

Original Research Article

Closed pinning for paediatric supracondylar fractures: does timing really matter?

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ABSTRACT

Background: Management guidelines and comparative studies are not yet clear for those patients who present early and late with widely displaced supracondyle humerus fracture in children.

Methods: A total of 74 children were included in this study, 30 patients presenting early within 24 hours as group 1, and 44 patients who presented late i.e. after 24 hours and within a week as group 2 underwent closed reduction and pinning.

Results: In group one 24 had excellent, 6 had good results, according to modified Flynn's criteria. One patient developed ulnar nerve palsy which was iatrogenic, and improved completely after wire removal. Another was brachial artery injury which was explored and recovered completely. In group 2 the average delay in presentation was 57.56 hours; mean time to surgery after presentation was 9.83 hours. Sixteen patients (36.36%) had neurologic complications at presentation to the emergency room of which three had median nerve palsy (6.81%) whereas seven (15.90%) had isolated anterior interosseous nerve palsy and six (13.6%) had radial nerve palsy all patients showed total neurological recovery at 12 weeks. Six patients (13.63%) had vascular compromise at initial presentation of which five patients had feeble radial pulse and one had absent radial pulse, but capillary filling was adequate in all. The pulse was restored within 24 hours in all patients following reduction. There were 37 excellent, 6 good and 1 fair results.

Conclusions: Our results support, closed reduction and Percutaneous pin fixation as an effective treatment option for grossly displaced supracondylar fractures presenting early and late but requires good and careful judgment and also technique.

Keywords: Timing of surgery, Paediatric supracondyle humerus fracture

INTRODUCTION

Supracondylar fractures are the most common fractures occurring in the first decade of life accounting for about 60% to 75% of all the fractures around the pediatric elbow and represents approximately 3% of all fractures in children.¹ Modern day healthcare has greatly evolved following advances in technology and medical research but despite the availability of these services, traditional bone setting has continued as an 'alternative' health service. In developing countries, especially in the Indian

subcontinent quacks treat 60% of all traumas, this mainly leads to delay in presentation to orthopaedician.² Displaced supracondylar fractures are difficult to treat, much more is the difficulty with fractures which present late. The difficulty is due to excessive swelling, earlier attempted and failed manipulations and sometimes presence of associated complications, such as neurovascular injury and compartment syndrome.³ The management guidelines are not clear for these patients presenting late but there are various treatment options for these fractures. The importance of our study is to draw

the attention of orthopedic surgeons to percutaneous pinning (PCP) for the treatment of displaced pediatric supracondylar fracture of humerus presenting early and late after injury with which the chances of redisplacement, loss of elbow motion, and cubitus varus deformity are minimal and to compare between the above two groups. However it is important to consider the options of treatment very carefully and tailor the treatment to the personality of each fracture.

METHODS

Seventy four patients who sustained type 3 supracondylar fracture humerus in age group between 4 to 12 years were included in this study. This prospective study was conducted at the orthopaedic and Trauma Department of Dr Pinnamaneni Siddhartha Institute of Medical Sciences and Research Foundation, Chinnoutpalli from January 2010 to July 2011. Out of 74 patients 30 were attended within 24 hours of injury were grouped as group 1, and remaining 44 patients who attended late from 24 hours to 6 days were grouped as group 2 were studied. All the children who come with the above injury were given resting splint immediately. They underwent radiographs and required investigations and taken for surgery under general anaesthesia. Parents' consent was taken both for closed and open reduction. Both group patients were taken up surgery as early as possible once they are fit for surgery. Patient was positioned supine with ipsilateral shoulder at the edge of the table. Affected elbow, arm and forearm was scrubbed, painted and draped leaving the elbow, lower third of arm and upper third of forearm exposed. Traction along the longitudinal axis with elbow in extension and supination were given. At the same time counter traction was given by an assistant by holding proximal portion of arm. Medial or lateral displacements were corrected by valgus or varus forces respectively. After that, posterior displacement and angulation was corrected by flexing the elbow and applying posteriorly directed force from anterior aspect of proximal fragment and anteriorly directed force from posterior aspect of distal fragment while maintaining traction in the axis of forearm. Almost all in postero medial displaced fractures elbow was fully flexed and fully pronated to lock the fractures and prevents displacement while passing the wires. Reduction was confirmed under image intensifier in two views; Stainless steel k wires of about 1.2mm to 2.0mm were used. We used to hold the reduced fracture with two K wires from lateral epicondyle in divergent manner, or crossed wires from both medial and lateral condyle. In the first group out of 30 patients 29 were stabilized with lateral pinning, and in the second group 24 patients out of 44 were stabilized with lateral pinning. Both pins were placed percutaneously. After the pins were placed, the elbow was extended and the carrying angle was compared with that on the non-affected side. The adequacy and stability of the reduction was checked under image intensification. The pins were bent to prevent migration and cut off outside the skin to allow removal in the outpatient clinic without anaesthesia. Pop

