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Original Research Article

Analysis of clinicoradiological parameters following fixation of paediatric supracondylar humerus fractures with three lateral pins

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ABSTRACT

Background: Supracondylar humerus fractures are one of the commonest fractures encountered in children. This fracture has been managed both conservatively with a long arm plaster and operatively by fixing with Kirschner wires. Debate still remains regarding the pin configuration to be used for fracture stabilisation. This study analyses the clinical and radiological parameters following fixation of supracondylar humerus fractures in paediatric patients with three lateral pins.
Methods: It is a prospective study with 30 patients conducted between April 2016 and September 2016 conducted in Medical College and Hospital, Kolkata. All the said patients underwent closed reduction and percutaneous pinning with three laterally placed divergent kirschner wires.
Results: Most of the patients in this study had clinicoradiological parameters well within normal limits, barring a few. The baumann's angle was well within normal limits in these cases as found in subsequent follow-ups.
Conclusions: In this study, it was found that lateral pinning can be safely employed for fixing supracondylar humerus fractures in children with lesser chances of iatrogenic ulnar nerve palsy which was encountered with crossed pin configuration.

Keywords: Supracondylar humerus, Kirschner wire, Baumann's angle

INTRODUCTION

Paediatric supracondylar humerus fractures are the most commonly seen elbow fractures in children.[1] There are well-known complications associated with supracondylar fractures and their treatment-neurovascular injury, compartment syndrome, and malunion leading to cubitus varus. The amount of neurological complication has ranged between 10% and 20%, with the most common nerve palsy being the anterior interosseous nerve. The rate of compartment syndrome is probably between 0.1% and 0.3% and in the presence of an ipsilateral forearm fracture, can increase to 9%.[2,3] The occurrence of deformity from malunion varies in the literature; it has been postulated to be 4.2% using data pooled from 1455 patients.[4,5]

The opinions regarding treating displaced supracondylar humerus fractures are divided. The current recommended practice for treating displaced supracondylar fractures is closed reduction and pin fixation. One school of thought advises fixation with two lateral pins, while the other advocates crossed pin fixation with medial and lateral kirschner wires. On placing medial wires, surgeons may choose to use a closed, mini-open, or open technique depending on their level of experience and current practice. Although two crossed pins were biomechanically more stable but the risk of iatrogenic ulnar nerve palsy was more with medial pin placement.[5]

This study aims to analyse the efficacy and complications of fracture fixation with three divergent lateral pins.

METHODS

An approval from the ethics committee was sought and the study was conducted in patients who were admitted between April 2016 and September 2016. The patients selected were aged between 5 to 12 years, attending the outpatient department or emergency department of Medical College and Hospital, Kolkata with supra-condylar fracture of the humerus. The study was conducted on 30 patients who had a traumatic aetiology leading to the fracture, fractures less than 5 days old, fractures without distal neurovascular deficit, without signs of impending compartment syndrome and gartland type II and III fractures. Patients with co-morbidities unfit for surgery, fractures more than 5 days old, patients unwilling to undergo surgery and those with gartland type I fractures were excluded from the study.

Parents and relatives of the patients were briefed about the operative procedure; patients who presented on or after the 5th day after fracture were counselled about failure of closed reduction and conversion of the procedure to open reduction and internal fixation. The possibility of development of cubitus varus in the future was also explained especially for gartland III fractures.

Figure 1 (a-d): Lateral three wire fixation of supracondylar humerus fracture.

Figure 2: Fracture union after three lateral divergent wires

Each child underwent a trial of closed manipulation following which check X-Rays were done. Immobilisation with long arm plaster was continued in those wherein reduction was acceptable while the rest were posted for closed reduction and percutaneous pinning.

