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To compare the functional outcome of cross k-wires v/s lateral k-wires in Gartland type-III supracondylar humerus fracture in paediatric age groups

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Abstract
Introduction: Supracondylar fractures of the humerus are very common fractures in pediatric age groups. If displaced, preferred treatment is close reduction with percutaneous K-wire fixation. This study compares the functional outcome of cross k-wires v/s lateral k-wires in Gartland type III supracondylar humerus fractures in paediatric age groups.
Materials and Methods: 30 cases of supracondylar fractures of the humerus gartland type III in children operated with closed reduction and pinning of which 15 were of lateral and 15 were of cross k wires group from January 2015 to June 2017 with minimum 4 months follow-up period were considered
Results: Functional outcome of the patients was assessed by Flynn's criteria. Results were excellent 13.33%, good 40% fair 46.6% in cross k wire group and excellent 6.6%, good 46.6% fair 40% and poor 6.6% in lateral k wire group
Conclusion: Both lateral entry pin fixation and crossed pin fixation are effective in the treatment of gartland type III extension supracondylar fractures of the humerus in children.

Keywords: Cross k wires, Lateral pinning, gartland type III Supracondylar fracture humerus, kirschner's wire (k-wire)

Introduction
Most Common Elbow Fracture In Paediatric Age Group Is Supracondylar Humerus Fracture With 50-70% Incidence, Of which extension type is about 98% and flexion type about 2% [1].
For gartland type III fractures, preferred methods are:
1. Closed reduction and percutaneous pinning, and
2. Open reduction and internal fixation (ORIF) [2].

The decision to operate depends upon the fracture reduction and stability to maintain reduction. For undisplaced fractures, cast suffices, but for displaced fractures, controversy exists in many [3] Loss of reduction and subsequent malunion is generally seen when type II and type III fractures are treated in cast, which led to percutaneous pinning as preffered option [4]. This study assesssed and compared crossed pinning and lateral pinning which is generally followed in the management of these gartland type IIIsupracondylar humerus fractures.

Materials and Methods
This was a prospective study, conducted in the Department of Orthopaedics and traumatology at Gandhi Medical College and Hamidia hospital Bhopal from January 2015 to June 2017. Total 30 patients with 15 each for cross k wires and lateral pinning were selected.

Inclusion Criteria
1. Age 2 - 12 years and presenting within 1 week of injury
2. Closed fractures
3. Gartland's Type-III supracondylar fracture

Exclusion Criteria
1. Open fractures
2. Floating elbow injuries
3. Previous fracture in the same elbow.

Gartland's classification.
Type I: Undisplaced supracondylar fracture of the humerus
Type II: Displaced supracondylar fracture with intact posterior cortex
Type III: Displaced supracondylar fracture with no cortical contact
a. Posteromedial
b. Posterolateral.

When the patient presented to the hamidia hospital Bhopal, careful neurovascular examination was done. Then, x rays done, both AP and Lateral views. Type lll supracondylar humerus fracture were immediately posted in emergency OT. Brachial block given for all cases. Patient was positioned supine on the operating table with affected limb being placed over the sterile draped C-arm image intensifier. Initially, closed manipulation was performed with linear traction and flexion of elbow, pushing the distal fragment anteriorly. Assessment of reduction was done under image intensifier
Then, accordingly, either 2 crossed K-wires from both the medial and the lateral epicondyles (cross k wires) or by passing two K-wires from the lateral condyle (lateral pinning) were used to maintain reduction in crossed pinning, the lateral pin was inserted first and medial pin was placed with the elbow in less flexion to avoid ulnar nerve injury. the adequacy of reduction was checked with AP and lateral images. After leaving about 2 cm of the pins outside the skin, pins were bent and cut off and well-padded posterior above elbow slab was applied with elbow flexed to 90° or less as tolerated. The Neurovascular status was again assessed post operatively.
The slab and k wires were removed after 4 weeks, and range of motion exercises and physiotherapy were started. Thus the patient was followed up at 1 month, 2 month, 4 month, 6 months and 12 months, which was the final follow up. The functional outcome was assessed by Flynn's criteria (Table 1). The results were graded as excellent, good, fair or poor according to the range of motion and loss of carrying angle. Complications if any, were also noted.

Observations and Results
The average age was 7 years (range 2-12 years) with a peak incidence in 5-8 years. 20 patients were having Left side and 10 patients were having right side fracture. fall on outstretched hand contributed to about 96% cases. In 60% cases, Posterio-medial displacement of distal fragment was seen. The average follow-up duration for patients was of 6 months. Radiological union was seen on an average in 5 weeks. Loss of Baumann's angle of 5° was seen in 33% lateral pinning cases and in 20% cross k wires cases. Loss of Baumann's angle of 2° was seen in 33% lateral pinning cases and in30% cross k wires cases

Table 1: Flynn's criteria

Results	Rating	Cosmetic factor: Carry ing angle loss (°)	Functional factor: Motion loss (°)
satisfactory	Excellent	0-5	0-5
	Good	6-10	6-10
	fair	11-15	11-15
unsatisfactory	poor	>15	>15

Table 2: Result for cross k wires

Results	Rating	Cosmetic factor: Carry ing angle loss (°) (patient no)	Functional factor: Motion loss (°) (patient no)
satisfactory	Excellent	15	2(13.33%)
	Good	0	6(40%)
	fair	0	7(46.6%)
unsatisfactory	poor	0	0

Table 3: Result for lateral k wires

Results	Rating	Cosmetic factor: Carry ing angle loss (°)	Functional factor: Motion loss (°)
satisfactory	Excellent	15	1(6.6%)
	Good	0	7(46.6%)
	fair	0	6(40%)
unsatisfactory	poor	0	1(6.6%)

Mean carrying angle loss was 3^0 in lateral k wire and in cross k wire it was 2^0 which was statistically significant ($p<0.05$). This loss of carrying angle was more in lateral group probably due to less stable construct. Loss of range of motion was in 10° cross k wires group and 11° in lateral pinning group, which was not statistically significant.

