A Study of Management of Supracondylar Fracture of Humerus in Paediatric Age Group by Open and Closed Reduction with Internal Fixation

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ABSTRACT

BACKGROUND
Supracondylar humerus fracture is the most serious paediatric skeletal injury of elbow in children. Supracondylar fracture of humerus leads to many complications due to the intrinsic fracture instability, close proximity of the brachial artery, three main upper extremity nerves, poor radiographs, contradictory perception of reduction and reduction management modalities and, lastly, patient compliance with care. The aim of this research is to determine the short-term outcomes of closed and open reduction and Kirschner wire fixation in childhood Gartland type III supracondylar humerus fracture.

METHODS
It is a comparative case series of 2 years duration conducted among 30 patients with supracondylar humerus fracture who were admitted and treated at the Department of Orthopaedics. Closed reduction was handled in 15 out of 30 patients, with the remaining 15 patients being treated by open reduction. The outcomes are calculated on the basis of the Flynn scale, which is based on change in the carrying angle and loss of motion after treatment.

RESULTS
Males (56.66 %) were more affected than females; left side (66.67 %) was more affected than the right side; fractures of type III were more common. 26 patients stayed in a sufficient range of motion, 4 patients had insufficient motion with a loss of more than 100, of which 3 were treated with a closed reduction and 1 with an open reduction. Twenty-six (86.66 %) of the 30 patients showed good to excellent results and four (13.33 %) showed mediocre to poor results. Of the four cases, one was handled with a closed reduction and three were handled with an open reduction.

CONCLUSIONS
We conclude that open reduction and K-wire fastening without triceps is a treatment option for displaced supracondylar humerus fractures.

KEYWORDS
Supracondylar Fracture, Humerus Fracture
Supracondylar fracture of the humerus in children is the most common paediatric skeletal injury around the elbow.\(^1\) Peak incidence is observed in the 6-9 year age range due to different causes, mainly ligamentous laxity, violent remodelling and structure of the humerus, i.e. flat transition tube at the lower end of the humerus.\(^2,3\) Supracondylar humerus fractures are described in the early writings of Hippocrates\(^4\). Even though it is so common and so early known to mankind, it has invited many debates, some resolved in due course of time and some are still continuing. To quote, in the past some diagnosed it as an abscess with chances of gangrenous complications and some considered it as elbow dislocation. Regarding the position of immobilisation some adopt hyper flexion, some ninety-degree flexion and some extension. Regarding the type of fixation some advocate lateral pinning and some cross pinning, and, in the past, even transverse pins were used to hold the reduction. Regarding the reason for cubitus varus deformity, some say it is due to melanin and some say growth arrest of medial candle and some say medial communication is the reason. Many treatment modalities are available in the management of supracondylar humerus fractures, such as closed reduction and immobilisation with elbow cast / slab above, overhead olecranon wing traction, closed reduction and percutaneous pinning under image intensification control, open reduction and pinning (lateral pinning, cross pinning constructs), lateral external fixator\(^5\) and straight arm skeleton.\(^6\) Supracondylar fracture of the humerus is noted for its complications due to the inherent instability of the fracture, close proximity of the brachial artery, three major upper extremity nerves and poor radiographs, and inconsistent understanding of the reduction and mode of management and, lastly, patient compliance with care. Supracondylar fracture of humerus is one of the few fractures that, if treated properly, might not give the surgeon a reputation, but if treated poorly, it would undoubtedly give notoriety to a well-known surgeon.

**EXCLUSION CRITERIA**

- Age < 5 years, > 15 years.
- Open fractures.
- Associated neurovascular injury.

Initially, radiological assessment consisted of anteroposterior and lateral films, Jones' view is evaluated after manipulation with or without pinning. In anteroposterior films – Baumann's angle was measured. In lateral films – anterior humeral line, crescent sign and the fish tail sign were noted. In Jones' view assessment of the coronal alignment of the distal fragments was done. For classification, we used Gartland classification with Wilkins adjustment extension form and flexion forms, depending on the sagittal tilt of the distal fragment.

Both types are further classified into
- Type i - Undisplaced.
- Type ii - Displaced with intact posterior cortex / anterior cortex.
- Type iii - Displaced with no bone contact.
- Type iv - Further classified into two types (Wilkins modification) depending upon the displacement type.
  - a) posteroomedial
  - b) posterolateral

For type iii (completely displaced): Sort III (completely displaced): Initially closed reduction was attempted. If not minimised by closed approaches, open reduction by posterior approach and K-wire fastening. After fixation, the elbow is protected by the pop slab or cuff and collar. Open reduction indications and K-wire fastening were

1) 2 to 3 attempts of failed closed reduction manoeuvring
2) An open fracture

**OPEN REDUCTION TECHNIQUE**

We did posterior (triceps reflecting) approach to lower end humerus to minimise open fracture. In this technique, patients are placed in the opposite side of the lateral decubitus position and the elbow is kept in the flexion position on one side. The skin incision and the subcutaneous tissue are made from 7 cm upper to 2 cm lower than the olecranon by a posterior midline method. Subcutaneous arteries were coagulated; subcutaneous tissues were dissected off the muscle and fascia of triceps without separating the muscle. The ulnar nerve is examined and maintained safely during surgery. Then the muscle of triceps is dissected from both sides of laughter and along the intermuscular septum, so the distal humerus rear surface is deperiosted. Therefore, all the regions of medial and lateral epicondyle, condyle and supracondylar ridge and joint surface are exposed, and the proximal part is exposed as much as the surgeon needs. In this approach, we do not need to cut the triceps mechanism. After an open fracture reduction, the pins are positioned either medially or laterally or two pins are positioned laterally, depending on the size of the distal fragment and the intraoperative stability. Pins can be left in place slightly longer after an open reduction than after a closed reduction. When the pin is removed, a healthy

**BACKGROUND**

Thirty patients with supracondylar humerus fracture were admitted to the Department of Orthopaedics, Gandhi Hospital, Secunderabad during the period from August 2015 to August 2017. Out of the 30 patients, 15 were treated with a closed reduction and the remaining 15 were treated with an open reduction (after a failed attempt at a closed reduction) followed by a K-wire fixation.

