



St. Paul Hospital Millennium Medical College

Graduate Study Program

Functional outcome after Operative treatment of supracondylar fractures in children and factors associated with it at Addis Ababa Burn, Emergency and Trauma Hospital.

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Addis Ababa, Ethiopia



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Functional outcome after Operative treatment of supracondylar fractures in children and factors associated with it at Addis Ababa Burn, Emergency and Trauma Hospital, from 2018 to 2022 GC.

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Traumatology Surgery)**

A research thesis to be submitted to the department of orthopaedics and traumatology Surgery, St. Paul's Hospital Millennium Medical College; for the partial fulfillment of the requirement for specialty certificate in orthopedics and traumatology.

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Abstract

Introduction; Supracondylar fractures of the humerus are the most common type of elbow fracture in children and adolescents, and the most common fracture requiring surgery in children. These fractures need a precise treatment approach in order to obtain satisfactory result and to avoid complications. The purpose of our study is to determine the functional outcome of the surgical management of displaced Supracondylar fracture of humerus.

Methods- A retrospective health facility based cross sectional study was conducted among patients with supracondylar humerus fracture treated operatively at AABET hospital. Data was collected by reviewing medical records and OR log books. The study was conducted on a sample size of 109 all eligible patients were included. Descriptive statistics such as frequency and percentage were used to summarize the results; Binary logistic regression was used to describe the association between variables. P-value < 0.05 was considered statistically significant. Then multivariable analysis was done to identify most important factor.

Result- Of 109 patients 99(90.8%) were male with a mean age of 7.35 ± 2.888 years. Garland type III constitutes 89 %, type II 6.4% and IV 4.6%. About 69.7% managed by open reduction and 30.3 closed reductions under C-arm. Only lateral pins were applied for 81.7% and cross pinning for 18.3 %.over all 81.7% had satisfactory outcomes.83.5 % satisfactory cosmetic outcome and 89 % satisfactory range of motion outcome. Being massaged, delayed presentation to hospital and delayed surgery >10 days had strong association with unsatisfactory outcome. The most important factor being delayed surgery.

Conclusion- The functional outcome of supracondylar fractures is satisfactory and comparable to other similar studies. Delayed presentation to hospital, delayed surgery and being massaged had strong association with the outcome and the most determinant factor is delayed surgery more than 10 days.

Key words- supracondylar, fracture, children, management, outcome,

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Abbreviations

AaBET: – Addis Ababa burn, emergency and trauma

CRPP: - Closed reduction percutaneous pinning

Dr.: – Doctor

MD:-Medical doctor

PI: - Principal investigator

ORIF: - Open reduction internal fixation

SCH : - Supracondylar humerus

SPHMMC: - Saint Paul's Hospital Millennium Medical college

SPSS:-Statistical Package for service solution

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1. Introduction

1.1 Background of the study

Supracondylar humerus fractures are the most common fractures around the elbow in children between 4 and 10 years of age(1). SCH fracture is usually a transverse fracture at the level of olecranon fossa which is the weakest area where the medial and lateral columns of the distal humerus are connected by a thin segment of bone between the olecranon fossa posteriorly and coronoid fossa anteriorly, resulting in a high risk of fracture to this area(2). Supracondylar fractures of the humerus are the most common fracture around the elbow in children, comprising approximately 12–17% of all pediatrics fractures and 50 to 70 % of all elbow fractures. There are different classification systems, the fractures are broadly divided in two types: extension type (98%), where the distal fragment is displaced posteriorly as the elbow hyperextends and the olecranon is forced into the olecranon fossa, and flexion type (2%), where the olecranon acts as a fulcrum pushing the distal fragment anteriorly(3). In general, the Wilkins modification of the Gartland classification system is a useful guideline by which orthopaedic surgeons determine the management for extension-type supracondylar fractures(4). Type I non displaced, type IIA intact posterior cortex, hinged in extension no rotation or translation, type IIB intact posterior cortex, hinged in extension with some degree of rotation or translation, type III complete displacement and type IV multidirectional instability incompetent periosteal hinge circumferentially(4,5). There are different management options based on fracture grade and stability, type I and IIA non surgical immobilization for 3 weeks. Grade IIB and above operative management with different pinning techniques(2,4,5).

1.2 Statement of the problem

Supracondylar fractures of the humerus are the most common fracture around the elbow in children, comprising approximately 12–17% of all pediatrics fractures and two-thirds of all elbow fractures(2,3). In a study done in Senegal elbow fracture accounted for 30.79% of fractures of the child and came in second place after fractures of the femur (39.17%)(6). The long-term outcome of extension-type supracondylar humeral fractures is generally good, but not exclusively benign, with the potential for long-term pain and ulnar nerve sensitivity, and a decrease in grip strength and range of movement in type II and type III fractures. Bony remodelling cannot be relied upon to correct any residual deformity(7). SCH fractures are

associated with a high risk of short- and long-term complications, both from the injury and its treatment. It is therefore essential that this fracture is managed well, from early diagnosis and initial management in the emergency department to prompt decision making regarding the need for surgical intervention and, if required, correct surgical technique(3). A displaced supracondylar humerus fracture is the fracture in childhood that gives the most frequent and serious complications(8). A high degree of unsatisfactory outcome including malunion, and/or elbow stiffness have been observed by clinicians while reviewing patients with supracondylar fractures of the humerus(9). Despite being commonly encountered fractures at our institution there is no single study on outcomes SCH fractures.

1.3 Significance of the study

There is no study done on functional outcome assessment of pediatrics SCH fractures treated surgically at AaBET Hospital and in our country as well. This study will fill knowledge gap concerning functional outcome of pediatrics patients who sustained SCH fracture and treated surgically using validated functional scoring system ;-(Flynn's score).This study will also assess factors contributing to the outcome of patients in this study. The finding of this study will contribute to the understanding of outcome of SCH fracture patients treated surgically in our trauma center.

