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***Original Research Article***

# Comparison of Post-Operative Range of Movement of Supra-Condylar Type 3 Fracture of Humerus in Children Operated by Medial and Posterior Approach

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**Abstract:** *Supracondylar fractures of the humerus are the most common elbow fractures in the pediatric population, often requiring surgical intervention when displaced. The choice of surgical approach can influence the functional and cosmetic outcomes, particularly the range of motion (ROM) post-operatively.* ***Objective:*** *To measure and compare the post-operative range of motion using two different approaches—medial and posterior—for open reduction and internal fixation of supracondylar humerus fractures in children.* ***Methods:*** *This quasi-experimental study was conducted at Sheikh Khalifa Bin Zayed/Combined Military Hospital (SKBZ/CMH), Muzaffarabad. After ethical approval, 250 pediatric patients with Gartland type-III supracondylar humerus fractures were included through random allocation into two groups: Group MA (medial approach) and Group PA (posterior approach). Open reduction and internal fixation were performed accordingly. The primary outcome was range of motion, classified as excellent, good, fair, or poor, while secondary outcomes included preservation of carrying angle and rate of complications. Data were analyzed using SPSS, and Chi-square test was applied to assess statistical significance.* ***Results:*** *In Group MA, 94 patients (76.4%) had excellent ROM, 25 (20.3%) had good ROM, and 4 (3.3%) had fair ROM. In Group PA, 76 patients (62.3%) achieved excellent ROM, 35 (28.7%) good, and 11 (9.0%) fair. The difference in ROM outcomes between the two groups was statistically significant ($p < 0.05$). Cosmetic outcomes corresponded closely with functional outcomes in both groups.* ***Conclusion:*** *The medial surgical approach for open reduction and internal fixation of type-III supracondylar humerus fractures in children is associated with significantly better post-operative range of motion compared to the posterior approach, with similar cosmetic outcomes and complication rates.*

**Keywords:** Articular, Child, elbow, Fracture, Humerus and Range of motion

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## Introduction

Children between the ages of three and ten, are susceptible to supracondylar humerus fractures which are among the most frequent upper extremity fractures in this age group. (1) The most complicated fracture type is type-III fracture which are completely displaced and If this fractures is not treated immediately, it may cause elbow deformity and limited range of motion at the elbow joint. (2) In cases where closed reduction is not feasible for fractures that are substantially displaced, open reduction is the preferred method. Open reduction is especially necessary in cases of vascular compromise. (3)

There's no agreement on the best surgical technique to be favored in the case of an open reduction of a supracondylar fracture of the humerus. Prior research has defined various approaches including medial, posterior and lateral approaches. (3) The benefit of the medial method is that it better restores rotation through direct vision and avoiding ulnar nerve injury during medial K-wire insertion but somehow local literature is scant on this approach. (4) The posterior approach has less neurovascular dissection and a wide view of the fracture line, making it comparatively easy to perform and it used most of times. Nevertheless, there is a chance that a posterior incision will disrupt triceps muscle extensor mechanism and elbow restriction and stiffness during movement. (5) Regarding lateral approach doesn't require extensive dissection but it has no superiority over medial and posterior approach. (6) According to local study by Fayyaz Ahmad Orfi et al (7) the posterior approach and lateral approach had similar functional outcome but they did not study medial approach in their study. No local study had compared medial approach as posterior and lateral approaches are widely used in Pakistan. According to international research a clear view of the supracondylar region is offered by the medial approach which makes thus technique more practical. Also there is less chance of ulnar nerve damage and the medial scar is more aesthetically better (8). But no local references are found to favor medial approach.

Therefore the rationale of our study is to compare the functional outcome of medial and posterior approaches in pediatric population. Our research will help contribute the data of our demographic population and guide regarding better approach.