**INCLUSION CRITERIA**

- Age group between 5 - 15 years.
- Early presentation.
- No associated fractures in the same limb.
- Not treated elsewhere.
callus can be identified at fracture, usually 3 to 4 weeks after injury. Results were graded as excellent, good, fair and poor according to the Flynn’s criteria.

**Excellent**  
- Loss of movement 0 - 5 (Functional)  
- Loss of carrying angle 0 - 5° (Cosmetic)  

**Good**  
- Loss of movement 5 - 100 (Functional)  
- Loss of carrying angle 5 - 10° (Cosmetic)

**Fair**  
- Loss of movement 10 - 150 (Functional)  
- Loss of carrying angle 10 - 15° (Cosmetic)

**Poor**  
- Loss of movement more than 150 (Functional)  
- Loss of carrying angle more than 15° (Cosmetic)

### RESULTS

| Age in Years | No. of Patients | Percentage (%) |
|--------------|-----------------|----------------|
| 5 – 8 years  | 14              | 46.67 %        |
| 9 – 12 years | 12              | 40 %           |
| 13 - 15 years| 4               | 13.33 %        |

**Gender**  

|           | Male | Female | 66.66 % | 43.33 % |
|-----------|------|--------|---------|---------|

**Side**  

|       | Right| Left  | 66.67 % | 66.67 % |

**Table 1. Demographic Distribution**

In the present sample, 56.66 % were male and 43.33 % were female. 46.67 % were in the 5 – 8 years age group, 40 % in the 9 – 12 years age group, 13.33 % in the 13 - 15 years age group. 66.67 % had left side fracture and 33.33 % had right side fracture.

**Table 2. Post-Operative Complications in the Present Study**

| Complication                  | No. of Cases | Percentage (%) |
|------------------------------|--------------|----------------|
| Cubitus varus deformity       | 2            | 6.66 %         |
| Pin tract infection           | 1            | 3.33 %         |
| Restriction of movement       | 1            | 3.33 %         |

Post-operatively, one patient had a pin tract infection, 2 patients developed cubitus varus deformity and one patient had restriction of movements.

In 86.67 % of the cases, the change in the carrying angle was less than 10 degrees.

In our study, 86.66 % of 30 patients were good to excellent and 13.33 % showed average and bad outcomes.

**Table 3. Final Results by Flynn’s Criteria**

| Results | Functional Factor (Loss of Motion in Degrees) | Cosmetic Factor (Loss of Carrying Angle in Degrees) |
|---------|-----------------------------------------------|---------------------------------------------------|
| Excellent| 0 - 5°                                        | 0 - 5°                                            |
| Good    | 6 - 10°                                       | 6 - 10°                                           |
| Fair    | 11 - 15°                                      | 11 - 15°                                          |
| Poor    | > 15°                                         | > 15°                                             |

Twenty-six patients had an acceptable range of motion only with a loss of 0 - 10°, four patients had inadequate motion with a loss of more than 10°, of whom three were treated with closed reduction and one patient with an open reduction. 6.66 % of cases had a carrying angle loss in excess of 10°. 10 % of cases had more than 10° loss of motion spectrum. 26 Cases (86.6 %) had outstanding and decent (satisfactory) results, 4 cases (13.3 %) had average and bad results.

**DISCUSSION**

In our study, one case had limitations on the mobility of the elbow after an open reduction and internal fixation, and a sufficient range of motion was achieved with physiotherapy. In 2 instances, a small degree of cubitus varus was observed due to the unsatisfactory reduction and fixation of the
Humerus supracondylar fracture is one of the most common injuries of elbows in infants. The most common cause for injury is fall on the extended hand. In view of the role of the affected extremity, supracondylar fractures should be considered essential and should be handled as such without delay. The treatment is based on complete anatomical reduction of the fracture fragments. There is a lack of reduction and a need for repeated manipulation in the closed reduction of splint or cast immobilisation. This will lead to

CONCLUSIONS

Humerus supracondylar fracture was one of the most common injuries of elbows in infants. The most common cause for injury is fall on the extended hand. In view of the role of the affected extremity, supracondylar fractures should be considered essential and should be handled as such without delay. The treatment is based on complete anatomical reduction of the fracture fragments. There is a lack of reduction and a need for repeated manipulation in the closed reduction of splint or cast immobilisation. This will lead to...
elbow stiffness and epiphyseal injury, the latter resulting in arm shortening. In particular, cast therapy is prescribed for undisplaced fractures. When used for displaced fractures, there is a risk of re-displacement after the swelling subsides. The use of lateral and medial pin fasteners offers more protection than lateral pins on their own. In order to have rigid fixation, the pins must proceed into the opposite cortex. A smooth pin is preferable to threaded pin. Open reduction and K-wire fastening without triceps is an option of treatment for displaced supracondylar humerus fracture in children, as reduced postoperative stiffness, prolonged function recovery and effective period of hospitalisation is 1 to 2 days.

In our study, there were no significant differences in postoperative reliability, functional outcomes and complications between percutaneous pinning and open cross-wiring reduction. It is assumed that these findings support the use of percutaneous pinning in the first section, which is easier and less violent than the open reduction.

Data sharing statement provided by the authors is available with the full text of this article at jebmh.com.

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