Is Medial Approach better than posterior approach for open Reduction & Internal Fixation of Supracondylar Fractures of Humerus in Children?

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ABSTRACT

Objectives: The aim of this study is to find that whether the medial surgical approach is beneficial to patients in term of radiological and functional outcome as compared to posterior approach for open reduction & internal fixation of displaced Supracondylar fractures of the humerus in children.

Materials & Methods: It is a descriptive study conducted at department of Orthopaedic Surgery SKBZ/CMH Muzaffarabad from June 2020 to June 2021 on pediatric patients admitted with Gartland III supracondylar fractures of the humerus managed by open reduction & internal fixation using K-Wires via posterior & medial approach.

Results: 113 children were included in this study. They were divided in to 2 groups. Group I managed with Open Reduction and Internal Fixation (ORIF) using medial approach and included 63 patients .Group II were managed with ORIF using posterior approach and included 50 cases. Flynn's criteria was used to assess the cosmetic and functional outcomes of the ORIF. 97 % had satisfactory functional outcome in medial approach while 90 % gained satisfactory results in posterior approach group both approaches had almost same cosmetic outcome in term of regaining carrying angel. Mean surgery time was 40 ±15 minutes with medial approach white it was 75±16 that was markedly significant.

Conclusion: Although different surgical approaches are used for ORIF of supracondylar fractures of humerus in children, but medial approach is safe, less time consuming and best scar acceptance than posterior and lateral approaches.

Keywords: Supracondylar fractures, medial approach, posterior approach, Open reduction & internal fixation

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INTRODUCTION

The most common fracture in pediatric population aged 2-12 years is supracondylar humerus fracture. It accounts for 50-70 % of all upper extremity fractures in children[1]. Supracondylar humerus fractures can be classified according to Gartland system into types I, II, III[2] (table I). There are also type IV fractures, a category introduced recently to describe multidirectional fractures. 98 % of the fractures are of extension type and are caused by fall on outstretched hand. The fracture management also depends upon the type of fracture. Most of the undisplaced type I fractures are usually managed by POP cast immobilization for a period of 3-4 weeks[3]. Closed reduction ad percutaneous K-wire fixation Is gold slandered management for type II fractures[4]. While Open reduction & internal fixation is considered the best way of management of Gartland III fractures, open fractures or fractures associated with vascular injury[2]. Most common causes of supracondylar fractures in children are trauma, fall from height and sports activities[5]. The annual incidence of supracondylar fracture of humerus is estimated about 188 /100000.It is the 2nd most common fracture of children[6]. These fractures are

sometimes associated with significant morbidity due to compartment syndrome, neurovascular injury and malunion leading to cubitus varus deformity. Initiallt these fractures were managed with closed reduction and forearm immobilization above 100 degree flexion of elbow joint. This may lead to neurovascular compromise and subsequent volkman ischemic contracture[7]. There is no single recommended approach for open reduction & internal fixation of these fractures. The main aim of open reduction is to achieve anatomical reduction of fracture as accurate as possible to avoid varus deformity .Different surgical approaches used for open reduction are medial[8], posterior[9] lateral[10,11], combined lateral & medial[12] and rarely anteromedial. Two most commonly used approaches are posterior and medial. However posterior approach leads to joint stiffness because of myositis ossificans as well as give poor exposure of anterior surface of fracture. Medial approaches provide excellent view of anterior, posterior and most important communated medial column thus providing excellent medial column restoration. Medial column comminution is not visible in lateral and anterior approach that may lead to cubitus varus deformity later on[12]. Blind insertion of medial K-Wire lead to sometime ulnar nerve palsy. We used Flynn's criteria to assess functional and radiological outcome as well as patient questionnaire about surgical scar cosmetic appearance (Table II)

