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ORIGINAL ARTICLE

COMPARISON OF MEDIAL AND LATERAL APPROACH FOR SINGLE INCISION OPERATIVE TREATMENT OF WIDELY DISPLACED PEDIATRIC SUPRACONDYLAR HUMERUS FRACTURE

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ABSTRACT: INTRODUCTION: Standard lateral approach for open reduction of widely displaced supracondylar fracture of humerus, especially in case of delayed presentation and/or failed closed reduction creates difficulty in anatomical reduction of medial column. This results in malunion and suboptimal function, and in absence of fluoroscopy, chance of ulnar nerve injury in blind cross pinning. Further it may be cosmetically unacceptable. Medial approach gives the opportunity to overcome these problems. We report the comparison analysis of the two surgical approaches. **METHODS:** Forty patients of closed Gartland type III variant supracondylar fracture humerus of mean 46 hours duration without neurovascular deficit were treated by open reduction and cross K wire fixation. The patients (mean age 7 years) were randomized to either lateral approach (n = 20) or medial approach (n = 20). The mean follow up was 15 months. We compared the results of treatment in terms of Flynn's criteria, rate of infections and neurovascular injury and parents' satisfaction. **RESULTS:** Patients treated by medial approach showed better results over lateral approach in terms of scheduled criteria on follow up. **CONCLUSIONS:** Medial approach is a preferred approach over lateral approach in open surgical treatment of supracondylar fracture of humerus.

KEYWORDS: Supracondylar humerus fracture, Medial column reduction, Ulnar nerve palsy.

INTRODUCTION: Extension type of supracondylar fractures of humerus is common between 5 and 8 years of age especially in boys. Gartland type III fractures may be associated with brachial artery injury, nerve injury, compartment syndrome which needs immediate intervention by closed reduction and percutaneous pinning[1,2]. However, delayed presentation, absence of fluoroscopic facility and unsuccessful closed reduction requires open reduction and internal fixation by Kirshner wires (K wires) to have anatomical reduction. There are several approaches for open reduction like lateral[3], medial[4,5], posterior[6] and anterior[7] with their advantages and disadvantages. Posterior approach gives unsatisfactory result due restriction of range of motion. Anterior approach allows visualization of neurovascular injury and their repair, if required. For this study we applied the lateral and medial approaches and compared their outcomes.

METHODS: For this study forty patients were selected within a period of two years at a tertiary care set up. The patients had closed Gartland type III supracondylar fracture humerus without neurovascular injury. Patients with neurovascular injury, compartment syndrome and open fractures were discarded from our study.

The patients selected for the study were randomly divided into two groups each containing 20 patients and treated with open reduction and internal fixation. Group 1 patients were treated by medial approach while Group 2 patients were treated by lateral approach.

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Outcome of the patients after surgery was compared using Flynn's criteria. In addition operative time, rate of infections, neurovascular injury and parents' satisfaction were also assessed as outcome parameters.

Microsoft 2007 Microsoft Excel (Redmond Washington, USA) was used for statistical analysis and reproduction of graphs. Mainly demographic statistics were used. For comparison unpaired Student t test at a $p < 0.05$ and 0.01 was applied.

Techniques: Both groups of patients were operated under general anesthesia.

Group 1 patients – Position of patient was supine with abduction and external rotation of the upper limb at shoulder and extension of elbow on a side-table. After preparation, draping and tourniquet application a single medial incision was given 3-4 cm proximal to elbow crease and 2 cm distal to it. Ulnar nerve was mobilized along the whole incision. The brachialis and triceps were subperiosteally elevated and the hematoma was drained. On the posterior surface olecranon fat-pad was removed. The entire anterior and posterior surface could then be visualized. Elbow was flexed at 20˚ and gentle traction was applied to visualize the distal fragment.

