

## ORIGINAL ARTICLE

### A PROSPECTIVE STUDY OF SUPRACONDYLAR FRACTURES OF THE HUMERUS IN CHILDREN TREATED BY CLOSED REDUCTION

Ch. Imobi Singh<sup>1</sup>, R. K. Rupabati Devi<sup>2</sup>, G. Satyabarta Sharma<sup>3</sup>

#### HOW TO CITE THIS ARTICLE:

Ch. Imobi Singh, R. K. Rupabati Devi, G. Satyabarta Sharma. "A Prospective Study of Supracondylar Fractures of the Humerus in Children Treated by Closed Reduction". Journal of Evidence based Medicine and Healthcare; Volume 2, Issue 33, August 17, 2015; Page: 4958-4967, DOI: 10.18410/jebmh/2015/692

**ABSTRACT:** There is no universal agreement regarding the management of displaced supracondylar fracture of the humerus in children. According to some orthopaedic surgeon almost all supracondylar humeral fractures should be treated operatively by reduction and pinning. While according to others closed reduction and pinning should be used for Gartland type II and some type III fractures. We present 50 cases of displaced supracondylar fracture treated by closed manipulative reduction under G.A. and immobilization with a posterior plaster of paris slab and collar and cuff. **OBJECTIVE:** To assess the functional results of the injured elbow and to study the incidence of change in the carrying angle of the elbow. **MATERIALS AND METHODS:** This prospective study was conducted in 50 patients with extension type of displaced supracondylar fractures of humerus in children (Gartland type II and type III) treated by closed manipulative reduction and immobilization in flexion of the elbow with a posterior plaster of paris slab and collar and cuff. Patients were followed up for 6 months. Flexion type of supracondylar fracture and those fractures which are absolutely indicated for operative intervention, Viz an open fracture and severe vascular compromise were excluded from the study. The range of movement and carrying angle was measured with the help of a Goniometer and Flynn criteria were used for functional assessment. **RESULTS:** At the end of follow up period, the end results were graded as excellent in 40%, good in 42%, fair in 12% and poor in 6%. A satisfactory result was therefore obtained in 94% and unsatisfactory result in 6% of the 50 patients who were followed and evaluated. **CONCLUSION:** This closed method of treatment for all practical proposes produces least complications, shorter hospital stay, can be expected to yield reproducible consistent satisfactory results not surpassed by any other method of treatment.

**KEYWORDS:** Supracondylar fracture, Children, Closed reduction, Carrying angle.

**INTRODUCTION:** Supracondylar fractures of the humerus are the most common type of elbow fractures in children and adolescents accounting for 50-70% of all elbow fractures.<sup>(1)</sup> Various methods of managing for these difficult displaced supracondylar fractures of humerus in children have been used including traction, closed manipulative reduction and plaster of paris cast immobilization with elbow flexed, Dunlop's traction, percutaneous pinning, open reduction and internal fixation. All these methods have their advantages and disadvantages.<sup>(2)</sup> No general agreement on the treatment of supracondylar fractures of the humerus is evident, and various forms of conservative treatment are recommended by some, while surgical treatment is recommended by others.<sup>(3)</sup> Change in the carrying angle of the elbow is the most common complication with which we have to deal in the treatment of supracondylar fractures of the humerus.<sup>(4)</sup> It is not only the most common but it is also the most neglected complication.

## ORIGINAL ARTICLE

---

The present study was conducted to treat Supracondylar Fractures of the humerus extension Gartland type II and type III in children by closed manipulative reduction under G, A. In our study, we assess the functional results of the injured elbow and study the incidence of change in the carrying angle of the elbow. The outcome of both early and late complications, with particular emphasis on functional and change in carrying angle is also described.

