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## RESEARCH ARTICLE

### RESULTS OF GARTLAND TYPE-III SUPRACONDYLAR FRACTURE HUMERUS WITH OPEN REDUCTION AND INTERNAL FIXATION IN CHILDREN AFTER FAILED CLOSED REDUCTION

<sup>1</sup>Dr. Sonali Sharma, <sup>2</sup>Dr. Sudesh Sharma, <sup>3,\*</sup>Dr. Mohammad Azhar ud din Darokhan, <sup>4</sup>Dr. Omeshwar Singh, <sup>5</sup>Dr. Rehmat Ali

<sup>1</sup>Registrar, Radiodiagnosis G.M.C. Jammu, India

<sup>2</sup>Professor, Orthopaedics G.M.C. Jammu, India

<sup>3,4,5</sup>Junior Resident Department of Orthopaedics G.M.C. Jammu, India

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#### ABSTRACT

Supracondylar fracture of humerus is the second most common fracture in children which account for 60–75% of all fractures around the elbow. There are various treatment modalities for type-III fracture, i.e., closed reduction and casting, skeletal traction, close reduction and percutaneous pinning and open reduction and internal fixation. This study was conducted to see the outcome of open reduction and internal fixation after failed closed reduction.

**Methods:** This study was conducted in the Orthopaedics Departments of G.M.C. Jammu on 30 children from June 2013 to June 2015. Patients included were of either gender with age range from 4–12 years with displaced supracondylar fracture (type-III) after failed closed reduction. All fractures were fixed with K-wires by open reduction and internal fixation by lateral approach. The patients were assessed both clinically and radiologically and results were tabulated according to Flynn criteria.

**Results:** Twenty-eight patients had excellent results while two had good results according to Flynn criteria. None of the patients had either fair or poor result.

**Conclusion:** Open reduction and internal fixation is a good and reliable method after failed closed reduction and gives stable fixation with anatomical alignment.

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## INTRODUCTION

Supracondylar humerus fractures constitute about 17% of all paediatric fractures and are second only to forearm fractures. Supracondylar humerus constitutes 50-60% of all pediatric elbow fractures. In total, 85% of these fractures are seen in children between ages of 4-11 years. Typically these fractures occur due to fall on the outstretched hand with extended elbow. The distal fragment displaced posteriorly in 97-99% of cases (extension type) and anteriorly in 1-3% (flexion type). Gartland classified extension type fractures into three categories based primarily on the degree of displacement.

### Gartland Classification

Type I: Un-displaced

Type II: Displaced with intact posterior cortex

Type III: Completely displaced with no cortex between the fracture fragments

Type III supracondylar humeral fractures in children are usually treated by closed reduction and percutaneous K-wires fixation, but open reduction and fixation is performed if an adequate reduction cannot be obtained by closed manipulation.

Goals in the treatment of pediatric supracondylar humerus fractures are full recovery of elbow movements, achieving normal cosmetic view of elbow, protecting the patient from neurovascular complications that may occur. Gartland type-III supracondylar fractures need either close or open reduction and percutaneous pin fixation. If closed reduction fails, then open reduction is the only option. Open reduction must be carried out carefully to prevent complications like varus or valgus deformities, myositis ossificans, stiffness of the elbow, neurovascular complications and compartment syndrome. We share our experience of treating of those supracondylar fractures in whom closed reduction failed and had to be treated with open reduction and internal fixation with Kirchner wires (K-wires).

## MATERIALS AND METHODS

The study was conducted on 30 children 24 males and 6 females.

\*Corresponding author: Dr. Mohammad Azhar ud din Darokhan,  
Junior Resident Department of Orthopaedics G.M.C. Jammu, India.

With displaced supracondylar fractures of the humerus attending the outpatient/emergency department of the Department of Orthopaedics, Government Medical College, Jammu for a period of two years from June 2013 to June 2015. Both male and female patients were taken up for the study.

#### Inclusion criteria

Failure of closed reduction of Gartland Type III supracondylar fractures after 2-3 attempts.