## Methodology

The ethical committee of hospital was approached first for grant of ethical certificate. After ethical approval the study was carried out Sheikh Khalifa Bin Zayed/Combined Military Hospital (SKBZ/CMH), Muzaffarabad from July 2023 to December 2023. The sample size was calculated with help of WHO sample size calculator. We decided to perform a Quasi-experimental study and we estimated sample size by keeping the significance level 5%, power of test 80%, the adequate functional outcome with medial approach to be 93% (1) and with posterior approach to be 81%. (1) The sample came out to be 123 therefore included 250 patients in our study. The sample size was collected over a period of one and half years through non-probability consecutive sampling. Inclusion criteria: we included patients of pediatric age group with age ranging from one to 15 years who had Gartland type III (9) supracondylar fracture of humerus who were operated through open reduction and internal fixation

and fracture was less than 36 hours old. Exclusion criteria: We excluded the following patients: Pediatric patients with type I and II Gartland fractures, adult patients and patients in whom closed reduction was tried first. After application of criteria furnished we randomized patients into two groups each containing 125 patients. All the patients were managed with open reduction and internal fixation (ORIF) with K-wire under general anesthesia with tourniquet after appropriate physical examination, radiological investigations and pre-anesthesia assessment. Strict aseptic measures were utilized during surgery. After randomization through sealed envelope, one twenty five patients were subjected to ORIF through posterior approach and these patients were grouped together and named group PA. In these patients midline and posterior incision was used to separate the triceps muscle longitudinally after positioning the child in lateral decubitus. After exposure of fracture site, medial retraction and exploration of the ulnar nerve was performed. The bone fragments were reduced and secured by crossing pinning, two in each of columns. Under C-arm fluoroscopy, the fracture's reduction and fixation were assessed once more. Interrupted sutures were used to close the muscle and fascia. After approximation of skin and soft tissue, a splint was applied to maintain forearm in pronation and the elbow in flexion (90degree). The sutures were taken out two weeks later if there was no premature removal due to infection. The pins were removed after 4 weeks of surgery and patients were allowed active motion at elbow joint. The group of 125 patients who were decided to undergo ORIF through medial approach was called as group MA. In all these children, the arm was abducted at 90° in the supine position and a 2-4 cm longitudinal incision was made on the medial epicondyle. The deep, subcutaneous, and cutaneous fascia were all dissected and ulnar nerve was explored and retracted to preserve it . The fracture line was discovered between column in the middle of the brachialis and triceps
muscles. Finger palpation was performed before reduction of fracture and K-wire was introduced under fluoroscopic guidance from medial to lateral aspect. Under C-arm fluoroscopy, the fracture's reduction and fixation were assessed once again. Splints were apllied in same way as group PA patients and stitches were removed after 2 weeks. The k-wires were removed after 6 weeks. All the patients were discharged on 3rd day in absence of any complication. They were requested for follow-up at two weeks for removal of stitches, at 4 weeks for removal of splints. At four weeks and active and passive exercises of limbs were advised to all patients. At six weeks, antero-posterior and lateral radiographs of both arms were done in all patients and K-wires were removed if patients had sufficient evidence of callus formation. The patients' range of motion (ROM) was assessed after K-wire removal. The range of motion and carrying angle was assessed at 8 weeks and range of categorized according to Flynns criteria. (10) The patients were categorized on basis of range of motion as excellent, good, fair and poor. 0-5% loss of function corresponded to excellent ROM, 6-10% loss of motion corresponded to Good ROM, 11-15% loss of motion corresponded to fair ROM and greater than 15% loss of motion corresponded to Poor ROM. The carrying angle was also calculated to evaluate cosmetic outcome and categories were devised as mentioned in Table below. The demographic details (age, weight, gender and operative time) and complications were recorded. . The primary outcome was range of motion and secondary outcome was cosmetic outcome and complications (nerve injury, pin site infection, premature removal of pins and elbow stiffness). The study flow diagram is also presented.

The data was recorded on SPSS (statistical package of social sciences) data sheet. Normality of data was checked through non-parametric test (Kolmogorov-Smirnov test). In case of non-normal distribution, median values and interquartile range was calculated. Frequencies and percentages were calculated for qualitative variables. Chi-square analysis was employed to compute significance. p value less than 0.05 was considered to be statistically significant.