METHODS

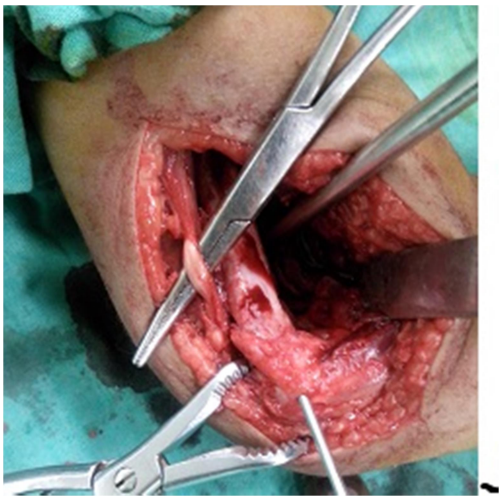
This descriptive study was conducted at department of Orthopaedic Surgery AKCMH Muzaffarabad from June 2019 to June 2021. Gartland system of classification[2] was used to classify the fractures (Table no I). Only displaced fractures Gartland type III were included in this study that could not be managed by closed reduction. Open fractures or fractures with neurovascular injury and patients presented late more than one week were not included .Written informed consent was taken from all patient's parents. 113 patients were included in this study. 63 patients were operated using medial approach while 50 patients were operated using posterior approach. All cases were operated by both senior consultants having more than five years of experience, one used always medial approach while second experienced in posterior approach. The mode of injury was fall from trees (n=62), sports injury (n=45) and others (n=6). 69 patients were male while 44 patients were female (M: F ratio 1.56:1). Mean age was 8.50 ± 2.05 years. 97(92 %) patients had extension type while 8 (9%) patients had flexion type fractures. These patients were divided into 2 groups. Group 1 included 63 patients and were managed by medial approach for ORIF.While group II were managed by posterior approach and included 50 patients.

In medial approach patient is put in supine position with the arm placed on side table. After general anaesthesia patient is draped .A tourniquet is placed high above the arm to control bleeding as well as to calculate duration of surgery .The upper limb was placed on side table in abduction and external rotation. A 4-5 cm medial incision was given centered on the tip of medial condyle of the humerus .Ulnar nerve was identified below the tip of medial condyle and separated (picture II). Plane between triceps and biceps was opened by blunt dissection. Joint capsule is opened to drain the hematoma. Fractured ends are cleared and any periosteum trapped in between fractured fragments is incised. Proximally fragment , that is usually pushed through brachialis, is delived back .The distal fragment is usually internally rotated. Proximal fragment is brought in anatomical reduction with distal fragment. Anterior and posterior surface of fractured fragments are looked for any malalignment, while the lateral column alignment is assessed by palpation to look for any step. Medial column is fixed with the help of one or two K-Wires In as much accurate anatomical position as possible. While lateral K- Wire is passed through palpable lateral column at 90 ° of medial Wire .Reduction is checked by C-Arm .Once satisfactory reduction achieved wound washed and then closed subcutaneously to gain nice and fine scar. All movements of elbow joint are checked .Above elbow POP back slab given with the arm in semi prone position and flexed at 90 °.Post operative check X-Ray (picture III) taken and neurovascular status checked Patient discharged on 3rd day and rest of the follow up same as in posterior approach.

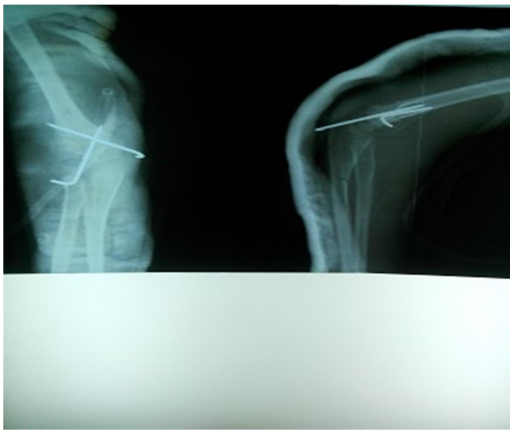
Group II Posterior approach included 50 cases. After general anaesthesia patient is turned to lateral side with the forearm hanging by support with operation table. After applying tourniquet the whole limb is prepared and draped. In posterior approach a modified Von Garder's incision is used. A 5-6 cm midline incision is given posteriorly centered at tip of olecranon process and extend 2 cm distal to it. After subcutaneous dissection triceps aponeurosis is exposed. Ulnar nerve is identified and separated. A reverse V shaped incision is given at musculotendinous junction to reach the fracture site. Fracture reduced and held by 2/3 crossed K-Wires. Triceps aponeurosis is stitched with vicryl 1 suture.

Subcutaneous tissue closed and skin incision is closed with proline 2/0 or skin stapler. In both groups reduction confirmed by fluoroscope. Above elbow POP back slab was given with the arm in semi prone position and flexed at 90 °. In both cases skin to skin time was noted using pneumatic tourniquet timer.

