Original article:

Outcome of displaced supracondylar fractures of humerus in children treated by closed reduction and percutaneous K-wire fixation

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Abstract:

Background: Supracondylar fractures of the humerus in children are more common. Undisplaced fractures are treated by above elbow splinting and displaced fractures are treated with closed reduction and percutaneous pin fixation. Always a controversyprevails regarding the optimal management of supracondylar humeral fractures in children.

Objectives: To study the outcome of displaced supracondylar fracture of humerus treated by closed Percutaneous Cross Pinning (PCP).

Patients and methods: A hospital based prospective study was conducted in the Department of Orthopaedics, Sri Manakula Vinayagar Medical College and Hospitalduring February 2015 to October 2015. The study included children between 3–12 yearsof age, with closed type II &type III supracondylar humeral fracture, extension variant, who were treated by closed reduction and Percutaneous Cross Pinning.

Results: 90 patients were included in the study. Their age ranged between 3–12 years, with mean ± SD of 6.7 years ± 2.34 years. All patients were treated with closed percutaneous cross pinning with satisfactory outcome in 90% of the patients.

Conclusion: PCP is safe and effective method for treatment of displaced supracondylar fractures in children. It provides good functional outcome with minimal and acceptable complication rate.

Keywords: Child; Humerus; Supracondylar fractures; Percutaneous CrossPinning (PCP); Nerve; Vascular; Outcome.

Introduction:

Hippocrates described supracondylar fractures (SCF) of the humerus in children as early as the third and fourth century [1]. Supracondylar fracture of humerus is almost exclusively a fracture of the immature skeleton[2].They accounts for 60% to 75% of all fractures around the elbow in children[1, 3-5]. Displaced supracondylar fractures are notorious for difficult reduction and loss of reduction. It remains one of the most challenging injuries for orthopaedic surgeons[6]. They are also quite commonly associated with neurovascular deficit. It primarily occurs in the first decade of life with peak at 6 years of age. There is slightmale preponderance with a male to female ratio of 2:1[1]. This might be due to the fact the male child is exposed to more outdoor activity than the female child and hence is more susceptible to injury.It most often occurs in the non-dominant arm[7]. Typically most fractures are due to a fall on an outstretched hand with hyperextension of the elbow joint[5]. 70% of the fractures are due to falls from a height. The usual mechanism of injury in children less than three year old is falling off household objects (beds, chairs etc).However,four year old and above children tend to fall from playground equipments such as monkey bars, etc[8].

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The Gartland classification system of supracondylar fracture humerus is widely used[9]. It is based on the degree of displacement and the anatomy of the fracture line[10]. It recommends treatment option for a particular fracture pattern and also helps in predicting the outcomes.

The fracture pattern determines the stability and gives a clue to the prognosis. Management is based on the direction of displacement and the ability to obtain an acceptable closed reduction.

The goalof treatment is to achieve and maintain stable anatomical reduction in such fractures.Various techniques have been described;including:

i. Closed reduction and application of a cast,
ii. Closed reduction and percutaneousK-wire pinning,
iii. Open reduction and internal fixation[11]

Gartland extension typeII and typeIII fractures are unstable type of fractures[12.] Chances of re-displacement loss of reduction and complications are more common even after acceptable initial reduction and immobilization with plaster [13, 14].Hence are not suited for conservative management. Cubitus varus or valgus deformity can occurs either due to malunion or distal humerus physeal growth arrest.

Percutaneouspinningis the gold standard treatment for displaced supracondylar humeral fractures[7, 15], but the optimal pin configuration remains controversial[10, 16]. Closed techniques have been simplified with the advent of newer imaging techniques and power equipments. This has also led to a overall decrease in the incidence of complications. Thus, with the availability of C-arm image intensifier in our hospital, we have treated all patients with supracondylar extension type II and type III fractures of the humerus by closed manipulative reduction and percutaneous pinning.

Patients and method:

A hospital based prospective study was carried out in the Department of Orthopaedics, Sri Manakula Vinayagar Medical College and Hospital during the period from February 2015 to October 2015.The aim of the study was to assess the outcome ofdisplaced supracondylar fracture of humerus in children treatment with closed reduction and percutaneous pin fixation.

Inclusion criteria:

The Gartland classification system of supracondylar humeral fractures was used and all closed typeII and typeIII supracondylar fractures of extension variant were included in the study.

Exclusion criteria:

TypeI supracondylar fractures**,** open supracondylar fractures, supracondylar fractures associated with neurovascular injury and supracondylar fractures with associated ipsilateral forearm fractureswere excluded.

Thorough pre-operative clinical examination to look for swelling, deformity, radial pulsation, capillary refilling, and nerve function of ulnar, radial and median was done. Under general anesthesia, with the patients in supine position and usingfluoroscopy guidance, closed reductions done using longitudinal traction, mediolateral instability correction, posterior displacement correction followed by hyperflexion of the elbow with forearm in supination or pronation depending on the fracture displacement. After satisfactory reduction, criss-cross K-wire fixation done. All patients withstood the procedure well without any intraoperative complication.

