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Outcome of Percutaneous Pin Fixation of Supracondylar Fracture Type 2 And 3: A Hospital Based Retrospective Study in Jalalabad Ragib Rabeya Medical College Hospital, Bangladesh.

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Abstract: ***A*** *supracondylar fracture is a physical damaged and badly inured to the humerus, or at its narrowest point of upper arm bone just above the elbow. Children are mostly suffered by Supracondylar fractures which are the most common type of upper arm injury.[i] They are frequently caused by a fall on an outstretched elbow or a direct blow to the elbow. [ii]These fractures are relatively rare in adults.[iii] Supracondylar fracture are further classified into three main types depending on how much the upper arm bone (humerus) has been displaced. Our study was to determine and compare the outcome of percutaneous pin fixation of supracondylar fracture in type 2 and type 3. We have reviewed 100 patients who received displaced supracondylar fractures during our study period. We analyzed their case records, fracture classification, treatment methods, delay surgical procedure, duration of surgery, wire configuration, Bauman's angle, radiocapitellar alignment and complications. During the study period, we admitted 105 patients in the hospitals and patients received different kinds of wire configuration and stabilized. Out of 105 patients, 9 were managed nonoperatively, and 12 were managed with a manipulation under anesthesia. None of these patients had any complications. All the remaining 83 patients were treated with K-wiring, either crossed or lateral. 51 patients were managed with crossed K-wires and 22 were managed with lateral K-wires. Out of these patients managed with wire stabilization 14.4% (12 patients) developed complications, including 6% (5 patients) with significant complications including nerve injuries (2 patients) and fracture displacements (2 patients). The mean Baumann's angle was 81.6 degrees in the group with no complication and 70.6 degrees in the significant complication group (p=0.02). Satisfactory performance were visible in the radiocapitellar line and anterior humeral line were not satisfactory in 8% and 18% of the group with no complications, and 9% and 17% of the group with significant complications.*

Key words*: Supracondylar fracture ,Bauman's, Humerous,Radiocapiteller, percutaneous*

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I. Introduction

A supracondylar humerus fracture is a fracture of the distal humerus just above the elbow joint. The fracture is usually transverse or oblique and above the medial and lateral condyles and epicondyles. This fracture pattern is relatively rare in adults, but is the most common type of elbow fracture in children.[iv] It is commonly found in children between 5 and 7 years (90% of the cases), after the clavicle and forearm fractures. It is more often occurs in males, accounting of 16% of all pediatric fractures and 60% of all pediatric elbow fractures.[v] Although these injuries are relatively rare, most orthopedic surgeons are called upon to evaluate and treat patients with these injuries and, therefore, must be equipped to achieve optimal outcomes.[vi],[vii],[viii]Supracondylar fractures are initially divided into two types, depending on the direction of displacement of the distal fragment. One is Flexion-type (rare) - distal fragment is displaced anteriorly another Extension-type (98%) - distal fragment is displaced posteriorly. Based on the extension type to describe the severity of displacement, supracondylar fractures are divided into 3 types (Garlands classifications)[ix]: Type 1. Undisputed fracture Type 2: Angulated fracture with intact posterior cortex. Type 3: Displaced distal fragment posteriorly, no cortical contact. A displaced fracture in extension typically has an S-shaped deformity. Swelling can be very rapid. Younger children can present with the appearance of a dislocated elbow. Percutaneous pinning are usually inserted over the medial or lateral sides of the elbow under X-ray image intensifier guidance. Percutaneous pinning after closed reduction of supracondylar fractures has got several advantages. Immediate fixation of these fractures reduces the duration of hospital stay. If the fracture is fixed immediately after closed reduction it can be splinted in a safe position without any fear of loss of reduction. This minimizes the risk of compartment syndrome and maximizes circulation.[x]There is 1.8 times higher risk of getting nerve injury when inserting both medial and lateral pins compared to lateral pin insertion alone. However, medial and lateral pins insertions are able to stabilize the fractures more properly than lateral pins alone. Therefore, medial and lateral pins insertion should be done with care to prevent nerve injuries around elbow region.[xi]Clinical signs that

