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RESEARCH ARTICLE

EPIDEMIOLOGICAL PATTERN OF SUPRACONDYLAR FRACTURES IN PEDIATRIC AGE GROUPS AT TERTIARY CARE HOSPITAL BKMC SWABI

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Abstract

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Background: Supracondylar fractures are common among pediatric patients and often necessitate surgical intervention. Understanding the demographics, fracture types, and management approaches is crucial for optimizing patient outcomes. This study aimed to contribute to the existing body of knowledge by investigating various epidemiological factors and treatments for supracondylar fractures in pediatric patients.

Methods: A cross-sectional study was conducted on pediatric patients with supracondylar fractures presenting to MTI-BKMC Swabi Pakistan, focusing on demographic data, fracture classifications, management strategies, and treatment outcomes. The study utilized data from patient records and imaging reports.

Results: Among the 155 pediatric patients, thefindings indicate that the majority of supracondylar fractures occurred in patients aged 4-6 years, with a predominance of right-handed individuals. Extension-type fractures were most prevalent, and the Gartland-type distribution of these fractures closely mirrored previous research. The management of these fractures predominantly involved closed reduction and percutaneous pinning, aligning with established treatment modalities. Notably, the present study revealed a greater incidence of open fractures than was typically reported, and the influence of delayed treatment on long-term complication rates differed from that of previous studies.

Conclusion: This study provides valuable insights into the demographic characteristics, fracture types, and management approaches for pediatric supracondylar fractures. While the findings are informative, the study is not without limitations, including its single-center nature and relatively small sample size. Further research encompassing larger and more diverse cohorts is warranted to enhance the generalizability and robustness of the results.

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Introduction:-

Supracondylar fractures are upper arm fractures that occur through the thin part of the distal humerus above the level of the growth plate. These fractures are commonly classified into four types based on the Gartland classification of supracondylar fractures (Table 1). These fractures are mainly classified as displaced or un-displaced fractures. In displaced supracondylar fractures, which are also called Gartland types III and IV, the metaphyseal fracture line of the distal humerus passes through both the medial and lateral condyles of the humerus without involving the intercondylar region.[1] In undisplaced fractures, also known as Gartland types I and II, there are two subtypes. In IIA, there is angulation, while in type IIb, there is angulation with rotation. [2, 3]

Supracondylar fractures account for 12–17% of pediatric age group fractures and require surgical intervention; otherwise, they may result in vascular compromise (10–20% of displaced supracondylar fractures), compartment syndrome, and vascular injury if not corrected on time. [4, 5] The immediate and late complications (compartment syndrome, vascular compromise, ~~i.e.,~~ ulnar nerve injury 6, angular deformity, malunion, and vicious consolidation) that arise are due to anatomical aspects and fracture fragment disparity. [7, 8]

Extension injuries account for 95% of cases, while flexion injuries account for 2–5%. [4] In 70% of cases, supracondylar fractures are most commonly caused by falling from heights while an arm is extended or by bicycle accidents; however, specific mechanisms have not yet been described. [3, 8.]

The mean age group of patients with these types of fractures was 5–6 years old. 9 The incidence between males and females varies within the literature. Many studies have shown a greater incidence of SCF in males, while others have reported a greater incidence in females. [9.] The left arm is more frequently injured than the right arm. [9.] The incidence of these fractures decreases with age due to skeletal maturation until the patients are 15 years old, at which time the injuries to the arm tend to present with an adult pattern. [5, 10]

The treatment options are either close or open reduction with or without k-wire fixation and immobilization, depending upon the vascular status and surrounding soft tissue inflammation.[6, 11] Treatment with close reduction and plastic immobilization was moderately discontinued over time due to frequent complications such as loss of reduction and compartment syndrome. [7] Supracondylar fractures are usually managed on the day of admission and result in after-hour surgeries, thus increasing the risk of complications for patients due to a non-specialized team, fatigue, etc. [10] In recent articles, additional complications have been reported in after-hour surgeries. [10] There is no consensus on the management of pediatric supracondylar fractures, as they are managed according to the individual surgeon's predilection. [12]

This study was conducted to determine the epidemiological factors contributing to supracondylar fractures and their management at the orthopedic department of the tertiary care hospital MTI-BKMC, Swabi, Khyber Pakhtunkhwa.

Table 1:- Gartland classification of Supracondylar fractures.

