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Open Reduction And Crossed K-Wire Fixation In The Management Of Displaced Supracondylar Humerus Fracture In Children: A Medial Approach.

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Abstract:
Background*: Supracondylar fractures of the humerus is the second most common fracture in children and accounts for about 60-75% of all fractures about the elbow in children. Management of such displaced fractures is challenging even with various options to choose from. In this study we present our findings of management of displaced supracondylar fractures of humerus by open reduction and crossed K-wire fixation with the medial approach with special emphasis on ulnar nerve injury, anatomical reduction and long term outcome.*
Materials and Methods*: From October 2011 to March 2013, fresh, closed, displaced (Gartland's type III) supracondylar humerus fractures in children aged between 3-14 years were managed by open reduction and crossed K-wire fixation with the medial approach under general anaesthesia. Patients were followed up for a minimum period of three years. Results were assessed by Flynn's criteria.*
Results*: The study included one hundred and twenty (120) patients: male=78 (65%), female=42 (35%). All patients were operated by medial approach. Operating time ranged from 25 – 40 minutes. Hospitalisation days ranged from 4 – 7 days. K-wires were removed between 4-6 weeks. Result was excellent in 103 (85.83%) patients, good in 15(12.5%) patients, and poor in 2(1.67%) patient who developed cubitus varus. There were no cases of iatrogenic nerve injuries. The approach is found to be safe and ensured good reduction with minimal later angular deformities.*
Conclusion: *The medial approach used in this study is a safe procedure and results of fixation are comparable to any other modalities. It also minimises iatrogenic nerve injuries and may safely advocated as a standard procedure.*
Key Word*: Supracondylar, displaced-fracture, medial-approach, humerus.*

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I. Background:

Supracondylar fractures of the humerus is the second most common fracture in children and accounts for about 60-75% of all fractures about the elbow in children. [1] These fractures range from a simple undisplaced fracture to grossly displaced fractures and are classified accordingly; Gartlands' classification [2] being the most commonly used in day to day practice. Management of displaced fracture is challenging even with various options to choose from.[3] Though functional outcome and cosmetic results are comparable across most modalities of treatment, the incidence of iatrogenic ulnar nerve injury varies.[4,5] Stable fixation can be achieved with varying combinations of crossed K-wires, whatever the approach may be. The open medial approach in the management of these fractures wherein the ulnar nerve is identified and thereafter fixation K-wires introduced is found to minise iatrogenic ulnar nerve injury and at the same time, functional and cosmetic results is found to be satisfactory with this approach. In this study we present our findings of management of displaced supracondylar humerus fractures (SHF) by open reduction and crossed K-wire fixation with the medial approach with special emphasis on ulnar nerve injury, anatomical reduction and long term outcome.

II. Material And Methods

The study was carried out between October 2011 to March 2014 at our hospitals with due approval of our Hospital Ethical Committee. Written informed consent was taken from parents/legal guardians of all participants. Fresh, closed, displaced (Gartland's type III) supracondylar humerus fractures (Fig.1) in children aged between 3-14 years were included in the study. All patients had routine pre-operative investigations and X-ray of the involved limb (X-ray elbow—AP/Lat views) and were operated under general anaesthesia through a medial approach (Fig. 2 and 3).

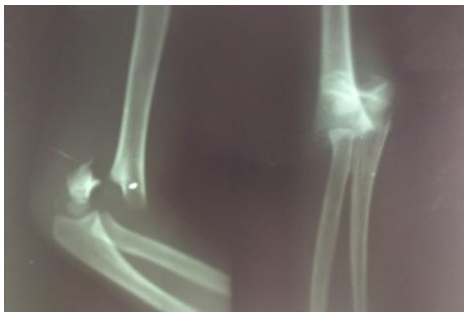

Fig. 1: Pre-Operative X-ray, AP/Lat.

Fig. 2: The Medial approach.

Fig. 3: Exposing the fracture site.

The fracture was reduced under direct vision, two crossed K-wires (1.5 mm to 2.5mm) were used to fix the fracture; the medial K-wire was introduced first from the tip of the medial epicondyle after identifying and isolating the ulnar nerve, the lateral K-wire was introduced from the lateral epicondyle. Each K-wire was introduced to a depth just flush of the opposite cortex which was determined by the "give away" feeling after penetrating the far cortex. Post operatively, limb was immobilised in an above elbow plaster of paris (POP) slab at 90 degree elbow flexion with the forearm in mid-prone position. Injectable abtibiotic was given for three to five days and changed to oral formulation for another five to seven days depending on the wound condition. Suture was removed on tenth post operative day and gradual flexion- extension encouraged thereafter. Check X-rays were taken in the immediate post operative day (Fig. 4) and then repeated at third week, sixth week and then six weekly depending on state of union, K-wires were removed between 4-6 weeks. Patients were followed up for a minimum period of three years. Results were assessed by Flynn's criteria[6] and special note on iatrogenic nerve injuries in general and ulnar nerve in particular was analysed in all patients.

