Open Journal of Orthopedics, 2016, 6, 113-119
Published Online May 2016 in SciRes. http://www.scirp.org/journal/ojo
http://dx.doi.org/10.4236/ojo.2016.65017

Assessment of the Outcome of Anterior versus Posterior Approach in the Management of Displaced Pediatric Supracondylar Humerus Fracture

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Received 3 April 2016; accepted 20 May 2016; published 24 May 2016

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Abstract

***Background*: Supracondylar fractures of the humerus are among the most common type of pediatric fractures. The outcome of severely displaced supracondylar fracture of the humerus in children subjected to wide controversies in term of safety, functional and cosmetic outcome. Closed reduction and percutaneous pinning is now considered as the gold standard rule, but open reduction still applicable in certain cases where intraoperative imaging is not available, in comminuted lateral column fractures and uneducable fractures. *Aim of the Study*: To compare the outcome (functional and cosmetic) of anterior (Henry) approach with the posterior (Campbell) approach used in two groups of patients' sustained displaced supracondylar fractures. *Patients and Methods*: This prospective study was performed on 48 pediatric patients who were been admitted to the Emergency Hospital in Sulaimani province sustained displaced supracondylar humeral fractures and treated during the period from the first of October 2009 to the thirty-one of January 2011. The study included 28 boys, 20 girls; their mean age was 7.5 years; their ages range 2 - 13 years. We used the modified Gartland classification to assess the fractures displacement and only Gartland type II B and III were included and managed operatively by open reduction and internal fixation with 2 crossed K-wires. Follow up continued for 6 months and the results finally assessed using Flynn's criteria. *Results*: According to the criteria of Flynn *et al.*, 20 patients (83.3%) treated by the anterior approach had excellent functional results while 4 patients (16.7%) had good functional results. While those treated by the posterior approach, 16 patients (66.6%) had excellent functional results, 6 patients (25%) had good results and 2 (8.3%) patients had fair outcome. Cosmetic results were excellent in 22 patients in the anterior approach group and 20 patients in the posterior approach group. *Conclusion*: Posterior Campbell approach is simpler than anterior Henry approach, but it creates additional soft tissue damage that can affect the circulatory status and**

How to cite this paper: Fatah, R.M.N., Amin, B.R.M., Mahmud, H.A. and Yusif, A.J. (2016) Assessment of the Outcome of Anterior versus Posterior Approach in the Management of Displaced Pediatric Supracondylar Humerus Fracture. *Open Journal of Orthopedics*, **6**, 113-119. http://dx.doi.org/10.4236/ojo.2016.65017

hence possible osteonecrosis of the trochlea and a higher percentage of limitation in joint mobility. While the anterior approach is technically more demanding, but it gives better functional results.

Keywords

Supracondylar Fracture, Anterior Henry Approach, Posterior Campbell Approach

1. Introduction

Supracondylar fracture is a fracture of the distal humerus just above the epicondyles that runs transversely through the coronoid and olecranon fossae of the humerus [1]. It constitutes 16.6% of all pediatric fractures and 60% - 70% of all elbow fractures. These fractures are mostly encountered in children who are less than 8 years old. Generally, extension type fractures seen after falling on an outstretched hand (95% - 98%). The major factor that may contribute to the predisposition of these fractures is ligamentous laxity [2].

Conservative treatment is preferred in non displaced fractures whereas surgical option takes over in displaced fractures [1]. Percutaneous pinning of such fractures was first described by Swenson [3] and subsequent studies of Flynn *et al*. [4]. Open reduction and internal fixation of the severely displaced supracondylar fracture of the humerus is now an accepted primary treatment modality [5]. It is a safe procedure yielding good results [5].

The anterior approach is not a new one; it was first described by Hagenbeck in 1894. Carcassonne; Bergoin and Hornung started to use the anterior approach again at the beginning of the 1970 [6]. The Gartland classification [7] [8] of supracondylar humeral fractures is the most commonly accepted and used system [8].