Type 1	Non displaced or minimally displaced
Type 2	Extension displacement , posterior cortical contact with intact posterior hinge II-A: no displacement in cortical plane II-B: rotational displacement in or angulation in coronal plane
Type 3	Complete displacement, no meaningful cortical contact
Type 4	Multidirectional instability, incompetent periosteal hinge circumferentially defined by instability in both flextime and extension during reduction attempt under fluoroscopy

Rationale

The purpose of this study was to determine the prevalence of various epidemiological factors among pediatric patients with supracondylar fractures and the most common methods of management taken at the tertiary care hospital.

Methodology:-
Objectives:-
Based on the literature, the following objectives were developed:
1. To determine which pediatric age groups had a higher frequency of supracondylar fractures
2. To determine which grade of fracture occurred most frequently according to the Gartland classification
3. To determine whether medical or surgical intervention was more commonly employed for the management of fractures
4. To determine whether open or closed fractures were common and how often the skin was intact in areas over the supracondylar fracture
5. To determine the frequency of patients with supracondylar fractures who also sustained another injury in addition to the supracondylar fracture.
6. To determine whether post-reduction complications were greater in closed fractures than in open fractures and whether delayed presentation was associated with a worse rate of complications.
7. To determine whether follow-up rate was greater in patients with open or closed fractures.

Operational definitions
A supracondylar fracture is a fracture of the distal part of the humerus just above the growth plate.
Pediatric patient: <15 years of age
ORIF:open reduction internal fixation
CCRP:closed reduction and percutaneous pin fixation

Hypothesis
Based on the most recent literature, it is hypothesized that the percentage of patients who present with supracondylar fractures of extension types will be greater than that of patients who present with flexion-type fractures. We either accept the above-mentioned hypothesis, which is our null hypothesis, or reject the null hypothesis and accept the alternate hypothesis, which states that both are equal.

Methods and Materials:-
This cross-sectional study was conducted in the orthopedic department of a tertiary care hospital, MTI-Bacha Khan Medical Complex, Swabi, Pakistan. This study was approved by the Ethical Committee at MTI-BKMC (RTMC No. SGR-2023-312-14822). The data was gathered from pediatric patients presenting to the orthopedic department from January 8th, 2024, to February 8th, 2024. The sample size for this study was calculated to be 155 patients. Consent was obtained from the patients, and the proformas were filled out by the doctor on duty. The data collected from the proformas was compiled in Microsoft Excel (version 16.0, 2016), where it was analyzed.

Study Design
Cross-sectional study

Setting
Department of Orthopedics at MTI-BKMC Swabi Khyber Pakhtunkhwa, Pakistan.

Study duration
One month duration from January 8th until February 8th 2024.

Sample size
155 Patients

Sampling technique
This study employed a nonprobability sampling technique.

Data Collection Method:-
Proformas were filled out by doctors in the orthopedic department during the study time frame.

Inclusion Criteria
1. Both Genders.

2. Patient age: 15 years and younger.
3. With pre- and post-reduction X-rays.

Exclusion Criteria
1. Having past history of elbow operations.
2. Bilateral supracondylar humerus fractures.

Results:-

Figure 1:- Age Distribution.