**MATERIALS AND METHODS:** Fifty (50) patients with Extension type of supracondylar fractures of the humerus in children (Gartland type II and type III) were treated by closed manipulative reduction under general anesthesia during the period from January 2012 and December 2014 after taking required consent. Flexion type of supracondylar fractures and those fractures which are absolutely indicated for operative intervention, viz (i) an open fracture and (ii) severe vascular compromise, especially if it is aggravated by attempts at reduction, were excluded from the study.

The undisplaced supracondylar fractures (Type-I) which usually requires no more than simple immobilisation for comfort and protection were also excluded from this study. At the time of attending O.P.D. or Casualty each patient was evaluated carefully regarding general physical condition, nature of injury and other associated injuries. Antero-posterior and lateral views X-ray of the affected elbow were taken. Upon making the diagnosis of displaced supracondylar fracture the extremity was examined for neurovascular deficit and gentle manual reduction under G.A. was performed as early as possible.

Gentle traction is applied to the forearm in supination without hyperextension. The overriding and medial or lateral displacement was then corrected. Then, maintaining the traction, the elbow was flexed by pushing the proximal fragment posteriorly while forward pressure is simultaneously exerted on the olecranon in order to correct the displacement of the distal fragment. At every step the radial pulse was checked to know the state of circulation in the hand.

For the maintenance of reduction, immobilization was done with a posterior plaster of paris slab and collar and cuff with the forearm in pronation extending from the level of posterior fold of axilla to the metacarpo-phalangeal joint of the hand with elbow in flexion more than 90° without producing any distal circulatory embarrassment of the forearm and hand.

Adequate collateral circulation of the forearm and hand, despite the absence of radial pulse was indicated by good capacity feeling of the nail beds, warm pink fingers. Following reduction of the fracture the child was kept for observation till fully recovered from general anesthesia. Then, the child was advice to keep the limb elevated for 24 hours, encourage active finger exercises. If the check X-ray shows adequate reduction, the child was sent back home with the advice to come after 3 weeks.

By this time bone union was apparent and there was no further risk of displacement. If adequate reduction has not been achieved, then re-manipulation was attempted. The adequacy of reduction was determined in terms of medial-lateral displacement and of rotation in the coronal plane of distal fragment.

The medial or lateral displacement was recorded in millimeters of displacement of the cortical margins on the antero-posterior view X-ray of the elbow, while rotation was recorded as

## ORIGINAL ARTICLE

the difference between the antero-posterior widths of the proximal and distal fragment measured at the fracture site on a true lateral view X-ray of the elbow.

According to the medial/lateral displacement and of rotation in the coronal plane of the distal fragment measured in millimeters, the quality of accepted reduction was group into 3 categories.

a) Good	Medical /Lateral Displacement	- 0 to 4mm
	Rotation	- 0 to 2mm
b) Mediocore	Medical /Lateral Displacement	- 5 to 10mm
	Rotation	- 3 to 5mm
c) Poor	Medical /Lateral Displacement	>10mm
	Rotation	>5mm

At the end of 3 weeks P.O.P. was removed and another check X-ray of the elbow was taken in A. P. and lateral views. Then, the patient was subjected to active physiotherapy to improve the range of movement of the elbow and forearm. The patients were subsequently followed up at the end of 6 weeks and 6 months.

### **At the follow up examination the patients were clinically assessed for:**

- (a) Vascular status.
- (b) Neural status.
- (c) The range of movement of
  - (i) Elbow joint for flexion and extension and
  - (ii) Forearm for pronation and supination.
- (d) Change in the carrying angle of the elbow assessed clinically and radio logically Comparing with that of the normal side.
- (e) Any other complications.

The range of movement and carrying angle was measured with the help of a goniometer. For measuring the carrying angle the fixed arm of the goniometer was placed on the median axis of the upper arm, the movable arm adjusted as to lie on the median axis of the forearm and the angle read on the goniometer. Bicipital groove, biceps humeri tendon at its insertion and Palmaris longus tendon at the wrist were palpated and marked as anatomical landmarks to demarcate the median axis of the arm and the forearm respectively while the elbow were held in full extension and supination.

