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A Comparative Study on Functional Outcome of Supracondylar Fractures of Humerus in Children with Closed Manipulation Vs Closed K-Wire Fixation

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Abstract: The frequency of supracondylar fractures of the humerus in children is increasing recently. The management of supracondylar fractures is controversial and often difficult. We in the present study tried to study the overall functional outcome and union rates of closed manipulation vs closed k-wire fixation in supracondylar fracture of the humerus. Methods: In the present study, twenty cases that had completely displaced supracondylar fracture of the humerus were studied. The study was conducted in Mahatma Gandhi Memorial Hospital, Warangal. Institutional Ethical Committee Permission was obtained for the study. A detailed history of the mode of injury was obtained from the parents as well as the patient. Out of the 20 cases, 12 (60%) sustained fracture due to a fall while playing and the remaining 8 (40%) patients due to falling from the cycle. All most all the cases had a history of fall on outstretched hand. All patients presented with pain, swelling, S-shaped deformity of the lower arm and inability to move the affected elbow. On examination, all patients had diffuse swelling around the elbow. Puckering of the skin was seen at the site of fracture in 2 cases. 10 patients were taken for conservative treatment and 10 patients were taken for closed k-wire fixation. Results: Five conservative cases (1 Gartland type I & 4 Gartland type II) and 8 operative cases (3 type II and 5 type III) exhibited good (65%) results, 2 conservative (1 type II & 1 type III) and 1 operative case (1 type III) had fair (15%) result and 3conservative (type III) and 1 operative case(1 type III) had poor result (20%). Indicating that Gartland type III fracture treated by conservative management had poor results and operative management had better results. Gartland type II fractures had good results with both conservative and closed k-wire fixation. Conclusion: we can conclude that conservative treatment necessitates hospitalization of the patient and demands supervision of the patient constantly. Traumatic neuropraxia of one or more of the three adjacent peripheral nerves is a common complication of displaced supracondylar fractures, with a great majority of these lesions responding to conservative treatment. The major complication of surgical management appears to be a loss of range of motion. The main reasons for the decrease in range of motion being delay in active exercises. Most patients will regain full function of the elbow if the K wires are removed following callus formation in X-ray and motion started 4 weeks after an injury early motion is the key.

Keywords: Supracondylar Fractures of Humerus, Children, Closed Manipulation, Closed K-Wire Fixation.

INTRODUCTION

Supracondylar fractures are the most common fractures seen in children. It comprises about 58% of elbow fractures in children [1]. The peak incidence is seen in the age group of 5-10 years [2]. This fracture involves the lower end of humerus involving a thin portion of humerus through olecranon fossa or above the fossa through metaphysis. The causative factors for this fractures in children are playing, cycling, and fall from height (bed, sofa). The number of patients separated and also the severity of the initial injury that happens, great diligence is required to secure an excellent result and to avoid or minimize the unhealthful complications, such as Volkmann's ischemic contracture, myositis ossification, stiffness, permanent nerve injuries, and malunion. It is a general belief that the correct reduction in youngsters isn't essential for a decent result, because growth may

correct a deformity. It is true that purposeful finish results of mal alignment square measure typically superb however is additionally true; the cosmetic end results are very poor. The stiffness of the elbow which sometimes follows relatively minor injuries, the remarkable sensitivity of the injured joint and too early passive movement adds to the difficulties of treatment and prognosis. Conservative treatment of fractures in children is the usual line of approach. Surgical treatment may be reserved for some physical injuries, fractures associated with neurovascular damage, open fractures. However, the management of management of supracondylar fractures of the humerus has evolved from a purely conservative approach to a more aggressive approach in recent years. Alterborough C.B., London, in their articles on the remodeling of the humerus after supracondylar fracture in childhood, said that in the treatment of supracondylar fracture of humerus in children, the aim should be perfect anatomical reposition of the fragments attained by closed manipulation. If for any reasons it is found impossible to achieve this goal, there are two alternatives; open reduction or immobilization in the unreduced position. He said the rotational deformity is not corrected by remodeling [3]. Schuz W and Borner M [4] described indication and methods for supracondylar fracture of the humerus. All remaining varieties of fractures of grade II and III severity ought to primarily be treated by open operations among eight hours of the accident. Risk of infection is no higher than with percutaneous Kirschner wire. Complications such as appreciable varus deformity, poor function, and nerve lesions can be largely avoided in this way. De Buys Roessingh A.S. and Reinberg O dealt over the controversy that lies between percutaneous pinning over open pinning fixation in children with supracondylar fracture humerus. They found, in comparison to open pinning fixation, percutaneous pinning reduced the length of hospitalization, reduced the risk of extension deficiency and of cubitus varus. They concluded that percutaneous pinning is a good surgical method for supracondylar fractures if performed by experienced surgeons [5]. With this background, we in the present study tried to evaluate overall functional outcome and union rates of closed manipulation Vs closed k-wire fixation in supracondylar fracture of the humerus.

