E-ISSN: 2707-8353
P-ISSN: 2707-8345
IJCRO 2021; 3(2): 125-128
Received: 21-05-2021
Accepted: 03-07-2021

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Floating elbow injury in high energy trauma and prognosis: A case study

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DOI: https://doi.org/10.22271/27078345.2021.v3.i2c.83

Abstract
The floating elbow is an uncommon grievance. It consists of a fracture of the humerus and one or both bones of the homolateral proximal forearm [1]. We present a composite pattern of floating injury, which included distal humerus fracture with intraarticular extension of the humerus and associated ipsilateral proximal fracture of radius and ulna. Pleasing outcomes were finally gained after operative management and early physiotherapy. This clinical case exemplifies the importance of judiciously assessing floating elbow injuries when they occur to improve the surgical strategies and the adequate timing of the treatment to obtain optimal results.

Keywords: Floating elbow injury, high energy trauma, homolateral proximal forearm

Introduction
The floating elbow, defined as a concurrent ipsilateral fracture of the humerus and ipsilateral radius and ulna, is a rare injury occurring in paediatric patients [2, 3] and also in adult patients [2-5].

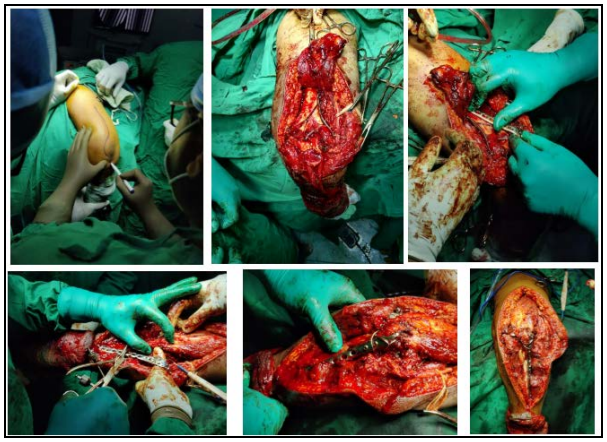
Initially the term “floating elbow” was restricted for ipsilateral humeral and forearm shaft fractures [6, 7]. But now, the term “floating elbow” also encompasses the intra-articular fracture of the distal humerus and elbow dislocation along with forearm shaft fractures. Because such injuries also lead to functional joint dissociation with the rest of the upper limb [8, 9]. Two types have been described in the literature [4]: Type-1 - involving skeletal disruption above and below a joint without injury to the intermediate joint and Type-2 - combined skeletal and direct articular injury. A type-3 lesion, including connected neurovascular damage of overlying soft tissue, with or without concurrent joint involvement was later described in the literature [7]. The first explanation of the floating elbow was testified in 1940 by Winderman [10].

Clinical case
29 years old male, driver by occupation, right-handed, previously autonomous, and without antecedents. He was admitted to the emergency room for a drastic trauma of the left upper limb, a chest, and abdomen trauma, following an accident on the public highway. The patient is a known case of Cushing’s Syndrome.

On admission, the patient was conscious, hemodynamically stable. Upon examining the left upper limb, a deformity of the entire left upper limb with significant oedema was noted, with no cutaneous opening, nervous or vascular disorder. The gross deformity was noted.

The standard radiographic workup showed a comminuted distal humerus (Type C3) fracture with comminuted proximal 1/3rd radius ulna fracture left side revealing a Type 2 floating elbow. Immediate splintage was given in the form of the above elbow slab for temporary stabilization. Required medical and anaesthesia fitness workup was commenced. Due to severe oedema at the operative site, the procedure was delayed by 4 days.