To measure the carrying on the X-ray, the goniometer was placed in the X-ray with its proximal arm on the longitudinal axis of the humerus and its distal arm aligned with two points; one on the midpoint of a transverse line drawn at the level of the metaphyseal flares of the radius and ulna; the other midpoint between radius and ulna two to three centimeter distal to the first point. (Fig. 1)

The mean carrying angle of each elbow as calculated from the clinical and radiographic measurement and compared with the measured mean carrying angle of the non-involved elbow.

## ORIGINAL ARTICLE

---

The difference between the two was recorded as change in the carrying angle. The final results were grouped into 4 grades according to Flynn Criteria.<sup>(5)</sup> [Table I].

**RESULTS:** The minimum age of the patients in this study was 1 year 3 months and maximum was 13 years, with an average of 6.83 years. In the series, there were 21 girls (42%) and 29 boys (58%) with a ratio of 1:1.3. In this study the right humerus was involved in 19 cases (38%) and the left in 31 (62%). The radiological analysis of the 50 cases revealed that, there were 6 (12%) Type II and 44 (88%) Type III fractures.

It was also found that 32 (64%) had postero medial displacement, while 12(24%) had postero lateral displacement of fracture and 6(12%) had only posterior tilt. About the vascular status, 4 patients (8%) had no radial pulse and 3 patients (6%) had a diminished radial pulse at the initial examination. All of these patients had completely displaced fracture. There were no permanent vascular sequelae.

All those children with absent or diminished radial pulse on attending the hospital shown the return of the radial pulsation after reduction of the fracture. In this series, acute neural deficit was found in 6 patients (12%) at the time of attending hospital. Median nerve injuries were observed in 4 cases (8%) and radial nerve injury in 2 cases (4%) only. None of the patients had ulnar nerve involvement. Cases with median nerve injuries were associated with postero-lateral displacements of the distal fragment and radial nerve lesions were associated with postero-medial displacements.

All nerve injuries recovered fully within a period of 3 to 20 weeks. There was no case of nerve injury developing after closed manipulation. In this study, the range of movement was measured clinically and compared with that of the uninjured side. 44(88%) of the 50 patients examined had full range of movement. Limitation of flexion occurred in 5 patients (10%) who had loss of 5 to 10 degrees. Limitation of extension of 5 degrees occurred in 1 patient (2%).

Hyperextension occurred in 3 patients with an increase of 5, 8 and 10 degrees; the average increase in extension being 8 degrees. The case with hypertension had full range of pronation and supination movement but there were restriction of terminal flexion, basically a change in the arc of movement at the elbow. The radiograph revealed that the fractures had healed with slight posterior tilt. The follow up study revealed that recovery of flexion and extension of the elbow was usually complete by 6 months. No patient had loss of pronation and supination.

In the study, the carrying angle of the normal elbow of 14 cases ranges from 0 to 5 degrees, with an average of 2.5 degrees and in 36 cases the normal carrying angle of the elbow ranges from 6 to 10 degrees. Change in the carrying angle of the case studied was shown in [Table 2]. This study shows a close co-relationship between the quality of reduction and the final result. [Table 3] The overall final result are shown in [Table 4] according to the criteria of grading described by Flynn et al -1974.

In the 50 patients evaluated, an excellent result was obtained in 20(40%); a good result in 21(42%); a fair result in 6(12%) and a poor or unsatisfactory result in 3(6%). A satisfactory results was therefore, obtained in 94% of the 50 patients who were followed and evaluated after treatment by closed reduction.

## ORIGINAL ARTICLE

---

**DISCUSSION:** Supracondylar fracture of the humerus is the most common fracture of the elbow in children and unfortunately, it can be one of the most difficult fractures to treat.