MATERIALS AND METHODS

In the present study, twenty cases that had completely displaced supracondylar fracture of the humerus were studied. The study was conducted in Mahatma Gandhi Memorial Hospital, Warangal. Institutional Ethical Committee Permission was obtained for the study. A written consent was obtained from all the Parents/Guardians of the patients involved in the study after explaining the study in the local language. A detailed history of the mode of injury was obtained from the parents as well as the patient. Out of the 20 cases, 12 (60%) sustained fracture due to a fall while playing and the remaining 8 (40%) patients due to falling from the cycle. All most all the cases had a history of fall on outstretched hand. All patients presented with pain, swelling, S-shaped deformity of the lower arm and inability to move the affected elbow. On examination, all patients had diffuse swelling around the elbow. Puckering of the skin was seen at the site of fracture in 2 cases. All the patients had shortening of the arm as compared to the normal side. The average period from injury to presentation was 10 hours, the mean age being 8.0 years. There were 14 boys and 6 girls. 18 patients presented with the involvement of the left side and 2 patients on the right side. Two cases gave the history of have received the massage from an osteopath. One case of posteromedial displacement was accompanied with radial nerve injury. These were traumatic neuropraxias and recovered completely in 10-12 weeks. X-ray of the elbow was taken in two planes, anteroposterior and lateral. 20 cases of supracondylar fractures were included in this series. These were further grouped into of Gartland's grade I, II, III types.

Conservative management

The patient hospitalized and advised nil by mouth. The fractured limb was splinted and elevation was done to reduce the swelling. Then the reduction was carried out under general anesthesia with full relaxation in the operating room. The carrying angle was assessed and noted down. First, the longitudinal traction applied to the forearm with the elbow in extension and forearm in supination. Counter-traction to the proximal arm was provided by the assistant. Then with the traction being maintained, the medial or lateral displacement was corrected by applying a valgus or varus force at the fracture site. Once length was re-established and the edges of the fragments, were joined, the displacement and angulation of the distal fragment were corrected by flexing the elbow. At the same time, a posteriorly directed force was applied to the anterior portion of the arm over the proximal fragment and an anteriorly-directed force was applied posteriorly over the distal fragment. The reduction was achieved, which was confirmed by full flexion of the elbow. Then the elbow was kept in 120° flexion and forearm in full pronation in a posterior splint. The distal vascularity was checked. A cuff and collar sling was applied.

Operative Procedure

Closed reduction and percutaneous pin fixation with Kirschner wires, under C-arm guidance. Anesthesia used was general anesthesia. Technique in brief: prepare and drape the elbow. The posterior triangle of the elbow is outlined. The fracture was reduced by applying longitudinal traction; extending the fracture; and manipulating with thumbs to correct the lateral tilt, medial impaction, or posterior displacement. The elbow was flexed from neutral. Anteroposterior and lateral reduction images were checked with aid of image intensifier. A 1.5mm K-wire was mounted over a

power drill. The K wire was passed from the medial epicondylar ridge obliquely across the fracture site to engage the opposite cortex. The medial pin was angled 40° from the axis of the humeral shaft and 10 degrees posteriorly, avoiding the ulnar nerve. In a similar fashion, another 1.5mm K wire was passed from the lateral epicondyle obliquely across the fracture site to engage the opposite cortex. The pins were cut off beneath the skin and bent. Radial pulse was noted as well as K wire placement. The reduction & stability of fracture was checked and the movements of the elbow verified both clinically and under C-arm guidance on the table. In the coronal plane, the wires travel up each S C Column with wide separation at the fracture site. This provides the most rigid biomechanical construct. Post-Operative Management: long arm posterior splint applied and limb was elevated. Antibiotics and analgesics were given. Ulnar, Radial and Median nerve were checked after anesthesia. A check X-ray was taken on the second day. The patient was advised to do active finger movements and discharged at a proper time. The patient was asked to review after 3 wk in the outpatient department and inspection done. The operated site was inspected for: a) swelling, b) extrusion of pins, c) pin tract infection if any d) stretch pain. The dressing did and splint removed. Follow up: Patients were advised immediately to do active movements of the elbow, both flexion and extension, and finger movements, without lifting any weight on the operated limb. The 3 cases that had neuropraxia were followed up for the status of the neurological deficit. Power of extensors was checked in radial nerve involvement; opposition of fingers was checked in median nerve involvement. Check x-ray was taken to see whether the union was in progress. The pins were removed when radiological callus was seen on the x-ray, after 6-8 weeks of fixation. After removal of the pin, the patient advised continuing active exercises of elbow and fingers as advised soon after the surgery. They were advised to come once in 4 weeks to assess the range of the elbow movements and union rate of fracture. They were then called at 3 months following surgery. X-rays were taken to assess the rate of union, Baumann's angle and carrying angle was assessed. Patients who were having neurological involvement were followed up 2 times a week following surgery. Later follow-ups were made at six months. The ranges of movements were measured using a goniometer at these intervals. X-rays were taken to assess radiological union.

