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OUTCOME OF SUPRACONDYLAR HUMERUS FRACTURE FIXATION IN CHILDREN

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ABSTRACT

Objectives: To assess the outcome of supra-condylar humerus fracture fixation in children.

Material and Methods: This prospective quasi-experimental study was performed at the Department of Trauma and Orthopedic, Khyber Teaching Hospital, Peshawar, Pakistan from August 2014 to June 2015. All children with close displaced Supra-condylar humerus fracture (Gartland type II & type III) were reduced and stabilized with either two lateral k-wires or two cross k-wires (depending on surgeon's choice and expertise). Post-operative above elbow back slab was given for 3-4 weeks. Patients were followed up for clinical and radiological healing of the fracture. After about 4-6 weeks (average 5 weeks) k-wires were removed. At the end of follow-up period Flynn's criteria was used.

Results: A total of 32 patients were enrolled in this study. Fourteen (43.75%) of them were fixed with two lateral k-wires while 18(56.25%) with two cross k-wires technique. There were 24(75%) male and 8(25%) were female children. Patients were evaluated by recording the outcome measures using Flynn's criteria. Twenty-three (71.8%) had excellent outcome, 5(15.6%) good, while 4(12.5%) had fair outcome. None of the patient had poor outcome. None of the patient suffered from iatrogenic ulnar nerve injury.

Conclusion: Close reduction and careful percutaneous pinning under fluoroscopic control is a safe and reliable method of supra-condylarhumerus fracture fixation in children.

Key Words: supra-condyle, K-wire, closed reduction.

INTRODUCTION

In children Supracondylar fracture of the elbow is one of the most common injuries. Extension-type accounts for 95% of it[1]. Gartland classification[2] is the commonly used classification which is based on degree of fracture displacement i.e. Type I-undisplaced, type II – displaced with intact posterior cortex, and type III – displaced with no cortical contact. There is a high association of this fracture with neurovascular complications and deformity which warrants an aggressive approach for its management. Uncomplicated supra-condylar fracture may even lead to complications like local swelling, deformity and neurovascular complications if not managed properly[3-7]. Therefore, these fractures deserve an accurate assessment and precise planning in method of treatment[3].

Closed reduction and percutaneous pinning under image intensifier is now the treatment of choice for most of the displaced supracondylar fractures of the humerus in children.[8-10] Generally, two pinning techniques have been used either crossed medial and lateral pinning oronly lateral pinning. The purpose of this study was to assess and evaluate the outcome of supra-condylar humerus fracture fixation in children.

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MATERIAL AND METHODS

The study was designed as a prospective clinical trial. Thirty-two patients of age group 3-12 years (average 7.5 years) with displaced extension-type supracondylar fractures of humerus admitted to Khyber Teaching Hospital, Peshawar from August 2014 to June 2015 were included in the study. Undisplaced fractures, open fractures and supracondylar fracture associated with ipsilateral limb fractures were excluded from the study. Fracture reduction and k-wires fixation was performed, which was either lateral or crossed pinning .There were 24 boys and 8 girls. None of the patients had any neurovascular injury at presentation. All the patients were given an above elbow back slab on admission. The patients were prepared for general anesthesia. The choice of pinning (K-wire) construct lateral or cross pinning was decided after fracture reduction by the operating surgeon.

All the patients were operated under general anesthesia. According to standard technique described by Rockwood and Wilkins (2006) close reduction was performed[11]. Reduced position was confirmed under the image intensifier in both antero-posterior and lateral planes. Size of the K-wire (pins) used were decided based on fracture configuration and size of the bone. After close reduction evaluation, two pins were inserted from the lateral aspect of the elbow in the lateral pinning technique. The pins were either parallel or divergent engaging the medial cortex. The elbow was kept hyper-flexed and in a position of pronation during insertion of the lateral pins. Then the elbow was extended fully and fracture reduction and stability confirmed under image intensifier. Similarly in the cross pinning technique, after fracture reduction, the lateral pin was inserted first as in the lateral pinning technique above. Then the elbow was extended to less than 90° position and a medial pin was inserted. The surgeon palpated ulnar nerve and pushed it posteriorly with the thumb for medial pin insertion. In case of severe swelling and inability to palpate medial epicondyle a small incision was made over the medial epicondyle to explore the ulnar nerve. The fracture reduction and stability was confirmed under image intensifier. Pins were bent and the excess length was cut. Povidone-iodine soaked gauze dressing was applied to avoid pin track infection. An above elbow back slab was applied for two weeks with the elbow in 90° flexion and full supination of forearm. Patients were discharged after one to two days based on their comfort. Patients were followed up for clinical evaluation (carrying angle, elbow range of motion, neurovascular complications and pin tract infections)and radiological evaluation (fracture displacement, metaphysio-diaphyseal angle, humero-capitellar angle) at regular intervals till the final follow up. The plaster slab were removed after three to four weeks and pins were removed couple of weeks later. Active elbow 'range of motion' exercises were encouraged. At the end of follow up period, Flynn's criteria[12] were used to grade the result. Results were graded as excellent, good, fair and poor. (Table 1) The final outcome was assessed based on Flynn's criteria.