Pic I: Trauma X-Ray



Pic II: Perop Ulnar Nerve

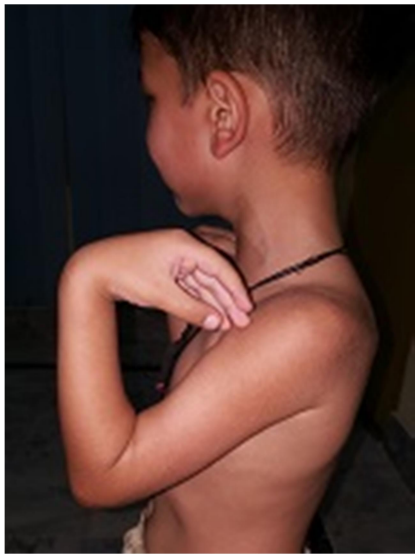


Pic III: Postop X-Ray

Pic IV: Follow up X Ray

Pic V: Follow up X-ray

Pic VI: Follow up ROM



Pic VII: Follow up ROM

Pic VIIII: Scar of posterior incision

Pic IX: Scar of medial incision

FOLLOW UP/RESULTS

In both groups POP removed at 4th week and gentle ROM exercises started. K – Wires removed at 6th week to prevent refracture of soft callus during early rehabilitation.AP and lateral view of the elbow joint taken preoperatively, 1st post op day, 4th week, 6th week,3rd month and 6th months interval.Radiograhic and functional outcomes of the patients checked at 3rd month and 6th month .Baumann (carrying angel) was used for radiological parameter while range of motion was used to assess functional outcomes using Flynn's criteria[15] (Table No. II). A subjective question regarding patient satisfaction about surgical scar was also taken. Results were collected on a proforma and assessed using SPSS II. Fracture union was defined as formation of soft callus on at least three cortices. Mean union time was not significantly different (p=0.350) in both groups. In group I mean union time was 16.7 (16-28) and 19.8 (18-33) days in posterior approach group II. The mean operating time was 40 ±15 minutes in group I, while it was 75±16 in group II. It was significant (p=0.003).Most probably more time was consumed in posterior group for triceps aponeurosis incision and closure as well as to locate ulnar nerve. No case of iatrogenic neurovascular injury, compartment syndrome, delayed /nonunion and major wound infection was reported in both surgical techniques. None of the patient had cubitus varus deformity or volkman ischemic contracture .successful (100 %) healing was achieved in both groups at about 60 days. In group I the mean carrying angel measured was 9.2° as compared to mean contralateral carrying angel of 10.5° (5°-16°) shown in table III. 54(85%) patients achieved excellent results, 4(6.5%) patients had good results while 2 (3%) patients got fair outcomes. The outcome was unsatisfactory in 3 (5.5%) patients most likely was due to initial managed by quack that lead to decreased range of motion .All 63 (100 %) patients were satisfied with the scar appearance because scar was hidden **(picture no.).** 12 cases of superficial pin tract infection were noted that also resolved without any antibiotics administration. Decrease in carrying angel (measured clinically on extended elbow with goniometer was 3.69° (range 0-16, SD: 3.17) and was 4.4°in group II (p=0.91).When ROM scores were assessed 61 (97%) gained satisfactory results wile 2 (3%) patients had markedly decreased ROM.

In group II 50 patients were included in the study. Mean carrying angel was 9° as compared to mean contralateral carrying angel of 10.3° (5°-16°) shown in table III. When Flynn criteria was used 35 (70%) patients had excellent result,4 (8%) got good results ,6 (12%) had fair and 5 (10%) patients had poor results. Overall 90% patients had satisfactory score in group II as compared to 95% score in group I.40 (80%) patients were satisfied with their scar

appearance. When functional outcome was assessed using Flynn's criteria 45 (90%) patients had satisfactory Results while 5 (10%) patients got poor functional results.

When Flynn criteria was used to assess the cosmetic outcomes in term of change in carrying angel 90 % children had excellent results while 10% children got good results. In posterior approach group 84 % children had excellent outcome while 16 % children had good results.

In another study Eren at all[22] compared the medial approach with lateral approach. He found better functional outcomes with medial approach while cosmetic results were same in both approaches.

Table 1: Gartland Classification of Supracondylar fractures of the humerus in children

Type I	Non-displaced
Type II A	Intact posterior cortex, hinged in extension. No rotation or translation.
Type II B	Intact posterior cortex, hinged in extension, with some degree of rotational displacement or translation.
Type III	Complete displacement.