This study will also provide data on outcome of pediatrics patients with SCH fracture who are treated surgically and will help surgeon to advice his/her patients on possible functional outcome after surgery. It will also provide baseline information for other researcher who wants to conduct further study on this area.

2. Literature review

Supracondylar humerus fractures are the most common fractures around the elbow in children between 4 and 10 years of age which needs operative intervention(1,11). The treatment of supracondylar humerus fractures can vary from conservative treatment to operative treatment depending on the fracture type. Currently, the decision to operate or conserve the fracture is taken on basis of Wilkins-modified Gartland classification of supracondylar humerus fractures(1,12). Non-operative treatment for type I fractures and operative treatment for type III fractures have been well-established in literature. The management of type II supracondylar humerus fracture creates confusion in the minds of numerous orthopaedic surgeons around the world(13).In most studies on functional outcomes after operative management are satisfactory and comparable when using cross pinning or lateral pins and whether reduced open or closed(12,14,15).

A retrospective study done in, China, Wuhan city on surgical management of Gartland type III supracondylar humerus fractures in older children, eighty-three cases of Gartland type III supracondylar humerus fractures in children older than 10 years were treated by open reduction by the small medial approach and cross-fixation with three kirschner wires from January 2010 to December 2015. All patients were followed up from 12 to 15 months (mean: 13 months). Assessments after 1 year included neurovascular examination, Flynn's criteria (elbow function and carrying angle), pain and complications (infections, growth disturbances or iatrogenic nerve injuries). All fractures healed within 2 months. According to Flynn's criteria, 80 (96.4%) patients achieved satisfactory outcomes, whereas three (3.6%) were graded as unsatisfactory because of limited elbow motion. The mean carrying angle measured 9.4° (1° – 16°)

No case of found with post op complications like cubitus varus, or neurovascular complications. They conclude that open reduction by the medial approach and cross- fixation with three kirschner wires for severely displaced Gartland type III fractures is a safe and effective method with a low incidence of complications for older children(16).

A prospective study published in chinese journal of traumatology in 2014, they studied the outcome of open reduction and internal fixation for displaced supracondylar fractures of the humerus in children with crossed K-wires via lateral approach followed 52 patients 37 were male and 15 female with average age of 7.9 years. the most common mechanism of injury was fall

while playing followed by fall from height. They use open reduction via lateral approach extending 3-4cm proximally from the lateral epicondyle under general anesthesia and tourniquet control. Fracture reduced and checked under direct vision for correct reduction and first lateral pin applied then with small incision over medial epicondyle blunt dissection with hemostat carried out and medial pin applied without identifying ulnar nerve then wound closed and splinted at 90 degree of flexion and supination. post operatively suture removed at 12th day and splint removed 3-4 weeks then range of motion started. Patients were followed a mean of 12 months. The result was majority regained full range of motion 6 weeks after pin removal, 2 patients had postoperative ulnar nerve palsy that removed after pin removal. The common late complication of cubitus varus was not seen in any patient. Delayed presentation to the emergency department, repeated manipulations by bone setters and massage with edible oil were responsible for stiffness in 5 patients. According to Flynn's criteria, 90.4% patients showed satisfactory results(17).

So they conclude that lateral approach for open reduction and internal fixation of the widely-displaced supracondylar fracture of the humerus is safe and straightforward, ensuring anatomical reduction and excellent function. The approach is easy and familiar to most orthopedic surgeons in our setup(17).

A systemic review on journals about functional, cosmetic and radiological outcomes in patients with totally displaced SCHFs managed with primary open reduction in comparison to primary closed reduction. From 164 papers 3 papers fulfill eligibility criteria and included. The primary closed reduction group consisted of 112 patients with a mean age of 7.3 years and a mean follow-up of 19.6 months. The primary open reduction group was comprised of 95 patients with a mean age of 7.8 years and mean follow-up of 23.16 months. A total of 207 patients were included in the analysis. Functional outcome Flynn's criteria for open compared to closed reduction was used. There was no heterogeneity among the studies compared in each subcategory. Regarding the excellent subcategory, there was a statistically significant overall result in favor of open reduction. The poor subcategory also showed statistical significance in favor of the closed reduction group. Cosmetic outcome as was done for the functional outcome, a representative forest plot for odds with a 95% confidence interval of cosmetic outcome according to Flynn's criteria in open compared to closed reduction was used. In this case, none

of the subcategories showed statistically significant differences. Radiological outcome assessment included the Baumann's angle difference and times to union and nonunion and there is no statistical significant difference in both groups. So they recommend starting with a closed reduction technique unless some special circumstances are present; if an anatomical reduction cannot be obtained after one or two closed attempts, an open reduction should be performed because repetitive manipulations could result in joint stiffness and transient neuropraxia. Obtaining an adequate anatomical reduction favors excellent to good functional and cosmetic outcomes as well as fewer complications(18).

A study done on 11 patients from 8 hospitals in 3 different countries from 1995 to 2005 retrospectively reviewed the occurrence of compartment syndrome in patients presented with low energy injuries with intact pulse. 10 patients had tense swelling at presentation and intact radial pulse, had a mean delay before surgery 22 hrs, one patient without tense swelling at presentation sustained arterial entrapment after reduction, with a subsequent compartment syndrome requiring release after 25 hours. Significant swelling at presentation and delay in fracture reduction may be important warning signs for the development of a compartment syndrome in children with supracondylar fractures of the humerus(19).

In another study done on Los Angeles children's hospital from 2000-2001 which enrolled 150 patients retrospectively to see the effect of delay more than 12 hrs on preoperative complications and the need for open reduction, 50 patients underwent surgery less than 12 hours and 100 more than 12 hours. There was no significant difference in rate of open reduction ($P = 0.55$), pin tract infection ($P = 1.0$), iatrogenic nerve injury ($P = 1.0$), vascular complication ($P = 0.33$), or compartment syndrome between the two groups. They conclude that a delay in the operative treatment of isolated supracondylar humerus fractures in children without significant soft tissue or vascular injury did not significantly increase the rate of open reduction or compromise the preoperative risks examined(20).

