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Health Outcomes of Elbow Fractures in Iraqi Children and Assessment of Risk Factors

***Dr. Ziad Tariq Ibraheem Aljameel*[1], *Dr. Ahmed Ghanim Mohsin*[2] *and Dr. Husham Abdulhameed Majeed*[3]**

[1]*M.B.Ch.B., C.A.B.M.S.\ (Orthopedic), Iraqi Ministry of Health, Baghdad Al-Karkh Health Directorate, Al-Mahmudiya General Hospital, Baghdad, Iraq.*

[2]*M.B.Ch.B., C.A.B.M.S.\ (Orthopedic), Iraqi Ministry of Health, Baghdad Al-Karkh Health Directorate, Al-Mahmudiya General Hospital, Baghdad, Iraq.*

[3]*M.B.Ch.B., F.I.B.M.S.\ (Orthopedic), Iraqi Ministry of Health, Baghdad Al-Karkh Health Directorate, Al-Mahmudiya General Hospital, Baghdad, Iraq.*

Abstract: An elbow fracture, which is usually as a result of falls or sports, is the most prevalent orthopedic injury in children. This research paper set out to assess the health-related outcomes of pediatric elbow fractures, including short-term and long-term outcomes and functional outcomes. It also aimed at determining risk factors, which are demographic, injury-specific, and treatment-related, resulting in adverse outcomes. It was a cross-sectional study and examined the medical records of children who had fractured their elbows. All data of 110 patients was documented both pre- and post-treatment, incorporating the morphology of the fractures and the complications. The functional outcomes are measured in short-term who less than 12 weeks, and long-term who more than 12 months. The most commonly used injury mechanism was falls from height (70%). In 60% of cases, they were treated conservatively. Short-term effects were nerve palsy (10%) and vascular compromise (4.5%). At the long-term evaluation, 80 % of the patients were completely recovered, 10 % reported some stiffness, 5.5% malunion, and 4.5 % nonunion. High-energy trauma (OR 2.8, p=0.004), postponing treatment longer than 48h (OR 3.2, p=0.001), and open fracture (OR 4.1, p=0.001) were significant risk factors of poor outcomes. The rate of great results was diverse among fractures. The fractures of the medial epicondyle reported the most excellent recovery of 80. The most prevalent type of pediatric elbow fracture, particularly in school-aged boys, is that of the supracondylar. Even though a significant proportion of patients do not die, there are risk factors such as high-energy trauma, delayed treatment, and open fractures that pose a significant risk to the occurrence of complications.

Keywords: Elbow fractures of children, complications, outcomes, function, and risk factors.

INTRODUCTION

Elbow fractures form a type of pediatric injury, which has an incidence of approximately 15% of all fractures in children [Sinikumpu, J. J. *et al*., 2013]. The growing elbow is characterised by secondary ossification centres, multiple growth plates, and complicated articular surfaces, which cause diagnostic issues and risk of functional impairment in the long run [Pilla, N. I. *et al*., 2020]. Fractures are particularly dangerous to the anatomy of the elbow, despite the remarkable ability of children, and this causes more complications than most childhood injuries [Lieber, J. *et al*., 2012; Rasool, M. N. 2004]. These complications are mild and cosmetic deformity to severe, life-changing conditions, such as neurovascular injury, malunion, post-traumatic osteoarthritis, and the devastating Volkmann ischemic contracture. Therefore, the management of a pediatric elbow fracture is more than just attaining bone union; it is a long-term, cautious process with functional recovery and a pain-free joint that enables daily activities, learning, and play [Kirkos, J. M. *et al*., 2003; Murphy, R. F. *et al*., 2017; Lawrence, J. T. R. *et al*., 2013].

Prolonged immobilization, intra-articular trauma, or scarring of the capsule widely causes rigidity, particularly loss of extension [Pring, M. E. 2012]. One of the well-known emergency complications of supracondylar fracture of the humerus is neurovascular compromise, in particular, of the anterior interosseous nerve or the brachial artery [Reed, M. W., & Reed, D. N. 2012]. The long-term outcome that may be most worrying is the angular deformity, i.e., cubitus varus or the gunstock deformity. Although they may be purely aesthetic, they may provoke secondary functional issues, such as ulnar nerve irritation and instability of a joint [Hughes, M. *et al*., 2019].

