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Original Research Article

Functional Outcome in the Mangement of Floating Elbow Injuries in Paediatric Age Group

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Abstract: Floating elbow is a very uncommon injury in the paediatric age group as it involves a high energy trauma to the affected limb. Isolated humerus fracture without involving the forearm axis, forearm fractures without involving the humerus are very common injury in a paediatric age group. Our study was to assess the functional outcome of floating elbow injuries in paediatric age group managed by various treatment techniques. In view of this varied complicated presentation management options varies, hence choosing the best management option needs a stronger study for management of floating elbow in paediatric age group.
Keywords: floating elbow, diaphysis, epiphysis, metaphysis, paediatric, intra articular, closed reduction, k wire

INTRODUCTION

Floating elbow is a very uncommon injury [1, 2] in the paediatric age group as it involves a high energy trauma to the affected limb. Isolated humerus fracture without involving the forearm axis, forearm fractures without involving the humerus are very common injury in a paediatric age group. When fracture of the humerus and forearm are involved in the same limb the elbow is dissociated from the rest of the limb thus the name "floating elbow" as coined by Stanitski and Micheli in 1980 [3]. Floating elbow injuries are associated with multiple complications which alter the prognostic factors for a better functional outcome. Multiple treatment options were suggested varying from closed reduction and pinning to open reduction and internal fixation for this fracture [4] and multiple staged procedures for compound and complicated injuries. Management remains controversial as this type of fracture involves at various levels around the elbow associated with open injuries, vascular injuries and neurological injuries at the time of trauma.

AIM:

Our study was to assess the functional outcome of floating elbow injuries in paediatric age group managed by various treatment techniques.

MATERIALS AND METHODS:

Our study was a prospective study conducted in Sree Balaji Medical College and Hospitals in the department of orthopaedics between November 2012-October 2016 involving nine cases of floating elbow injuries which includes three cases of open injuries and two cases with neurological deficit and one with vascular injury within the selected group. They were surgically treated and were followed up for an average period of 16 months' duration.

Inclusion criteria: All patients who presented to our casualty with floating elbow injury who is less than 19yrs of age, with ipsilateral supracondylar fracture or shaft of humerus fracture associated with radius and ulna fracture without intra articular extension. Patients more than 19yrs of age and fractures involving intra articular extension were not included in the study.

The average age of the patients at the time of injury was 9.33yrs, of which seven were male and two were female (1:3.5). Out of which seven where in the dominant arm and two were in the non-dominant arm. Three patients (33.33%) had a history of fall from stairs, two patients (22.22%) had a fall from bicycle and two patients (22.22%) had a fall from height and one patient (11.11%) met with a road traffic accident and one patient (11.11%) had injury during contact sports and one patient (11.11%) had injury while playing a slide.

The average follow-up period was 15.56 months. Out of nine cases of floating elbow injuries eight cases

(88.89%) were in the supra condylar region and one (11.11%) was in the shaft of humerus. Among the forearm fractures three (33.33%) were in the diaphysis, three (33.33%) were in the metaphyseal region and three (33.33%) where in the epiphyseal region. Out of the three epiphyseal injuries one (11.11%) is trans epiphyseal Salter Harris type-1 and the two (22.22%) were Salter Harris type-2 fractures.

All nine patients were treated surgically. Among which six (66.67%) were closed injuries and three were open injuries (33.33%). All six patients (66.67%) who had closed injury primary closed reduction and k wire pinning was done under image intensifier. All three patients (33.33%) who had open injuries were first treated by primary wound irrigation lavage and debridement was done. Among which one patient (11.11%) who had shaft of humerus fracture with Gustilo- Anderson type IIIc injury with neurological deficit was treated by open reduction and plate osteo-synthesis and exploration of radial nerve which was found to be intact, one patient (11.11%) who had a vascular injury required primary stabilisation with external fixator followed by vascular repair performed by a team of vascular expertize and then definitive secondary procedure of k wire fixation was executed after two weeks, and one patient(11.11%) definitive k wire fixation was done after primary wound debridement.

Among the forearm fractures, three patients (33.33%) who had diaphyseal fracture was treated with long k wire fixation, three patients (33.33%) who sustained metaphyseal injury was treated by dorsal radial k wire fixation, three patients (33.33%) who had epiphyseal injury was treated by dorsal radial k wire fixation and respectively. All the patients were followed up for an average period of 15.56 months with serial radiological and functional assessment.