#### Exclusion criteria included

- Compound fractures,
- Nerve injuries,
- Vascular injuries,
- Fractures with intercondylar extension and
- Patients presenting with compartment syndrome

The patients after admission in the hospital were provided first aid treatment, splintage of the part and other necessary resuscitative measures. Detailed history, general physical examination, systemic and local examination were recorded. Routine investigations of blood, urine, renal function tests, X-ray chest and X-ray of elbow, both anteroposterior and lateral views, were taken. History was taken as per the following routine: name, age, sex, mode of trauma, limb involved, any other associated injury, type of fracture, any history of previous operation, disease or injury to the affected limb. All patients were operated under general anaesthesia with the patient in supine position. After proper scrubbing and draping closed reduction was attempted first. In the event of failure of closed reduction, fracture site was opened by lateral approach and interval made between triceps posteriorly and origins of extensor carpi radialis longus and brachioradialis anteriorly. In most of the patients brachialis muscle was found interposed between the two fragments and was responsible for the failed closed reduction. The fracture site was cleaned, washed, reduced and fixed with 2 or 3 crossed K-wires of appropriate diameter. The ends of the wires were left outside the skin for easy removal. Wound was washed thoroughly and closed back in layers. ASD was applied and POP back slab applied in 50-60 degrees of flexion.

Patients were discharged at 3rd post operative day. At 10 days sutures were removed. At 3 weeks the POP back slab and k wires were removed on outpatient basis. Patients and parents were instructed to continue active range of motion (ROM) exercises at home. Subsequent follow ups were done at 2, 3, 6 and 12 months. At each follow up patients were assessed clinically and radiologically and following parameters were recorded: range of motion around elbow, loss of elbow motion, carrying angle and Baumann's angle. Final results were assessed as per Flynn's criteria. In Flynn's criteria patients are evaluated according to functional and cosmetic parameters.

#### Flynn's criteria

Results	Cosmetic factor – Loss of carrying angle (degree)	Functional factor – Loss of motion (degree)
Excellent	0 – 5	0 – 5
Good	6 – 10	6 – 10
Fair	11 – 15	11 – 15
Poor	>15	>15

## RESULTS

The mean age of subjects was  $7.9 \pm 2.42$  (range 4-12) years. The maximum incidence was seen in the age group between 6 to 10 years 14 cases (70%). Male subjects outnumbered female subjects 24 cases (80%). Male to female ratio was 4:1. All of the subjects had extension type of fracture. The mechanism of injury was fall in 24 (80%) patients and RTA in 6 (20%) patients. In the present study, 21 (70%) subjects had fracture on the left side and 9 (30%) had fracture on the right side. Mean injury to treatment interval was  $21.60 \pm 15.52$  (range 10 to 72) hours. Injury to treatment interval was observed most in 0 to 24 hours (65%), followed by 24 to 48 hours (30%). Overall 23 (57.50%) subjects were operated within 24 hours. Mean procedure duration was  $70 \pm 13.76$  (range 50 to 90) minutes. Only 3 (10%) subjects were operated within 1 hour, rest all 27 (90%) subjects procedure time ranged from 1 to 3 hours.

Patients were kept in hospital for 3 to 8 days for observation, intravenous antibiotics and dressings. 15 patients (50%) were discharged after 5 days. Two subjects were discharged after 8 days of hospital stay. Mean time of discharge from hospital was  $5 \pm 1.35$  days. Stitches were removed on 10<sup>th</sup> postoperative day. The end results were classified according to the criteria given by Flynn; excellent, good, fair and poor results were observed in 45%, 25%, 20% and 10% subjects respectively. Neither any iatrogenic nerve injury nor myositis ossificans occurred in the present study. One superficial pin tract infection occurred each and was treated with antibiotics. One case of wound infection occurred which required opening of stitches, thorough washing, debridement and secondary closure of the wound. In our study cubitus varus was not seen in any patient.

## DISCUSSION

In the present study, 30 cases of displaced supracondylar fracture (type-III) after failed closed reduction was treated by open reduction and internal fixation with K wires by lateral approach. The final results were assessed clinico-radiologically. The maximum incidence of supracondylar fracture in the present study was seen in 6 to 10 years of age group (24; 60%) and the average age was  $7.55 \pm 2.69$  years. Karapinar *et al.* reported the maximum affected age group to be 2 to 13 years. Sial *et al.* observed the trend as 3 to 13 years. Huang *et al.* reported maximum cases between the age group of 5 to 12 years which is in consonance with the present study. Karapinar *et al.* reported average age around 7.6 years which is consistent with the present study. Huang *et al.* reported average age as 7 years while Gorkan *et al.* reported it to be around 7 years.

In the present study, the male to female ratio was 4:1 which is in favour of males. This fracture is more frequent in males as reported by various authors. The high incidence in males can be explained by the fact that male children are more active and indulge more often in outdoor and tougher sports activities than females. Males outnumber females in all age groups, similar to the observations made by most of the authors like Sial *et al.*, Huang *et al.* and Jiang *et al.* In the present study, the

fracture affected left side in 21 (70%) cases and right side in 9 (30%) cases. Our study correlates with the findings of Sial *et al.* and Yadav *et al.* who also observed similar results.