RESULTS

Thirty-two patients with supra-condylar humerus fracture were enrolled in this study. Fourteen of them were treated with lateral pinning and 18 with cross pinning technique. There were 24(75%) male and 8(25%) were female children. Twelve (37.5%) belonged to age group 6-9 years, 10 (31.25%) to 3-6 years, 6 (18.75%) to 1-3 years while only 4(12.5%) children were older than 9 years. In 22(68.75%) left supra-condylar fracture occurred while in 10(31.25%) right supracondylar humerus fracture happened. There were no significant differences of baseline characteristics such as age, gender and types of fracture between two groups. The mean period of fracture union was about 4 weeks.

Patients were evaluated by recording the outcome measures using Flynn's criteria. Twenty-three (71.8%) had excellent outcome, 5 (15.6%) had good outcome while 4(12.5%) had fair outcome. None of the patients had a poor outcome. Five patients developed superficial pin tract infections which was treated successfully with oral antibiotics and regular dressings. No patient developed any iatrogenic ulnar nerve injury in the cross pinning group. Overall, none of the patients developed any neurovascular complications during the treatment and follow up period.

Table 1: Grading of results according to Flynn's criteria[12]

	Cosmetic factor loss of carrying angle (degrees)	Functional factor loss of movement (degrees)
Excellent	0°-5°	0°-5°
Good	5°-10°	5°-10°
Fair	10°-15°	10°-15°
Poor	>15°	>15°

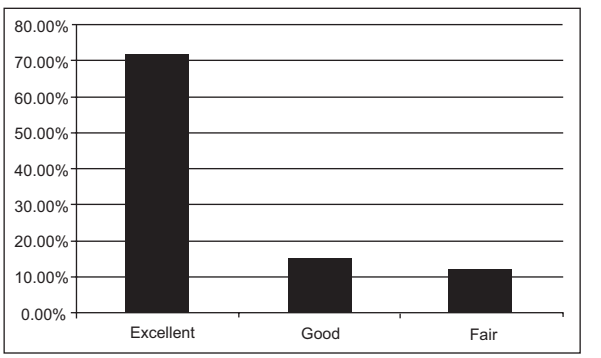

Figure 1: Outcome of supra-condylar fracture fixation based on Flynn's criteria

DISCUSSION

In children Supracondylar fracture of the humerus is the most common fracture around the elbow.[13,14] This fracture is notoriously associated with neurovascular complications.[5,15,16] To avoid serious complications, appropriate and aggressive treatment is advised. Child presents with swollen painful elbow with tenderness around bony land marks. In contrast to previous studies, in acute injury of elbow, the extension test alone or in combination with assessment of point tenderness cannot safely rule out clinically significant injury[17]. There are frequent neurologic complications with the anterior interosseous nerve being the most commonly affected.

Although less common but vascular injuries, can result in long-term sequelae, so should be recognized and managed promptly. Similarly, loss of reduction can happen with both surgical and nonsurgical treatment. Infection and compartment syndrome are rare, but require rapid recognition and solution. Therefore it is very important to be familiar with the potential complications surrounding the treatment of pediatric supracondylar-humeral fractures and to know when a referral may be warranted in order to maximize the outcomes[18]. Similarly, cubitus varus (30%) and valgus (3-7%) mostly result from an insufficient initial anatomic reduction of the fracture[19].

