

A Novel Technique of Management of Open Fracture of Forearm In Floating Elbow Injuries In Adults Using A Combination of Locking Compression Plate For Humerus With External Fixation And Pinning Forearm Fractures: A Prospective Study.

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Abstract: Floating elbow fracture in adults is a rare and complex injury with unpredictable outcome. The aim of our study was to assess the demography, clinical outcome and complications of classic floating elbow in adults with different treatment modalities.

Method: Between 2016 and 2017, 10 patients with floating elbow involving open injuries of the forearm were treated in orthopedics department of regional institute of medical sciences, imphal with a mean follow up of 20.6 weeks. Out of 10 floating elbow cases all were open fractures of the forearm with closed fractures of humerus.

Results: Fracture healing observed upto 6 months post operatively. All fractures were united within 6 months. The average DASH score at the final follow up was 31.9. 3 cases showed evidence of elbow stiffness and one case showed additional complex regional pain syndrome.

Conclusion: Floating elbow injuries complicated by compound fractures of forearm are difficult to treat owing to the complexity of articular involvement and associated soft tissue trauma.

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I. Introduction

In 1980 Stanitskyn, micheli¹ introduced the term floating elbow to describe the injury pattern of ipsilateral supracondylar humerus and forearm axis fracture that disconnects the elbow from remaining limb in children. This description is extended to adults who sustained the concomitant fractures of humerus and forearm in the same extremity^{2,3,4}. Because of high energy trauma it can be combined with severe soft tissue damage leading to open fractures and neurovascular injury. For this reason these injuries usually have unpredictable clinical outcome after treatment. Although literature describing functional outcomes in patients with floating elbow is limited, surgical treatment has been widely accepted. Evidence that these injuries are treated most effectively with surgical stabilisation of humerus and forearm, using a plate or external fixation or intramedullary nailing has been well reported in the literature. However most studies have emphasized the complexity of these injuries and the potentially unpredictable long term functional outcomes.

II. Methods

Ten patients who had sustained classic floating elbow injuries were admitted from emergency department of orthopaedics, rims between February 2016 to may 2017. Classic floating elbow is defined as an ipsilateral diaphyseal fracture of humerus, radius and ulna. Patients aged older than 18 years were included in the studies. Out of ten patients 7 were male and 3 were female. 6 dominant limb and 4 non-dominant limb affected. Out of them 6 patients were injured due to road traffic accident, 3 were fall from height and 1 due to building collapse. According to location of fractures 6 middle third fractures of humerus and 4 were distal third fractures and all forearm fractures were open fractures. Of the forearm fractures 2 were type 3, 6 were type 2 and 2 were type 1 open fractures. None of the fractures were associated with neurovascular compromise in the affected limb.

III. Surgical Treatment

All the patients were received from emergency orthopaedics department of rims. Stabilisation of the affected limb done by either cramer wire application or above elbow slab application. Then third generation injectable cephalosporin antibiotic with injectable aminoglycoside started. Tetanus prophylaxis given. Head , chest, pelvis and spinal injuries along with other long bone injuries were ruled out except affected upperlimb. Patient advised to stay nil per oral till the operation. Patient and patient relatives were counsellled about fixation of the affected fracture and emergency blood investigations were done. Aftreer their written consent patient was shifted to the operation theatre. All the patients were operated under general anesthesia.

Patients put in supine position on the OT table with affected limb put over a armrest. For all the type 1 and type 2 open fracture of the forearm wound toileting done and for all the type 3 open fracture of the forearm proper wound debrivement was done. Then radius was fixed with uniplanar unilateral external fixation and ulna was fixed with k- wire. For all the humerus fractures incision made by anterior approach and fixation done by 4.5 mm locking plate with multiple screws. Post operatively limb was immobilised with above elbow slab. Injectable antibiotic continued till post operative day 2 and from the same day active range motion exercise of the shoulder and wrist exercise was started. Stich removal done on 10th day. On the 14th day above elbow slab was broken at the elbow for range of motion exercise of the elbow. From 3rd week onwards both passive and active exercise of the arm,shoulder and wrist started.

IV. Radiological And Clinical Assessment

Radiological outcome were evaluated using serial plain radiograph post operatively. Functional outcome assessed using DASH score. Residual complication were evaluated.