In the series, there were 6 patients (12%) with displaced fracture with intact posterior cortex (Type II) and 44 patients (88%) with completely displaced fracture with no cortical Contact (Type III). The average age at the time of injury was 6.83yr. With a range of 1¼ to 13 years. This finding is comparable with that of J. Mangwani et al <sup>(6)</sup> who reported an average age of 6.4 years and also that of Ramji Lal Sahu.<sup>(7)</sup> who reported similar age group of 1.5 years to 13 years. In this series, there were 21 girls (42%) and 29 boys (58%) with a ratio of 1:1.3. A single, perfect and ideal method of treatment displaced supracondylar fracture of the humerus in children is yet to emerge.<sup>(8)</sup>

The treatment followed by us offered the advantage of simplicity did not need any sophisticated instruments and avoided the risk of infection. An acceptable method of treatment for supracondylar fracture of the humerus must provide excellent functional result and an elbow of normal appearance with as little risk as possible for the patients. Many of the supracondylar fractures of the humerus cannot be reduced to hairline apposition not only by closed methods but also even by K-wire fixation after open reduction and of the few that can do so, some become displaced subsequently.<sup>(9)</sup> We were thus frequently faced with the decision as to what position was acceptable and what was unacceptable.

To discuss the least important factor, accurate apposition of the fracture surfaces is inconsequential. This has little effect on the final range of motion and none on the carrying angle. The extensive remodeling that will occur in this age group and even compensate for complete lack of end to end contact in these fractures.<sup>(10)</sup> Rotation of the distal fragment about the long axis of the arm is of more importance but it, too, has little effect on function and none directly on the carrying angle.

It does however; give a bizarre appearance to the X-ray and this has probably led to a number of unnecessary re-manipulation. Alignment of the fragments is another matter. Accurate alignment is of paramount importance to the final result.<sup>(11)</sup> It is unfortunate that apposition and rotation are easily seen on X-ray, whereas coronal tilt is often most difficult to determine accurately in the A.P. view.

This is probably the prime reason for the high incidence of change in the carrying angle after closed methods of treatment of this fracture.<sup>(12)</sup> Acceptance of poor position leads to imperfect results. A bad reduction did not always lead to an unsatisfactory result. In our study, 6 cases with poor reduction leads to 3 fair and 3 poor or unsatisfactory results. Open reduction and internal fixation of these fracture might control the position of the fragments, Balasubramanian Balakumar.<sup>(13)</sup> however, pointed out the technical difficulties of open reduction and reported an incidence of changes in the carrying angle with open reduction.

There are dangers of infection in open reduction and chances of joint stiffness are definitely higher than with other methods.<sup>(14)</sup> In our study of 50 cases, we kept the forearm in pronation with elbow flexed as a position of immobilization. Immobilization of varus fractures after reduction with the forearm in pronation is not a new concept;<sup>(15)</sup> but apparently this position is often not used. The forearm had to be immobilized in moderate pronation even after surgery

## ORIGINAL ARTICLE

---

because of the risk of slipping. From the stand point of function, limitation of flexion of the elbow is considerably more disabling than limitation of extension.

In our series of 50 cases, there were 5 cases (10%) showed with limitation of flexion ranging from 5 to 10 degrees and 1 case (2%) of limitation of motion extension of 5 degrees.

This low incidence of limitation of motion at the elbow may be because of the early supervised physiotherapy after 3 weeks of immobilization. Change in the carrying angle can produce functional impairment. This deformity is also unsightly. In our series, 22 cases (44%) had cubitus varus and remaining 24(48%) had shown reduction in carrying angle by 6 to 20 degrees.

Cubitus varus deformity following supracondylar fracture often is not recognized until the elbow regains its full mobility after it had been immobilized in flexion. Even in the normal elbow the carrying angle is obscured in flexion. In general, a cubitus varus deformity that seems to be increasing, actually is made obvious by the return of extension of the elbow. It has been shown convincingly that medial tilt of the distal fragment is the only displacement, which is responsible for cubitus varus deformity. The sole cause of varus deformity was incomplete correction of the medial rotation of the distal fragment.