A study done in India to assess the effect of delayed open reduction of type IV SCH fracture, 20 patients included in the study with surgical delay of 11-17 days because of swelling and blisters they use posterior approach and the outcome was 35 % had alteration in carrying angle most cases recover to 90 degree of flexion/extension, 17 patients had small amount of myositis ossificans.

Conclude that late open reduction does not increase either the frequency or the extent of myositis ossificans although some stiffness of the elbow results(21).

Studies assessing the reliability of on modified Gartland classification systems found moderate interobserver, and substantial intraobserver agreement in treatment decision making. The largest disagreements between surgeons were observed for type IIA and IIB fractures and treatment decisions did not follow expected trends based on surgeons' preferred treatment methods for each fracture type. Leitch and colleagues added a type IV classification, describing a multi-directionally unstable fracture in both flexion and extension with complete loss of the periosteal hinge. Type IVs are often only diagnosed intraoperatively(2,4,22).

Though supracondylar humerus fracture is the most common fracture around the elbow and has multiple classification systems, there is still controversy regarding the best possible way to classify supracondylar humerus fractures in children in terms of clinical utility, treatment protocols and fixation methods. This leads to difficulty in defining a treatment algorithm for these fractures. The modified Gartland classification decides the need for operative intervention of a supracondylar humerus fracture but we propose that the type of intervention and the fixation method be guided by the Bahk classification(1).

Studies on epidemiology of SCH fractures states they contribute 12-17 % of all pediatric fractures and 50-70 percent of pediatric elbow injuries(1,2). In the African context a study done in Senegal for 8 years 2003-2011 on 465 patients, the annual incidence was 58.12. Elbow fracture accounted for 30.79% of fractures of the child and came in second place after fractures of the femur (39.17%). The average age was 7 years with a peak incidence between 4 and 6 years. The majority observed are male with a sex ratio of 3.6: 1. Most of our patients (96.1%) came from the suburbs of the capital. The circumstances of occurrence were dominated by recreational accidents (59.5%) and the fall was the most frequently mechanism with 90.1% of cases. The left elbow sustained injury in 63.45% of cases. Supracondylar fractures accounted for 81.29% of cases. They conclude that supracondylar fractures are more common in their setup(6).

Studies regarding pin configuration lateral versus cross pinning in paediatric supracondylar humerus fractures: a meta-analysis of randomized control trials study published 2021 conducted systemic reviews in different databases, a total of 900 patients in 11 studies included,455

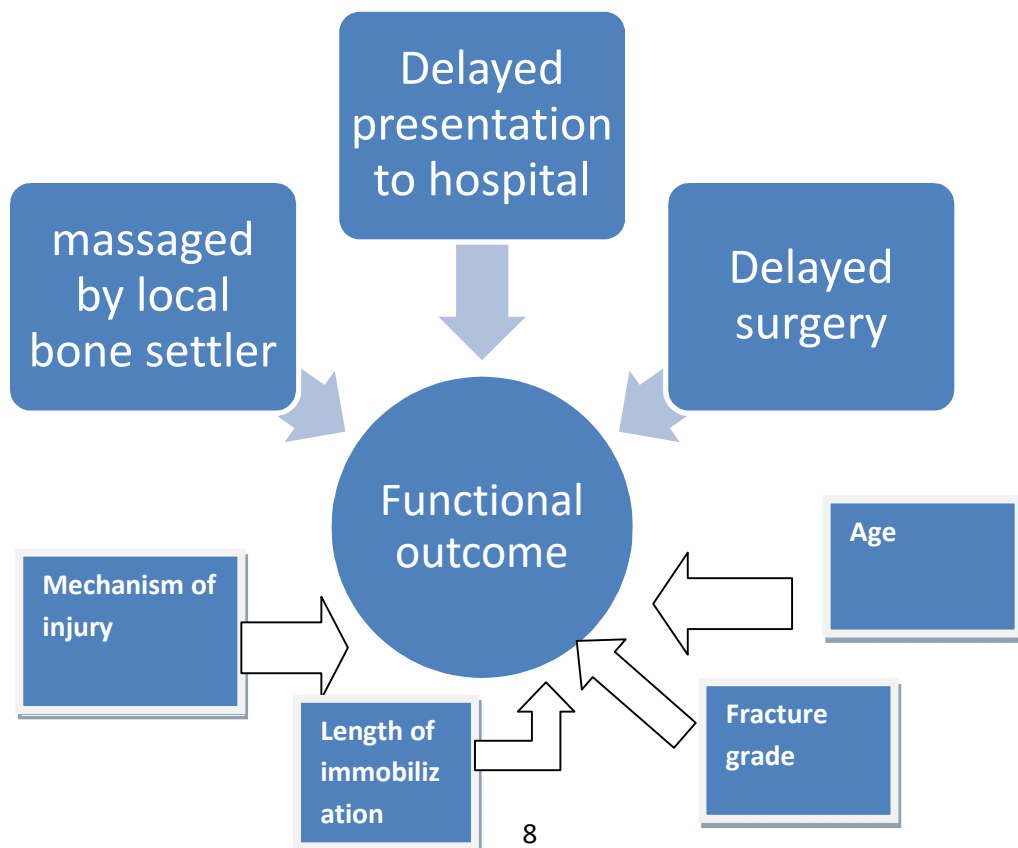
underwent cross pinning and 445 lateral pinning. In this meta-analysis cross pinning provides superior stability in the treatment of supracondylar humerus fractures in children; however, it carries greater risk of iatrogenic ulnar nerve injury(23). Other similar studies also have similar outcomes(10,24,25). Regarding complications of SCH fractures management guide written by symposium of orthopedics states these fractures are associated with a high risk of short- and long-term complications, both from the injury and its treatment. It is therefore essential that this fracture is managed well, from early diagnosis and initial management in the emergency department to prompt decision making regarding the need for surgical intervention and, if required, correct surgical technique(3). Vascular injuries can occur in up to 20 % and nerve injuries in up to 11-16 % of the time(26).