All 30 children were planned for lateral pin fixation with three divergent pins (Figure 1). Adequacy of fixation was assessed with the help of fluoroscopy. The upper limb was immobilised in a long arm plaster slab with elbow in 90 degrees flexion and forearm supinated. Limb elevation was given. Post-operative anteroposterior and true lateral views of the elbow were obtained and the results of the procedure were evaluated clinically in subsequent follow ups using Flynn's criteria, time of return to normal activities, pin tract infection, iatrogenic nerve injury and radiologically using baumann's angle, anterior humeral line and humerotrochlear angle.[7]

The data obtained was analysed using appropriate tests for significance.

Table 1: Flynn's criteria.

Result	Flynn's rating	Cosmetic factor- loss of carrying angle (degrees)	Functional factor- loss of movement (degrees)
Satisfactory	Excellent	0–5	0–5
Satisfactory	Good	6–10	6–10
Satisfactory	Fair	11–15	11–15
Un-satisfactory	Poor	>15	>15

RESULTS

The mean age of the sample of 30 children selected from the population was 8.833. Males constituted 73.33% of the study population while females constituted 26.67% of the study. 56.66% of the supracondylar humerus fractures were on the left side while the remaining 43.33% belonged to the right side. In the study, most of the patients with supracondylar humerus fractures belonged to the 8 year old group with 7 cases (23.33%). Next in line were 10 year olds with 5 cases (16.67%), followed by 9 and 12 year olds with 4 cases each (13.33%). The cases were classified by gartland classification and type III (86.66%) was found to be most abundant followed by type II (13.34%). Results illustrated in Table 2 are elaborated as follows:

Table 2: Clinicoradiological parameters following lateral pin fixation.

Parameters	Lateral pin fixation
Range of movement at the elbow (mean degrees)	145.9
Carrying angle (mean degrees)	6.14
Baumann's angle (mean degrees)	9.38
Humero-trochlear angle (mean degrees)	36
Anterior humeral line	62.07% passed through the middle third of the capitellum
Clinical varus	10.34% developed cubitus varus
Clinical result	79.3% had excellent result
Time of return to activity (mean weeks)	7

The mean range of movement at the elbow joint was 145.9 degrees. The minimum net range of movement was 125 degrees and the maximum was 154 degrees. One patient out of these had developed 10 degrees fixed flexion deformity, one had developed 20 degrees fixed flexion deformity and one had developed 30 degrees fixed flexion deformity while another had developed 10 degrees hyperextension. 17 patients had 150 degree or more range of motion.

The mean carrying angle was 6.14 degrees, the minimum value being 2 degrees and the maximum value being 9 degrees. The mean baumann's angle in this study sample was 9.38 degrees, the minimum value being 2 degrees and the maximum value being 15 degrees. Most of the post-operative cases had baumann's angle 10 degrees. The mean humero-trochlear angle in this sample population was in this sample population were 36 degrees, the minimum value being 25 degrees and the maximum value being 46 degrees. Most number of cases had humero-trochlear angle of 40 degrees. The anterior humeral line in 29 patients who underwent lateral entry three wire divergent pinning passed through the middle third of the capitellum in 18 cases, through the anterior third in 8 and the posterior third in 3 cases. Of the 30 patients that underwent lateral pinning with 3 pins, 3 cases had clinically detectable varus, 26 cases did not and 1 child who underwent lateral pinning had persistent rotation deformity and varus collapse for which he underwent open reduction and internal fixation with crossed kirschner wires. Among the 29 patients studied, 23 had excellent result, 4 had good result and 2 had poor result. 2 had unsatisfactory outcome, while the remaining 27 had satisfactory outcome. 1 patient who underwent lateral pin fixation had to undergo open reduction and internal fixation with crossed kirschner wires as there was rotation deformity with varus collapse. The mean time of return to daily activities is 7 weeks, the minimum time required being 5 weeks and the maximum time required being 10 weeks. 1 patient was reposted for surgery due to failed reduction (persistent rotation and varus collapse) wherein the child underwent open reduction and internal fixation with crossed 1 medial and 1 lateral Kirschner wire each. This patient has been excluded from follow up and the study.