Rotation predisposes to medial angulation, but rotation by itself did not cause cubitus varus. Median nerve injury was seen in 4 cases and radial nerve injury in 2 cases thereby showing more frequent incidence of median nerve injury in association with supracondylar fractures of the humerus. Out of 4 cases of median nerve injury, 3 were having postero-lateral displacement of the fracture on the X-ray.

The median nerve is injured mainly with postero-lateral displacement of the distal fragment and radial nerve is injured mainly with postero-medial displacement. Supracondylar fractures in which distal fragment is driven posteriorly and the lower end of the proximal fragment anteriorly, the sharp ragged edges of the latter buried in the brachialis muscle and a stretch of the median nerve results.

Fracture haematoma may also compress the median nerve. No case of ulnar nerve involvement was observed in our series. Chances of injury to the ulnar nerve in supracondylar fractures with posterior displacement of the distal fragment are minimal, as the ulnar nerve gets relaxed and is carried backward away from the fracture edge. All the nerve injuries in our series fully recovered spontaneously within 3 to 20 weeks showing thereby that these lesions were all in continuity; as reported earlier in previous studies.<sup>(16,17)</sup>

Our study shows that, displaced supracondylar fractures of the humerus in children, conservative treatment by manipulative reduction under general anaesthesia and immobilization with posterior plaster of paris slab yields high percentage of satisfactory result. The advantage of closed treatment are, no risk of infection, no production of excessive callus and no stiffness of the elbow and avoidance of unsightly surgical scar. Our overall results were quite satisfactory, considering that we have about 40% excellent, 42% good and 12% fair results.

**CONCLUSION:** Closed reduction and immobilization in flexion with posterior plaster of paris slab as treatment of extension type of displaced supracondylar fractures of the humerus in children still remains an option in a developing country like India where availability of image intensifier still remains a problem. No residual neurovascular deficit was present at follow up.

## ORIGINAL ARTICLE

This closed method of treatment for all practical purposes produces least complications, shorter hospital stay, good outcome achieved with less complicated procedures and can be expected to yield reproducible consistent satisfactory results not surpassed by any other method of treatment.

**ACKNOWLEDGMENT:** We sincerely acknowledge Mr. Th. Sanjoy Singh, Plaster – technician for his valuable help in applying plaster of paris for this study.

Result	Rating	Cosmetic factor: Carrying angle – Loss (Degree)	Function factor: Motion Loss (Degree)
Satisfactory	Excellent	0 - 5	0 – 5
	Good	9 - 10	9 – 10
	Fair	10 - 15	10 - 15
Unsatisfactory	Poor	>15	>15

Table 1: Criteria for Grading [Flynn J C et Al 1974]

Status of the carrying angle	No. of Cases (%)	Range of reduction in the carrying angle (Degree)	Average reduction in carrying angle (Degree)
No change	4 (8%)	0	0
Reduction in carrying angle with Cubitus varus	22 (44%)	6 to 20	11
Reduction in carrying angle without Cubitus varus	24 (48%)	2 to 9	4

Table 2: Shows the Change in the Carrying Angle of the Elbow

REDUCTION	RESULTS				TOTAL
	Excellent	Good	Fair	Poor	
Good	12	16	2	0	30
Mediocre	8	4	1	1	14
Poor	0	1	3	2	6
<b>Total:</b>	<b>20(40%)</b>	<b>21(42%)</b>	<b>6(12%)</b>	<b>3(6%)</b>	<b>50</b>