Postoperatively clinical examination was carried out to assess fracture reduction and to check for neurovascular state of the operated limb.

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Postoperatively, thepatient's elbow was immobilized in above-elbow splintfor three weeks. By the end of third week, the slab was removed and radiographs done. The X-rays are inspected for signs of union and k-wires wereremoved if satisfactory union present. Patients were then started on active range of movement exercises andthe final follow-up was done at 12 weeks. During this follow-up, the functional outcomeof the patient was evaluated according to the criteria of Flynn *et al*.Statistical analysis of these results was done usingChi□square test as a test of significance.

Results:

Out of the 90 children included in the study (mean age 6.7 years,agerange ß3-12 years), 75 (83.3%) were boys and 15 (16.7%)were girls. The left side was involved in 63 (70%) and27 (30%) had right sided injuries. All the 90 admitted patients were of extension typesupracondylar humerus fracture. 66 (73.3%)fractures were of Gartland type III and 24 (26.7%) weretype II. 63 children presented withposteromedial displacement (70%) and27 (30%) fractures hadposterolateral displacement. The results were analyzed statistically using Chi-square test for significance and it was noted that there is no statistically significant difference in results in patients operated at various durations after injury($p > 0.05$)

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At the final followup at 12 weeks, 6 (6.67%)patients had elbow stiffness and six (6.67%) cases were noted with cubitusvarus deformity. Results were evaluated according to Flynn *et al*[4] criteria.Accordingly, excellent resultwas achieved in 12 patients, good in 54 and fair in 15 patients. According to Flynn criteria, poor results were obtained in 9 cases in which loss of reduction was noted postoperatively. Thus, satisfactory result was obtained in 90% cases and the rest 10% had unsatisfactory results.

Discussion:

The mean age and sex incidence observed in our studywas comparable to the studies ofNacht*et al*[17], Wilkins et al[1], Fowles et al[18] and Aronson et al[19].In ourstudy, all patients were treated with closed reduction and percutaneous fixationof the fracture. Postoperatively capillary filling and distal radial pulse was checked immediately in all cases.Musa *et al*[20] in their studyobserved a 10% incidence of iatrogenic ulnar nerve injurywith crossed percutaneous pinning, whereas Balakumarand Madhuri[21]noted an incidence of iatrogenic nerve injuries of 1.1%, 2.2% and 1.1% for ulnar, median andradial nerves respectively using various techniques of percutaneous pinning. We have not observed any case ofiatrogenic nerve injury. Postoperative complications included loss of reduction in nine (10%) cases. In their study,Devkota*et al.*[22]noted loss of reduction postoperativelyin 1.96% cases; Lee *et al.*[23] observed the same to be7%, whereas Balakumar and Madhuri in their study observed postoperative loss of reduction in 18.2% cases.

Majority of patients regained almost full range of movement at 12 weeks. Nine (10%) patients had loss of movements at the elbow more than 15°. Mean loss of flexion was 7.3°and ranged from 0° to 25°. Mean loss of extension was 2.6°and varied from 0° to 18°. In their studies, Maity*et al*[24], Musa *et al*. and Foead*et al*[25]observed the mean loss ofmovements at final followup to be 3.86°, 4.6° and 18.3°respectively. A slightly more loss of movements at finalfollow up was observed in our study, which may be attributedto a shorter period of follow-up. In our study, most of thepatients (54 i.e. 60%) had a minimal decrease in carrying angleonly up to 5°. Loss of carrying angle ranged from 0° to 18° witha mean decrease of 5.1°. Postoperatively, 6 (6.67%) patients developed cubitus varus but none had increased valgus. Musa *et al*.[20] observed 2.6° and Foead*et al*[25]noted 3.7° mean change in carrying angle in their studiesrespectively.

We achieved 12 (13.3%) excellent, 54 (60%) good, 15 (16.67%) fair and 9 (10%) poor results according to Flynn criteria. Thus,satisfactory results were obtained in 90% cases and therest 10% had unsatisfactory results. Fowles and Kassab[18]in their study achieved 87.5% satisfactory results; Davis *et al*.[26]80% and Aronsonand Prager[19] obtained 100% satisfactory results in theirstudies. Hence, the results in our study were similar to theresults noted in most other studies.

A probable limitation in our study was a shorter periodof follow-up as compared to most of the other studies.Thus, the results of this study reflect the early outcome ofclosed reduction and percutaneous pinning in pediatricsupracondylar humerus fractures and may vary slightly fromthe results of other studies with a longerfollow-up.

Conclusion:

Unstable supracondylar Gartland type II and III can be treated successfully with a technique of Closed Reduction and Percutaneous pinning. It is an effective and reliable method oftreatment, as it seems

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to offer stable fixation of the fracture, shorter period of immobilization, few operative complications and good end results. However, because of the small number of patients, the true need for open reduction of these fractures cannot be predicted.

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