2. Patients and Method

This is a prospective study carried out on 48 pediatric patients who were admitted to the Emergency Hospital in Sulaimani province sustained displaced supracondylar fracture of the distal humerus and treated during the period from the first of October 2009 to the thirty one of January 2011. Fractures were evaluated according to modified Gartland classification system [7] and only type II B and III fractures were included in the study (**Figure 1(a)** & **Figure 1(b)**),we excluded concomitant vascular injury, associated nerve injury and flexion type. The Causes of injuries were fall on the outstretched hand in 42 patients, and fall from high place in 6 patients. All patients had extension type fractures. Their fractures were evaluated by anteroposterior and lateral roentgenograms after applying a temporary splint to immobilize the fracture (**Figures 1(a)-(c)**). After all, these patients prepared for surgery and operated upon. 22 patients were operated on in the first eight hours, the rest were operated on between 9 - 24 hours after injury; the mean duration before surgery was 10.08 hours.

Patients were divided randomly into two categories: the first category was those who were treated using *anterior approach* which included 24 patients, while the second category underwent surgery by *posterior approach*

(a) (b) (c)

Figure 1. (a) shows AP and lateral X ray of Gartland type III fracture shows type III. (b) (c) Temporary splint.

that also included 24 patients.

There were 28 male and 20 female cases. Our study showed higher prevalence of 28cases (58%) of left side fractures while there were 20 cases (42%) of right side fracture.

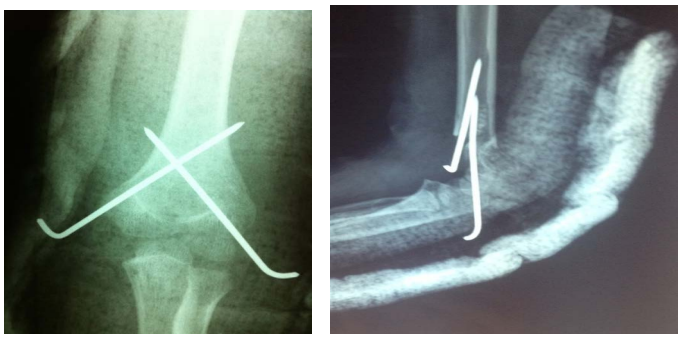
The first group who were treated by anterior approach included 18 cases (75%) of grade III fracture and 6 cases (25%) of grade IIB while the second group there were19 case of grade III (79.1%) fracture and 5 case of grade IIB (20.9%).

All patients who were admitted to emergency department, a complete history and physical examination undertaken carefully. Special attention was made for exclusion of vascular injury and thorough nerve examination was done. Ethical approval was obtained from the Institutional Review Board of Sulaimani University hospital. Informed consent was obtained from both parents prior to the procedure; though some parents understood the right of voluntary participation and withdrawal from the trial. After those informed consents were taken from the parents about the anaesthesia, the approach type and the possible complications including tourniquet palsy, risk of ulnar nerve injury and wound infection. Surgeries were performed under general anaesthesia; pneumatic tourniquet was applied, closed reduction done first to reduce skin tenting (**Figure 2(a)**), the standard. Henry approach of the distal humerus uses the interval between the brachialis and brachioradialis muscles with protection of the radial nerve was applied for the anterior group while standard Campbell approach which involve vertical split in the substance of the triceps tendon was used for posterior approach. The K wires inserted in crossed manner in both groups and their ends kept outside and bent (**Figure 2(b)**, **Figure 3(a)** & **Figure 3(b)**). For both groups, repeated neurovascular examination post-operatively undertaken and follow up kept up to 2 weeks when the stitches were removed and the posterior splint changed. Four weeks after surgery, the posterior splints were removed, and radiographic signs of callus formation were used to confirm the union. The follow up period was divided into 3 intervals according to Flynn criteria (**Table 1** & **Table 2**) [4]: the early results which started from the first day to 4 weeks post operatively, the second interval was between second and fourth (**Table 3** & **Table 5**) months and the last follow up was at sixth month and represented the late results (**Table 4** & **Table 6**).