Table 2: Flynn's criteria []

	Rating	Loss of carrying angle	Loss of motion
Satisfactory	Excellent	0-5°	0-5°
	Good	5°-10°	5°-10°
	Fair	10°-15°	10°-15
Unsatisfactory	Poor	≥ 15°	≥ 15°

Table 3: Patients outcome according to Flynn's criteria

	Excellent	**Good**	**Fair**	**Bad**
Functional				
ROM loss (°)	**0-5°**	**6°-10°**	**11°-15**	**≥ 15°**
Medial(n=63)	55(87%)	4(7%)	2(3%)	2(3%)
Posterior(50)	35(70%)	4(8%)	6(12%)	5(10%)
Loss of carrying angel (°)	**0-5°**	**6°-10°**	**11°-15**	**≥ 15°**
Medial	57(90%)	6(10%)		
Posterior	42(84%)	8(16)		

DISCUSSION

As AKCMH Muzaffarabad is located in a mountain area rich with walnut trees and lots of fruits trees. That is why lots of children presented in Accident and Emergency department with history of fall from trees and sustained mostly upper limbs fractures. Most common of upper limb fractures in children are forearm fractures followed by supracondylar fractures of the humerus and then fracture of lateral condyle[6]. Most of these fracture occurs in skeletally immature children in a mean age of 6-7 years. It is because supracondylar area is thinner as compared to cylindrical cortex so can easily break. In more than 90 % of cases distal fragment is usually displaced posteriorly[13].The management of severely displaced supracondylar fractures of the humerus is also challenging. The main goals in the management of supracondylar fractures of humerus in children are : full recovery of range of movements of elbow joint, avoidance of any neurovascular compromise and good cosmetic outcome of surgical scar[14]. Although most of the type I & II Gartland fractures are managed by either closed reduction alone or

combined with percutaneous K wire fixation using C arm fluoroscope[4]. But lack of such facilities in emergency department particularly in developing countries and inability to gain good anatomical reduction and fixation in severely displaced fractures need open reduction and internal fixation. Furthermore some time closed reduction and percutaneous K-Wire fixation lead to iatrogenic ulnar nerve injury in 4 -15 % cases[15]. Excessive swelling around elbow joint in severely displaced fractures also make it difficult to achieve anatomical reduction. As in most of the cases distal fragment is rotated internally and associated with medial column comminution that can lead to loss of carrying angel that is one of the late complication[16]. Biomechanical studies also showed that medial component of distal humerus is also under more stress and strain forces under axial load as compared to lateral column. Therefore internal rotation of distal fragment lead to varus deformity and is necessary for coronal tilt to corrected. Although it is hard to look for medial column angulation on immediate postoperative X -r ay but measurement of Baumann's angel give prediction of final carrying angle and success of closed reduction. Failure to achieve anatomical reduction need ORIF[16]. Furthermore closed reduction may be difficult to achieve in old neglected cases ±specially in developing countries where patients have trend first to consult local bone settlers[17] There are four different types of surgical approaches used for ORIF of supracondylar fractures of the humerus[18]. All approaches have their own advantages/ disadvantages. Until now there are no single set standard regarding time of surgery, surgical approach and K-wire configuration. Some surgeons prefer to put K wires only from lateral column side to avoid iatrogenic ulnar nerve injury while most of the surgeons use crossed k wire procedure[19]. In a study conducted by Wieland higher incidence of cubitus varus deformity was seen because of poor judging the medial column pathology[20]. It is still debatable which surgical approach is preferable when ORIF of supracondylar fracture is required. When Flynn's[15] criteria is used to assess the functional and cosmetic outcomes Ramsey et all observed 95% and Barlas et al[21] seen 90 % good to excellent results. Eran et al compared medial approach with lateral approach He found 95% good functional and 100 % cosmetic results with lateral approach while it was 100% good to excellent both functional and cosmetic outcomes with medial approach[23]. Regarding duration of surgery from skin to skin the mean operation time in posterior approach was 70±12 minutes while it was 35±15 minutes in medial approach. This difference may due to direct visualization and easy fixation of medial column. Furthermore in posterior approach time is consumed in incising the triceps aponeurosis and then repairing it as medial incision used virgin plane. In medial incision we use an intermuscular plane between triceps and biceps brachi thus avoiding any damage to virgin tissue surrounding the elbow joint. While in posterior approach triceps muscle is cut and repaired which ultimately lead to tissue scaring around the elbow joint. This lead to delay in rehabilitation process and ultimately some restrictions in elbow joint movements .Kessler reported 3 % decrease in power of triceps muscle in posterior approach[23]. Medial approach also provides a direct visualization of Ulnar nerve throughout the surgery which prevents iatrogenic ulnar nerve palsy. In lateral incision blind K – Wiring lead to 2-3% incidence of ulnar nerve injury while no such injury has been seen in literature in medial approach[24].

CONCLUSION

Medial surgical approach for open reduction and internal fixation of displaced supracondylar fractures of the humerus in children is better than posterior surgical approach. It is safe, cosmetically excellent with minimal risk of iatrogenic neurovascular injury. Posterior surgical approach has more incidences of elbow joint stiffness as well as exposed surgical scar. The operation time was also significantly less with the medial approach as compared to posterior approach.

Conflict of Interest: None

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