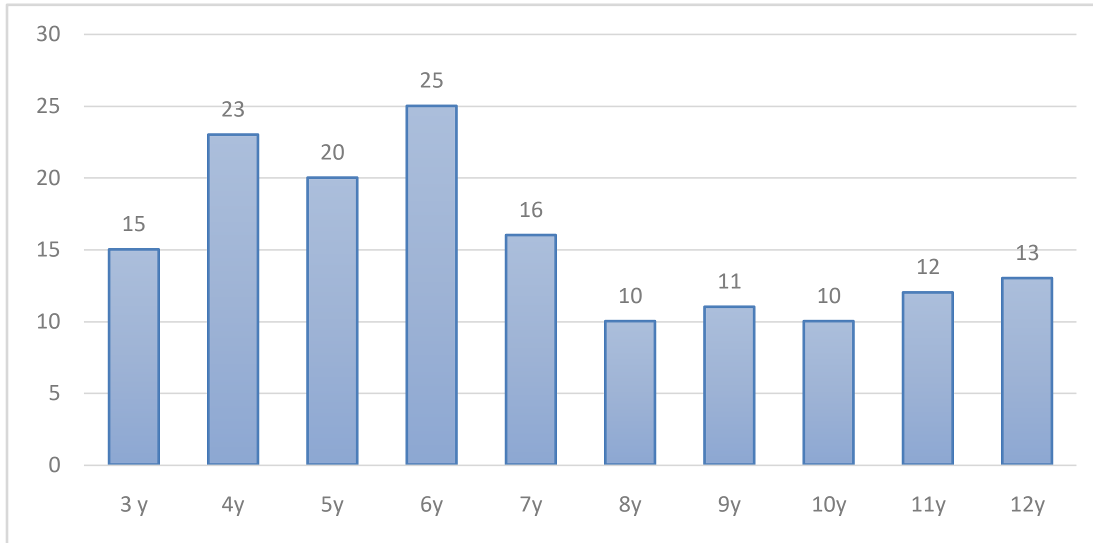
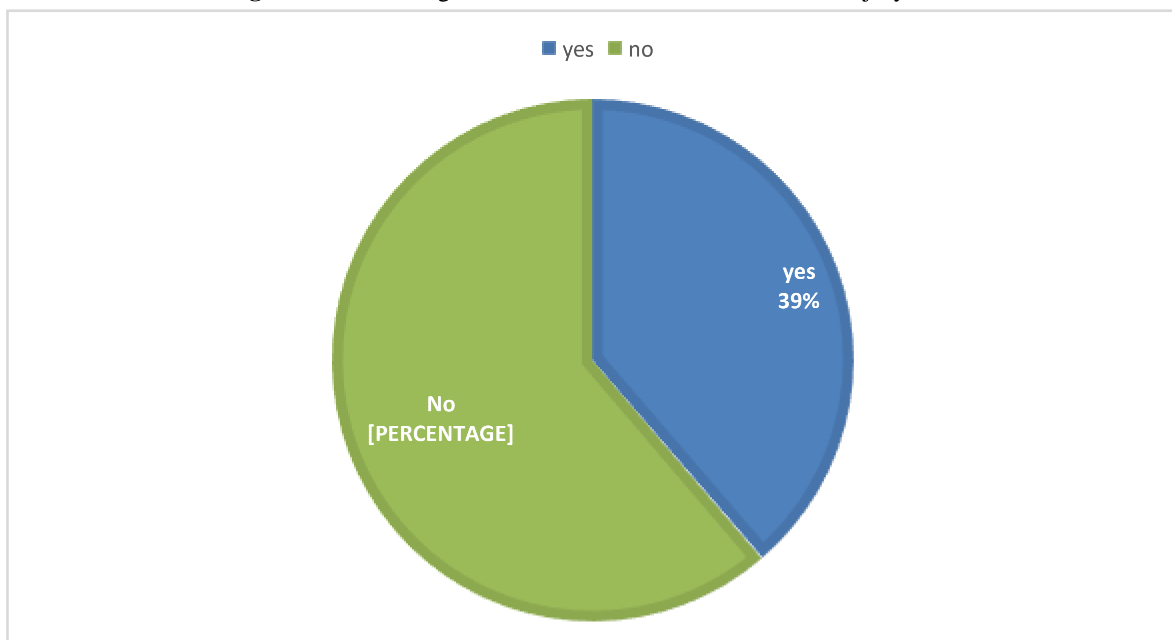


Table 2:- Extremity Affected.

Extremity	Number of patients
Right arm	68
Left arm	62
Both	25

Figure 2:- Percentage of Patients Who Also Had another Injury.



All 155 patients were aged 3–12 years. The mean age was 6.88 years, and the median age was 6 years. The majority of the patients presented with extension-type supracondylar fractures (83.87% of our study population); the remaining patients had flexion-type fractures. In our study, the dominant hand was involved in 43.87% of patients, and the non-dominant hand was involved in 40% of the patients, while the remaining patients had bilateral cases as shown in Table 2. Figure 3 shows that the skin integrity was intact in 90% of the patients and breached in the remaining 10%. Among the patients, 30% had Gartland type III 28% had type I, 24% had type III, and 18% had type IV, as shown in Table 3. The majority of the patients were surgically managed (83.87%), and the remaining 16.12% were conservatively managed (Table 4). Isolated supracondylar fractures were observed in 61.29% of the cases, and concomitant injuries to other areas were observed in 38.7% of the cases (Figure 2). Surgical intervention in the form of CRPP was performed in 78.4% of patients, and the remaining 21.5% of patients were managed by ORIF (Figure 4). The frequency of comparative post-reduction complications was greater in the close reduction group (63.2%) than in the open reduction group (8.38%) (Table 6). When such patients were observed for long-term follow-up, the rate of follow-up was greater among patients in the open reduction group (70.9%) than in the close reduction group (22.58%) (Table 7). The functional outcomes of those who presented to the hospital 24 hours after the incident were satisfactory in 88.3% of the cases, and in the remaining cases, they were poor. (Table 6a).

Table 3:-Type of Fractures based on Gartland Classification.

Type	Number of patients	Percentage
Type I	43	28
Type II	37	24
Type III	47	30
Type IV	28	18

Table 4:- Type of Intervention Taken for Management of Supracondylar Fractures.