RESULTS

A total number of (n=20) cases were included the age range 3-12 years the mean age was 8 years and out of which male were n=14 and females were n=6. 10 patients were taken for conservative treatment and 10 patients were taken for closed k-wire fixation. No case sustained fracture due to a fall on a flexed elbow and all 20 cases fell on an outstretched hand. The average period from injury to presentation was 24 hours.

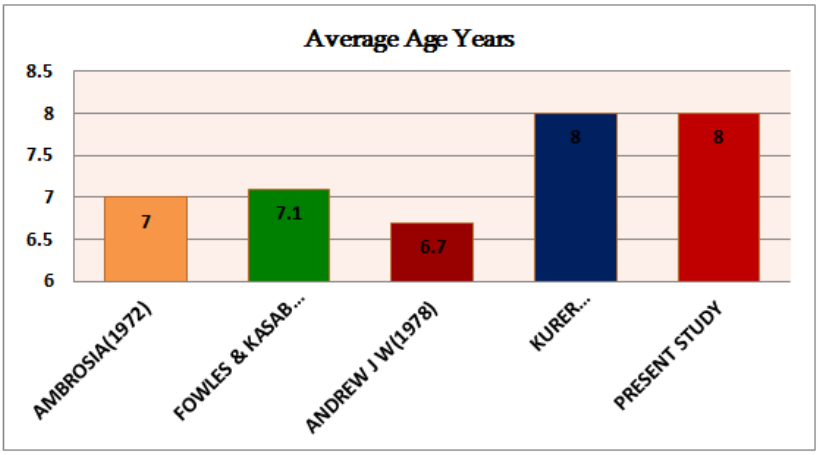

Fig-1: showing the Average age of involvement of fractures in comparison with other studies

Table-1: Showing the sex wise and side involvement of fractures

Sex	Right Elbow	Left Elbow	Total	Percentage
Male	2	12	14	70
Female	0	6	6	30
Total	2	18	20	100

Among the 20 cases of displaced fractures and all 20 were of extension type. Of the 10 conservative cases Gartland type I are 1, type II 5 & type III 4. Of the 10 operative cases Gartland type I are 0, type II is 3, & type is III 7. All 20 cases were taken up for reduction under C-arm guidance. Cases with failed reduction where taken for closed k-wire fixation in the present all the 20 (100%) cases of fractures were extension type.

Table-2: Showing the carrying angle loss in patients

Carrying angle	Male	Female	Total	Percentage (n=20)
Normal (5°-15°)	2	1	3	15
< 5 °	9	4	13	65
>15 - 20°	1	0	1	5
> 20 °	2	1	3	15

Of the total 20 cases, 10 cases had to be taken up for closed reduction and 10 cases for closed reduction with percutaneous pin fixation with Kirschner wires under C-arm guidance. Special care was taken while introducing the K wire anteriorly into the medial epicondyle so as to prevent ulnar nerve injury. After regular postoperative follow-ups, the results were assessed as follows according to Adams and Mitchell criteria. Five conservative cases (1 Gartland type I & 4 Gartland type II) and 8 operative cases(3 type II and 5 type III) exhibited good(65%) results, 2 conservative (1 type II & 1 type III) and 1 operative case(1 type III) had fair (15%) result and 3conservative(type III) and 1 operative case(1 type III) had poor result (20%). Indicating that Gartland type III fracture treated by conservative management had poor results and operative management had better results. Gartland type II fractures had good results with both conservative and closed k-wire fixation.