slab was applied in elbow 90 degrees of flexion by keeping eye on radial pulse. Patient was encouraged to move fingers. A careful observation for any neurovascular deficit was observed at regular intervals. Appropriate antibiotics and analgesics were used. Check x rays in AP and lateral views were taken. Patients were discharged on 1st post-operative day with pop slab. Weekly once child comes for pin tract dressings. At four weeks following surgery the Plaster of Paris slab was removed. Clinical evaluation was done to rule out distal neurological deficit. Check X-ray was taken to see whether union had taken place or not. Most of the patients had union at about four weeks. The K-wires were removed in the out-patient department. The Plaster of Paris slab was discarded and sling was given for one week. Patients were advised active elbow movements after demonstrating it to the patient. They were advised to come once in four weeks to assess the range of the elbow movements. They were then called at three months following surgery, X-rays were taken the range of elbow movements and carrying angle was assessed. Patients who were having neurological involvement were followed up every week following surgery. Later follow-ups were made at end of six months and one year. The range of movements and presence of deformities were measured by using a goniometer at these intervals. The functional results were graded based on Flynn's et al grading. Our data was analyzed based on central tendency and dispersion measures.

RESULTS

Group 1

In thirty cases of type 3 supracondylar fracture of humerus treated with closed percutaneous K wire fixation the mean age was 8.03 years. There were 21 males and 9 females. Twenty three, 76.7% left elbow were involved. Mechanism of injury was fall an out stretched hand (Table 1). Majority of patients had extension type of fracture 93.3%. One patient had ulnar nerve injury and 1 patient had brachial artery injury. Both were noticed post operatively. On first post-operative day wire was removed nerve function improved by 6-8 weeks. Loss of brachial pulse was noticed on table and 2D colour dopler was done which showed complete block. Within 6 hours exploration was done, clot was evacuated; total pulse was regained without any disability. All cases included in this study group were fresh fractures and attended to our hospital within 6 hours of time and they underwent surgery around 8 hours after admission to hospital. All the patients were discharged on first postoperative day and followed regularly every week for K wire dressings. In one case while passing a k wire from lateral condyle there was a split of distal fragment and appears as lateral condyle fracture. This fragment was also fixed with additional k wire which subsequently healed. In present series three cases had post-operative pin tract infection which was treated with appropriate antibiotics. There were no cases of k-wire loosening. In 96% of cases we

used two lateral divergent k wires. One case we did crossed pinning which developed ulnar nerve palsy (Table 2). The results were graded based on Flynn's et al

criteria, excellent in 24 cases 80%, good in 6 cases 20% (Table 3).

Table 1: Patient characteristics of group 1 and group 2.

Number	Characteristics	Group1, (30 patients)	Group2, (44 patients)
1	Age	4 to 12 years	4 to 12 years
		Mean - 8.03 years	Mean - 7.5 years
2	Sex	Male 21 (70%)	Male 25 (56.8%)
		Female 9	Female 19
3	Mechanism	Fall an out stretched hand 30	Fall an out stretched hand 44
4	Side	Left 23 (76.7%)	Left 34 (77.27%)
		Right 7	Right 10
5	Displacement	Postero medial 21 (70%)	Postero medial 24 (54.54%)
		Postero lateral 7 (23.33%)	Postero lateral 18 (40.90%)
		Flexion 2 (6.66%)	Posterior 2 (4.54%)
6	Time to surgery	Within 8 hours	4 hours to 13 hours (9.83 hrs)
7	Type of fixation	Lateral divergent pins 29 (96.66%)	Lateral divergent pins 24 (54.54%)
		Crossed pinning 1	Crossed pinning 20 (45.45%)
10	Manipulations prior to presentation	Nil	Quack 16, doctor 2
11	Cause for delay in presentation	Transportation	Attend to quack 26
			Socio economic 14 Unknown 4

Table 2: Complications.