A hospital based cross sectional study done at Mulago national hospital, Uganda from 2019-2020 to assess the short-term management outcomes of Supracondylar Fractures of the humerus and their associated factors in Children, in this study 77 patients were included 46 were male and 3 female. Flynn's criteria, current flexion and extension at the elbow joints, humeroulnar angle and the neurology were assessed and compared to the contralateral limb to get the functional outcomes. The pre-management digital radiographs of the elbow joint were compared with the current radiographs to assess radiological outcomes. Bivariate and multivariate analyses were used to determine the associated factors. Results were the overall satisfactory functional outcome was 46.7%, while 81.8% of the patients had a satisfactory radiological outcome at 6 months after the intervention. Delay in seeking treatment, type I fracture, and prolonged duration of immobilization were significantly associated with unsatisfactory functional management outcome. Type II fracture and prolonged duration of immobilization were significantly associated with unsatisfactory radiological management of SCF of the humerus. Conclusion: The short-term functional outcome was unsatisfactory, while a satisfactory radiological outcome was found in most of the patients. Duration of immobilization, type of fracture, and seeking late medical care had a negative impact on the outcome of these fractures(9).

A population-based follow up study with a minimum follow up of ten years and normal matched comparisons was done to study the long-term outcome of childhood supracondylar humeral fractures. In this study the clinical and radiographic outcome of 81 children with Gartland type I to III supracondylar humeral fractures at a minimum follow-up of ten years (mean 12.1 years;

10.3 to 16.1) following injury were studied and the result was ,according to Flynn's criteria, most fractures (75.3%) resulted in a satisfactory (“good or excellent”) outcome. Satisfactory recovery was achieved in 75.0% of type I fractures treated by closed splinting ($p = 0.013$). Type II fractures were associated with both satisfactory (57.7%) and unsatisfactory (42.3%) results, regardless of the type of treatment, although the numbers were small in the sub groups. Most type III fractures were treated operatively, and most (76%) had a satisfactory outcome according to Flynn’s criteria ($p = 0.015$). Compared with none among the normal subjects, flexion of the elbow was reduced by $> 10^\circ$ at long-term follow-up in 20 cases (24.7%, $p < 0.001$) and 9 (11.1%) had a reduced flexion of $> 15^\circ$ ($p = 0.004$). In patients who had sustained a type III fracture, the carrying angle was decreased by 35.7% (from 9.8° to 6.3° ; $p = 0.048$). All patients achieved an excellent Mayo Elbow Performance Score (mean 96.4 points). They Conclusion was the long-term outcome of extension-type supracondylar humeral fractures is generally good, but not exclusively benign, with the potential for long-term pain and ulnar nerve sensitivity, and a decrease in grip strength and range of movement in type II and type III fractures. Bony remodelling cannot be relied upon to correct any residual deformity(7).

Conceptual frame work



3. Objectives of the study

3.1 General objective

The general objective of this study is to assess functional outcome of operatively treated pediatrics patients with supracondylar fractures and factors associated with their outcome at AaBET Hospital, Addis Ababa, Ethiopia from September 2018 to september 2022.

3.2 Specific Objectives

1. To determine functional outcome of pediatrics patients with supracondylar fracture treated operatively at AaBET Hospital, Addis Ababa, Ethiopia.
2. To identify factors associated with outcome of operatively treated supracondylar fractures of children at AaBET Hospital, Addis Ababa, Ethiopia.

4. Methods and Materials

4.1 Study setting and Period

The study was conducted in Orthopedics and Traumatology department of AaBET Hospital. AaBET hospital is an affiliate of SPHMMC, one of the largest tertiary hospitals in the country based in the capital city of our country, Addis Ababa. It is the first trauma hospital established in Ethiopia since 2015 with more than 200-beds and 12 intensive care unit beds. It has been giving neurosurgery, orthopedics, trauma, burn, emergency and critical care services since its establishment. It has a total 4 operation room (OR) tables and 2 recovery rooms. The hospital provides both emergency and elective surgical services to the needy patients 24 hours a day. . Orthopedic wards have 63 beds, 49 beds for adult and 14 beds for pediatrics, respectively. The human source of the department comprises of 17 consultants and 43 orthopedic surgery residents of different year of study. The study was conducted over 2month's period, from 15st February up to 15th April, 2023.

4.2 Study design

A Cross-sectional study design was used.

4.3 Population

4.3.1 Source population

All pediatrics patients who sustained supracondylar fracture and presented to AaBET Hospital will be the source population 1st September 2018 to 30th September 2022.

4.3.2 Study population

All pediatrics patients diagnosed to have supracondylar fracture and treated surgically in AaBET Hospital from 1st September 2018 to 30th September 2022 were included in the study population if they fulfilled the inclusion criteria of the study.

4.4 Eligibility Criteria

4.4.1 Inclusion criteria

All pediatrics patients who were diagnosed with supracondylar fracture and treated operatively in AaBET Hospital from 1st September 2018 to 30th September 2022 were included to the study.

