

OUTCOME OF CROSSED K-WIRES WITH LATERAL K-WIRES FOR TYPE-III SUPRACONDYLAR FRACTURE OF HUMERUS IN CHILDREN

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Abstract

Background and Objectives: Elbow is the most common site of fractures in children. It accounts for approximately 60% of all injuries in children. These fractures are caused by direct or indirect low energy trauma. Immediate & late complications are common in fracture of this region. The objective of this study was to compare the outcome of two different modes of treatment i.e. crossed K-wires versus lateral wires for displaced type-III supracondylar fracture of Humerus in children.

Methods: A total of 80 patients having age between 2-13 years with type-III supracondylar fracture of Humerus type III those fulfilling the inclusion criteria were admitted through emergency department of this hospital. All these patients underwent x-rays of the elbow joint both AP & Lat views before the surgery. Patients were randomly divided into 2 equal groups. In group A, all fractures were fixed with crossed K-wires after reduction of these fractures, one wire from the medial condyle and one from the lateral condyle while in group B all fractures were fixed from the lateral condyle with 2 parallel K-wires of 2mm size in a divergent way after reduction of these fractures. In both of these groups, all these fractures were reduced closely under G/A with the help of image intensifier.

Results: In group A 62.5% patients presented with type-III A while 37.5% presented with type-III B fractures. In group B 70.0% patients had type-III A fractures while 30.0% patients type-III B fractures. Functional & radiological assessment was done with Baumann's angles & modified Flynn's criteria. At the final follow up the Baumann's angle was equal in both of these groups (78.15 + 3.32 in Group A) & (79.1 + 4.21 in Group B p>0.45).

Conclusion: This study concluded that there is no statistical significant difference in both modes of treatment regarding the stability of fixation and in terms of functional outcomes. However there are more chances of ulnar nerve injury with crossed k-wires fixation.

Key Words: Crossed K-wires, lateral K-wires, percutaneous fixation and Supracondylar fractures.

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Displaced supracondylar fractures of Humerus are the most common elbow injury (60%) in children after forearm fractures. These fractures account for 15-18% of trauma dealt by orthopedic surgeons in children.^{1,2,3} The peak incidence of these

fractures are between ages of 5-7 years. During fall outstretched hand is used by the children as a protective mechanism.^{4,6}

Supracondylar region is a thin, weak bone of distal Humerus in children. Its posterior boundary is olecranon fossa, anteriorly it has coronoid fossa and on both sides supracondylar ridges form the lateral and medial boundaries.^{7,8} The normal valgus angle in boys is 4° while in girls it is 8°. Observing from metaphysis to diaphysis the distal Humerus narrows antero-posteriorly. The Humerus is thin here as compared to its width. This creates a weak point in this region. Various muscles are attached to the supracondylar ridges, condyles and epicondyles. These are respon-

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sible for displacement and rotation of distal part of supracondylar portion.^{9,10} This region undergoes remodeling at 6-7 years a age. It is weak and thinner as compared to cortex of Humerus with greater chances of fracture when forceful extension occurs at the elbow.¹¹⁻¹⁴

Supracondylar fractures can be classified in many ways like displaced and undisplaced, open or closed, extension type (95%), flexion type (5%). The most commonly used classification to classify these fractures is Modified Gartland's classification by Wilkins.^{15,16} This classification is based on the lateral radio graphs. It is one of the most commonly used classification regarding the management & decision making^{17,18} regarding these fractures:

TYPE I: Undisplaced supracondylar fracture.

TYPE II: Displaced with angulation but posterior cortex intact.

Type IIA: Displaced with intact posterior hinge.

Type IIB: Displaced with mal rotation & intact posterior hinge.

TYPE III: Completely displaced- no meaningful cortical contact but only Periosteal Hinge is intact either medially or laterally.

TYPE IIIA: Medial periosteal hinge intact-fragment is displaced postero medially

TYPE IIIB: lateral periosteal hinge intact-fragment is displaced postero laterally

TYPE IV: Grossly displaced- no periosteal hinge, has multidirectional instability

Neurovascular complications are most common in type III & type IV Supracondylar fractures. Anterior interosseous nerve, median nerve, radial nerve, and brachial artery are vulnerable to this injury. Cubitus Varus is the most common deformity which occur as a result of this fracture especially in type III supracondylar fractures. To prevent these complications these fractures require meticulous management and strict vigilance.^{14,15}

This injury occurs as a result of fall on outstretched hand or it can occur as a result direct blow to the elbow in children. The fall on outstretched hand causes hyper-extension of the elbow joint which result in engagement

of olecranon fossa by olecranon process. This further causes the production of extensile force on the distal Humerus. Supracondylar region fractures at the weakest point creating a tensile force at the anterior cortex. Posterior cortex may be intact. The resultant force produced in this way is responsible for extension type (95%) supracondylar fractures.¹⁶ The patient present with pain, swelling and deformity at the elbow joint, distal neuro vascular status may or may not be intact. The most commonly damaged nerve is anterior intra-osseous nerve followed by median nerve and radial nerve.^{17,18} Ulna nerve palsy is seen in flexion type of supracondylar fractures. Brachial artery is the most commonly damaged artery in supracondylar fractures especially in Gartland's type-III fractures (38%). It is damaged because of closed proximity at the fracture site. One should be vigilant to differentiate these fractures from the medial and lateral condyles physis.^{19,20}