It is possible to divide risk factors into various groups: patient factors, injury, and treatment factors. Young children remodel better, whereas teenagers are almost at skeletal maturity, and their pattern of fracture is like that of adults, hence less tolerant of displacement [Pathy, R., & Dodwell, E. R. 2015]. In addition, fracture type and displacement extent, nondisplaced lateral condyle fracture, or severely displaced supracondylar fracture with posteromedial displacement, or

***Corresponding Author:** Dr. Ziad Tariq Ibraheem Aljameel

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Monteggia fracture are also significant in prognosis [Gottschalk, H. P. *et al*., 2012].

Decisions on treatment are powerful risk factors that need to be modified. Clinicians are able to control the timing of intervention, the accuracy of reduced or open reduction, fixation stability, and the duration as well as location of postoperative immobilization, which directly influence outcomes [Duffy, S. *et al*., 2021]. Recovery patterns have also not received much appreciation due to the socioeconomic determinants, which include access to specialist care and rehabilitation resources [Gausepohl, T. *et al*., 2007]. In this study, the researcher tries to assess the health outcomes of pediatric elbow fractures in a comprehensive manner, which will give a rigorous analysis of the combined risk factors.

Samples Collection

A cross-sectional study was performed in health outcomes of patients with elbow fractures. The primary goal was to establish the health outcomes of epidemiology, treatment, the spectrum of complications, and long-term functional prognoses of these common injuries. The inclusion criteria were all age subjects aged 2-16 years who had an acute and traumatic fracture of the distal humerus, proximal radius, or proximal referred to as an elbow fracture, and a full medical history, and at least 12 months follow-up. Potential criteria were also the pathological fractures, comorbid major polytrauma, and pre-existing neuromuscular disorders of the upper extremity.

The demographic features was grouped as low-energy (simple falls off standing height) and high-energy (falls off height, motor-vehicle collisions, sports-related injury) in age, sex, and mechanism of injury. The modes of treatment were categorized as conservative (casting or splinting), closed reduction and percutaneous pinning (CRPP), or open surgical fixation. Time-to-treatment intervals were documented, particularly the more than 48-hour delay between the injury and the final treatment.

The short-term complications, which are complications that occur after six weeks of injury, were nerve paralysis that occurred because of trauma-related vascular compromise, and surgical site infection. Long-term outcomes were appraised using clinical examination and tested functional scoring systems during a 12–month follow–up of the injury. The primary functional measure that was made of the results was the modified Flynn criteria, whose results were categorized as Excellent, Good, Fair, and Poor according to the cosmetic carrying -angle loss and range-of-motion losses .

The statistical analysis was done using the SPSS software (version 25.0). The descriptive statistics provided the overview of the patient demographics, fracture types, and treatment regimes. Categorical variables were represented by frequencies and %ages, and means with standard deviations or medians with interquartile ranges were perceived as a summary of continuous variables based on the distribution. A univariate p -value of less than 0.10 was used to include variables in a multivariate logistic regression model, from which the adjusted odds ratios (ORs) and 95 % confidence intervals (CIs) were obtained, hence, adjusting against possible confounders. In the final model that was used, a p -value of less than 0.05 was taken to indicate a statistically significant value.

RESULTS

Table 1: Distribution the demographic features of patients based on age and gender.

Variable	Number (n=110)	%age (%)
Age Groups		
<5 years	22	20.0%
5–10 years	55	50.0%
>10 years	33	30.0%
Gender		
Male	66	60.0%
Female	44	40.0%

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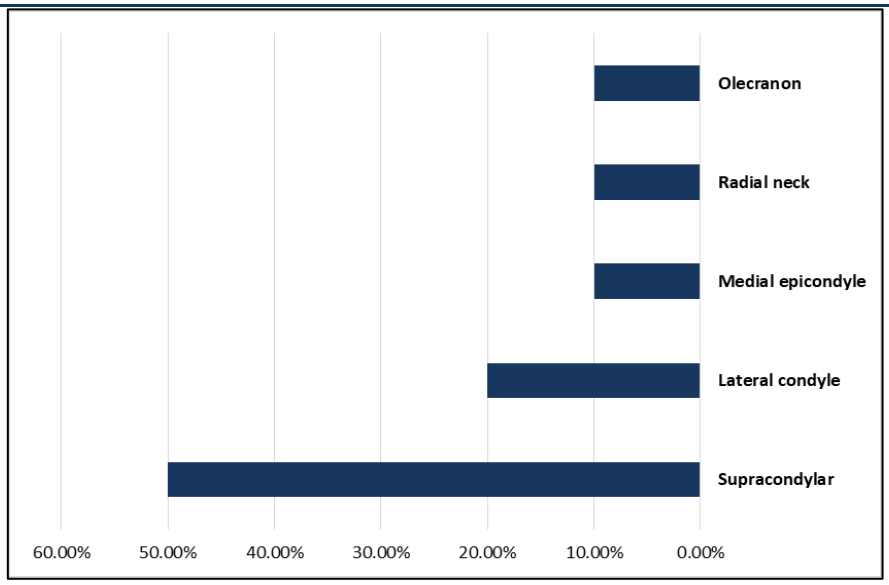

