
ORIGINAL ARTICLE

TREATMENT OF OPEN FRACTURES OF BOTH BONES OF FOREARM IN CHILDREN USING UMEX FIXATOR: A STUDY OF 30 CASES

Athmaram M¹, V. Nava Krishna Prasad²

HOW TO CITE THIS ARTICLE:

Athmaram M, V. Nava Krishna Prasad. "Treatment of Open Fractures of Both Bones of Forearm in Children Using UMEX Fixator: A Study of 30 Cases". Journal of Evolution of Medical and Dental Sciences 2015; Vol. 4, Issue 26, March 30; Page: 4403-4410, DOI: 10.14260/jemds/2015/637

ABSTRACT: External fixation is one of the accepted treatments for open fractures. Open fractures of both bones of forearm in children are not an uncommon entity. Thirty cases of such fractures in children were treated using Universal Mini External Fixator under image intensifier. The importance was given to maintain the interosseous space as wide as possible by keeping the forearm in 30° of supination during reduction. All the wounds healed well and there was no case of osteomyelitis. The average angulation was 9° and the average loss of rotation was 24.5° UMEX fixator is easy to apply and maintain, complications are minimal and the final outcome is good.

KEYWORDS: Children, Open fractures of forearm, External fixation.

INTRODUCTION: Forearm fractures are common injuries in childhood. They account for 45% of all fractures in children and for 62% of upper limb fractures. The vast majority 81% occur in children who are older than 5 years of age, with a peak incidence of distal forearm fractures occurring at ages 10 to 12 in girls and 12-14 in boys.⁽¹⁾ Approximately 75-84% of forearm fractures occur in the distal third, 15-18% in the middle third and 1-7% in the proximal third.^(2,3)

Rotation of forearm is the motion most frequently lost after these fractures.⁽⁴⁾ Mild limitations of rotation are not noticeable to the patient, because abduction and internal rotation at the shoulder adequately compensate for any loss in pronation, and adduction and external rotation of the shoulder may partially compensate for limitation in supination.⁽⁵⁾ Therefore even with stringent criteria, 85% achieve satisfactory results from closed reduction of the forearm.^(6,7)

Narrowing of the interosseous space has been shown to restrict the rotation of the forearm. With the forearm in the range of neutral to 30° of supination, the interosseous space forms an elongated ellipse that is widest in the middle third of the forearm. The interosseous membrane becomes increasingly relaxed with further supination or pronation. The narrowest distance was in pronation.⁽⁸⁾ From this, it appears that in treating fractures of the forearm, restoring the interosseous distance with the forearm in neutral to 30° of supination is ideal for regaining full rotation. Bayonet apposition, or overlapping does not limit rotation as long as the interosseous space is maintained.⁽⁹⁾

Morrey and associates established that 30° to 130° of flexion at the elbow, and 50° of pronation to 50° of supination are needed for most activities of daily living.⁽¹⁰⁾ Experimental studies have showed that 10° of rotatory malalignment does not produce any significant clinical impairment.⁽¹¹⁾

The main causes of limitation of rotations were residual angulatory deformity (Especially if it resulted in narrowing of the interosseous space), residual posterior angulation of the ulnar fracture, residual rotational malalignment of the fracture fragments, and derangement of the inferior radioulnar joint owing to relative shortening of the radius.^(7,5)

ORIGINAL ARTICLE

Price uses the following guidelines for acceptable alignment.⁽¹²⁾ Distal fractures may be treated closed in the presence of complete displacement and up to 15° of angulation and 30° of malrotation. Proximal shaft fractures in the older age group will have a satisfactory result with complete displacement and up to 10° of angulation and 30° of malrotation.⁽¹²⁾

MATERIAL AND METHODS: This is a prospective study of 30 children with open fracture of both bones of forearm from 2000 March, at the Government Medical College Hospital – Anantapur.

INCLUSION CRITERIA:

- Children with acute open fractures of both bones of forearm.
- Children who are below and equal to 14 years age.
- Children with wounds which are Gustilo's Type I and II.
- Children who had not been treated outside for the same injury.
- Children who had the injury within 24 hours from the time they were examined in the casualty.
- Children with associated injuries.

EXCLUSION CRITERIA:

- Badly crushed injuries which had loss of skin or any compartment of muscle.
- Injuries which were Gustilo's Type III and above.
- Patients who had undergone any form of treatment (partial or complete) definitive treatment outside.
- Epileptics and mentally retarded children.