The treatment of these fractures depend upon the geometry of fractures¹¹. For undisplaced fractures and Type IIA fractures with minimal displacement can be treated non-operatively provided the alignment is satisfactory.^{7,18}

When there is medial comminution it can result in Varus malunion and displacement of the fracture.^{20,21} Operative treatment is indicated for type IIB and type III fractures. Close reduction and internal fixation should be done under image intensifier.^{12,14} If the fracture is not reduced then open reduction and internal fixation can be done with crossed K-wires or the fracture can be fixed with two parallel K-wires either from the medial or from the lateral side of the elbow.^{11,15-17} For the multidirectional unstable fractures, one can used the joystick technique to fix these fractures.

METHODS

This prospective comparative study was conducted at Department of Orthopedic Surgery, Services Hospital, Lahore from January 2018 to December 2018. After permission from the Hospital Ethical Review Board, a total number of 80 patients of age between 2-13 years with Supracondylar fracture of

Humerus type III were admitted through emergency department of this hospital. After admission a written consent was taken from parents of each patient. These patients were divided into 2 equal groups A and B, each group having 40 patients. There were 30 males and 10 females in group A while Group B had 25 males and 15 females. Mechanism of injury in 40 patients was fall on the outstretched hand while they were cycling, in 20 patients it was as a result of fall from the stairs while in 15 patients it occurs as a result of fall from the bed, in the remaining 5 patients because of RTA. All these patients underwent x-rays of the elbow joint both AP & Lat views before the surgery. In group A all fractures were fixed with crossed K-wires after reduction of these fractures while in group B all fractures were fixed with 2 parallel K-wires of 2mm size in a divergent way after reduction of these fractures. Before surgery, each patient's parent was counselled regarding the pro-cedure. Patients with polytrauma, neurovascular injury, compartment syndrome, head & spine injury & patients with open fractures were excluded from the study. All these fractures were fixed closely under G/A with the help of image intensifier.

Radiological and functional assessment was done with modified Flynn's criteria, bauman's angle and interior humeral line at the end of 1st week, 5th week and after 03 months. All data were assessed by using SPSS version 22. A paired sample t-test was use to evaluate the difference for two modes of treatment. p value of <0.05 was considered as significant.

RESULTS

A total number of 80 patients were divided into 2 equal groups A and B, each group having 40 patients. There were 75% were males and 25% were females in Group A while in Group B, there were 62.5% were

males and 37.5% females. Mean age in group A was 7±1.5 years while in group B it was 5.5±1.85, Mechanism of injury in 50.0% patients was fall on the outstretched hand while they were cycling, in 25.0% patients it was as a result of fall from the stairs while in 18.6% patients it occurs as a result of fall from the bed while playing & in the remaining 6.4% patients it was because of RTA. In group A, 62.5% patients had type-III A fractures while 37.5% patients had type-III B Supracondylar fractures of Humerus. Similarly in Group A 70.0% patients had type IIIA fractures while 30.0% patients had IIIB. There was no significant loss of reduction in both of these groups at the end of 1 week, 3 weeks and at the final follow up at 3 months. Radiological & functional assessment was done by Baumann's angle, anterior humeral line & Modified Flynn's criteria. The Baumann's angle was normal in all patients at the end of 1st week in both the groups (mean: 77.8 ± 3.38 in group A, in group B it also normal mean 79.4 ± 4.2 p=0.49). At the end of 5th week it was 78.15 + 3.32 in group A while in Group B it was 79.1 + 4.29 and it remained as normal at the final follow-up after 03 months (P=0.45).

Anterior Humeral line was intact at the end of first week post-operatively in 95% of the patients in group A (38 patients) while in group B it was intact in 92.5% of the patients (37 patients). On removal of K-wires in both of these groups at 5th week, it was intact in 38 patients (95%) in group A and in 37 patients in group B (92.5%). Loss of anterior humeral line was present in 2 patients in Group A and in 3 patients in Group B which was negligible. Outcomes were same after 3 months post operatively.