**Table-I: The range of motion (ROM) and cosmetic outcome (CO)**

| Range of Motion (ROM) | Loss of Function (LOF)% |
|---|---|
| Excellent | 0-5 |
| Good | 6-10 |
| Fair | 11-15 |
| Poor | >15 |
| Cosmetic outcome (CO) | Carrying angle |
| Excellent | 0-5% |
| Good | 6-10% |
| Fair | 11-15% |
| Poor | >15% |

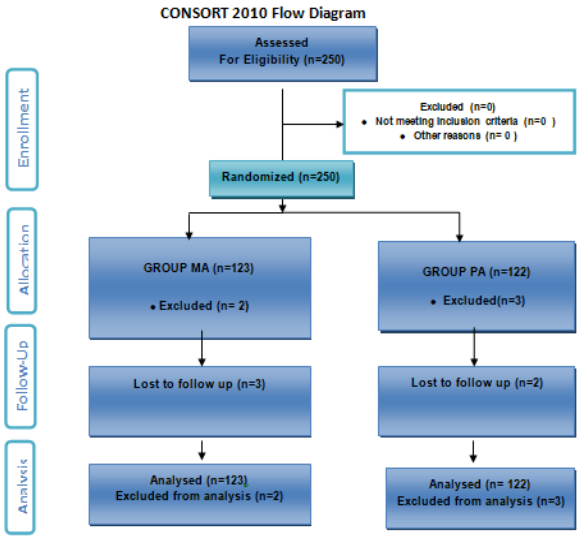


**Figure-1: Study Flow diagram**

**Results**

We enrolled 250 patients in the study but 5 patients could not complete the study protocol and they were dropped from final results. The primary outcome was restoration of range of movement. There were total 245 patients, 123 patients in group MA and 122 patients in group PA. The distribution of quantitative demographic variables was not normal in both groups with p value less than 0.05 when compared through Kolmogorov-Smirnov test. The median age of group MA was 6.00 years with interquartile range (IQR) of 4.00-8.00 years and median age of group PA was also 6.00 with IQR of 4.00-8.00 years. The median weight of group MA patients was 21.00 kg (IQR 17.00-25.00) and group PA patients was 20.50 Kg (IQR 17.00-23.00). The median operative time was 76.00 minutes (IQR 70.00-82.00) in group MA and 78.00 minutes (IQR 73.75.00-87.00) in group PA. The gender distribution was similar in both groups as there were 87(70.7%) males and 36(29.3%) females group MA and there were 93(76.2%) males and 29(23.8%) females in group PA. The demographic parameters are tabulated in Table-II.

The primary outcome was range of motion after surgery. The range of motion (ROM) was excellent in 94(76.4%) group MA patients, good in 25(20.3%) patients and fair in 4(3.3%) patients. The range of motion (ROM) was excellent in 76(62.3%) patients in group PA, good in 35(28.7%) patients and fair in 11(9.0%) patients with p value of <0.05. The outcomes are tabulated in Table-III. The frequency of pin site infection and cubitous varus deformity was minimal in both groups with no significant difference. Three (2.4%) patients developed elbow stiffness in group MA and 5(4.1%) developed elbow stiffness in group PA for which they were advised active limb physiotherapy. One (0.8%) patient developed cubitus valgus in group MA and 7 (5.7%) patients developed cubitus valgus in PA as tabulated in Table-IV.

**Table-II: The demographics parameter of study groups (n=245)**

| Demographic parameter | | Group MAn=123 Median (IQR) | Group PAn=122 Median (IQR) | p value |
|---|---|---|---|---|
| Age (years) | | 6.00(IQR 4.00-8.00) | 6.00(IQR 4.00-8.00) | |
| Weight (kg) | | 21.00(IQR 17.00-25.00) | 20.50(IQR 17.00-23.00) | |
| Operative time | | 76.00(IQR 70.00-82.00) | 78.00(IQR 73.75.00-87.00) | |
| | | Frequency (%) | Frequency (%) | |
| Gender | Male | 87(70.7) | 93(76.2) | 0.203 |
| | Female | 36(29.3) | 29(23.8) | |

**Table-III: The Range of motion (ROM) and cosmetic outcome (CO) of study groups at six weeks of intervention (n=245)**

| | | Group MA n=123 | Group PA n=122 | p value |
|---|---|---|---|---|
| Range of motion (ROM) | Excellent | 94(76.4) | 76(62.3) | <.05 |
| | Good | 25(20.3) | 35(28.7) | |
| | Fair | 4(3.3) | 11(9.0) | |
| Cosmetic outcome (CO) | Excellent | 94(76.4) | 76(62.3) | <0.05 |
| | Good | 25(20.3) | 35(28.7) | |
| | Fair | 4(3.3) | 11(9.0) | |