Table-1. Details of nine patients with floating elbow

Case	Age	Sex	Side	Mechanism	Classification Gartland/ Gustilo	Forearm Fracture Site	Surgery For Humerus	Surgery For Forearm	Comment	Complications
1.	7yrs	M	R	Stairs	3	Metaphysis	CR/LMK	CR/DRK		
2.	9yrs	F	R	Bicycle	3	Epiphysis-SH-1	CR/LMK	CR/DRK	Neuropraxia recovered	Ulnar nerve palsy
3.	7yrs	M	R	Stairs	3	Diaphysis	CR/LMK	CR/DRK		
4.	8yrs	M	L	Bicycle	3/III a	Epiphysis-SH-2	CR/LMK	CR/DRK		
5.	11yrs	F	R	Slide	3/III a	Epiphysis-SH-1	CR/LMK	CR/DRK		
6.	8yrs	M	L	RTA	3	Metaphysis	CR/LMK	CR/DRK	Staged procedure done	Brachial artery tear
7.	9yrs	M	R	Stairs	3	Diaphysis	CR/LMK	CR/DRK		
8.	10yrs	M	R	Contact sports	3	Metaphysis	CR/LMK	CR/DRK		
9.	14yrs	M	R	Height	3/III c	Diaphysis distal 1/3rd	OR/PLATE	CR/DRK	ORIF done had neuropraxia and recovered	Radial nerve palsy

(*SH- Salter- Harris classification, CR-closed reduction; OR-open reduction; K-k wire fixation; L-lateral; LL- double lateral; M- medial; D- dorsal; R-radial)

Table-2: Results in nine patients according to Flynn's criteria

WRIST FOREARM

(Df- Dorsiflexion, Pf- Palmar flexion, Sn.- Supination, Pn.- Pronation)

	Age/ sex	Affected side	DF	PF	Sn.	Pn.	Loss of elbow flexion	Change in carrying angle	Result
1	7/M	Right	76	79	81	84	2	1	Excellent
2	7/F	Right	52	54	47	49	13	12	Fair
3	8/M	Right	68	67	63	67	6	6	Good
4	9/M	Left	62	64	66	61	7	7	Good
5	15/M	Right	77	79	82	80	1	0	Excellent
6	11/F	Right	66	63	70	59	8	7	Good
7	8/M	Left	67	65	70	63	7	8	Good
8	10/M	Right	78	77	85	82	2	3	Excellent
9	9/M	Right	53	55	56	45	12	13	Fair

RESULTS:

Our study has included nine cases of paediatric floating elbow injuries who were surgically managed and their functional outcome were categorized as per Flynn's criteria which showed three excellent, four good and two fair results. Three patients who had excellent outcome were taken up immediately for closed reduction and k wire fixation showed excellent results. Four patients showed good results with closed reduction and k wire fixation. Two patients who had fair results had change in their carrying angle with an increase in varus deformity in comparison to the opposite limb. Two patients initially had neurological injury and recovered in due course of six months. One patient had brachial artery injury and underwent staged procedure for correction of fracture and arterial injury and made a complete recovery after surgical management.

DISCUSSION:

Floating elbow injuries are an uncommon type in paediatric age group. Where in an isolated distal both bone fracture or a supracondylar fracture of humerus is common, but in combination it is an uncommon injury. This type of fracture occurs in high velocity injury with a fall on an outstretched hand. Closed fractures with extensive soft tissue injury involvement makes it difficult to assess the neurovascular status as studied by Blakemoore [6], because of this the incidence of compartment syndrome was 33%. Open fractures, compartment syndrome, neurovascular injuries are very common in children with floating elbow [7]. Various studies like Rodger *et al.;* [8] had described closed reduction techniques alone causes 100% non-union of distal humerus without a rigid fixation, Manipulation and closed reduction produces increased oedema and increases the chances of compartment syndrome. Closed reduction techniques leads on to more chances of cubitus varus deformity [10]. Closed reduction and k wire fixation allows us to monitor the neurological status as well as proper care for open injuries. Hence invasive procedures like k wire pinning was done for stabilisation of fractures and to achieve a good anatomical reduction so as to increase the rate of fracture healing and to prevent deformities due to fractures even though ulnar nerve palsy is a common post-operative complication.

In this series study we managed floating elbow injuries with immediate closed reduction and k wire fixation in paediatric age group which showed a majority of good to excellent results according to Flynn's criteria [5], where in staged procedures also for open fractures with neurovascular injuries showed good results but with mild acceptable deformity and delay in recovery period.

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