

FUNCTIONAL OUTCOME OF GARTLAND TYPE III SUPRACONDYLAR FRACTURES WITH CLOSED / OPEN REDUCTION AND K WIRE STABILISATION: A RETROSPECTIVE STUDY

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Abstract

Background: The most frequent bone injury to children near the elbow is a supracondylar fracture of the humerus. The management of severely displaced forms is controversial and has given rise to various schools of thought. Advantages of percutaneous pinning (Kirschner wire) include rapidity and absence of periosteal separation and dissection, which result in a minimal risk of infection. Disadvantages are the higher risk of secondary displacement and the risk of iatrogenic nerve injury. The open technique allows fracture reduction under visual guidance, which limits the risk of ulnar nerve injury, but is associated with higher risks of infection and motion range limitation and may result in unsightly scars. The aim of this study is to evaluate the short term functional outcome of closed and open reduction with Kirschner wire fixation in Gartland Type III Supracondylar fracture of humerus in children.

Materials and Methods: Study Design: A Retrospective hospital based observational study. Study area: Department of Orthopaedics, Kovai Medical Center and Hospital, Tamil Nadu, India. Study Period: April 2021 to March 2023. Study population: Children 5-15 yrs with Gartland Type III Supracondylar fracture of humerus treated in Department of Orthopaedics. Sample size: 30 subjects. Sampling method: Convenient sampling. Data collection procedure: Case notes review to collect Age, Sex, Side of injury, closed/open reduction, pin construct and complications. Functional outcome assessment: At around 3 months follow up functional results will be graded according to the Flynn's criteria as excellent, good, fair and poor, based on documented range of elbow movement and carrying angle. **Result:** 66.66 % of patients had excellent results and 20% of cases had good results. The total satisfactory results were 86.66%, 10% of cases had fair results and 3.33% of cases had poor results. The total unsatisfactory results were 13.3%.

Conclusion: In our study, no significant differences were found between percutaneous pinning and open reduction with cross-wiring in terms of functional outcomes and complications. We believe these results support the first-line use of percutaneous pinning, which is simpler and less aggressive than open reduction but malreduction by either means would give poor results.

INTRODUCTION

The most frequent bone injury to children near the elbow is a supracondylar fracture of the humerus.^[1] Peak incidence occurs between the ages of 6 and 9 years due to a variety of factors, most notably ligamentous laxity, active remodelling, and the anatomical structure of the humerus, namely the metamorphosis from a tube to a flat end at the lower end.^[2,3]

Supracondylar humerus fractures are described in the early writings of Hippocrates⁴. 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 some, 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 malunion and some say growth arrest of medial condyle and some say medial comminution is the reason.

Many treatment modalities are available in the management of Supracondylar fracture of humerus like

1. Closed reduction and immobilisation in an above elbow cast / slab
2. Overhead olecranon wing screw traction
3. Closed reduction and percutaneous pinning under image intensifier control
4. Open reduction and pinning (lateral pin, medial pin and cross pinning constructs)
5. Lateral external fixator
6. Straight arm skeletal traction

Supracondylar fracture of humerus is known for its complications because of the inherent fracture instability, close vicinity of brachial artery, three major nerves of upper extremity and poor radiographs and poor interpretation of reduction and modality of maintenance of reduction and lastly patient compliance to treatment.

The treatment goal in displaced supracondylar humerus fractures in children is anatomic reduction. If an anatomic reduction cannot be achieved with closed reduction, open reduction is indicated. This can be done without an increased risk of complications.

Supracondylar fracture of humerus is one of the few fractures which when treated well may not bring reputation to the surgeon but when treated improperly will definitely bring discredit even to a well reputed surgeon.

Hence the present study was undertaken to evaluate the short-term results of closed and open reduction (only after failed closed reduction) and Kirschner wire fixation in Gartland Type III Supracondylar fracture of humerus in children.

Aim: The aim of this study is to evaluate the short-term results of closed and open reduction (only after failed closed reduction) and Kirschner wire fixation in Gartland Type III Supracondylar fracture of humerus in children.