Unstable Gartland type II and above

Age < 18 years

4.4.2 Exclusion criteria

- Patients who have bilateral injury
- Polytrauma patients
- Patients who have confirmed vascular injury

4.5 Sample size determination and sampling procedures

For the purpose of this study Sample size could be calculated using single population proportion as follows.

$$n = \frac{(z_{\alpha/2})^2 \cdot pq}{d^2}$$

n = required sample size

$Z_{\alpha/2}$ = Critical value = 1.96 (normal Standard deviation usually set at 1.96 which corresponds to the 95% confidence interval)

d = precision (marginal error) = 0.05

P - Is taken as 50% because there is no similar study done in our setup

$$n = \frac{(1.96)^2 \times (0.5) \cdot (0.5)}{(0.05)^2}$$

$$\Rightarrow 384$$

Since the source of population is 140, which is below 10,000, population correction formula is used to determine adjusted minimum sample size.

$$n_f = \frac{n}{1 + n/N}$$

Where; n = initial sample size (384)

N = total number of source of population (140)

n_f = Minimum sample size

$$n_f = 384 / (1 + 384/140)$$

$$= 112$$

By adding 10% non-response rate = 11

Hence the minimum sample size will be 123

Since the numbers of patients are small all 140 patients were included in the study.

4.6 Study Variables

Dependent variable -Functional outcome in terms of range of motion and cosmetic outcome

Independent variables,

Age

Sex

Side affected

Mechanism of injury

Fracture grade

Time to operation

Time to hospital presentation

Type of reduction (closed or open)

Massaged or not

Type of pinning (cross or lateral pins only)

Length of immobilization post operatively

4.7 Operational definitions and Measurement

- SCH fracture –extra-articular occurring in the distal metaphyseal humerus Gartland IIB and above which is indicated to treat surgically.
- Functional outcome is the outcome assessed using Flynn’s criteria
- Satisfactory outcome –loss in elbow range of motion less than 15 degree
- Unsatisfactory outcome loss in elbow range of motion greater than 15 degree
- Satisfactory cosmetic outcome –loss in carrying angle less than 15 degree
- Unsatisfactory cosmetic outcome-loss in carrying angle greater than 15 degree

4.8 Data collection method, tool and procedures

Functional outcome of pediatrics patients with SCH fracture who were operatively treated in AaBET Hospital was assessed Flynn's criteria and some questionnaires were also developed by principal investigator to analyze potential factors affecting outcome at the same time.

Flynn's score is a functional and cosmetic outcome score developed to assess the outcome of patients treated for supracondylar fracture. It has functional and cosmetic components each graded from excellent to poor outcomes, for simplification we used satisfactory for excellent, good and fair outcomes and unsatisfactory for poor outcomes(27). Elbow range of motion and carrying angles was measured clinically using Goniometer.

For this study, the source of the data was Operation theater logbook, patient chart and patient him/herself. The data was collected at AaBET Hospital. Two trained General practioner were hired for the purpose of this study under supervision of the principal investigator.

Once the patients who fulfill the inclusion criteria were identified; they were invited to hospital on working days at their follow up visit and the questionnaires was filled by data collectors and clinical measurements was be done by principal investigator using Goniometer. The parent who gave consent was communicated early to arrange their follow up visit. The minimum postoperative duration was 6 months to be included in the study.

To assure the quality of data one day training was given for data collectors and properly designed and validated data collection instrument, was used. The questionnaires were checked for completeness and clarity by principal investigator on the day of data collection.

4.9 Data quality control

To ensure the quality of data, the questionnaire was pretested on 5% of the sample size. The result of the pretest was discussed and all the necessary amendments were made on the instructions, contents, order and grammatical issues based on the pretest results. During the study period, all data was checked for completeness, accuracy, clarity and consistency by the principal investigator immediately after the data collection. The principal investigator and the supervisors closely monitored the data collection process.

4.10 Data processing and analysis plan

After completing data collection, data was checked by the principal investigator for completeness and coded. The coded data was entered in to Epi data and then exported to SPSS Version 27 for further analysis. Frequency and cross tabulation used to summarize descriptive statistics. Then, mean median, standard deviation and proportion was calculated for each Flynn's score and compared to the normal side.

Bivariate logistic regression analysis was done to assess the association between the dependent and independent variables. For variables with p values ≥ 0.2 on multivariate logistic regression analysis was carried out to see the relative effects of independent variables on the dependent variables. Odds ratio with a 95% confidence interval and p-value of less than 0.05 was used to interpret results. Graphs, pie charts and tables are used for presentation of results.

4.11 Ethical considerations

Ethical clearance was obtained from the research ethical review board (IRB) of St. Paul's Hospital Millennium Medical College, SPHMMC. Official letter for cooperation was sent to AaBET Hospital. Approval for use of patient records was obtained from AaBET Hospital medical director. Confidentiality was maintained when handling each case files. Name and chart of patient was not shared with anyone outside the research team and the information is used for the research purpose only. Written informed consent was obtained from parents of a child who were willing to participate in the study after they were given information about the purpose of the study. There was neither conflict of interest nor incentive taken or forced to do this research.

4.12 Dissemination of results

The findings of the study will be submitted in both hard and soft copy to the department of orthopedics and trauma surgery, AaBET Hospital. The result of the study will be presented to St. Paul's Hospital millennium medical college, SPHMMC research coordinate office, to department of Orthopedics and Traumatology and also presented in front of audience as a graduation thesis, to Ethiopian society of orthopedics and traumatology and to other concerned bodies as per need at SPHMMC. Through publication the research result will reach other concerned and interested bodies.

5. Results

Of a total of 109 patients with supracondylar humerus fracture recruited, the majority of patients were males 99(90.85). The mean ages of participants were 7.35 ± 2.888 SD.(figure 1) Majority of times the left extremity were injured (73.4%) and the commonest mechanism of injury were fall down accident while playing (67%) followed by fall down accident from height(23.9%). More than half of patients presented to hospital within 24 hours (72.5%), 24-72 hours (12.8%), 72 hours to 7 days (11.9%) and more than 7 days 2.8 percent.(figure 2). More than two thirds of patients were operated within 10 days of presentation (75.3%), 7.3% operated after two weeks. Open reduction was used for 69.7 % of patients and closed reduction under C-arm for 30.7%, and only lateral pinning was done for majority of patients(81.7%) and cross pinning 18.3 %. Majority of fractures were Gartland type III (89%).From all patients 22.9 % visited local bone settlers before visiting hospital (table 1). Using flynn's score 89 % of patients had satisfactory range of motion out come and 83.5% had satisfactory outcome in carrying angle. Overall 81.7% had satisfactory outcome when either of them affected (table 2).