The fracture was reduced by gentle traction and flexion with the thumb pressing the olecranon anteriorly. The quality of reduction was assessed by inspection of the medial column anteriorly, medially and posteriorly and the fracture line anteriorly and posteriorly. A pair of artery forceps was used to feel for a step in the lateral column. In most cases the fracture spikes were found to interdigitate to lock the reduction. Maintaining the elbow in 60° to 80° flexion with gentle traction was essential to prevent posterior tilt. Cross K-wires were passed medially and laterally, distal to proximal, kept outside the skin. Elbow movements and stability of external fixation were checked after the operation and the tourniquet was deflated. After checking the radial pulse and capillary refill the wound was closed in layers. The elbow was immobilized with POP back slab at less than 90° flexion in supination and this was followed by a check X ray.

Group 2 patients - Position of patient was lateral and the upper limb was kept on a pillow with shoulder abduction and elbow flexion at 90˚. After preparation, draping and tourniquet application a single lateral incision was given 3-4 cm proximal to elbow crease and 2 cm distal to it. The brachialis and triceps were subperiosteally elevated and hematoma was drained. On posterior surface olecranon fat-pad was removed. The entire anterior and posterior surface could be visualized. Elbow was flexed at 20˚ and gentle traction was applied to visualize the distal fragment. The fracture was reduced by gentle traction and flexion with the thumb pressing the olecranon anteriorly. The quality of reduction was assessed by inspecting the lateral column anteriorly, laterally and posteriorly and the fracture line anteriorly and posteriorly.

A pair of artery forceps was used to feel for a step in the medial column. Generally the medial column alignment is difficult and proper reduction takes time. Moreover the opposite or the medial column visualization by this approach becomes more difficult than medial approach. Maintaining the elbow in 60° to 80° flexion with gentle traction was essential to prevent posterior tilt. Excessive traction could antevert the distal fragment. Cross K-wires were passed laterally and medially. The pin insertion was blind with no exploration of the ulnar nerve. Distal to proximal and ends were kept outside the skin. Elbow movements and stability of fracture fixation were checked. The tourniquet

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was deflated and radial pulse and capillary refill was checked before closing the wound in layers. The elbow was immobilized with POP back slab at less than 90° flexion in supination and this was followed by a check X ray.

Follow up: The children were kept on intravenous antibiotics after operation during their stay in the ward. After 48 hours they were switched to oral antibiotics. They were given NSAIDs and calcium supplements in addition. The sutures were removed at 2 weeks and the posterior slab was kept. The slab and wires were removed at 4 weeks and elbow mobilization was started. The subjects were followed up at 6 weeks and then at 8-weekly intervals until maximal recovery of movement were recorded. Assessment at final follow-up included clinical measurement of the carrying angle of both the elbows and range of elbow motion using a goniometer and radiographic assessment of union.

RESULTS: The demography showed a male preponderance with 30 boys and 10 girls in the whole study sample. There were 14 and 16 boys in group 1 and 2 respectively. The average age of the patients was 7years in either group. The mean delay in presentation was 52.45 hours and 39.94 hours in groups 1 and 2 respectively. Among the study groups 37 patients had extension type injury and 3 patients had flexion type injury. Most patients were operated within 10 hours of admission. Average follow-up period was 15.5 and 14.5 months respectively in the two groups.

Anatomical reduction was achieved in all the cases. There were no postoperative neural or vascular complications. Follow up showed that pin tract infection affected 15% (3 patients) in group 1 and 20% (4 patients) in group 2 ($p = 0.457$). Range of motion similarly was restricted in 20% (4 patients) in group 1 and 25% (5 patients) in group 2 ($p = 0.498$). Similarly ulnar nerve damage was seen in 5% (1 patient) among group 1 and 10% (2 patients) among group 2 ($p = 0.28$). Significant difference was noted between groups in terms of cubitus varus (5% or 1 patient in group 1and 15% or 3 patients in group 2; $p = 0.03$). Parent satisfaction was also significantly high in group 1 than in group 2 (95% or 19 parents satisfied in group 1 compared to 85% or 16 parents satisfied in group 2; $p = 0.003$).

All the cases showed radiological signs of beginning of union at 4 weeks postoperative time. Of the 4 patients with restriction of elbow motion, one patient had restriction of both flexion and extension while the other three had only extension loss. No myositis ossificans or deep infection was seen. Anatomical reduction was achieved in 17 cases (85%). There were two cases of ulnar nerve neuropraxia which were recovered on follow up. 15 patients regained full range of motion within 6–8 weeks of pin removal. Some of the radiological evidence is shown in Figure 1.