MATERIALS AND METHODS

Study Design: A Retrospective hospital based observational study.

Study Area: Department of Orthopaedics, Kovai Medical Center and Hospital, Coimbatore, Tamil Nadu, India

Study Period: April 2021 to March 2023.

Study Population: Children 5-15 yrs with Gartland Type III Supracondylar fracture of humerus treated in Department of orthopaedics.

Sample Size: Study consisted of 30 subjects.

Sampling Method: Convenient sampling.

Inclusion Criteria

- Age group between 5- 15 years.
- Early presentation.
- No associated fractures in same limb.

- Not treated elsewhere.

Exclusion Criteria

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

Ethical Consideration

Institutional Ethical committee permission was taken prior to the commencement of the study.

Data Collection Procedure

For classification we used Gartland classification with Wilkins modification.

Extension types and Flexion types depending upon the sagittal tilt of distal fragment.

Extension Type

- Type I - Undisplaced
- Type II - Displaced with intact posterior cortex
- Type III - Displaced (No cortical contact)
- III A - Posteromedial
- III B - Posterolateral

Flexion Type

- Type I - Undisplaced
- Type II - Displaced with intact anterior cortex
- Type III - Completely Displaced

Only Gartland extension type Type III fractures were included in this study.

Evaluation of case notes were done in terms of Age, Sex, Side of limb injured, open or closed reduction, Pin construct and complications like Infection, nerve injury and pin problems.

At 3 months follow up, results were graded according to the FLYNN's criteria as excellent, good, fair and poor results.

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

Statistical Analysis

Data was entered into Microsoft excel data sheet and was analyzed using SPSS 22 version software. Categorical data was represented in the form of Frequencies and proportions. Chi-square test was used as test of significance for qualitative data. Continuous data was represented as mean and standard deviation. Analysis of variance (ANOVA) was used for various continuous variables in different groups to find the statistical significance. P value <0.05 will be a statistically significant study.

RESULTS

Out of 30, 15 were treated by closed reduction and the remaining 15 by open reduction (after failed attempt at closed reduction) followed by k- wire fixation.

Table 1: Age wise Distribution.

Age in years	No. of patients	Percentage
5—8 years	14	46.67%
9—12 years	12	40%
13—15 years	4	13.33%

In the present series of 30 patients, most of the patients are in the age group of 5-8 years (46.67%) in our study.

Table 2: Sex wise Distribution

Sex	No. of patients	Percentage
Male	17	56.66%
Female	13	43.33%

Incidence of supracondylar fracture of Humerus was found to be more in males (56.66%) when compared to females (43.33%) in our study.

Table 3: Side of Injured LIMB.

Side	No. Of patient	Percentage
Right	10	33.33%
Left	20	66.67%

In our study involvement of left side (66.67%) is more than right side.

Table 4: PIN Constructs

Type of construct	No. of patients	Percentage
2 lateral pin construct	3	12.5%
1 lateral and 1 medial pin	20	83.33
2 lateral and 1 medial	1	4.17%

In a total of 30 supracondylar fractures of humerus patients, our preferred construct was cross pinning. We did 1 lateral and 1 medial pinning in 20 cases, and 2 lateral pins in 3 cases and 2 lateral pins and 1 medial pin construct in 1 case.

Table 5: Post Operative Complications

Complications	No. of ASES	Percentage
Cubitus varus deformity	2	6.66%
Pin tract infection	1	3.33%
Nerve injury	0	0
Proximal migration of pins	0	0
Restriction of movement	1	3.33%

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

Table 6: Change in carrying angle

Change in carrying angle	No. of patients	Percentage
0—5	20	66.6%
6—10	6	20%
11—15	3	10%
above 15	1	3.33%
Total	30	100%

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

Table 7: Final Results

Result	According to loss of range of motion		According to loss of carrying angle		Average percentage
	No of patients	Percentage	No of Patients	Percentage	
Excellent	20	66.66%	20	66.66%	66.66%
Good	6	20%	6	20%	20%
Fair	3	10%	3	10%	10%
Poor	1	3.33%	1	3.33%	3.33%

According to FLYNN'S criteria results of our study are analysed. 66.66% of patients had excellent results and 20% of cases had good results. The total satisfactory results were 86.66%, 10% of cases had fair results and 3.33% of cases had poor results. The total unsatisfactory results were 13.3%.