Functional outcome in terms of Flynn's criteria was

Cross k wires		Lateral k wires	
excellent	2(13.33%)	excellent	1(6.6%)
good	6(40%)	good	7(46.6%)
fair	7(46.6%)	fair	6(40%)
poor	0	poor	1(6.6%)

In this study, no pin tract infection was encountered, no ulnar nerve was injured in any case. It was also found that, when the distal fragment was small, crossed pinning fared well than lateral pinning in terms of stability. Loss of reduction was seen more in lateral wire group but eventually all achieved radiological union with < 5^0 angulation. The difference in functional outcome between the two groups was not statistically significant (0.69).

a) Pre-Operative X-Rays

b) Immediate Post-Operative X-Rays

c) Clinical pictures, with Range-of-motion

Fig 1: lateral k-wires

a) pre-operative X-rays

b) Immediate Post-Operative X-rays

c) Clinical pictures, with Range-of-motion

Fig 2: cross k-wires

Discussion

Supracondylar fractures of the humerus is a fracturethat occurs at supracondylar area or metaphysis of distal humerus.[5] For closed reduction and percutaneous pinning, two configuration of K-wires exists ether lateral pinning or cross k wires. In this study, the average age for supracondylar fracture of the humerus was 7 years (range 2-12 years) with peak incidence in 5-8 years. Other showed similar age groups on average being 7.0 in Ramsey and Griz [6]. Age group was average 6.4 years in study of Nacht *et al*. [7] In our study, there were 90% male children 10% females. Higher no of males was also seen in study by Fowles and Kassab (89%) [8] Males also were more in study of Nacht *et al.* (50%) [7] In our study, left sided fractures were more than right sided fractures. Fowles and Kassab showed left (57%) more involved than right [8]. Similar results were seen in study by Nacht *et al.* (55%) [7]. In our study, fall on an outstretched hand (96%) was common which is same as that in series by Mostafavi and Spero [9]. Study by Bhuyan also showed similar results [10].

The average follow up in our study was 10 months (range 4-12 moths). Other studies showed follow up 8.93 months in Foead *et al*. [11] Follow up was 7.4 months in study by Zamzam and Bakarman [12]. In our study, the average radiological union was seen in 5 weeks (range 3 to 9 weeks). Other studies showed, average radiological union at 7.6 weeks by Sudheendra *et al.* [4]. Study by Rijal and Pandey showed radiological union in 6 weeks [13]. In our study, Cross k wires had better stability. Lee SS *et al*., and Ziouts *et al*., reported that medial and lateral entry provides greater torsional rigidity than lateral entry pin fixation does [14, 15]. Sudheendra *et al*. [4] in their study noted 82% excellent results and 18% good results in cross k wires case and 71% excellent results and 29% good results in lateral pinning case. Raffi c *et al*. [16] in their study found 72% excellent results and 28% good results with lateral pinning. Khan obtained 88% excellent, 4% good and 4% poor results in his study [17]. In our series, the functional outcome following cross k wires was excellent in 13.33%, good in 40% of cases, fair 46.6% and poor in 0% and lateral pinning showed 6.6% excellent, 46.6% good results, 40% fair with 6.6% poor results. The difference in functional outcome between the two groups was not statistically significant (0.69).

Sudheendra *et al*. [4]	Cross k wire	82%	18%	0%	0%
	Lateral k wire	71%	29%	0%	0%
Raffi c *et al*. [16]	No cross k wire done in this study				
	Lateral k wire	72%	28%	0%	0%
Khan *et al*. [17]	Both randomly	88%	4%	0%	4%
Deepak *et al*.	Cross k wire	13.33%	40%	46.6%	0%
	Lateral k wire	6.6%	46.6%	40%	6.6%

No ulnar nerve palsy occurred in our study. Skaggs *et al*. [18] found no ulnar nerve palsy and no reduction was lost in 124 children managed with only lateral-entry pins. Skaggs *et al*. [19] noted the incidence of ulnar nerve injury as 4% in patients whom the pins were applied without hyper flexion of the elbow and as 15% in whom the medial pin was applied with the elbow hyperflexed. The rate of ulnar nerve injuries varies in different studies. Lyons *et al*. [20] have reported this number as 6%, Royce *et al*. [21] as 3%, Agus *et al*. [22] as 58%. No Pin tract infection occurred in our series. In the series by Mostafavi and Sperothe incidence of pin tract infection was 5% [9]. The incidence of infection was 2% in Pirone *et al.* which was found more compared to our study [23].

No pin migration or significant loss of reduction was seen in our study. Gordon observed pin-tract migration in 6% of cases and Lee noticed the loss of reduction in 7% of cases [24, 14].

Conclusion

cross k wire or lateral k wire, both are similar in effect for the final functional outcome with no significant difference for treatment of gartland type iii supracondylar humerus fracture in paediatric age group, although taking into consideration the ulnar nerve injury, lateral k wire technique has an upper hand, but at the cost of slight loss of reduction. However, it depends upon the surgeons practice and preference which may negate these complications. Hence, in our study, we found lateral k wire and cross k wire equally good in terms of safety and efficacy, but stability is more in cross wires if the distal fragment is too small.

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