Three cases (15%) of cubitus varus were seen in the present series. All the cases showed radiological signs of beginning of union at 4 weeks postoperative period. Of the 5 patients (25%) with restriction of elbow motion, three patients had restriction of both flexion and extension while the other two had only extension loss. No myositis ossificans or deep infection was seen. Superficial pin tract infection occurred in 4 cases (20%). Pin tract infection resolves with dressings once the pins were removed. Based on Flynn's[1] criteria 12 patients (60%) had a satisfactory outcome. On the basis of qualitative survey parents of 4 patients (20%) were not satisfied regarding scar mark. Some of the scars are shown in Figure 2.

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DISCUSSION: Delayed presentation, absence of fluoroscopy and unsuccessful closed reduction of displaced supracondylar fracture of distal humerus requires open reduction and internal fixation by Kirshner wires (k wires) to have anatomical reduction [8-10]. Medial column comminution and internal rotation of the distal fragment predispose to the medial tilt, which causes loss of the carrying angle [4, 5, 11-13]. This is the most common complication. The medial tilt may be obscured on X-rays and not always easily appreciable[12, 13]. After closed reduction and/or percutaneous fixation the tilt can be best appreciated only after the elbow is completely extended and extension causes loss of reduction or requires pin removal.

Medial approach provides the opportunity to get a direct vision of medial column for anatomic reduction of the medial supracondylar column. Furthermore, if malreduction of opposite lateral supracondylar column at all occurs, it causes cubitus vulgus which is more acceptable than commonly occurring cubitus varus caused by malreduction of medial supracondylar column commonly met while operating through lateral approach.

Regarding exposure, we had done some cadaveric study that showed view of opposite column was easier in medial approach than lateral approach. Our average follow-up period of 15 months is adequate to comment on the results of open reduction and internal fixation because the end result is usually seen within 4 to 6 months of surgery. This is the time by which most of the children regain complete range of motion[10,12,14]. Further follow-up is rarely needed to detect the related complications. Late development of an abnormal carrying angle is rarely seen[15]. An uncorrected medial tilt during the initial treatment is only unmasked when complete extension is regained. Growth disturbance is seldom the cause of change in the carrying angle[11,12]. However, the change in carrying angle was the most frequently encountered complication by Weiland [13] who used the lateral approach. Inadequate reduction with residual medial tilt was the reason for cubitus varus deformity following open reduction and they accepted that inaccurate reduction was due to the limitation imposed by their surgical approach. Furthermore, Weiland[13] acknowledged errors in appreciation of persistent medial tilt under roentgenographic control.

In our study, late presentation (mean delay 111hours) is one of the reasons for reduced range of motion in patients[16]. Three children in our series had repeated manipulations elsewhere and three had history of massage by quacks. The extent of soft tissue trauma prevented normal joint motion. Therefore soft tissue trauma became the most important prognostic indicator for recovery of range of elbow motion. Extension loss is more obvious and disabling than a similar reduction in flexion and is due to fibrosis in the torn brachialis.

There were 2 patients of iatrogenic ulnar nerve palsy occurred in lateral approach cases. Visualization of the ulnar nerve, careful dissection and retraction eliminate the risk of ulnar nerve palsy in medial approach[4,5]. Blind pinning is generally associated with an incidence of 2–3% of temporary ulnar nerve palsy. Nerve palsy requires pin removal, which may compromise the reduction and necessitate repeat reduction and/or exploration. This was also a qualitative study regarding aesthetic status of the scar mark. It was seen that parents of four female patients were not satisfied regarding scar mark of lateral approach.

We conclude that medial approach is better than lateral approach for open reduction and internal fixation of the widely displaced supracondylar fracture of the humerus in children. It offers the best exposure of the medial column pathology, helps in maximum probability of accurate

anatomical reduction, avoids iatrogenic ulnar nerve palsy and provides highly satisfactory cosmetic results especially for the female children.

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Fig. 1: Panels A (Lateral) and B (AP) show radiological findings before surgery and Panels C (AP) and D (Lateral) views after surgery

Fig. 2: Panels A and B show the scar formation

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