Figure 1: Classification of the types of elbow fracture in the 110 patients.

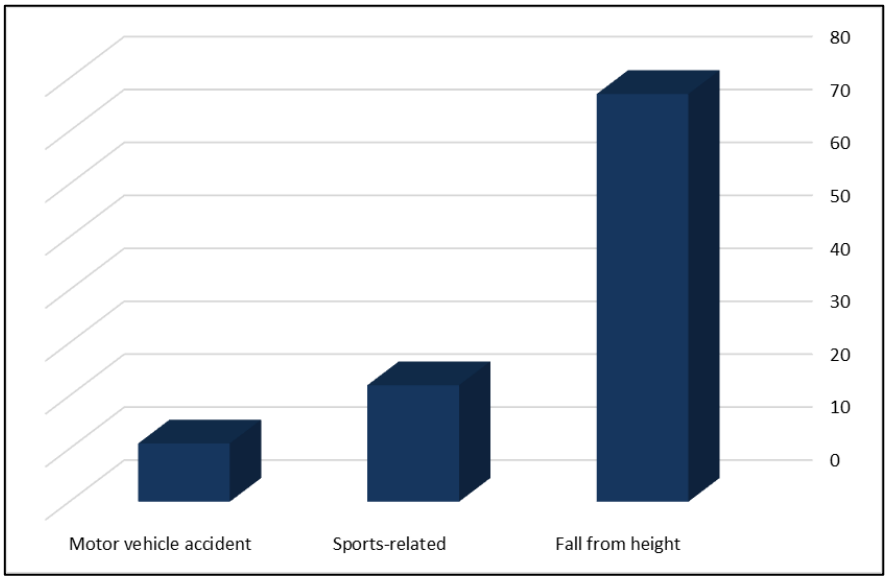

Figure 2: Determining the causes of elbow fracture injury.

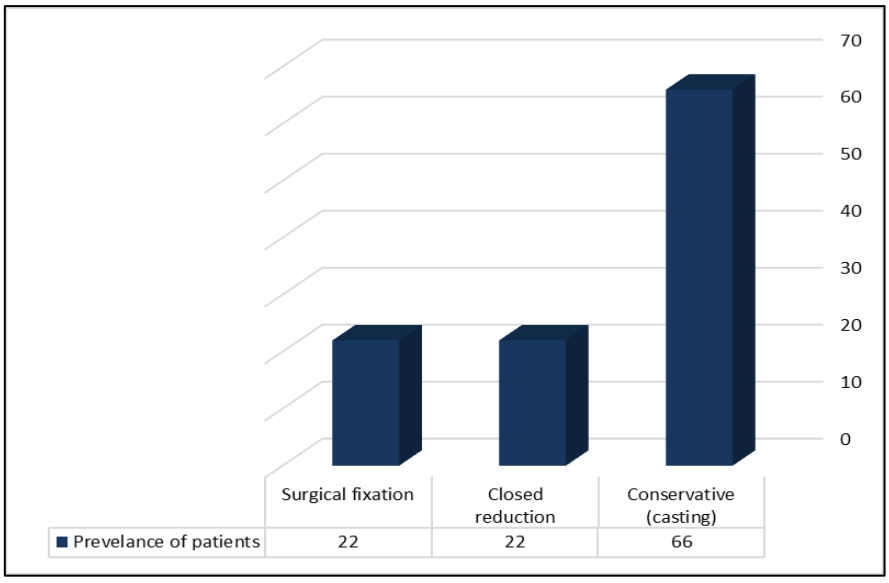

Figure 3: Identifying the main types of treatments performed in the patients.