Intervention type	Number of Patients
Surgical	130
Conservative	25

Figure 3:- Open Vs Closed fractures.

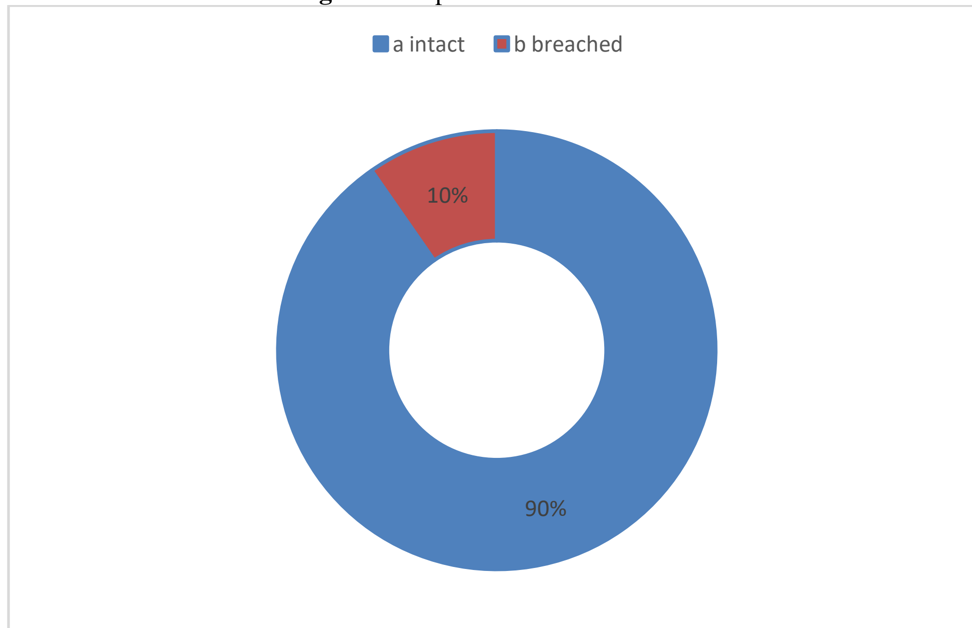


Figure 4:- Frequency of ORIF vs CRPP in Surgical Intervention for Management of Supracondylar Fractures.

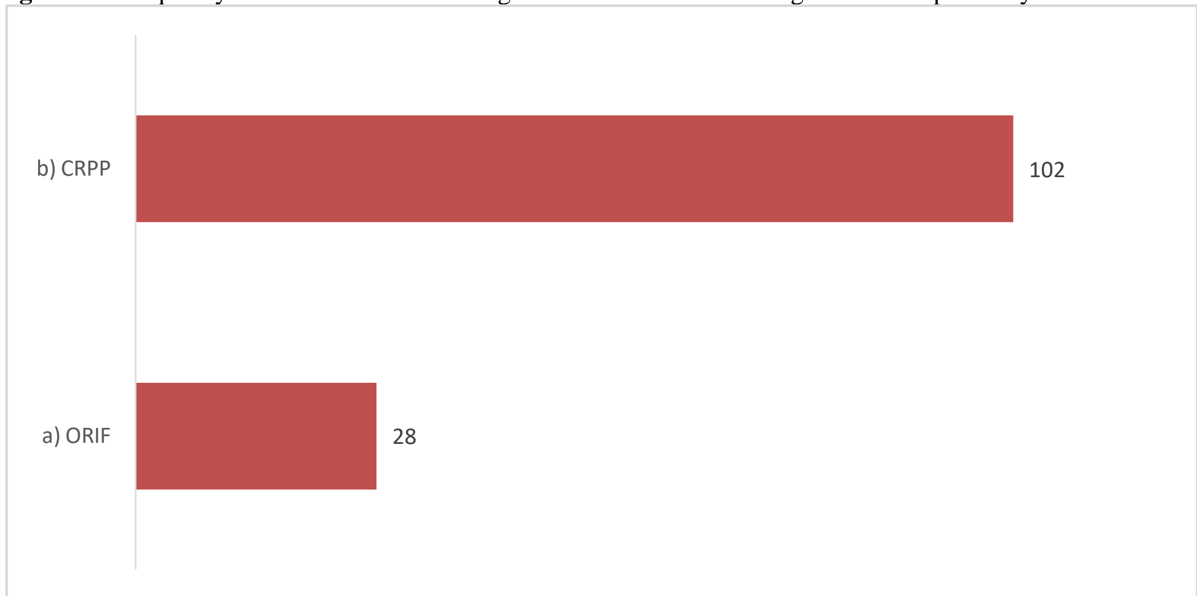


Table 6:- Frequency of Post-Reduction Complication after Close Vs Open Reduction.