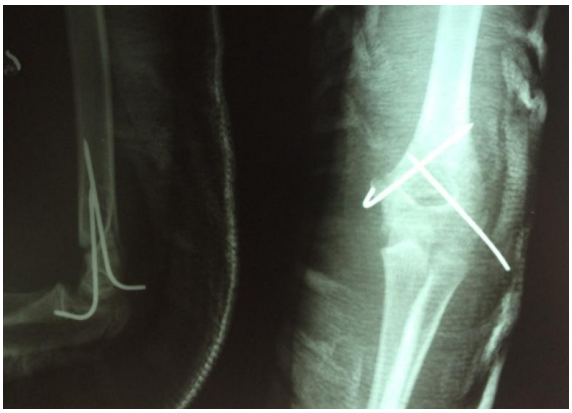

Fig. 4: Post Operative X-ray of affected limb (AP/Lat)

III. Result

One hundred and twenty (120) patients (table 1): 78 (65%), female=42 (35%) with isolated closed SHF sustained from various modes of injury were included in the study (table 2). Right side was involved in 55 patients and the left side in 65 patients. All patients were operated under general anaesthesia within 1 to 3 days of sustaining SHF. Operating time ranged from 25 – 40 minutes. Hospitalisation days ranged from 4 – 7 days. K-wires were removed between 4-6 weeks. Radiological union was seen in 4-6 weeks in all patients. Result was excellent in 103 (85.83%) patients, good in 15(12.5%) patients, and poor in 2 (1.67%) patients who developed cubitus varus deformity (Fig. 5). There were no cases of iatrogenic nerve injuries. Five patients had superficial pin tract infections which healed with regular dressings and an additional course of oral antibiotics. There were no other major complications.

Fig. 5: Cubitus Varus deformity, a major complication.

Table 1: Age-Sex distribution of patients.

Age in years/Sex	Male	Female	Percentage (n=120)
<6	25	14	32.50% (39)
6-10	43	20	52.50%(63)
>10	10	8	15.00%(18)
Total	78	42	100

Table 2: Mode of Injury

Mode of injury	No. of Patients	Percentage (n=120)
Fall while playing	94	78.33%
Fall from height	26	21.67%

Table 3: Functional result

Results	Ratings	No. of Patients	Percentage
Satisfactory	Excellent	103	(85.83%)
	Good	12	(12.50%)
	Fair	0	0%
Unsatisfactory	Poor	2	(1.67%)

IV. Discussion

Operative management of Type III Gartland's SHF is the norm in present day orthopaedic practice, only the approach and pin configuration varies.[3] In the present study, we used the medial approach for the following reasons. Firstly, 75% of type III Gartland's SHF are displaced postero- medially with significant soft tissue trauma on the medial aspect.[7] Considering this significant soft tissue trauma at injury, surgical soft tissue injury induced by the approach is comparatively very minimal except for the skin incision; most of the dissection required has already been done by the fracturing force. At the same time significant decompression of fracture hematoma can also be achieved.[8] Secondly, the fracture is reduced under direct vision with near anatomical reduction and this reduction is maintained even while the fixation K-wires are passed and any tilt so observed prior to determining the final wire placement can be corrected under direct vision and this prevents most of the later possible malunion.

Thirdly, through this approach the ulnar nerve was easily identified, isolated and removed from harms way as the medial K-wire was introduced. This minimized the chance of iatrogenic nerve injury which is not possible through other approaches and closed pinning.[9,10] The results of open reduction and internal fixation in displaced SHF in terms of safety and good results are well documented.[11,12,13,14] Our results are also comparable with other studies in terms of outcome; K Barlas et al[9] (medial approach), Ritabh Kumar et al[10] (medial approach), Pirone M et al,[15] Gowda PM et al,[16] Kumar S et al,[17] (lateral approach).

We cater to patients from rural and sub-urban areas who mostly belong to lower and lower middle class group and our patients cannot afford to attend super-speciality hospital. Being a district level hospital, we are equipped with basic power drills and lack the luxury of C-arm facilities. In spite of this our patients were operated within 1-3 days of injury and this delay is primarily due to late arrival at the hospital due to poor transportation facility and poor health seeking behavior of many parents who still prefer traditional healers as the first referral point. Barlas K et al[9] advocates surgical intervention within 12 hrs of admission to decrease elbow stiffness but did not comment on the impact of union.

We believe this did not have any ill effect on our patients who did well irrespective of delay in operative intervention. One patient however developed cubitus varus who is otherwise functionally comfortable with the deformity except for the cosmetic impairment. Kumar S et al[17] reported two cases of cubitus varus in 30 SHF while Weiland et al[18] reported significantly higher varus angulation deformity.Five patients in our study developed superficial pin tract infections. Reports of such complications are also seen in most studies.[17,19,20] Major infections involving the bone and soft tissues were not seen.

Patients and parents all accepted the operative scars very well as it lies medially and is not easily visible to others. However, we cannot comment on the long term acceptance as our patients are mostly pre teens. With growing years, the cosmetic acceptance may eventually change. Barlas T et al[8] reported that no patient in their series of 48 patients required operative scar revision. We did not encounter any case of iatrogenic nerve injury, the ulnar nerve in particular. Incidence of iatrogenic ulnar nerve injury in operative SHF varies from 0-6% [4,5] while Bronwyn et al[21] found that there is an iatrogenic ulnar nerve injury for every 28 patients treated with crossed pinning as opposed to lateral pinning. Brown and Zinar[22] reported that even with correctly placed medial pins the risk of ulnar nerve injury still remains. These complications are avoided by lateral multiple pins but at the cost of desirable fixation.

There is now a gradual change in the trend of pin configuration with a gradual shift towards lateral multiple pin pattern.[3] This may be due to the incidence of iatrogenic ulnar nerve injuries with long period of recovery or further surgical interventions required in their management. Our study shows that the open medial approach wherein the ulnar nerve is safely isolated prior to pinning can be safely carried out. It is also a basic and straight forward procedure even for a beginner. It shortens hospitalization period and ensures rapid return of limb functions. The incidence of iatrogenic nerve injuries can be significantly nullified with this approach. Other studies on similar approach advocates similar opinion.[9,10]

V. Conclusion

The medial approach for the management of displaced supracondylar humerus fracture in children is a safe approach. It minimises iatrogenic nerve injuries and results of fixation are comparable to other approach and modalities of fixation. Considering these findings, the medial approach can safely be advocated as a standard approach in the management of these fractures.

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