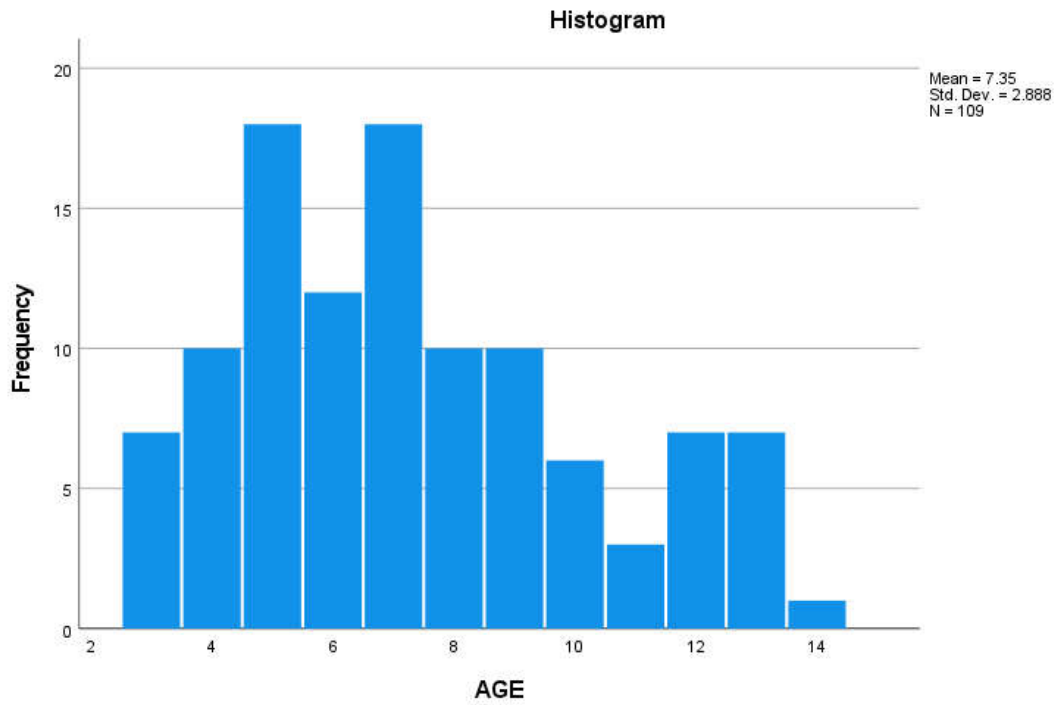


Figure 1 Histogram showing age distribution

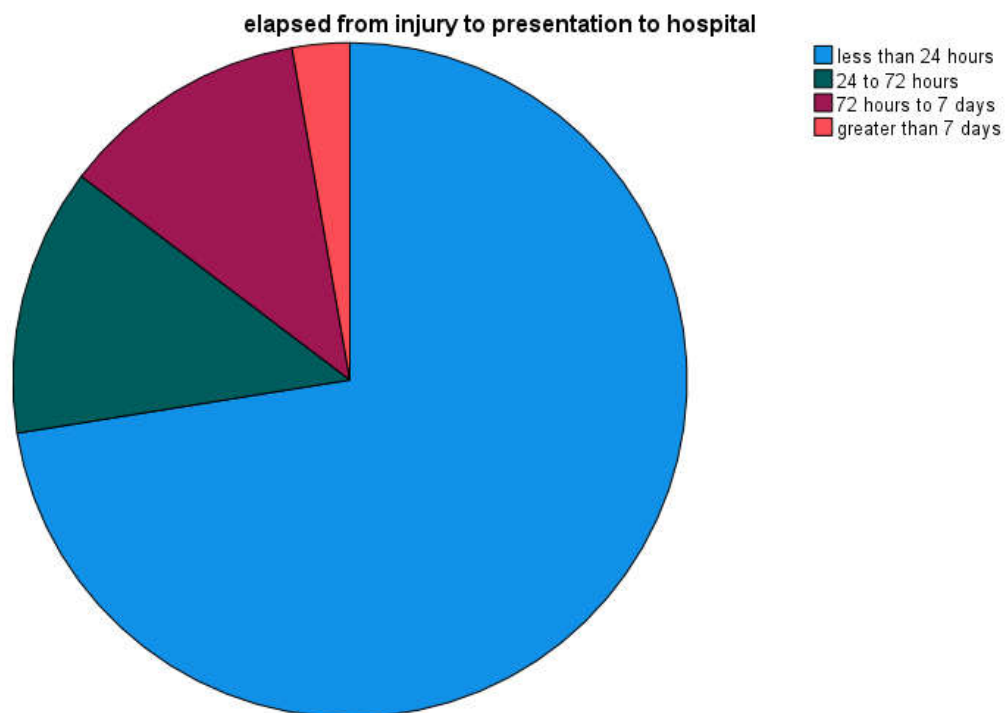


Figure2 Pie-chart showing time from injury to presentation

Table 1 Social Demographic Characteristic of Study Participants

Characteristics	Frequency N=109	Percentage %
Sex		
M	99	90.8
F	10	9.2
Age(Mean $\pm$ SD)	7.35 $\pm$ 2.888	
3-9 years	85	78
10-14 years	24	22
Time elapsed from injury to hospital presentation		
<24 hour	79	72.5
24-72 our	14	12.8
72hour -7 days	13	11.9
> 7 days	3	2.8
Time elapsed from injury to surgery		
<5 days	32	29.4
6-10 days	50	45.9
11 -15 days	19	17.4
>15 days	8	7.3
Mechanism of injury		
FDA while playing	73	67
Fall down from height	26	23.9
Others	10	9.1
Side of the fracture		
Left	80	73.4
Right	29	26.6
Gartland grade		
IIB	7	6.4
III	97	89
IV	5	4.6
Massaged by local bonesetter		
Yes	25	22.9
No	84	77.1
Type of reduction used		
Closed reduction using C-arm	33	30.3
Open reduction	76	69.7
Type of pining		
Only lateral pining	89	81.7
Cross pining	20	18.3