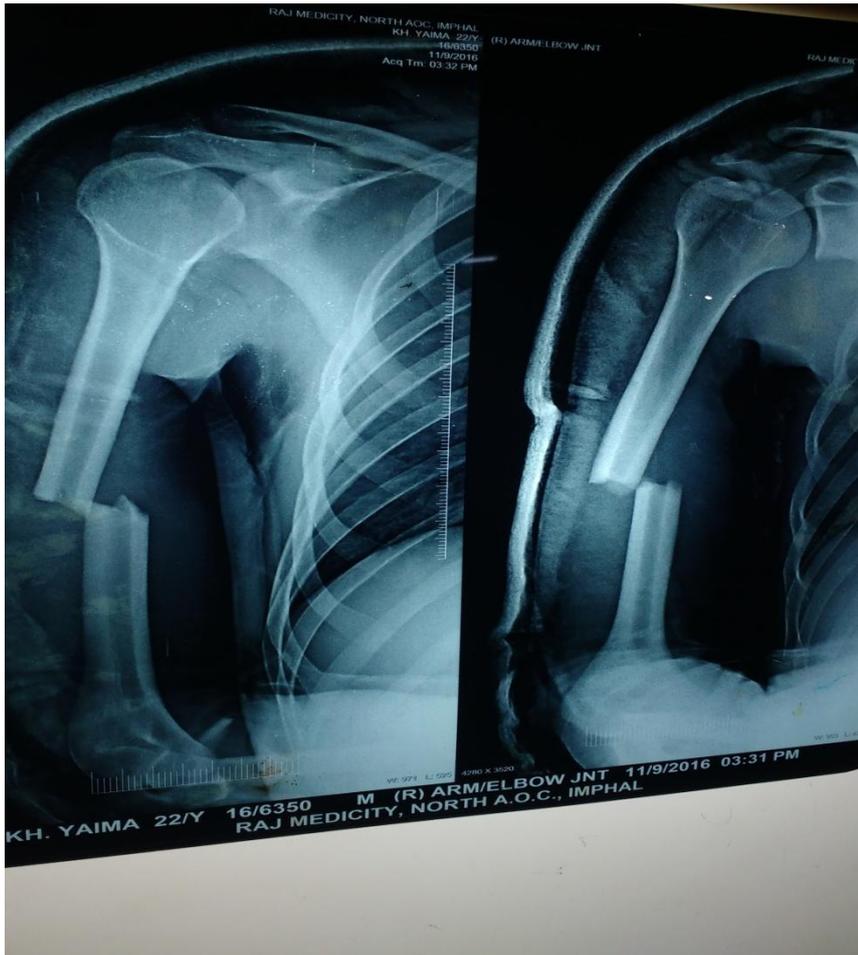
V. Result

Serial no	Age	sex	mode of injury	Type of open fracture of forearm	T/t of humerus Fracture	T/t of open forearm fracture	Pre op DASH score	Post op DASH score	Final DASH score	Follow up (in weeks)	Complications
1	33	M	Rta	Type 3 both bone	plating	External fixation of radius n k-wire of ulna	34	34	30	16	Nil
2	22	M	Rta	Type 2 both bone	Plating	External fixation of radius and k-wire of ulna	30	30	26	20	Nil
3	57	F	Fall from height	Type 1 both bone	Plating	External fixation of radius n k-wire of ulna	38	36	35	24	Stiffness of elbow
4	48	M	Rta	Type 2 both bone	Plating	External fixation of radius and K wire fixation of ulna	42	42	40	20	Crps type 1
5	27	F	Rta	Type 2 both bone	Plating	External fixation of radius and k-wire of ulna	34	32	30	20	Nil
6	41	M	Building collapse	Type 3 both bone	Plating	External fixation of radius and k-wire of ulna	38	38	36	20	Stiffness of elbow
7	47	M	Fall from height	Type 2 both bone	Plating	External fixation of radius and k-wire of ulna	32	32	30	22	Nil
8	60	F	Rta	Type 1 both bone	Plating	External fixation of radius and k-wire of ulna	38	38	36	24	Nil
9	25	M	Rta	Type 2 both bone	Plating	External fixation of radius and k-wire of ulna	34	32	30	20	Nil
10	18	M	Fall from height	Type 2 both bone	Plating	External fixation of radius and k-wire of ulna	30	28	26	20	Stiffness of elbow

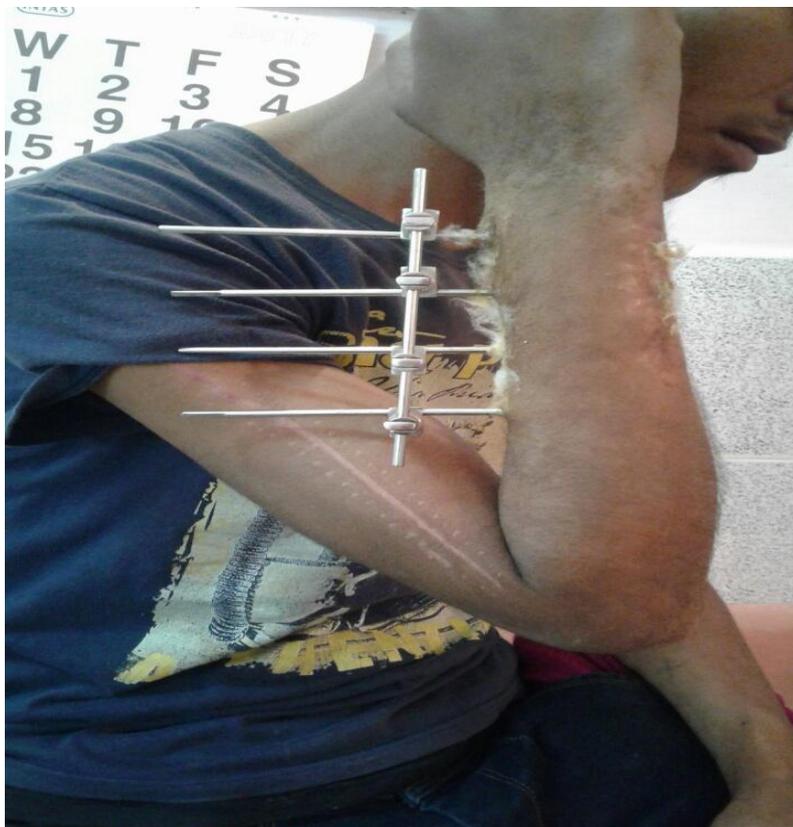
Crps ; complex regional pain syndrome type 1, T/t; treatment, Rta; road traffic accident, DASH;Disabilities of the arm, shoulder and hand.