indicate urgent orthopedic review in the ED include: absence of radial pulse ischemia of hand: pale, cool severe swelling in forearm and or elbow skin puckering or anterior bruising open injury neurological injury. Clinically deformed fractures should be immobilized in about 30 degrees short of full extension, prior to x-ray evaluation. This is important for pain management. Anteroposterior (AP) and lateral x-rays of the distal humerus (not elbow) should be obtained. If there is any clinical suspicion of injury in the forearm or wrist then separate films of these areas should be ordered. [xii]Based on clinical radiological examination, Percutaneous pin fixation need to be done when close manipulation fails to achieve the reduction, unstable fracture after closed reduction, neurological deficits occurs during or after the manipulation of fracture, and surgical exploration is required to determine the integrity of the blood vessels and nerves.[xiii] Type 1 treatment in nonoperatively in an above-elbow plaster cast with the elbow in 60-90 degree flexion's for 3 weeks with identified radiological assessment for further displacements. Type 2 and type 3 are treated normally with closed reduction and percutaneous pin fixation for preventing malnunion

II. Material & Method

Study design and sampling: A Retrospective study conducted on 105 patients from both rural and urban area. Admitted in orthopedic department of Jalalabad ragib rabeya medical college hospital, sylhet, Bangladesh from November 2012 to November 2016. Patient were closely monitored and collected their demographic overview. We carried out to review case notes, collected theatre records and radiological assessment ,determine the age of the patients ,classification of the fracture, treatment method, delay to theatre, duration of surgery, types of wire configuration.

Study subjects

We have identified and reviewed 100 cases of displaces supracondylar fractures in children aged 2-10 years. Those children required immediate management who were treated by closed reduction and percutaneous pinning fixation for greater functional outcome of the patients. We have identified treatment category considering Garland's classifications.

Technique of Percutaneous wire fixation:

Percutaneous K-wiring is the most widely advocated method to stabilize displaced supracondylar fractures after reduction. There is no clear consensus on the configuration of K-wiring. Commonly used configurations include a crossed configuration with a medial and a lateral K-wire, and lateral configuration with two lateral K-wires

This procedure is used for both type II and type III fractures after preoperative evaluation. Under general anesthesia and under C arm fluoroscopy, closed reduction is done. Both anteroposterior and lateral images must confirm good reduction which is very important for a good outcome. When using crossed k wire, medial k wire fixation carries the risk of ulnar nerve compression or injury, so care was taken to avoid that. After the fixation, the elbow was moved through its full range.[xiv]

Percutaneous pinning were usually inserted over the medial or lateral sides of the elbow under X-ray image intensifier guidance. There is 1.8 times higher risk of getting nerve injury when inserting both medial and lateral pins compared to lateral pin insertion alone. However, medial and lateral pins insertions stabilized the fractures more properly than lateral pins alone. 2nd and 3rd Postoperative weeks were followed carefully. Even X rays were taken to identify any callus formation considered in lateral points. After slab removal and any swelling if have identified or any pin track infection occurred, physiotherapy was continued. All the movements' focsed on elbow range and angle will be carefully observed.

Sampling method: Random sampling method was considered. We have identified and reviewed 100 cases of displaces supracondylar fractures in children aged 2-15 years. Patients were classified based on the Garlands classification and patients with undisplaced fractures, pathological fractures and comminuted type 3C (Gustillo Anderson classification) open fractures were excluded from the study.

Statistical analysis

After collecting data, we have analyzed the data by using statistical software SPSS 17. We conducted some in depth interview with the parents of the patients and also the nurses and duty doctors and caregivers of the patients. $P<0.05$ was considered statistically significant. Data entry was done in MS Excel and analysis was done in IBM SPSS v 17.0.

Ethical approval

We filled up an informed consent form and also discussed the expected outcome and side effects of the patients. We carefully followed up the patients who percutaneous wire configured up to the 24 months. The study was approved by the ethical research review committee of the hospital administration and maintained privacy act of the patients. Those Patients and /their parents/guardian refused to consent were excluded from the study.

III. Results

We have identified and reviewed 105 cases of displaced supracondylar fractures in children aged 2-10 years. Those children required immediate management who were treated by closed reduction and percutaneous pinning fixation for greater functional outcome of the patients. We identified treatment category considering Garland's classifications. Patient were closely monitored and collected their demographic overview. We carried out to review case notes, collected theatre records and radiological assessment ,determine the age of the patients ,classification of the fracture, treatment method, delay to theatre, duration of surgery, types of wire configuration. We also have also carefully reviewed Bauman's angle, radiocapiteller alignment, anterior humeral alignment and complications. During this period, we have also observed the side effects after percutaneous pin fixation and collected the outcome based on fins criteria. We carefully followed up the patients who percutaneous wire configured up to the 24 months.