Type I (Gartland) fractures can be adequately managed by immobilization in an above elbow cast.[20] However, controversy exists regarding the optimal treatment for displaced supracondylar fracture (Gartland type II & type III). Various treatment options exist for displaced supracondylar fractures of humerus in children i.e. skin traction, closed reduction and plaster casting, closed reduction and percutaneous pinning and open reduction and pinning. Parikh et al. recommends closed reduction and plaster casting for treatment of extension type II supracondylar fractures.[21] To correct the rotational malalignment if exist, open reduction is often necessary. However, a new closed reduction technique for the correction of this deformity using a Kirschner wire as a joystick has been introduced[22]. Lateral cross pinning technique (Dorgan's technique) is also recommended by some authors.[23-25] Multivariate analysis has revealed that a fracture below the level of humeral isthmus was significantly associated with poor prognosis in terms of the range of elbow movement, Flynn grade and angulation. Similarly, age over ten years was also a poor prognostic factor for attainment of the range of elbow movement.[26] Weinberg et al in a biomechanical model compared four osteosynthesis techniques for management of supracondylar fracture and concluded that external fixators are a good alternative to cross pinning if the fracture reduction is difficult due to swelling.[27] In sagittal loading, the external fixators proved to be significantly more stable than crossed pinning.[28] Fahmy et al proposed a posterior intra focal pinning technique for extension type supracondylar fractures of humerus.[29] Li et al described a mini invasive technique using mosquito forceps for reduction of severely displaced supracondylar fractures.[30]

Keeping in mind the difficulty and inconvenience of keeping the patients in hospital for long or calling for close follow up, we chose primary fixation with 'k' wires for displaced (Type II & Type III) supracondylar fractures of humerus. This treatment offers adequate stabilization, minimizes soft tissue trauma and promotes rapid recovery. Thus after fracture reduction, fixation with k-wires maintains reduction and allows early mobilization. Post operatively plaster cast with padded foam is given to increase the strength and allowing space for swelling.[31] A few studies suggest that the treatment of an uncomplicated displaced supracondylar fracture can be delayed up to the next day[3,32]. In our study none of the patients had any neurovascular complications at presentation as well as during hospital stay.

Regarding the choice of pinning technique, for displaced extension type supracondylar fractures controversy exists. Intact posterior periosteum prevents rotational misalignment in type II fractures. However, type III fractures are inherently unstable and completely displaced. Associated medial cortex comminution adds to this instability further. This is the main reason put forth by the supporters of crossed pinning technique (besides the higher torsional rigidity of the crossed pinning construct).[26,33,34] However there are studies which document that lateral pin fixation is as strong as crossed pinning while decreasing the risk of iatrogenic ulnar nerve injury also.[35] The risk of iatrogenic ulnar nerve injury varies widely and depends on the pin insertion technique. Iatrogenic nerve injuries after operative treatment of supracondylar fractures occur in as many as 3-4% of cases.[36] Brauer et al from a systematic review found that the probability of iatrogenic nerve injury is 1.84 times higher with cross pinning technique in comparison to lateral pinning.[37] However in this study, none of the patients in cross pinning group developed any iatrogenic ulnar nerve injury. Moreover, a separate medial incision to explore the ulnar nerve for medial pin insertion is recommended. In our study, only very few patients with gross swelling of elbow required an incision on medial side because the swelling precluded the palpation of ulnar nerve. In remaining patients, the ulnar nerve was palpable and was pushed backwards with thumb before inserting the medial pin. Based on clinical outcome in our study, there is no significant difference between the two pinning techniques.

According to Flynn criteria final outcome of operative treatment of pediatric supracondylar fractures by closed reduction and percutaneous pinning has yielded excellent result in 57-81% patients, good result in 13-23%, fair result in 3-6% and poor result in 2-14% of patients.[38,39] In present study, we achieved excellent result in 71.8% of good result in 15.6% cases and fair result in 12.5% cases.

Similarly, in another study based on Flynn's criteria, cosmetic results were excellent in 37 (92.5%) patients and good in 3 (7.5%) patients, and functional results were excellent in 36 (90%) patients, good in 3 (7.5%) patients, and poor in 1 (2.5%) patient. A surgi-

cal success rate of 97.5% was noted.[40] In our study, we observed flexion and extension at the time of final assessment quite similar to the findings of others like Boyd et al and Mehserle.[39,41]

Points which strengthen this study are its prospective design, standardized method of fracture reduction, pin placement, and follow up assessment of the patients. The limitations of this study are the number of patients and relatively short follow up period.

CONCLUSIONS

This method is an effective and safe with good functional and cosmetic results and more convenient for the patient with a shorter hospital stay.

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AUTHOR'S CONTRIBUTION

Following authors have made substantial contributions to the manuscript as under:

Shah SDBA: Idea creation, proforma designing, typing.

Khan AS: Statistics.

Kabir SK: Bibliography.

Gillani SUH: Table and graph designing.

Khan AR: Data collection.

Durrani Z: Overall supervision.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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