All the related data were entered to the excel program and analysed by SPSS programme and P value estimated for the variables, significance was set at P value < 0.05.

(a) (b)

Figure 2. [9] (a) the position of the limb after reduction. (b) shows the position of the wires after insertion.



(a) (b)

Figure 3. (a) shows the fracture after reduction and fixation by k wires in AP views. (b) shows the lateral view of the same fracture.

Table 1. Shows Flynn's criteria for cosmetic and functional outcome [4].

Rating	Loss of motion (˚)	Carrying angle (˚)
Excellent	0 - 5	0 - 5
Good	5 - 10	5 - 10
Fair	10 - 15	10 - 15
Poor	>15	>15

Table 2. Shows combined Flynn's criteria when the carrying angle and loss of motion scores were combined [4].

	Satisfactory		Unsatisfactory	
	Excellent	Good	Fair	Poor
Gartland II	5	5	0	3
Gartland III	10	10	2	18
Total		32		21

Table 3. Shows secondary results of anterior approach in the period between (2 - 4) months.

Degree of motion loss	No. of patients
<10˚	4
10˚ - 20˚	10
21˚ - 30˚	8
>30˚	2
Total	**24**

Table 4. Shows cosmetic and functional results in anterior approach.

	Cosmetic Difference in car carrying angle (˚)	Functional Loss of range of motion (˚)
Excellent 0 - 5	11	10
Good 6 - 10	1	2
Average 11 - 15	0	0
Poor > 15	0	0
	P value = 0.426922	

3. Results

3.1. Anterior Approach Group

- Early results.

We had two cases of ulnar nerve palsy treated conservatively, infection was reported in one case which was treated by oral antibiotics, there was no compartment syndrome reported, mild anterior displacement was reported in two cases because of comminution of the lateral column.

- Secondary (intermediate) results between 2 and 4 months (**Table 3** & **Figure 4**)
- Late results include final assessment at sixth month (**Table 4**).

3.2. Posterior Approach Group

- Early results

Early results of posterior approach didn't report any complication except one case of infection, which was treated by oral antibiotics.

- Secondary results (**Table 5**)
- Late results at 6 months (**Table 6**)

4. Discussion

Although supracondylar fracture nowadays being treated by closed reduction and percutaneous K wire, still open reduction is indicated in several situations, in the presence of vascular injury and in places where there is lack of availability of imaging tools inside the theatres [3] [10] and unreducible fractures. We compared the results of our study with that of the original study made by Gennari *et al*. (1998) [11].

Figure 4. [9] Results after 3 months of surgery by anterior approach (a) Extension loss of 17˚, (b) flexion, 130˚, (c) the normal carrying angle is restored.

Table 5. The secondary results of posterior approach.

Degree of motion loss	No. of patients
<10˚	2
10˚ - 20˚	8
21˚- 30˚	8
>30˚	6
Total	**24**

Table 6. The cosmetic and functional results in posterior approach.

	Cosmetic Difference in carrying angle (˚)	Functional Loss of range of motion (˚)
Excellent 0 - 5	10	8
Good 6 - 10	1	3
Average 11 - 15	1	1
Poor > 15	0	0
	P value = 0.330180	

The results were assessed and graded according to Flynn's criteria [4], The mean age in our study was 7.5 years, which was approximately similar to the mean age in Gennari *et al*. study [11].

Regarding sex prevalence, our study showed a male to female predominance (58.33% compared to 41.67%, respectively); these data where similar to that of Gennari *et al*. study which also revealed a male predominance, Ersan [12] published similar results.