Table 3: Shows the Co-Relation Between Quality of Reduction and Final Results

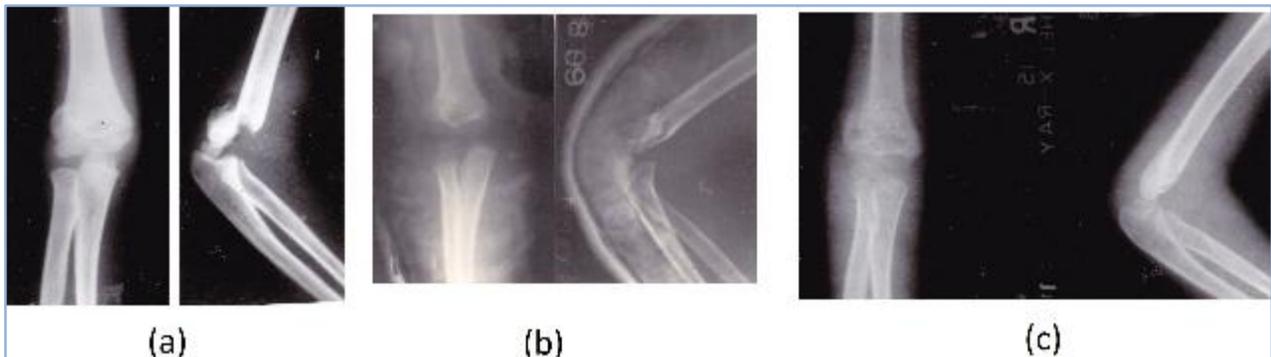
## ORIGINAL ARTICLE

GRADING		No. of cases	Percentage
Satisfactory	Excellent	20	40
	Good	21	42
	Fair	6	12
Unsatisfactory	Poor	3	6

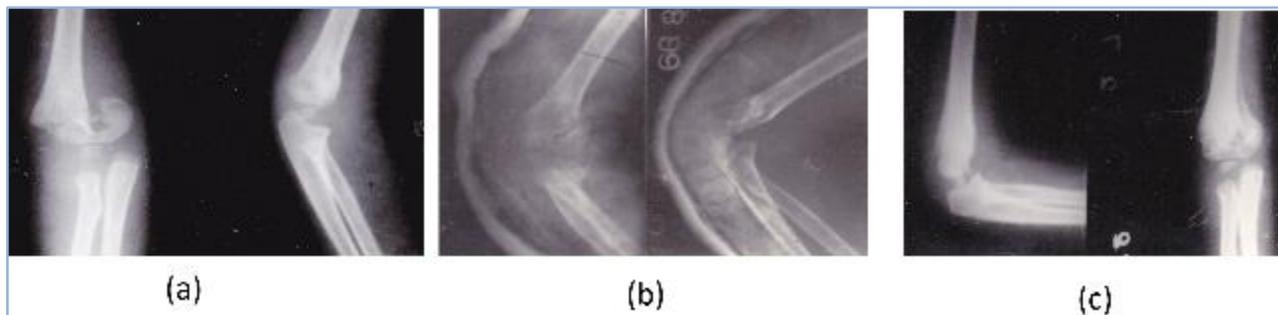
**Table 4: Shows the Overall Final Result According to Flynn Criteria of Grading**