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Table 2: Post–treatment complications in the short–term period after 7 weeks.

Complications	**Number (n=110)**	**%age (%)**
Nerve palsy	11	10.0%
Vascular compromise	5	4.5%
Infection	3	2.7%
Total	19	17.2%

Table 3:- Post – intervention complications in long – term after 12 months.

Long – term outcome	Number (n=110)	%age (%)
Full recovery	88	80.0%
Stiffness	11	10.0%
Malunion	6	5.5%
Nonunion	5	4.5%

Table 4: Assessment of risk factors in the prediction of poor outcomes of patients.

Risk Factor	OR (95% CI)	p-value
High-energy trauma	2.8 (1.4–5.6)	0.004
Delayed treatment (>48h)	3.2 (1.6–6.3)	0.001
Open fracture	4.1 (2.0–8.4)	<0.001

Table 5: Post-treatment functional outcomes assessment according to fracture type.

Fracture Type	Excellent (%)	Good (%)	Fair/Poor (%)
Supracondylar	70%	20%	10%
Lateral condyle	60%	30%	10%
Medial epicondyle	80%	15%	5%

DISCUSSION

Management of pediatric elbow fractures remains to be one of the most problematic issues of the orthopedic practice because the anatomy is complex, the developmental disturbances that could be present are enormous, and the functional demands of the upper extremity in children are enormous. We have an age distribution of demographic with high incidence of the age group of 5-10 years (50 %) and a high proportion of males (60 %) which is consistent with some studies conducted in the United States [Schmittenbecher, P. P. *et al*., 2005] which reported an age group of boys of 5-10 years and high energy play to be more prone to risky behaviors [Sofu, H. *et al*., 2016]. The supracondylar fractures dominate (50), which is a fact which can be attributed by the relative weakness of the thin supracondylar part of the immature humerus during a fall on an outstretched hand. The reason is that the height (the most frequent injury mechanism) constituted 70 % of the total number of falls [Schwab, G. H. *et al*., 1980].

Conservative casting was the first type of treatment; it was sufficient in 60 % of the cases, typically of non-displaced or minimally displaced fractures. The current normal practice of using equal measures of closed reduction and surgical fixation (20% each) in more complicated wounds is due to the goal of achieving an anatomical restoration to prevent permanent complications. The reported cases of the short-term complications are low (nerve palsy, 10 %, and infection, 2.7 %) as compared to a study in Japan [Marson, B. A. *et al*., 2022], meaning that it was performed with a successful surgical procedure and further treatment. At 10 %, transient nerve palsy is recognized as a risk factor that is associated with supracondylar fracture and is self-limiting [Hopf, J. C. *et al*., 2015].

In addition, 80 % of the patients received complete recovery. However, the 20 % who have residual issues (stiffness 10 %, malunion 5.5 %, nonunion 4.5 %) show that a big majority of patients experience permanent morbidity. Also, as well as, medial epicondylar fracture recorded the highest %age of excellent results (80%), supracondylar fracture and lateral condylar fracture recorded higher %age of fair/poor results (10% and 10% respectively). These latter types of fractures are particularly vulnerable to stiffness, avascular necrosis, and cubitus varus/valgus deformities [Wilmshurst, A. D. *et al*., 1989; Fowles, J. V. *et al*., 1990, Di Gennaro, G. L. *et al*., 2013; Kaziz, H. *et al*., 2016].

Additionally, in our analysis, high-energy trauma (OR=2.8) was identified with an increasing degree of the transfer of kinetic energy, resulting in a

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greater degree of soft-tissue and bony injuries. Delay in timeliness can lead to swelling, reduction issues, compartment syndrome, and stiffness. Further, open fracture (OR=4.1) revealed that both bony injury and contamination have a two-fold risk wherein infection, absence of union, and the undermining of soft tissues happen.

CONCLUSION

The reported results show that most of the patients are reported to have good long-term outcomes, and 80 per cent of them are reported to be full of health. Spracondylar fractures and height falls are the most common injuries and cause of falling, respectively. The other predictors of poor results, which were identified during the study, are crucial and changeable ones. Malunion, stiffness, and nonunion are all independent risk factors of open fractures, greater than 48 hours' delay of treatment, and high-energy mechanisms. Among the findings, there is one clinical imperative that is obvious, and it consists in high-risk injuries that need to be treated immediately in a vigorous manner.

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