Poor and fair results were because of difficulty in reduction and fixation of the fragments in unsatisfactory position.

Complications encountered in this study: In our study one case had restriction of elbow movement after open reduction and internal fixation, with physiotherapy satisfactory range of motion was obtained, In 2 cases mild degree of cubitus varus was noticed, because of unsatisfactory reduction and fixation of the fragment in poor position. Of the two, one was treated by closed reduction and the

other by open reduction. The degree of Cubitus varus was more in the case treated by closed reduction. One case developed pin tract infection which had open reduction and later settled with a course of antibiotic. 26 patients retained satisfactory range of motion just by loss of 0-10 degree, 4 patients had unsatisfactory range motion by loss of more than 10 degree, out of which 3 were treated by closed reduction and 1 by open reduction.

6.66 % of cases had loss of carrying angle more than 10 degree.

10 % of cases had loss of range of motion more than 10 degree.

26 cases (86.6%) had excellent and good results (satisfactory) 4 cases (13.3%) had fair and poor results.

DISCUSSION

Limitations of our study are the small sample size, and absence of randomization, with the surgical strategy being dependent on the usual practice of the surgeon. Thus, open reduction was performed when inadequate closed reduction precluded percutaneous pinning. The diverse range of treatment methods attests to the challenges raised by extension-type supracondylar fractures of the elbow. The management of severely displaced forms is controversial and has given rise to various schools of thought. Advantages of percutaneous pinning include rapidity and absence of periosteal separation and dissection, which result in a minimal risk of infection.

Disadvantages are the higher risk of secondary displacement and the risk of iatrogenic nerve injury. The open technique allows fracture reduction under visual guidance, which limits the risk of ulnar nerve injury, but is associated with higher risks of infection and motion range limitation and may result in unsightly scars.

Our assessment of outcomes using Flynn's criteria showed no significant difference between percutaneous pinning and open reduction with crossed K-wire fixation in terms of satisfactory outcome.

Musa et al,^[7] conducted a prospective study based on 30 cases with type III Gartland fracture managed by crossed percutaneous pinning over a period of two years. Age group range was 2 to 13 years with a mean age of 7.06 years. In the present study, the average age is 10 years (range 5 to 15 years) and the most common age group affected was between 5—8 years (46.67%).

Pirone A M et al,^[8] in their study of 230 patients with supracondylar fracture of humerus showed that boys (119) were affected more than girls (111). Robert D Ambrosia,^[9] in his series found an incidence of supracondylar fracture of humerus in male child is 63% and female child is 37%. In our study, the incidence of supracondylar fracture of humerus is 56.66% in male and 43.33 % in females.

Robert D Ambrosia,^[9] found involvement of left elbow was 64 % and involvement of right side was 36 % among his cases of supracondylar fracture of humerus in children. Lee et al,^[10] in their study of supracondylar fracture of humerus in children showed the predominance of left side involvement. In the present study left side was involved in 67% and right side 33 % cases. In our study, Incidence of fracture was found to be more on the left side (66.67%).

Pirone A H et al,^[8] studied 230 cases of displaced supracondylar fracture of humerus and observed that 137 (62%) cases were type III fractures and 83 (36%) were type II in type III fractures 94 were with posteromedial displacement, 22 with posterolateral displacement and 21 with direct posterior displacement.