Out of the 30 patients treated by open reduction and internal fixation, 20 patients were operated within 24 hours and 9 patients were operated within 24 to 48 hours. One patient presented late and was operated within 72 hours and overall average injury to definite treatment interval being  $21.60 \pm 15.52$  hours. The procedure duration ranged from 50 to 90 minutes with average being  $70 \pm 13.76$  minutes. Patients were kept in the hospital for few days ranging from 3 to 8 days, average being  $5 \pm 1.35$  days. They were kept for regular dressings, intravenous antibiotics given for 5 days and observation. Stitches were removed on 10<sup>th</sup> postoperative day in the outpatient department.



Fig 1a.



Fig 1b.

**Pre Operative X rays, AP (Fig 1a) and lateral (Fig 1b) views showing Gartland type 3 Supracondylar fracture in a 7 year old child**

1 patient had superficial pin tract infection which was treated with antibiotics and antiseptic dressing. Infection subsided, however, he had decreased range of motion. Another patient had wound infection after discharge from the hospital. He was

readmitted, wound opened, thoroughly washed debrided and intravenous antibiotics were given.

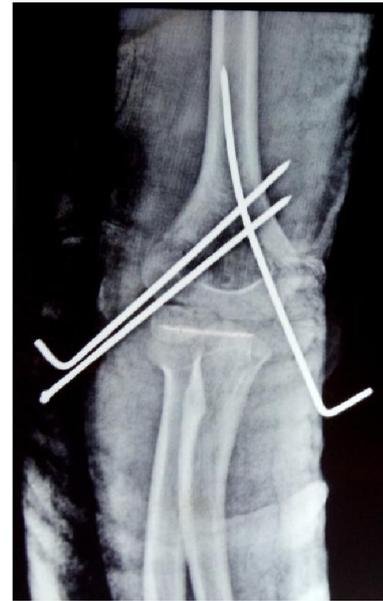


Fig 2a.



Fig 2b.

**Post Operative X ray after open reduction and fixation with 3 K wires AP (Fig 2a) and lateral view (Fig 2b)**

Infection got cured and secondary closure of the wound was done. The results of the present study are comparable with those of Sial *et al.* and Yadav *et al.* With respect to range of motion, the range of motion of the operated side was compared with that of the normal side. 21 patients (70%) had good to excellent ROM with restriction of  $<10^{\circ}$ , 6 patients (20%) had fair and 3 patients (10%) had poor outcome.

Aronson and Prager evaluated the quality of reduction by measuring the Baumann's angle after reduction. They accepted the reduction if Baumann's angle of the fracture extremity was within  $4^{\circ}$  of the normal extremity. In our study, Baumann angle and humero-ulnar angle were measured from unaffected arm preoperatively and compared with affected elbow postoperatively after completion of the treatment. In all of the 30 cases, Baumann's angle was maintained up to  $4^{\circ}$ . Range of motion was essentially equal between the affected and unaffected elbow. All the fractures united in normal anatomical position.

Oppenheim *et al.* suggested that the humero-ulnar wrist angle is the most consistent and accurate method of determining true carrying angle. In the present series of 30 patients, all fractures found to be of extension type. Mean age of injury was 7.5 years. No Volkmann's contracture was found in any of the cases. In our series of 30 cases, average time of injury and surgery was 20 hours for open reduction and percutaneous pinning. In our study cubitus varus was not seen in any patient. Weiland *et al.* reported few but milder cases of cubitus varus deformity (25%) treated with open reduction via lateral approach. However the deformity appeared to result from faulty reduction with persistent medial angulation of the distal fragment. With posterior approach also the incidence of cubitus varus is significant. The results reported in the present study are comparable with the results observed by other authors in literatures.

## Conclusion

Supracondylar fractures of humerus in children needs proper evaluation and treatment. Open reduction of displaced Gartland type 3 supracondylar fractures of humerus in children via lateral approach is safe and relatively easy to perform. Most pediatric orthopaedic surgeons would reserve this approach for open fractures or for those associated with vascular injury. Although we agree that closed reduction should remain the first line of treatment, we believe that open reduction with internal or percutaneous pinning should be seriously considered when closed reduction is unattainable after 2 or 3 reasonable attempts. In our hospital lateral approach is being routinely, and successfully done in these type of fractures.

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