Open Reduction	13
Close Reduction	98
Same result in both close and open	44

Table 6a:- Functional Outcomes in Patients with Delayed Presentation (>24 hours after injury).

Outcomes were the same as an early presentation	137
Outcomes were unsatisfactory	18

Table 7:- Frequency of Long-Term Follow-up after Close Vs Open Reduction Procedure.

Open Reduction	110
Close Reduction	35
Same in both	10

Discussion:-

In our study, the majority of the patients were aged 4-6 years, which aligns with the findings of similar research conducted in the Chinese Journal of Traumatology. [13] In our study, the majority of the patients affected were right-handed (43.87%), which contradicts the findings of many studies in which the non-dominant hand (left) was mostly involved. A study conducted at Korle Bu Teaching Hospital revealed that dominant hand (right) injuries accounted for 62.4% of the patients,[14] and similarly, 64.89% of patients in a study conducted in a pediatric trauma center [15]. Our study revealed that the extension type of fractures was more prevalent (83.87%) than the flexion type of fractures. This finding is consistent with the results of previous studies in which 96% of all patients had the extension type and another in a pediatric trauma center in which 89.32% had an extension type of fracture .[14, 15]In our study, the relative percentages of different Gartland fracture types were as follows: Type I, 28%; Type II, 24%; Type III, 30%; and Type IV, 18%. This distribution closely resembles the findings observed in a similar study at Korle Bu Hospital, in which the relative percentages were as follows: Type I, 31.7%; Type II, 24.7%; and Type III, 43.6%. However, no data was found on Type IV in the study.[14] In our study, the management strategies included CRPP (78.4% of cases) and ORIF (21.5% of cases), demonstrating similarities to treatment modalities observed in previous papers in which 47% of cases were managed by CRPP and 53% of cases by ORIF.[16]This same study found that during follow-ups for subsequent complications, in the long run, only 5% of overall patients developed complications, 33.33% of which were from group A and 66.66% from group B [16] .In our study, subsequent complications among the close reduction group were more common, and long-term follow-up among the open reduction group was more common. Interestingly, we observed a greater percentage of open fractures (10%) than was typically reported (1%), indicating a deviation from the norm.[17] Our study showed that delayed treatment did

not significantly influence long term complication rates, which coincides with the results of a study conducted on 137 patients. That study followed patients who underwent surgery 48 hours after presentation and were followed for 5 months. The results were excellent in 52.8% of the patients, good in 18%, fair in 12.4%, and poor in 15.7% of the patients.[18]These findings were markedly close to 88.38% satisfactory results and 11.61% unsatisfactory results in our study.

Limitations

It is important to note that this study has several limitations. First, the study was conducted at a single hospital, which may limit the generalizability of the findings to other healthcare settings. Second, the sample size in our study was relatively small, which could potentially affect the statistical power and generalizability of the results. Third, the study focused on a specific population (pediatric patients with supracondylar fractures); therefore, caution should be exercised when these findings are applied to other patient populations or types of fractures. Overall, while our study provides valuable insights into the management and outcomes of supracondylar fractures, further research with larger sample sizes and diverse populations is needed to strengthen the validity and generalizability of the findings.

Conflict of interest

There are no conflicts of interest to state.

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Performa

1. Name: ---------------
2. Age: -------------------
3. Gender: ---------------
4 Date: -----------------
5 MR. Number: --------
6 Type of Supracondylar Fracture: A) Extension type b) flexion type
7 Extremity affected by the supracondylar fracture
A) Right arm b) left arm c) both
8 Is there any associated injury to the other parts of the body? A) Yes b) no (isolated)
9 The fracture is multi fragmented or not: A) Multi fragmented b) not multi fragmented
10 Skin integrity at the time of presentation: A) Intact b) breached
11 Gartland Classification at the time of presentation
A) Type-I b) Type-II c) Type-III d) Type-IV
12 Type of fracture according to AO Classification
A) Type A b) Type B c) Type C d) None
13 Management of supracondylar fracture
A) Surgical intervention b) conservatively managed (non-surgical)
c) More with non-surgical intervention
14 Functional Outcome in Patients with delayed presentation i.e. after 24hrs
A) Same as that of early presentation b) unsatisfactory
15 Post reduction patients presented with complications is more in
A) Open Reduction b) Close Reduction c) Same
16 Long term Follow up is more in
A) Open reduction b) Close reduction c) same
17 Pateints being managed by
A) ORIF b) CRPP
18 Crossed K- wires Vs Unilateral CRPP