**Table-IV: The frequency of complications (n=245)**

| | | Group MA n=123 | Group PA n=122 | p value |
|---|---|---|---|---|
| Elbow Stiffness | Yes | 3(2.4) | 5(4.1) | 0.356 |
| | No | 120(97.6) | 117(95.9) | |
| Pin Site Infection | Yes | 2(1.6) | 2(1.6) | 0.686 |
| | No | 121(98.4) | 120(98.4) | |
| Cubitus Varus | Yes | 1(0.8) | 0(0) | 0.502 |
| | No | 122(99.2) | 122(100) | |
| Cubitus Valgus | Yes | 1(0.8) | 7(5.7) | 0.032 |
| | No | 122(99.2) | 115(94.3) | |

**Discussion**

The results of our study showed that medial approach for open reduction of supracondylar fracture of humerus was better than posterior approach in terms of functional and cosmetic outcome. Not only range of motion was better but the side effects like elbow stiffness and cubitus valgus were lower with medial approach. The posterior approach is widely used as it is easy to perform and it provides an extended view of the fracture and it also provided good range of motion in a large number of patients but it resulted in elbow stiffness and cubitus valgus in significant number of patients. Mostly the surgeons are familiar with posterior approach but it has risk of complications. (11) some authors have advocated that medial technique has better outcomes when compared to posterior approach and has the advantage of leaving more aesthetically acceptable scars from medial incisions. (12, 13) The long-term results of 70 patients who underwent various surgical techniques were most recently compared by Kizilay et al (13) and they concluded that the posterior technique produced less functional benefits than the medial and lateral methods. They did note that the medial technique was more advantageous because the risk of ulnar nerve damage is reduced. In our study nerve damage was not seen in any patient although the sample size was large. This is partly due to fact that both posterior and medial approaches are quite safe when it comes to ulnar nerve damage. According to a comprehensive review of literature (14) it was concluded that posterior approach provided a complete reduction and reduced risk of injury to ulnar nerve but it associated with 25% excellent to good results compared to medial approach (83%). The result of their study showed an abvious superiority of medial approach.(14) Our study also favored the medial approach but

according to Sahin et al, both approaches had same functional and radiological outcomes. However in their study, operative time was lower with medial approach. In our study the median operative time was similar in both groups.

The range of motion was better with media approach in our study. According to Juan Pretell Mazzini et al (15) the posterior approach was associated with high rate of poor outcomes. The functional outcome was excellent in 23 patients with posterior approach and 40 patients treated with medial approach. The frequency of poor functional outcome was also higher (13 versus 3). In our study functional outcome was better with medial approach but the difference was low that is range of motion was excellent in 76% patients with medial approach and 62% with posterior approach. According to another study by …et al, the posterior approach was deemed comparable to combined medial-lateral approach. (16) However we used only medial approach and found it superior to posterior approach.

The medial approach had been advocated for the supracondylar fractures which present late which makes this approach a promising and reliable approach. According to Ritabh Kumar et al (17) the medial approach provides excellent view of the fracture site and helps in anatomic reduction. It is devoid of neurovascular complications and helps in regaining range of motion in six weeks post-opetaively. It does not interfere with carrying angle. (18) The range of motion and carrying angle was better preserved in patients managed with medial approach in our study with minimal side effects. This helps to safely recommend the medial approach for open reduction and fixation of supracondylar fracture of humerus.

## Conclusion

We came to conclusion that post-operative range of movement (ROM) of children with of supra-condylar type-III fracture of humerus was better with medial approach compared to posterior approach.

## Declarations

**Data Availability statement**
All data generated or analysed during the study are included in the manuscript.

**Ethics approval and consent to participate**
Approved by the department concerned. (IRBEC-SKBZ-03124-24)

**Consent for publication**
Approved

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Not applicable

## Conflict of interest

The authors declared the absence of a conflict of interest.

## Author Contribution

**HR** (Postgraduate Trainee)
*Manuscript drafting, Study Design,*
**KM**
*Review of Literature, Data entry, Data analysis, and drafting articles.*
**SHK** (HOD)
*Conception o*(Senior Registrar)*f Study, Development of Research Methodology Design,*
**IA** (Consultant)
*Study Design, manuscript review, critical input.*
**S** (Ex Medical Officer),
*Manuscript drafting, Study Design,*

*All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the integrity of the study.*

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