FDA falling down accident, RTA road traffic accident

Table 2 grading of outcomes according to Flynn's criteria

Outcome	Loss in carrying angle (cosmetic outcome)		Loss in range of motion(functional outcome)		Either of them affected	
	frequency	percent	frequency	percent	frequency	Percent
Satisfactory	91	83.5	97	89	89	81.7
unsatisfactory	18	16.5	12	11	20	18.3

Pearson qui-square and fisher exact test was done to see the association between dependent and independent variables and time to hospital presentation, time to surgery and whether massaged or not had significant association. A significant higher proportion of patients operated after 10 days (88.9%) had unsatisfactory outcome compared to those operated less than 10 days.(table 3)

Table 3 Pearson chi-square and fisher exact test

Variables		Loss in carrying angle			Loss in range of motion		
		satisfactory	unsatisfactory	P-value	satisfactory	unsatisfactory	P-value
Time to hospital presentation	<24hrs	72(79.9%)	7(38.9%)	<0.001	74(76.3%)	5(41.7%)	<0.01
	>=24hrs	19(20.9%)	11(61.1%)		23(23.7%)	7(58.3%)	
Time to surgery	<10 days	80(87.9%)	2(11.1%)	<0.001 FET <0.001	82(81.4%)	0(0%)	<0.001
	>=10days	11(12.1%)	16(88.9%)		15(15.6%)	12(100%)	
Massaged or not	Yes	15(16.5%)	10(55.6%)	<0.01	18(18.6%)	7(58.3%)	<0.02
	No	76(83.5%)	8(44.4%)		79(81.4%)	5(41.7%)	
Sex	M	83(91.2%)	16(88.9%)	0.755 FET 0.669	88 (90.7%)	11(91.7%)	<0.95 FET 1
	F	8(8.8%)	2(11.1%)		9(9.3%)	1(8.3%)	
Age	3-9 years	69(75.8%)	16(88.9%)	0.222 FET 0.351	74(76.3%)	11(91.7%)	<0.225 FET 0.458
	10-14year	22(24.2%)	2(11.1%)		23(23.7%)	1(8.3%)	
Side	Right	25(27.5%)	4(22.2%)	0.645 FET 0.776	27(27.8%)	2(16.7%)	0.409 FET 0.51
	Left	66(72.5 %%)	14(77.8%)		70(72.2%)	10(83.3%)	
Type of reduction	Closed reduction	31(34.1%)	2(11.1%)	0.5 FET 0.089	31(32%)	2(16.7%)	0.277 FET 0.34
	Open reduction	60(65.9%)	16(88.9%)		66(68%)	10(83.3%)	
Type of pining	Crossed	15(16.5%)	5(27.8%)	0.258	16(16.5%)	4(33.3%)	0.155 FET 0.227
	Only lateral	76(83.5%)	13(72.2%)		81(83.5%)	8(66.7%)	
Fracture grade	Type II	7(7.7%)	0	0.472 FET 0.675	7(7.2%)	0(0%)	0.525 FET 0.550
	Type III	80(87.9%)	17(4.4%)		86(88.7%)	11(91.7%)	
	Type IV	4(4.4%)	1(5.6%)		4(4.1%)	1(8.3%)	

Mechanism of injury	RTA	4(4.4%)	0	0.461 FET 0.476	4(4.1%)	0(0%)	0.281 FET 0.37
	FDA from height	23(25.3%)	3(16.7%)		25(25.8%)	1(8.3%)	
	FDA while playing	60(65.9%)	13(72.2%)		62(63.9%)	11(91.7%)	
	Others	4(4.4%)	2(11.1%)		6(6.2%)	0(0%)	

FET=fisher exact test

Bivariate and multivariable regression analysis was done for both loss in carrying angle and effect range of motion and the only statistically significant variable after multivariable analysis is time to surgery. Patients with time to surgery more than 10 days were 98.7% less likely to have satisfactory cosmetic outcome. None of the patient factors was found to have an association with the degree of range of motion at multivariate analysis. (Tables 4 and 5)

Table 4. Bivariate and multivariate logistic regression for carrying angle outcome

Variable	COR (95% CI)	AOR (95% CI)	p-value
Time to admission			
>24 hours	0.16(0.057-0.492)	0.612(0.13-28.17)	0.800
<24 hours	1	1	
Time to surgery			
>10 days	0.017(0.003-0.085)	0.013(0.001-0.11)	<0.001
<10 days	1	1	
Mechanism			
Road traffic	0.000	0.000	0.999
Fall down from height	0.43(0.072-2.6)	0.059(0.002-1.43)	0.082
Fall down while playing	0.261 (0.033- 2.089)	0.076(0.004-1.44)	0.086
Others	1	1	1
Massage			
Yes	0.158(0.054-0.466)	0.454(0.01-21.09)	0.680
No	1	1	
Type of reduction			
Closed	4.13(0.89-19.13)	1.513(0.193-11.880)	0.694
Open	1	1	

Table 5. Bivariate and multivariate logistic regression for range of motion outcome

Variable	COR (95% CI)	AOR (95% CI)	p-value
Time to admission			
>24 hours	0.22(0.064-0.767)	0.513(0.082-3.210)	0.476
<24 hours	1	1	
Massage			
Yes	0.163(0.046-2.572)	0.236(0.038-1.460)	0.122
No	1	1	
Type of pinning			
Cross	0.395(0.106-1.470)	0.314(0.074-1.3300)	0.116
Lateral	1	1	