Mehlman et al,^[11] during their study of operative treatment of supracondylar fracture of humerus in children found that according to Gartland's classification, 77.4% were type III fractures and 18.3% were type II fractures. On comparison, in the present study of 30 patients, all the cases included were Gartland type III fractures.^[12]

Pirone A H et al,^[8] studied 230 cases of displaced supracondylar fracture of humerus and observed that out of 78 cases treated with closed reduction and percutaneous pinning 2 cases had pin tract infection. Cramer K E,^[13] in his retrospective review of 29 children with supracondylar fracture of humerus in children treated with closed reduction and percutaneous pinning and open reduction and percutaneous pinning 1 patient in closed reduction and percutaneous pinning group out of 15 cases showed superficial pin tract infection.

Chang-Wug Oh et al,^[14] showed no case of pin tract infection in 20 cases of supracondylar fracture of humerus cases treated with closed reduction and percutaneous pinning. In our study 1 patient showed evidence of pin tract infection, which was a case of open reduction and pinning and settled with a course of antibiotic.

Topping et al,^[15] showed incidence of cubitus varus in one patient (4.3%) out of 43 cases treated with closed reduction and percutaneous pinning. Franklin¹⁹ observed 2 cases with cubitus varus deformity among 32 cases of displaced supracondylar fracture of humerus in children. In the present study, two patients (6.67%) developed cubitus Varus. This deformity is seen with one patient in open reduction and percutaneous pinning group and the other patient in the closed reduction group.

Pirone A M et al,^[8] observed migration of one lateral pin out of 96 cases treated with closed reduction and percutaneous pinning. In our study, in no case we saw this complication because in all pinning cases we bent k-wires outside the skin after application.

Musa et al,^[7] in their study observed a 10% incidence of iatrogenic ulnar nerve injury with crossed percutaneous pinning. Balakumar and

Madhuri,^[14] noted an incidence of iatrogenic nerve injuries of 1.1%, 2.2% and 1.1% for ulnar, median and radial nerves respectively using various techniques of percutaneous pinning.

Iatrogenic nerve injuries are seen in about 6% of patients with supracondylar fractures and consist chiefly in damage to the ulnar nerve during percutaneous pinning, which has been reported in 11% of patients. Gurkan et al,^[16] reported iatrogenic ulnar nerve injury in 4.5% of cases after reduction via the medial approach. The cause was probably stretching of the nerve during reduction manoeuvres. In contrast, we found no cases of iatrogenic ulnar nerve injury after closed or open reduction.

In their study, Devkota et al,^[17] noted loss of reduction postoperatively in 1.96% cases. Lee et al. observed the same to be 7%, whereas Balakumar and Madhuri,^[18] in their study observed postoperative loss of reduction in 18.2% cases. In our study, no loss of reduction was noted at the time of first postoperative X-ray (satisfactory reduction was achieved under C-arm in all these cases).

Franklin et al,^[19] in study of 106 patients with displaced supracondylar fracture of humerus treated with closed reduction and percutaneous pinning showed 85.7% good to excellent results with 10.7% satisfactory results and 4.6% with unsatisfactory results.

Ababneh et al,^[20] in his retrospective study of 135 patients with displaced supracondylar fracture of humerus treated with three different methods, results of closed reduction and percutaneous pinning were superior, with excellent and good results in 87% patients and poor results in 8% patients.

Bopanai and Rakesh sharma et al,^[21] studied 54 cases of supracondylar fracture of humerus and found that 80% good results and 20% unsatisfactory results in open reduction and internal fixation group compared to 44 % unsatisfactory results in closed reduction and percutaneous pinning group.

In our study, results are evaluated according to Flynn's criteria which is based on change in carrying angle and loss of movement after treatment. Out of 30 patients, 26 (86.66%) patients showed good to excellent results and 4 (13.33%) showed fair and poor results. Out of the 4 patients, 1 was treated by closed reduction and 3 by open reduction.

CONCLUSION

In our study, no significant differences were found between percutaneous pinning and open reduction with cross-wiring in terms of functional outcomes and complications. We believe these results support the first-line use of percutaneous pinning, which is simpler and less aggressive than open reduction but malreduction by either means would give poor results.

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