Number	Type of complications	Group 1	Group 2
1	Complications at the time of presentation	Nil	Radial nerve 6
			Ulnar nerve 7 Median nerve 3 Brachial artery 6
2	Iatrogenic complications	Ulnar nerve -1 Brachial artery 1 Lateral condyle rupture 1	Nil
		Pin tract infection 3	Loss of flexion >15 degrees Pin tract infection 6 Myositis ossificance 1
3	Final complications		

Group 2

The mean age was 7.5 years. There were 25 males and 19 females. All the patients had pain, gross swelling and restricted elbow movement at presentation. The left elbow was involved in 34 cases and right in 10 cases. The usual cause was a fall on the outstretched hand. The minimum delay in presentation from injury was 24 hours and maximum was 6 days. 26 of our patients underwent primary treatment from an unqualified person in the form of manipulation, massaging, splinting or just medication before presentation to us. The mean time to surgery after presentation was 9.83 hours and the mean time to surgery after trauma to surgery was 67.39 hours. The non-dominant upper extremity was involved in 34 cases. Majority of patients had posteromedial (Table 1). Sixteen had nerve injuries at the time of presentation which

recovered completely within 12 weeks. Five patients presented with a feeble radial pulse but all had adequate capillary filling at presentation. Colour Doppler studies were done as a routine in all these patients which revealed spasm of brachial artery in the adjacent area of fracture. Adequate blood flow was restored in all cases within 24 hours after reduction which was confirmed by Doppler. The time required for clinicoradiological union was 4weeks. Six patients had pin tract infection which regressed after pin removal and one week of oral antibiotics (table 2). Each patient was followed up for at least one year and results were graded using the Flynn's criteria. We had 37 excellent results (84.09%), 6good results (13.63%) and fair results in 1 case (2.27%) at the final follow up (Table 3).

Table 3: Results - Flynn's criteria.

Grading	Group 1	Group 2
Excellent	24 (80%)	37 (84.09%)
Good	6 (20%)	6 (13.63%)
Fair	Nil	1 (2.27%)

DISCUSSION

Delayed presentation of fractures in a child is common in developing countries.² Ours being a tertiary referral center with patients being referred from as far as 100 km late presentation is much more common. Modern day healthcare has greatly evolved following advances in technology and medical research but despite the availability of these services, traditional bone setting has continued as an 'alternative' health service.² In developing countries especially in the Indian subcontinent quacks treat 60% of all trauma, this mainly leads to delay in presentation to an orthopaedician.² Even in developed countries 18% of trauma patients undergo Surgery 48 hours or longer following presentation in the hospital after injury.⁴ The management guidelines are not clear for these patients who present late and there is a fear of high incidence of perioperative and late postoperative complications in these patients. Fractures which present late are difficult to treat because of excessive swelling, earlier attempted and failed manipulations and sometimes presence of associated neurovascular complications.³ There are concerns about higher incidence of serious perioperative complications and inability to achieve satisfactory reduction while treating these patients, potential complications include higher risk of elbow stiffness, myositis ossificans, loss of motion, infection, higher incidence of inadequate reduction and compartment syndrome.⁵ The relative incidence of nerve injuries has been reported as being 12–20% and they mainly (86–100%) consist of neurapraxias, which usually resolve spontaneously.⁶ In our series the incidence of nerve palsy was higher in group 2 (36.36%), probably because we accounted only patients with delayed presentations and type 3 fractures but all our patients recovered spontaneously requiring no definitive treatment. The management of patients with a pulse less but otherwise well perfused hand still remains controversial. Post-traumatic arterial spasm is a transient phenomenon with no permanent injurious sequelae unless it is prolonged, in such cases status of collaterals play an important role.⁷ Pre-operative evaluation based on a thorough clinical examination with the aid of Doppler sonography is considered to be sufficient in evaluating the patency and status of the brachial artery.⁷ If the hand remains pulseless due to arterial spasm but well perfused after stabilization, vascular injury need not be treated as it is a transient phenomenon and instead rely on collateral circulation, a time window ranging from 12 hours to 24 hours post reduction is usually given beyond which brachial artery is unlikely to recover its patency.⁸ At 24 hour post reduction re-evaluation all our patients who earlier showed signs of brachial artery spasm showed

good patency both clinically and by Doppler study. In only one patient in group 1 we did arterial exploration because it showed total block in doppler. There was a direct relation between duration of delayed presentation and the times of manoeuvre.