Out of 10 patients of floating elbow ,all had open fractures in the forearm. Open fractures were classified according to Gustillo Anderson classification. Out of all the open fractures 2 were type 1 , 6 were type 2 and 2 were type 3 open fractures. All the cases were followed up within 6 months post operatively with a mean follow up of 20.6 weeks. The cases were followed up using DASH score. The average DASH score at final follow up was 31.9 . Total 4 cases had residual complication out of which 3 had stiffness of elbow joint and 1 case developed complex regional pain syndrome type 1.











VI. Discussion

The combination of ipsilateral fractures of humerus and forearm creates an unstable intermediate articulation. classic floating injuries may be a different entity than floating elbow variant injury. Floating elbow variant injuries , including elbow fractures, may have different injury mechanisms and poorer clinical outcomes because of direct injury to elbow. In our study , patients with ipsilateral diaphyseal fractures of the humerus, radius, ulna were only included for assessment of demographics, clinical outcomes, and complication of classic floating elbow in adults. Although their injuries show a very rare

fracture pattern, combined problems usually occur^{5,6}. Associated neurovascular injuries and soft tissue damage not only adds to the complexity of the surgical management but also, more often than not, adversely influences the functional outcome of the upper extremity. Jockel et al⁷ reported that floating elbow represents high energy trauma and there are significant associated injuries. They concluded that nerve injury is correlated with lower subjective clinical outcomes. Simpson and Jupiter³ reported that the floating elbow was an exceptionally complex injury and that complication such as non union, infection, or neurological sequelae, which led to the potential for long term functional disability of involved limb, could be considerable. In our study all the ten cases had open fracture in forearm and in all cases humerus fractures were closed without any neurological injury pre or post operatively. Floating elbow injuries may require temporary fixation, staged fixation, or late reconstruction if any associated problem or complication. Since 1984 when Rogers et al. reported a 100% non-union rate in humerus in floating elbow injuries treated without rigid fixation, rigid internal fixation of the humerus and forearm fractures has been accepted as the treatment of choice for this injury, temporary external fixation can be used in the management of the soft tissue injury for maintenance of length and rotational alignment. Yokoyama et al⁴ reported that good or excellent clinical results were achieved in 67% of patients with floating elbow injuries. Rogers et al⁸ documented 19 floating elbow injuries in adults and concluded that the open reduction and internal fixation of both humerus and forearm fractures were preferable for management of these injuries. In our study, we did not encounter any neurovascular injuries, rather we observed higher incidence of joint stiffness. Loss of elbow motion is common place, particularly involving elbow flexion and extension. We also have one case with complex regional pain syndrome type 1 which treated post operatively by NSAIDs and physiotherapy.

Pierce and Hodruski⁹ reported that the most common injury associated with floating elbow was residual nerve damage, which occur in more than 50% of patients and was a factor contributing to poor function. Vascular injuries associated with severe soft tissue injuries and neurological deficits were speculated to be factors contributing to poor outcome from the findings. Solomon et al² showed that patients with associated nerve injury have lower functional outcomes.

In our study 3 cases had elbow stiffness and one case had complex regional pain syndrome type 1. We did not perform statistical analysis because of small number of patients. This study will be helpful to surgeons in the effort to provide more accurate counselling to patients with floating elbow regarding the long term outcomes and implication of concomitant problems such as neurological sequelae and stiffness of the joints. The limitation of the study was small number of patients. The limitation was due to rarity of cases of floating elbow injuries and observer bias due to treatment data from a lone institute.

VII. Conclusion

Floating elbow injuries complicated by compound fractures of forearm are difficult to treat owing to the complexity of articular involvement and associated soft tissue trauma. Our modality of treatment merits a larger clinical trial as it has proven to be effective with respect to stability of fixation and early restoration of function.

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