Table-3: Results of treatment by conservative and operative treatment

Result	Conservative Treatment	Operative Treatment	Total	Percentage
Good	5	8	13	65
Fair	2	1	3	15
Poor	3	1	4	20
Total	10	10	20	100

Mitchell and Adam [6] have proposed the criteria for evaluation of the end results of supracondylar fractures. Good: Change in the carrying angle less than 5 degrees or limitation of elbow motion less than 10 degrees. Fair: Change in the carrying angle from 5-15 degrees or limitation of elbow Motion 10-20 degrees. Poor: Change in the carrying angle, more than 20 degrees or limitation of elbow motion, more than 20 degrees. 4 cases (20%) had poor results, which are considered as failures. These cases had a Change in the carrying angle, more than 20 degrees.

DISCUSSION

Elbow fractures of children are very common injuries the supracondylar fractures of humerus results in complete displacement of fracture fragments in many cases. Vascular complications are inadvertent however are preventable in many cases. Cubitus varus deformity is also one of the other common complications in spite of different methods of treatment [7]. John Dunlop in 1939 made observation that transcondylar or bicondylar fractures of humerus are difficult for reduction, not because of the fragments cannot be brought end to end but because of difficulty in maintaining the reduction [8]. The main difficulty observed is that the upper and lower fragments became rotated in relation to each other. Many reductions were previously done by rotation of fractured fragments resulting in their locking. When fractures were reduced by this method deformity was resulted surely [6]. Table 3 shows the method employed for reduction and the average patients with varus and average angle. The mean change in the carrying angle was greater in the patients treated by manipulation.

Table-3: Mitchell and Adams (1961) [6]

Method	Patients with varus	Average angle
Dunlop traction	18%	3.8°
Manipulative treatment	60%	10°

The only method besides surgery to prevent the error of internal or external rotations that persists after manipulative reduction or even skin traction is skeletal traction [9]. However, the result depends largely on the precision management of traction system and confines the child to bed. All the patients in the present series were followed for a period of twelve months postoperatively. Two patients had a history of massage by osteopath but there were no signs of myositis ossificans. Feeble radial pulse in 2 cases, before reduction there was diffuse swelling at the time of presentation and tight bandage as applied by an osteopath. The pulse had returned immediately after reduction. Rozil Chir et al; studied the significance of radial artery pulse in displaced supracondylar fractures. They observed that the importance of palpabale or non-

palpable radial artery pulse in children with these kinds of fracture has not received the attention required the relative independence of Volkmann's contracture on palpable or nonpalpable pulsation of radial artery may be one of the reason [10]. In the present study the immediate postoperative complication was pin tract infection in 2 cases was treated with the antibiotic course. The residual complication seen was the decrease in the range of movement (flexion) is 14 degrees in 2 cases (10%) and 12 degrees in 4 cases (20%) the cause being the failure of early active elbow movements though advised. In a similar study by Zionts *et al.* the time of return of elbow motion after percutaneous pinning of supracondylar fractures of the humerus in children treated with lateral pins and crossed pins found the displaced supracondylar fractures of the humerus stabilized with either two or three lateral entry pins. Pins were to be removed by 3-4 weeks' time. The range of motion in follow up was recorded for an injured and uninjured arm [11]. The elbow range of motion returned to 72% of contralateral elbow motion by 6 weeks after and progressively increased to 86% by 12 weeks and up to 98% by 52 weeks after pinning. After closed reduction and percutaneous pinning of displaced and uncomplicated supracondylar fractures of humerus 94% of the range of motion was seen by 6 months. Therefore the results of closed reduction with percutaneous pin fixation when compared to closed reduction by conservative management were good and predictable only if early anatomic restoration is carried out. This may eliminate the inaccuracies of conservative management which may be imprecise especially in Gartland Type III fractures. In the present study also the overall outcome by conservative management was good only in 50% of cases whereas the operative management achieved good results in 80% of cases and the fair and poor results by operative management were also 10% each.

CONCLUSION

Within the limitations of the present study, we can conclude that conservative treatment necessitates hospitalization of the patient and demands supervision of the patient constantly. Traumatic neuropraxia of one or more of the three adjacent peripheral nerves is a common complication of displaced supracondylar fractures, with a great majority of these lesions responding to conservative treatment. The major complication of surgical management appears to be a loss of range of motion. The main reasons for the decrease in range of motion being delay in active exercises. Most patients will regain full function of the elbow if the K wires are removed following callus formation in X-ray and motion started 4 weeks after the injury early motion is the key.

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