Greater was the delay to presentation more was the difficulty in satisfactory reduction and more was the number of times we had to repeat the manoeuvre before pinning. The results of our study indicate that the majority of widely displaced supracondylar fractures of the humerus even with a delay in presentation of up to 6 days can be safely treated with the technique of closed reduction and percutaneous pinning described by us. The healing of a metaphysis in children is fast, presence of soft tissue callus by the end of the first week renders the fracture irreducible.⁹ so we didn't attempt this method in children presenting to us on the seventh day or more after injury. France and Strong compared the various modalities of treatment of these fractures and found closed reduction and percutaneous pinning to be superior.¹⁰ Cheng et al and Topping et al compared lateral and cross k- wiring and found equivalent excellent results in both groups.^{11,12}

The results of our study indicate that the majority of widely displaced supracondylar fractures of the humerus even with a delay in presentation of up to 6 days can be safely treated with our technique of closed reduction and percutaneous pinning with excellent clinical results. In our series, closed reduction and percutaneous pinning was possible in all our patients. The rate of conversion to open reduction in delayed presentations of these fractures has been reported in literature as ranging from less than 10% up to 36%.^{4,13} Archibeck et al reported entrapment of brachialis muscle as a cause in 90% of irreducible supracondylar fractures.¹⁴ We did not encounter any such problems in our series. Deep infections and osteomyelitis following fixation of supracondylar fracture are rare, while pin tract infections are common, which usually heal well with oral antibiotics and removal of wires, Infection rates of 2% - 6.6% have been reported with percutaneous fixations.^{11,15} In the present series, 9 out of 74 patients (12.16%) developed pin tract infection. All the infections healed after removal of K-wires and administration of a short course of oral antibiotics. Greater incidence of pin tract infections in our series was probably due to excessive swelling (due to various reasons) at presentation. Percutaneous pinning enabled us to immobilize the elbow in less than 90deg flexion in postoperative period, facilitating venous outflow and significantly reducing the risk of compartment syndrome.⁴ In addition, it prevents tenting of ulnar nerve and allows healing of the brachialis in a slightly elongated state which hastens regaining of extension during mobilization.^{16,17} None of our patients developed compartment syndrome, Leet et al reported similar observation and suggested that vascular injury at the time of trauma is a bigger predisposing factor for development of compartment syndrome than delay in surgical

intervention.¹⁸ Although modern pinning techniques have reduced the incidence of complications the most common complication in these fractures continues to be an alteration of the carrying angle, nearly always in varus.^{18,19} The cause of deformity is coronal rotation or tilting or a combination of both of the distal fragment due to faulty reduction or the inability to maintain good reduction till union.¹⁹ It is not an epiphyseal growth disturbance as earlier believed.¹⁹ The most important factor correlating with the final varus deformity following closed reduction and percutaneous pinning is the difference in Baumann's angle between the operated and normal side.¹¹ In all our patients, Baumann's angle was restored to within 4deg of the uninjured side. None of our patients had cubitusvarus deformity at a minimum follow up of 1 year. Our study results agree with other studies, which have reported that cubitusvarus is caused by inadequate reduction.¹⁹ None of our patients had loss of reduction during follow-up. We used lateral pinning technique in majority of our cases and reserved the cross pinning technique for cases where comminution of medial supracondylar ridge was present or in cases where lateral pins alone did not appear to give satisfactory stability intra operatively. The use of a small medial incision over medial epicondyle as described by Green et al for medial pinning in cases with severe elbow swelling helped to prevent ulnar nerve injury.²⁰ In our series, we had excellent results in 37 (84.09%), good results in 6 (13.63%) and fair results in 1 case (2.27%) at the final follow up in group 2 and 24 cases had excellent results, 6 cases have good results, according to modified Flynn's criteria in group 1. The fair in group 2 result due to loss of flexion of 20 deg and loss of extension of 10 deg in was probably due to myositis ossificans.

Patient presented to us on the 5th day after trauma and had a history of massage and repeated manipulations by a quack which probably added to the initial soft tissue injury and may have contributed to the unsatisfactory result in our patient. All the neurological injuries we assumed were noted in late presented patients either because of massages, swelling, repeated manipulations by quacks. Only in one patient developed ulnar nerve injury iatrogenic this was recovered completely after removal of pin.

CONCLUSION

In developing countries even today quacks and traditional bone setters are the first to attend to Trauma patients. Fall on outstretched hand is the most common mechanism of supracondylar fractures with the non-dominant extremity being commonly involved. Most common displacement of the distal fragment is postero-medial. Our preliminary results support our recommendation i.e. closed reduction and percutaneous pin fixation as an effective treatment option for grossly displaced supracondylar fractures presenting both early and late presenters but requires good and careful judgment and also technique by the surgeon to avoid complications. Delay in presentation

increases the incidence of neurovascular complications at time of presentation. Our results also support the chances of spontaneous recovery of peripheral nerve palsy and brachial artery spasm post reduction over a period of time in majority of cases though they present late.

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