6. Discussion

This study investigated the outcomes of operatively managed supracondylar fractures and factors affecting the outcomes. Males constituted 90.8 % and the average age of patients were 7.35 ± 2.888 . In this study, more than half of the patients were aged between 5 and 9 years. This indicated that the occurrence of fractures decreased as the age increased. This explains that the supracondylar region of the humerus is thin particularly in young children, which makes them more prone to these injuries as opposed to older children, where the bone becomes thicker as the child continues to grow(9). Falling down accident while playing is the major mechanism of injury and the left side is affected in 73.5 % of cases. This result goes in line with research done at Mulago national hospital, Uganda(9), in which males constitute higher proportion 60% and average age was 7.86 ± 2.30 . Similar results are found in another study conducted at Senegal, male to female ratio was 3.6:1 and mechanism of injury was fall 90.1% of time(6). This indicates that males are affected more may be because of their involvement in dangerous and adventures recreational activities.

In this study most of fractures are Gartland type III in contrast to Abdirizak Abdullahi Sheikdon et.al where the majorities were type I. This may be because of only operated patients are included in this research.

Most patients in this study presented to hospital within 24 hours 72.5% but 14.7 % presented after 72 hours and 20.7 of patients operated after 10 days. This is in contrast to other studies Wael A.et.al(10) where all patients operated within 24 hours. 25(22.9%) of patients visited local bone settlers and massaged which is mentioned in studies to affect functional outcome of patients(28). We found a strong association between delayed presentation and being massaged. Those presented greater than 24 hours had 29.6 times risk of being massaged 29.6(95 % CI 9.08-96.4, $P < 0.001$)

Studies conducted comparing the significance of open versus closed reduction concluded there is no statistical significance on the outcome(29). Similarly in this study 69.7 % was open reduction and 30.3 closed there is no statistical significant difference in outcome. the reason for this could be due to lack of C-arm in our setup. The same is true for pin configuration no significant effect in the outcome in this study, as is also mentioned in other studies(23).

Over all 81.7% of patients had satisfactory outcome and in chi-square test time to hospital presentation (61.1% Vs 38.9% $P < 0.001$, time to surgery (88.9% Vs 11.1% $P < 0.001$) and whether massaged or not (55.6% Vs 44.4%, $P < 0.001$) have strong association. After conducting bivariate and multivariate regression analysis only time to surgery had statistical significance. Those who are operated more than 10 days had 98.7 % less chance of satisfactory outcome. This results are comparable to Wael A.et al where 90.4 % had satisfactory and 8.4% unsatisfactory outcomes after percutaneous lateral cross pinning technique(10).

7. Limitation of the study

- The study is a cross sectional study and hence cannot establish a cause and effect relationships
- Chart documentation as not complete for some of patients and excluded from the study.
- Difficult to incorporate radiologic outcome because of availability.

8. Conclusion

Our system of managing supracondylar humerus fracture is generally efficient with 81.7% satisfactory outcome. We demonstrated delayed presentation to hospital, delayed surgery and being massaged had strong association with the outcome and the most determinant factor is delayed surgery more than 10 days. There are different management options including closed reduction under C-arm and pinning and open reduction and pinning. In this study we didn't found significance difference in outcome regarding type of reduction and type of pinning.

9. Recommendation

- Massage by local bone settler is common and advise parents to avoid visiting local bone settlers
- The hospital the health bureau and ministry of health should work together to advocate against traditional bonesettlers practice and to make them accountable.
- Future studies may be needed to validate our result prospectively on the same center and multicenter study with a larger sample size by including additional confounding factors.

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Annexes

Annex-I: Questionnaires

S. No.	The study variables	Response	Remark
	Card Number	_____	
1. Socio-demography of the participants			
1.1.	Sex	1. Male 2. Female	
1.2.	Age	_____	
2. History of the trauma patient who sustained SCH fracture and presented to AaBET Hospital			
2.1.	Time elapsed from injury to presentation to hospital	_____	
2.2.	Time elapsed from injury to surgery		
2.3.	Mechanism of injury	1. Road traffic accident 2. Fall down from height 3. Fall down while playing 4. Other(specify) _____ _____	
2.4.	Side of fracture	1. Right 2. Left 3. Bilateral	
2.5.	Grade of injury based on Gartland classification	1.Type II 2.Type III 3. Type IV	
2.6.	Whether massaged by local bonesetter or not	1. Yes 2. No	
2.7.	Types of reduction used	1.closed reduction with C-arm 2. open reduction no C-	

		arm	
2.8.	Type of pinning	1.cross pinning 2.only lateral pinning	
2.9.	Length of immobilization post op	1.3-4 weeks 2.greater than 4 weeks	

Name of data collector _____ signature _____ date _____

Name of Investigator _____ signature _____ date _____

Annex II Flynn's criteria

Outcome	Loss in carrying angle=cosmetic outcome(in degrees)	Loss in range of motion=functional outcome(in degrees)
Satisfactory		
Excellent	0-5	0-5
Good	6-10	6-10
Fair	10-15	10-15
Unsatisfactory		
poor	Greater than 15	Greater than 15

Annex 3.

Declaration of investigator

I the undersigned resident declare that this research project is my original work in partial fulfillment of the requirement for certificate of specialty in orthopedics and traumatology.

I also declare that it has never been presented in this or any other higher institution and all the resources and materials used in the research work have been duly acknowledged.

Name of the Resident: Dr. Tilahun Mulu Birhanie (4th year orthopedics and traumatology resident)

Signature: _____

Date: _____

Approval of Advisors

Name of Clinical Advisor: Dr. Addisu Deribe (MD, Assistant Professor of Orthopaedics and Traumatology Surgery)

Signature: _____

Date: _____