Carrying angle was excellent (0-4.9) in 30 patients & good (5 O -9.9 O) in 10 patients in group A while in

Table 1: Modified Flynn's Criteria At Final Follow-up

CARRYING ANGLE	OUTOMCE		FLEXION		EXTENSION	
	Group A	Group B	Group A	Group B	Group A	Group B
Excellent (0-4.9)	30 (75.0%)	29 (72.5%)	30 (75.0%)	30 (75.0%)	30 (75.0%)	30 (75.0%)
Good (5-9.9)	10 (25.0%)	11 (27.5%)	08 (20.0%)	07 (17.5%)	08 (20.0%)	07 (17.5%)
Fair (9.9-14.9)	0 (0.0%)	0 (0.0%)	02 (5.0%)	03 (7.5%)	02 (5.0%)	03 (7.5%)
Need more (≥ 15)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)

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Group B it was excellent in 29 patients & good in 11 patients. Flexion was excellent (0° - 5°) in 30 patients, good (6° - 10°) in 08 patients & fair in 02 patients in Group A while in group B it was excellent in 30 patients (0° - 5°) & good in 07 patients (60° - 10°) and fair in 03

Table 2: Baumann's Angle Comparison Between Group A & Group B Post Operatively And At 1st Week And After 3 Months

Groups	Intra-Operative	Post-Operative (1 ST Week)	Post-Operative 03 Months	p-Value
A	74.02± 3.04	77.80 ± 3.38	78.15 ± 3.32	P=0.49
B	74.21 ± 4.18	79.1± 4.29	79.1 ± 4.21	

Table 3: Anterior Humeral Line After 1st Week and 3 Months

Anterior Humeral Line	Group A (Patients)	Group B (Patients)	P-VALUE
Maintained	38 (95.0%)	37 (92.5%)	P=0.646
Disturbed	2 (5.0%)	3 (7.5%)	

patients (11° - 15°). There was no significant difference in the loss of carrying angle ($p>0.05$), extension loss ($p>0.05$) and loss of flexion in both of these groups ($p>0.05$). Two patients developed ulna nerve injury in Group A while no nerve injury was observed in group B. Both of these patients recovered completely after 12 weeks.

DISCUSSION

The treatment of grossly displaced supracondylar fracture of Humerus (Type-III) remained a challenge for Orthopaedic surgeons. The aim of surgical treatment of Type-III fractures are to obtain functional & cosmetically acceptable outcomes without any complication.^{13,14,15,16} There are several different surgical approaches to fix these fractures. The success of treatment depends on good reduction & adequate internal fixation of these fractures.^{6,7,8,9}

In our study, we have compared the two different treatment modalities i.e., crossed k-wires versus two parallel k-wires for fixation of these fractures. Good functional & radiological outcomes were achieved by both of these techniques.¹⁷ There was no significant difference in the Baumann's angle and anterior Humeral line as criteria for reduction in both of these groups.

The Baumann's angle was normal in all patients in both of these Groups at the final follow-up. Similarly the anterior humeral line was normal in 38 patients in group A & in 37 patients in group B ($p>0.05$). The carrying angle and range of motion were almost equal in both of these groups at the final follow-up. A lot of studies show that both of these treatment options have comparable results.^{10,11,12}

In the study conducted by S. Krishna et al.¹¹ shows that both crossed & lateral k-wires provide good stability in supracondylar fracture of Humerus in children.

In a study conducted by Sandip et al.² regarding the comparison of two percutaneous pinning techniques for Gartland's Type-III pediatric supracondylar, they came to the conclusion that both of these techniques offer equally satisfactory cosmetics & functional results.²

In view of Aher D et al.³ both the lateral entry pinning and crossed k-wires fixations are affective in the treatment of Type-III supracondylar fracture of Humerus in children.³

In his study in 2018, Abdel Rahman A Sadek et al.⁴ in fixation supracondylar fractures of Humerus with crossed K-wires & lateral pinning technique, they concluded that there was no significant difference between crossed wiring and lateral pinning techniques in clinical & radiological outcome.⁴

Another study conducted by Komang Arung Irianto et al.¹⁵ in the management of Gartland's Type-III supracondylar fracture of Humerus with crossed k-wires & lateral k-wires fixation, they concluded that no difference was found in the clinical & radiological outcomes of these fractures in the children. There was also no difference in the complication rate of both of these technique for fixation of supracondylar fracture of Humerus in children.

The study conducted by Ali Mohammed El-Geushy et al.¹¹ with crossed k-wires versus parallel k-wires for Type-III supracondylar fracture of Humerus, There was no difference in between both of these groups regarding the movements, loss of reduction, carrying angle & Baumann's angle. They concluded

that no significant difference was noted in both of these groups regarding the stability, reduction loss & healing of these fractures. Lateral pinning are as stable as crossed pinning for supracondylar fractures of the Humerus¹¹

All these studies are comparable to our study in terms of fixation techniques, Baumann's angle, carrying angle, loss of reduction & fracture healing.^{18,19,20,21}

CONCLUSION

Both these modes of treatment provide excellent stability for supracondylar fracture of Humerus in children. No statistical significant difference was found regarding the radiological and functional outcomes with both modes of treatment in terms of loss of reduction, fracture healing and Neuro vascular injuries However there were slight increased chances of ulna nerve injury in patients where the crossed K-wires were used.

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