A detailed history concerning the mode of injury, time of injury and the first aid were obtained. Detailed examination regarding the level of the injury, wound and associated injuries were conducted.

Routine investigations and were done and other injuries were looked for. All cases were operated under general anesthesia. Through debridement and was done and the wounds were closed primarily.

Under image intensifier control the fracture was reduced with traction and the forearm held in 30° supination and over-riding was corrected. Bayonet opposition was accepted.

With forearm in 30° of supination, two 2 mm k-wires were passed into the radius and ulna at least 4 cm proximal to the fracture line, and at least 3 cm distal to the fracture line. The distracting rods of the UMEX fixator were applied and the distraction was maintained, so that adequate traction was maintained and the fracture was reduced. Over-riding was not accepted.

Four patients had supra-condylar fracture on the same side. Four had sustained fracture of the ipsilateral clavicles. Three had sustained ipsilateral metacarpal fractures.

In the same sitting, the supracondylar fractures were reduced and fixed with k-wires under image intensifier control. In patients with metacarpal fractures, two k-wires were introduced into the metacarpals distal to the fracture site and the traction was maintained with additional extension rod attachment. Conservative treatment was followed for the clavicles using figure of "8" bandage with cuff & collar.

ORIGINAL ARTICLE

POST-OPERATIVE MANAGEMENT: Adequate antibiotics were given. Mobilisation of the fingers was started as soon as the pain and the swelling subsided. Patients were given an arm pouch to keep the affected limb. Sutures were removed on the 10th day.

Patients were discharged after suture removal and reviewed every two weeks. Check x-rays were taken every four weeks and the fixator was removed after eight weeks. They were asked not to lift weight for another month. Elbow and wrist mobilization were done.

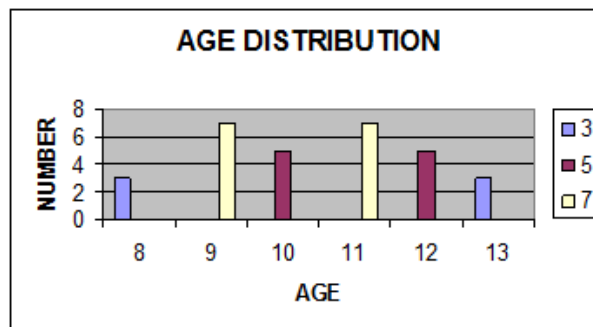
In one patient above elbow cast was given for another four weeks as the fracture had not yet united completely. The ulnar angulation was measured as soon as the fixator was removed and the loss of rotations was measured after one month of fixator removal.

All the patients were reviewed in April 2003 and the ulnar angulation and loss of rotations were measured again. The results were measured using Price's criteria⁽¹²⁾ for children aged 8-12 years. The criteria are as follows:

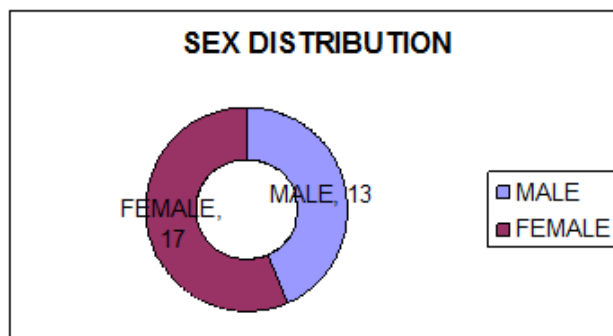
PRICE CRITERIA	Good	Fair	Poor
Angulation	0-10°	10°-15°	> 15°
Malrotation	0-30°	30°-45°	> 45°

OBSERVATION: This study is concerned with management of open fracture of both bones of forearm in children with UMEX fixator with a particular stress on the measurement of angular and rotational deficits in the long term follow up.

Children were between 8-13 years of age with majority being aged 9 and 11.

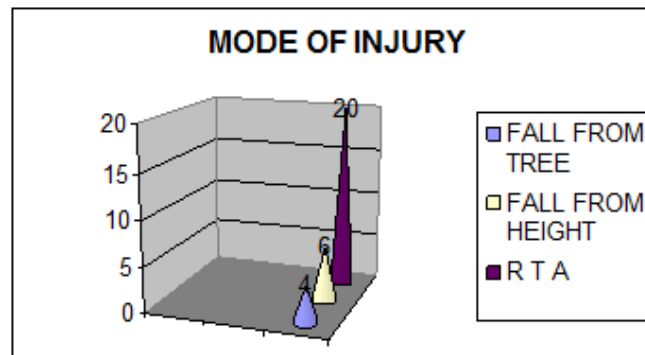


Majority were Female:

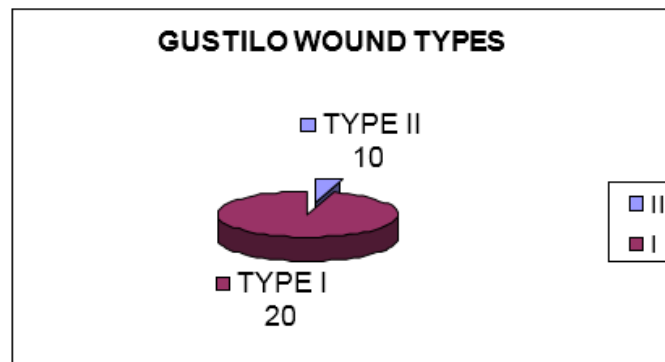


ORIGINAL ARTICLE

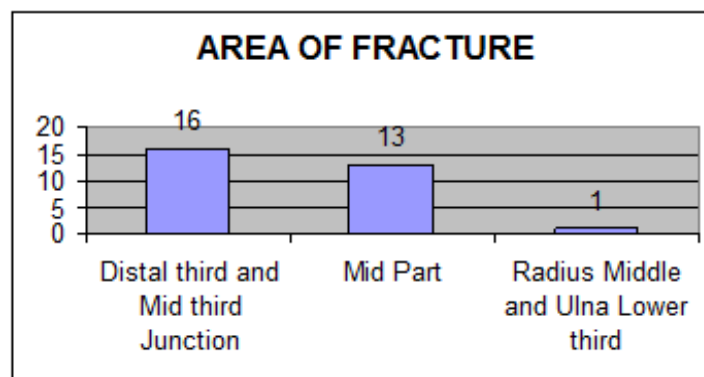
Most of them sustained the injuries after a road traffic accident while the rest sustained the injury after a fall.



Two thirds of the wounds were Gustilo's Type I, the rest were Type II.



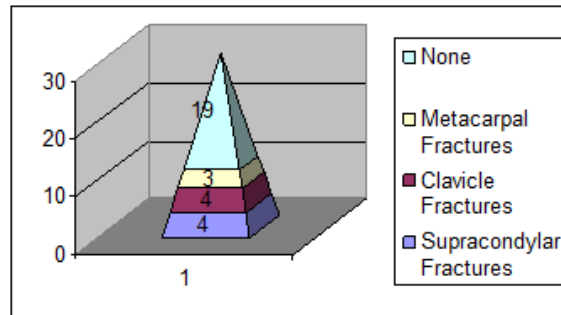
Most of the children had a fracture at the junction of the distal third and mid third of the forearm. Thirteen had the fracture in the mid part. One had a fracture of the mid part of radius and lower part of ulna.



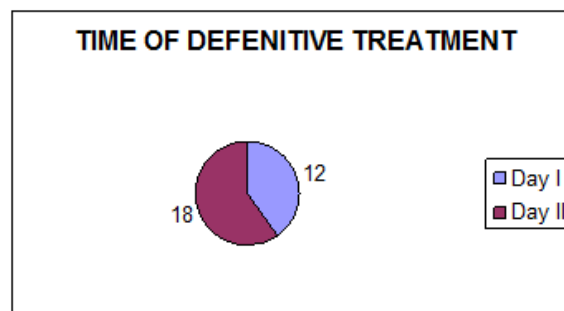
The associated injuries were ipsilateral supracondylar fractures in four, ipsilateral clavicle fractures in four and metacarpal fractures in three.

ORIGINAL ARTICLE

Associated Injuries:



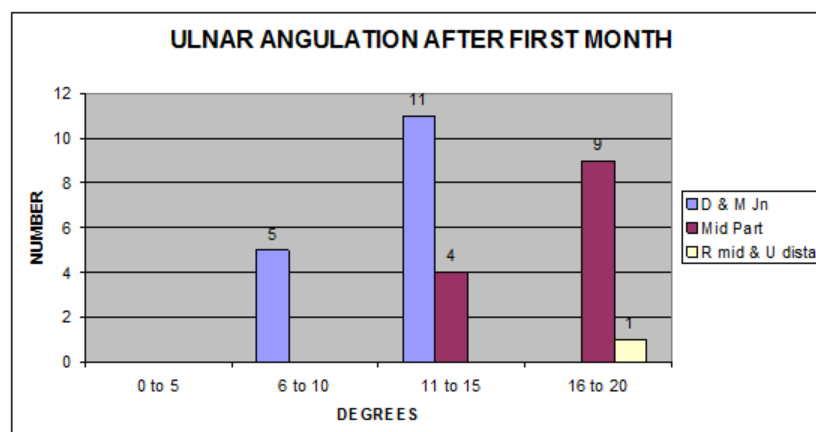
All the children were operated within 48 hours of arrival to the hospital.