DISCUSSION

The supracondylar humerus fractures in the study were all of extension type. They are the most common fractures around the elbow in children and adolescents, in the non-dominant hand.[12] Gartland type I fractures, being undisplaced are treated in an above elbow plaster slab. Gartland type II and type III fractures are the ones that are displaced and the preferred treatment is controversial. Five methods of treatment of extension type supracondylar fractures have been described in literature. These are closed reduction and above elbow casting, Blount's procedure (reduction is maintained in a flexed elbow in a collar and cuff sling), skeletal traction, primary closed reduction and percutaneous fixation (using medial and lateral crossed wires or only lateral wires) and open reduction and internal fixation.

The present study was conducted in Medical College and Hospital, Kolkata, over a period of 6 months in the department of Orthopaedics. Thirty cases of paediatric supracondylar humerus fractures were treated with three divergent lateral pins. Each patient was followed up postoperatively over a period of 6 months for analysis of clinicoradiological parameters.

The study conducted by Gordon et al included 89 type III fractures and 49 type II fractures which proposed fixation of type II fractures with 2 lateral pins and 2 lateral with 1 medial pin in type III fractures after testing stability of fixation.[1] Skaggs et al retrospectively reviewed 345 children amongst whom there were 141-type II fractures and 204-type III fractures and inferred that routine crossed pin fixation is to be avoided.[2] The study

conducted by Lee YH included 37-type III fractures and 24-type II fractures and found three lateral pin fixation to be safest and most stable achieving excellent results in 91.8% patients and good results in 8.2% patients.[3] Foead et al found no difference between stability and restoration of radiographic parameters between crossed pin and lateral pin placement.[4]

Most of the studies done to evaluate effectiveness of lateral pinning against crossed pinning found no statistically significant difference between lateral and crossed pin fixation.[4-6,8,12,13,19,21] Some advocate routine use of lateral pins and reserve crossed pin configuration for unstable type III fractures.[1,2,22] Some have found excellent results with lateral pin fixations in unstable fractures thereby avoiding iatrogenic nerve injury.[11,14,15,17,18,20,23] Hamdi et al measured the biomechanical stability of the lateral pin construct and found that maximum divergence provided maximum stability.[9] Sangkomkamhang et al found higher incidence of loss of fixation in fractures fixed with only lateral pins, BMI>25 and poor surgical technique.[16]

In this study, both the groups of patients were evaluated post operatively as per Flynn's criteria.[7] In the crossed pinning group, 26 patients (87%) had excellent outcome, 3 patients (10%) had good outcome and 1 (3%) had fair outcome. In the lateral pinning group, 24 patients (80%) had excellent outcome, 4 patients (13%) had good outcome and 2 patients (7%) had poor outcome.

Mazda et al conducted a study on 116 displaced paediatric supracondylar fractures and found that closed reduction and pinning with 2 lateral pins was a safe and effective procedure producing good or excellent results in 96% patients.[13]

No cases of pin tract infection were noted in the lateral pinning group.

Also one patient who underwent lateral entry three pin fixation, was reoperated upon due to a persistent rotation deformity and varus collapse, with open reduction in internal fixation with crossed medial and lateral kirschner wire. The patient elbow was mobilised 4 weeks after the surgery and allowed to return to his daily activities 8 weeks after surgery.

No cases of nerve palsies were recorded from the lateral three wire divergent pinning group.

The limitations of this study lie in its small sample size and short duration of follow up. For better evaluation of surgical techniques, larger sample size with longer follow up duration in a higher study protocol like a randomized controlled trial is needed.

Fixation with 3 divergent lateral pin for displaced supracondylar humerus fractures in children is a safe and stable configuration without any risk of iatrogenic ulnar nerve injury and minimal chances of displacement in the post-operative period. However, one may consider adding a medial pin in modified gartland Type IV fractures or in cases with medial column comminution.

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