**Fig.1: Showing Radiological Measurement of Carrying Angle**



**Fig. 2: (a) Pre – Reduction, (b) Good Post Reduction, (c) After Six Weeks**



**Fig. 3: (a) Pre – Reduction, (b) Post Reduction, (c) After Six Weeks**

#### REFERENCES:

1. Ramji LS. Percutaneous k-wire fixation in paediatric supracondylar fractures of humerus-a retrospective study. *Med J Nigeria*. 2013; 54(5):329-334.
2. Sadiq MZ, Syed T, Travlos J. Management of grade III supracondylar fracture of the humerus by straight-arm lateral traction. *Inter Orthop* 2007; 31(2):155- 158.
3. Wael A, El-Adl, Mohammed A, El-Said, *et al*. Results of treatment of displaced supracondylar humeral fractures in children by percutaneous lateral cross-wiring technique. *Strategies Trauma Limb Reconstr*. 2008; 3(1):1-7.
4. Kartikey G, Manik G, Satish K. Displaced supracondylar fracture of the humerus in children- a modified technique of closed reduction. *Ind J Orthop* 2006; 40(2):108-110.
5. Flynn JC, Mathews JG, Benoit RL. Blind pinning of displaced supracondylar fractures in children. *J Bone Joint Surg [Am]* 1974; 56: 263-273.
6. Mangwani J, Nadarajah R, Paterson JM. Supracondylar humeral fractures in children- ten years' experience in a teaching hospital. *J Bone Joint Surg Br* 2006; 88:362-5.
7. Ramji LS. Percutaneous lateral kirschner wire fixation in pediatric supracondylar fractures of humerus. *J Orthop Trauma Rehab* 2013; 6(1):78-83.
8. Boparai RPS, Rakesh S, Rajesh K, *et al*. Supracondylar fractures in children- closed reduction vs open reduction. *Ind J Orthop Trauma* 2006; 40(2):103-107.
9. Shijin VD, Soumya G, Arunima C, *et al*. Management of displaced supracondylar fracture of the humerus in children. *Saudi J Sports Med* 2015; 15(2):193-198.
10. Jacob W, Brubacher, Seth DD. Pediatric supracondylar fractures of the distal humerus. *Current Review Musculoskel Med* 2008; 1(3-4):190-196.
11. Kamath SU. Open reduction and internal fixation of severely displaced humeral supracondylar fractures in children. *Ind J Orthop* 2003; 37(1); 9.
12. Ayenger RS, Singh R, Badole CM, Patond KR. Closed reduction and percutaneous kirschner wire fixation of displaced supracondylar fractures of humerus in children. *Ind J Orthop* 2003; 37(1):10.
13. Balakumar B, Madhuri V. A retrospective analysis of loss of reduction in operated supracondylar humerus fractures. *Ind J Orthop* 2012; 46(6):690-697.

## ORIGINAL ARTICLE

14. Dudani B, Sancheti KH, Treatment of supracondylar fracture of the humerus in children by closed reduction and adhesive plaster strapping. *Ind J Orthop* 1983; 17(1):35-39.
15. Antoine de G, Damien B. Outcome of Gartland type II and type III supracondylar fractures treated by Blount's technique. *Ind J Orthop* 2010; 44(1):89-94.
16. Yadav UB, Singhal R, Tonk G, et al. Crossed pin fixation in displaced supracondylar humerus fractures in children. *Ind J Orthop* 2004; 38(3):166-169.
17. Mohamad O, Emad Abd AH, Percutaneous lateral cross-pinning of paediatric supracondylar humeral fractures. *Egypt Orthop J* 2014; 49(3):188-192.

### AUTHORS:

1. Ch. Imobi Singh
2. R. K. Rupabati Devi
3. G. Satyabarta Sharma

### PARTICULARS OF CONTRIBUTORS:

1. Assistant Professor, Department of Orthopedics, Jawaharlal Nehru Institute of Medical Sciences, Imphal, Manipur.
2. Assistant Professor, Department of Pediatrics, Jawaharlal Nehru Institute of Medical Sciences, Imphal, Manipur.
3. Senior Resident, Department of Orthopedics, Jawaharlal Nehru Institute of Medical Sciences, Imphal, Manipur.

### NAME ADDRESS EMAIL ID OF THE CORRESPONDING AUTHOR:

Dr. Ch. Imobi Singh,  
Department of Orthopedics,  
Jawaharlal Nehru Institute of Medical Sciences,  
Promopat, Imphal East,  
Manipur, India.  
E-mail: cdr.imobi@yahoo.co.in

Date of Submission: 08/08/2015.  
Date of Peer Review: 10/08/2015.  
Date of Acceptance: 12/08/2015.  
Date of Publishing: 13/08/2015.