Left sided fracture was more than right side (58% versus 42%, respectively), the left side predominates over the right side in other studies also [11]-[14], when we Compared the technique between the two groups, we found that the anterior approach is a more delicate technique as reduction is aided by the surgeon's thumb and because the fracture fragments are not easily seen in this approach. Moreover, the smaller surgical field of the anterior approach makes the insertion of the K-wires much more difficult to achieve. This approach was much easier to perform for Gartland type II B in which the posterior periosteum is intact and hence facilitates reduction. On the other hand, the posterior approach showed easier reduction and smoother K wire insertion, we reported one case of infection each group (4.1%), Gennari *et al*. study reported three cases (10%) in the anterior approach group and on e cases (3.3) in the posterior approach, Ersan [12] reported 2 cases (6%). Iatrogenic ulnar nerve palsy was reported in one case that underwent surgery by the anterior approach which was recovered 9 weeks after surgery, Ersan [12] reported one case of radial nerve injury.

Four months after surgery, secondary results indicated the speed of recovery of elbow movement with much shorter time for the anterior group in comparison with the posterior approach. Only four cases (16.6%) treated with the anterior approach showed a decrease of range of motion of 10˚ or less compared to 13.3% in Gennari *et al*. study, while the rest exhibited excellent results (83.4%) in comparison to 86.6% according to Gennari, whereas four cases (16.6%) treated with the posterior approach showed a deficit in flexion and extension this was compatible with 16.6% in Gennari *et al*. study; Ersan had 31 excellent (67%) and 15 good results (33%); there were no poor and bad results, he used a small transverse incision at the cubital fossa [12].

Moreover, a higher number of cubitus varus was observed with the posterior than with the anterior approach, (four cases 16.6% in the posterior approach group versus two cases 8.3% in the anterior approach group). This could be related to the dissection of the posterior part of the medial condyle and possible osteonecrosis of the trochlea as described by Rigault [15]. According to Gennari *et al*., 1 patient (9.3%) had a cubitus varus of less than 10˚ in the anterior approach group while 2 patients (16.6%) were left with cubitus varus of less than 10˚ in the posterior approach group.

The anterior approach doesn't make any damage, because it crosses an area already affected by the trauma. The posterior approach crosses the non injured zone and causes additional trauma. This explains the longer recuperation time observed in children with posterior approach. This study showed improved functional results when the anterior rather than the posterior approach was used: 10 versus 8 improvements ($p = 0.322177$), respectively, these results were also comparable to Ersan *et al*. study [12].

The throng of the posterior approach is much more numerous [15] [16]. However, for more than 20 years, the percentage of excellent and good results with the posterior approach has not increased [17]. The posterior approach is inadequate, contributing to the poor and bad results in a lot of published studies [1] [18]-[22]. Because the posterior approach injures the extension apparatus unnecessarily, it commonly results in a limitation of the extension with possible damage to the trochlear blood supply [17].

5. Conclusions

1) The anterior approach requires more surgical skills to perform than the posterior approach, especially because the simultaneous reduction and manipulating the K-wires seems to be a difficult task. However, the drawbacks in the use of the anterior approach have only a slight effect on the final result.

2) The posterior approach provides better visualization of the fracture site and allows exploration of the ulnar nerve which will be protected during medial K-wire insertion and it is technically easier to perform than the anterior approach.

3) Medium and long-term results are more satisfactory with the anterior than with the posterior approach. No case manifested a poor result, and the range of motion was better in the treated limb. Our study had some limitations, first the small sample size, secondly our follow up period was six months only, we have to keep longer follow period to give more confirmative long term outcome of the complications

We recommend that The anterior approach is better to be performed for grade II B fractures in which the posterior periosteum remains intact for the reasons mentioned above while For severely displaced Gartland type

III fractures, or when there is a comminution affecting the medial or lateral condyles in which percutaneous pinning is difficult to perform, reduction of the fracture fragments via the posterior approach will be better.

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