General anesthesia was administered in all. In all the patients the wounds were closed primarily.

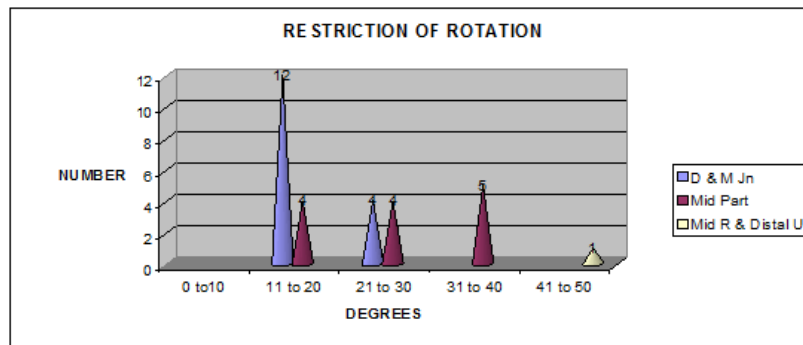
RESULTS: In all patients the forearm rotation loss and the ulnar angulation were measures after one month after fixator removal. Again the both values were measured in the month of April 2003. In April 2003 four patients were lost for follow up.

FOLLOW UP ON THE FIRST MONTH: The ulnar angulations in the first month after fixator removal in various fractures are as follows:

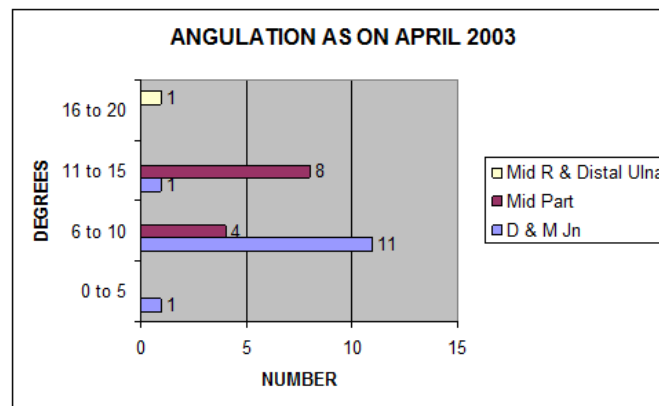


ORIGINAL ARTICLE

The loss of forearm rotations observed are as follows:

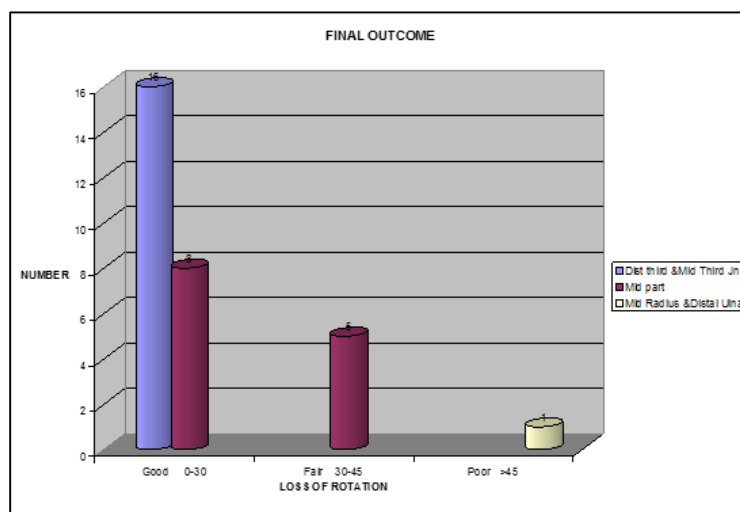


FOLLOW UP IN APRIL 2003: After a mean follow up of 18 months there was some remodeling and the angular deformity got corrected a little. Four were lost for follow up.



The average correction of angulation was 4.3°. The rotation deformity did not correct at all.

The final outcome of different fractures measured as per criteria laid down by Price are as follows:



ORIGINAL ARTICLE

The presence of associated fractures in the ipsilateral side didn't alter the final outcome. It was noticed that the type of open wound is not the main factor determining the final outcome. The final outcome is dependent of the level of the fracture in the forearm.