There were 105 patients with Garlands type II and type II fractures admitted to outdoor unit over the four year period and complete notes were available for 105 patients.

Table 1 : Demographic characteristics of the study populations:

Age (in Years)	Number of Patients	Percentage	Average age	Standard Deviation
4-8 years	56	53%	6.80 years	+/-1.1349
9-14 years	49	47%	10.75 years	+/-1.738
4-14 years	105	100%	8.65 years	+-2.45

Table 2: Sex ratio of the Patients:

Sex	Number of patients	Percentage
Male	44	41.90%
Female	61	58.10%
Total	105	100%

Out of 105patients, 9 were managed nonoperatively, and 12 were managed with a manipulation under anesthesia. None of these patients had any complications. All the remaining 83patients were treated with K-wiring, either crossed or lateral. They had a mean age of 8.65 years (SD 2.45 years).

These included 46 type II and 37 type III fractures. 51 patients were managed with crossed K-wires and 22 were managed with lateral K-wires. The ages and fracture types were not significantly different between the two wire configuration groups.

Table 3: Types of fracture

Types of fracture	Number	Percentage
Type1	21	20.00
Type 2	46	43.81
Type 3	38	36.19

Table 4 : Type of treatment category:

Treatment Category	# of Patients	Percentage
Manipulation under anesthesia	12	11.43
Crossed K-wire	62	59.05
Lateral K-wire	22	20.95

Out of these patients managed with wire stabilization 14.4% (12 patients) developed complications, including 6% (5 patients) with significant complications including nerve injuries (2 patients) and fracture displacements (2 patients). Out of the 2 nerve palsies, one was radial nerve palsies, and one was a median nerve palsy.

Table 5: Complication

Key Complications	# of Patients	Percentage
Over-Granulation	11	10.48
Soft Tissue Infection	7	6.67
Hypersensitive Scar	2	1.90
Neurapraxia	2	1.90
Axonotmesis	1	0.95
Metal migration	3	2.86
Revision K-wiring	3	2.86
Re-manipulation under anesthesia and plaster	2	1.90
Tendonitis	1	0.95
Osteomyelitis	1	0.95

Complication was observed clearly with the patients who received the procedure. Patients developed any pin tract infection carefully observed and 7 of the patients was treated with antibiotic who had also hypertrophic granulation tissue. During the study period,near about 7 consultants and 15 medical officers and 20 nurses had tremendously managed the complication and follow up continuously after discharge from the hospital.

Flynn's Criteria: **Table 6**

Results	Cosmetic factor carrying angel loss	Functional factor Movement loss (degrees)	Overall Results (Percentage)
Excellent	0-5 degree	0-5	83%
Good	5-10 degree	5-10	13%
Fair	10-15 degree	10-15	4%
Poor	>15 degree	>15 Degree	0

The mean age, classification, time to theatre and duration of surgery were not significantly different between the patients with and without complications ($p > 0.05$). The rate of complications was not different between the two groups; 17 % in lateral wire configuration compared with 12 % in those treated with crossed wires. Three of the significant complication patients had lateral wire configuration whereas the other 2 had crossed wires. All 2 nerve injuries had crossed wire configuration, whereas all 2 fracture displacements had lateral wire confirmation. The mean Baumann's angle was 81.6 degrees in the group with no complication and 70.6 degrees in the significant complication group ($p=0.02$). The radiocapitellar line and anterior humeral line were not satisfactory in 8% and 18% of the group with no complications, and 9% and 17% of the group with significant complications.

