pinning group had the perfect performance of mobility, while 51.06% of the open reduction group had mobility recover.

Table 8: Assessment of functional recovery of patients' mobility after surgical intervention.

Mayo Elbow Performance Scores	**Open reduction**	**Closed reduction and percutaneous pinning**
Excellent, {100}	24 {51.06%}	37 {78.72%}
Good {70 – 100}	13 {27.66%}	6 {12.77%}
Moderate, {50 – 70}	6 {12.77%}	2 {4.26%}
Poor, < 50	4 {8.51%}	2 {4.26%}

Table 9: Assessment of health quality of life questionnaire (SF-36) in patients after surgical intervention.

Items	**Open reduction**	**Closed reduction and percutaneous pinning**
Physical function	73.4 ± 9.4	87.5 ± 6.6
Psychological function	74.66 ± 4.6	85.4 ± 6.0
Social and emotional function	71.10 ± 7.7	80.3 ± 4.0
Daily activity	68.3 ± 6.3	77.3 ± 5.9

Discussion

Children's elbow fractures are serious injuries that may affect their quality of life and long-term functioning ***[9].*** The majority of the 94 children in our study (51.06%) were between the ages of 11 and 14, which is consistent with previous studies ***[10,11,12,13]*** showing that older children are more prone to elbow fractures as a result of greater physical activity and sports engagement. Our study's gender distribution revealed a greater frequency in Boys (68.09%), which is in line with other research ***[14]*** showing that boys sustain injuries from sports-related activities more frequently than girls. According to the body mass index (BMI) research, 40.43% of the kids were obese. Because being overweight can lead to falls and more strain on the elbow joint, this conclusion is consistent

with American research ***[15]*** that found a link between obesity and increased fracture rates. According to our findings, falls accounted for 25.53% of cases, while sports-related injuries accounted for 53.19%. Sports are a major source of elbow fractures in children, especially when it comes to activities that require falling or using the arms to break a fall, according to a German study that supports this result ***[16].*** The most often found fracture type was supracondylar (45.74%), which was followed by medial epicondyle (21.28%) and lateral condyle (32.98%). This distribution is consistent with Asian research ***[17,18,19]*** that shows supracondylar fractures to be the most common form of elbow injuries in children. The prevalence of right-sided fractures (61.7%) in our study is likewise in line with other data, which may indicate a bias associated with children's handedness. We separated the kids into two groups for surgical management: open reduction and closed reduction with percutaneous pinning. According to our findings, the open reduction group underwent surgery for 84.34 minutes, while the closed reduction group underwent surgery for 35.11 minutes. In our study, the open reduction group experienced a complication rate of 12.77%, whereas the closed reduction group saw a complication rate of 6.38%. These results are consistent with a British study ***[20]*** that shows open reduction is linked to increased incidence of complications, such as delayed healing and infection. In particular, our investigation identified nonunion and lateral spurs, which have been reported as possible consequences of surgical treatment for juvenile elbow fractures. According to functional results measured by the Mayo Elbow Performance Score, children in the closed reduction group had good mobility in 78.72% of cases, whereas those in the open reduction group had great mobility in 51.06% of cases. These data demonstrate how crucial surgical technique is in affecting recovery outcomes, which is in line with research that indicates less intrusive procedures typically provide better functional outcomes ***[21,22,23].*** Children who had closed reduction also showed markedly improved physical and psychological functioning, according to quality of life evaluations using the SF-36 questionnaire. This is consistent with findings from recent studies ***[24,25]*** that highlight the importance of minimally invasive techniques in improving pediatric patients' overall quality of life and postoperative recovery.

Conclusion

The current study demonstrated that closed reduction and percutaneous pinning result in better recovery for pediatric patients compared to open reduction. However, open reduction also demonstrated improvements in functional recovery and movement in pediatric patients. Furthermore, our results showed a 6.38% reduction in complications after closed reduction and percutaneous pinning compared to 31.91% after open reduction. Our study indicated the impact of risk factors on patients' long-term quality of life, with obesity, fracture type, surgical duration, complications, and fracture severity being the most prominent risk factors.

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