COMPLICATIONS: Early complications like wound infection occurred in ten patients and of these seven were Gustilo's type II and rest were Gustilo's type I. Pin tract infection was noticed in seven patients. These healed after a course of oral antibiotics and daily dressing. Loosening of pins which required re-application of the pins was noticed in one patient who had a fracture of mid part of radius and lower third of ulna.

CONCLUSIONS:

- The majority of open fractures in children between 8-13 years are of the distal third and mid third junction.
- The commonest cause being road traffic accidents.
- During the fixator application the forearm should be held at 30° of supination is ideal.
- Fractures of the mid third and distal third junction have good result in terms of residual ulnar angulation and total loss of rotations.
- Fractures of forearm where the radius and ulna are fractured in the mid part of the forearm also have good results with this method of treatment.
- Fractures of forearm where radius and ulna are fractured at two levels do badly.
- The presence of associated injury does not alter the outcome of the treatment.
- We can expect correction of angulation but the loss of rotations are permanent and do not get corrected.
- Failure to maintain the maximum width of the interosseous membrane gives bad results.
- The UMEX fixator is easy to apply, maintain and patient friendly with minimum complications.

Hence when conditions are favorable and facilities exist the u m e x fixator is an ideal solution for open fractures of the distal third and mid part of the forearm in children. This is not an ideal choice when the radius and ulna are fractured at two different levels.

REFERENCES:

1. Bailey, D.A.; Wedge, J.H.; McCulloch, R.G.; et al. Epidemiology of fractures of the distal end of the radius in children as associated with growth. *J Bone Joint Surg* 71A: 1225–1231, 1989.
2. Blount, W.; Shaefer, A.; Johnson, J. Fractures of the forearm in children. *JAMA* 120: 111, 1942.
3. Gandhi, R.K.; Wilson, P.; Mason Brown, J. J.; Macleod, W. Spontaneous correction of deformity following fractures of the forearm in children. *Br J Surg* 50: 5–10, 1962.
4. Matthews, L.S.; Kaufer, H.; Garver, D.F.; Sonstegard, D.A. The effect on supination-pronation of angular malalignment of fractures of both bones of the forearm. *J Bone Joint Surg* 64A: 14–17, 1982.
5. Knight, R.A.; Purvis, G.D. Fractures of the forearm in adults. *J Bone Joint Surg* 31A: 755–764, 1949.
6. Creasman, C.; Zaleske, D.J.; Ehrlich, M.G. Analyzing forearm fractures in children: The more subtle signs of impending problems. *Clin Orthop* 188: 40–53, 1984.

ORIGINAL ARTICLE

7. Daruwalla, J.S. A study of radioulnar movements following fractures of the forearm in children. Clin Orthop 139: 114–120, 1979.
8. Christensen, J.B. A study of the interosseous distance between the radius and ulna during rotation of the forearm. J Bone Joint Surg 46B: 778–779, 1964.
9. Rang, M. Children's Fractures, 2nd ed. Philadelphia, J.B. Lippincott, 1982, p. 197 ff.
10. Morrey, B.F.; Askew, L. J.; An, K.; Chao, E.Y. A biomechanical study of normal functional elbow motion. J Bone Joint Surg 63A:8 72–877, 1981.
11. Price, C.T.; Scott, D.S.; Kurzner, M.E.; Flynn, J.C. Malunited forearm fractures in children. J Pediatr Orthop 10: 705–712, 1990.
12. Price, C. Fractures of the midshaft radius and ulna. In: Letts, R., ed. Management of Pediatric Fractures. New York, Churchill Livingstone, 1994.

AUTHORS:

1. Athmaram M.
2. V. Nava Krishna Prasad

PARTICULARS OF CONTRIBUTORS:

1. Associate Professor, Department of Orthopaedics, Government Medical College, Anantapur.
2. Associate Professor, Department of Orthopaedics, Government Medical College, Anantapur.

FINANCIAL OR OTHER

COMPETING INTERESTS: None

NAME ADDRESS EMAIL ID OF THE CORRESPONDING AUTHOR:

Dr. Athmaram M,
13-2-540,
Ramachandra Nagar,
Anantapur-515001.
E-mail: athmaramadishes@yahoo.com

Date of Submission: 18/02/2015.
Date of Peer Review: 19/02/2015.
Date of Acceptance: 18/03/2015.
Date of Publishing: 27/03/2015.