IV. Discussion

Closed reduction and percutaneous pin fixation of supra condylar fracture in children is a sound and effective technique especially for type 2 and type 3 fractures.[xv],[xvi] The type 1 fractures are safely treated with immobilization in plaster of Paris. In total 83 patients who were fixed with Percutaneous wires, excellent results in 83 % patients, good results in 10% patients & fair results in 7% patients were obtained. Of the 83 cases, according to Flynn's criteria 83% patients had limitation of 0-5 degree, 13 % patients had 5-10 degree, 4% patient had 10-15 degree and no patient had limitation of movement >15 degree. A systematic review [xvii] in 2012 looked at randomized controlled trials comparing efficacy of crossed versus lateral K-wire fixation in extension type Gartland type III fractures and identified four studies but none was level 1. There had no blind therapy and 83 patients received careful treatment advantages unlike other patients. They have been invited and offered every possible time to confirm their good healthy movements performing percutaneous wire configuration. We have detected by analyzing the data that there has no statistical significant in complication rates, range of motion, or radiographic alignment (Baumann's angle and humerocapitellar angle). During the study period vascular injury, nerve damage and injuries and also some compartmental syndrome including non union and infections is carefully observed and follow up with proper management. Even when needed, Others specialist from cross sectional physiscian was involved to overcome the situation.

Unlike nerve injuries as a side effects , There had a study by Foead *et al.* [xviii] looking at 55 patients, but it lacked postoperative baseline radiological assessments and all reductions were assumed to be anatomical, limiting follow-up assessments. They reported an overall ulnar nerve iatrogenic injury rate of 12.72% consisting of five crossed configuration patients and two lateral configuration patients. This difference was not statistically significant. The authors also noted a radial nerve palsy in the lateral wire group postoperatively. The authors found no statistically significant difference in the alignment, range of movement or Baumann's angle between the two groups. The mean Baumann angle loss in medio-lateral pin fixation group and lateral pin fixation group, was 4.3 and 4.5 respectively. Analysis of the angle loss did not show much difference between the 2 groups. In this study we also did not find any significant relation with 2 nerve injuries particularly one radial nerve palse and another median nerve palse.

We found a less side effects considering complication profile where fracture displacement found only with lateral wiring where as nerve injuries seen with crossed wires. Neither study found a significant difference in the clinical or radiological parameters between the two wire configurations. Although Kocher *et al.* did not report any nerve injuries, Gaston *et al.* reported two cases with the crossed configuration. They report one case of 'tenting of the nerve' with incomplete recovery at three months follow-up, and one case of 'pin indenting the nerve' at 90 degrees of elbow flexion with complete recovery at three months.[xix]

It is not associated with the percutaneous wire configuration. In our study fracture displacement was seen only with lateral wiring, and nerve injuries only seen with crossed wires. Another important finding in our study was the statistically significant difference in the Baumann's angle in the group with no complication and the complication group.

We also showed that the radiocapitellar line and anterior humeral line were not satisfactory in a higher proportion of patients in the group with significant complications. These findings highlight the need to obtain adequate reduction to reduce the chances of complications.

Limitation: By nature, the study was a retrospective and surgical and pin fixation process & procedure was done with a number of different orthopedicsurgeon. The study has only considered 105 patients which is very limited .we did only focused on percutaneous pin fixation where we did not consider the three lateral wire configuration or the K-wire sizes. A few other literature also have similar type observation with different side effects. Our findings were nevertheless are supported by the broader literature and by biomechanical studies. But A few studies may differ comparing the outcome of the percutaneous configuration and complications. There has a lot of clinical biochemical study needed to asses the etiology of the percutaneous k wire pin fixations. That's is our limitation rials comparing the outcome of crossed versus lateral K-wire configuration in supracondylar fracture that found no significant difference, they all have limitations[xx].

V. Conclusion

The treatment of type 2 and 3 supracondylar fracture by closed reduction and percutaneous pin fixation has given consistently good results, compared to closed reduction and plaster of parish casting. Children now in Bangladesh has been consistently increased different types of injuries which sufferings in their life must be minimized .Percutaneous pin fixation considered with both lateral and crossed k wire is the best option to achieve or fixation problem. It is also a relatively safe and easier method compared to other fixation. The pin fixation from lateral side has the advantage of avoiding ulnar nerve injury but the fixation may be relatively less stable and some authors reported that mediolateral entry provides greater torsional rigidity than lateral entry method does. All Type IV fractures of supracondylar humerus are unstable; therefore, requires percutaneous pinning. Besides, any polytrauma with multiple fractures of the same side requiring surgical intervention is another indication for percutaneous pinning. The outcome of the percutaneous pinning methods is the best option for reducing nerve and vascular injuries than any other methods.

Conflict of Interest: The author has no conflict of interest. The author have not been received or will be received from any party related directly or indirectly to the subject of this article. .

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