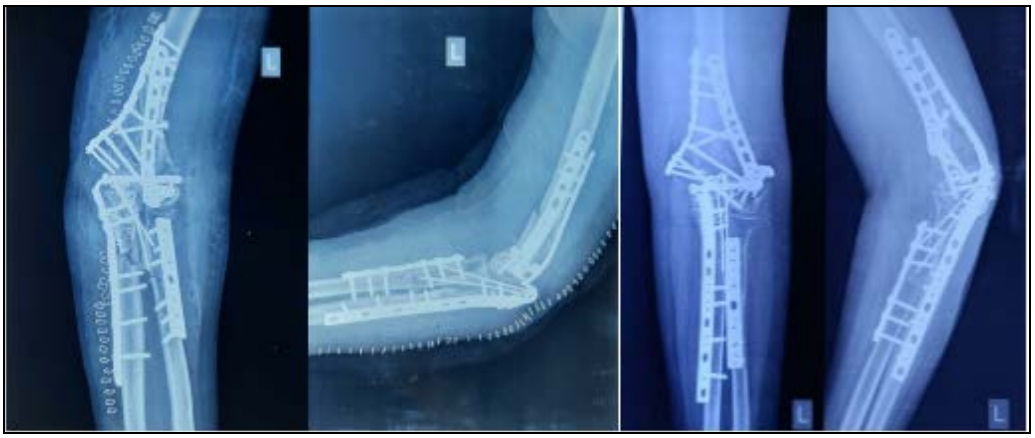
The patient was taken to operation theatre, under general anaesthesia, the patient was placed in the right lateral position on an operating table. Firstly, the humerus fracture was reduced and fixed by bi-columnar octagonal plating using distal humerus plate and cannulated cancellous screws by “trans-olecranon” osteomy approach and in the same position we fixed proximal ulna fracture by using a “SS-wire” (tension band wiring) and “hook plate”. In the supine position, we performed osteosynthesis of the radius by DCP by Modified Henry’s Approach.



Postoperatively the limb was immobilized with a shoulder pouch, which was continued till POD 21. Active Range of motion exercises of the operated limb were commenced from POD 1.

Radiological and clinical follow-up were accomplished at 1, 3, 6 months. A functional valuation was completed by means of the Liverpool Elbow Score (LES) [10]. The LES encompasses of patient-answered questionnaire and surgeon-oriented items, with a total score ranging from 0 (worst) to 10 (best). The patient's fractures partially united within 3 months and radiological evaluation 6 months after surgical intervention displayed the union of all fractures. The elbow joint showed 120 degrees of flexion and full extension, the pronation and supination of the forearm were full, and the palmar grip strength, when assessed with a static strength tester was 75% with respect to the contralateral uninjured limb.

Pre operative x-ray scan **Pre Operative CT**



Immediate post operative x-ray **POD 3 months x-ray**

Clinical photos

Discussion

The combination of the ipsilateral fracture of both bone forearm and distal humerus is an uncustomary entity [11, 12]. The constellation of skeletal trauma with a combined forearm and distal humeral fracture (floating elbow) has an incidence of 3-13% [13]. Contrary to isolated fracture, the floating elbow injury is high-energy trauma and poses difficulty in treatment. Management strategy of floating elbow injury has been changing constantly over time from closed reduction with posterior slab, olecranon traction to the K-wire pinning.

In the literature, the innumerable novelists recommend linked treatment of the lesions with inflexible internal osteosynthesis approving initial rehabilitation. Their recommended form of fixation in floating elbow injuries is plating [14] and is the gold standard method, even for the most complex forearm fractures [15]. The preference of fixation varies among authors. Even after diligent search, no definitive study could be found which prioritized the fixation order for supracondylar fracture or forearm injury of the floating elbow. Some authors have favored to first fixing the supracondylar fracture. They assumed that by this, neurovascular access of limb and fracture reduction will be easier. And the management of open fracture and dressing would have posed difficulty if the forearm fracture would have been managed firstly [3].

We used a medial and a posteo-lateral plate on the humerus to obtain adequate control of the fracture fragments avoiding extensive soft tissues dissection. This procedure led to fracture healing, because of the stable reconstruction and early physiotherapy. Indeed, one longer plate used mainly for the fixation of the diaphyseal fragment decrease to the time period of postoperative immobilization.

Indeed, in primary cases, a shorter immobilization period (i.e., 1 week after surgery) has been recommended [16], but we started mobilisation on first postoperative day.

A dynamic compression plate was used to fix the radius, whereas a “ss-wire”(tension band wiring) and hook plate was used to treat the ulnar fracture. Our patient was content with the last functional result of the surgical intervention, the range of motion of his elbow and mainly the extension was near normal. A deprived functional outcome is common after a floating elbow injury [16, 17]. But we here have been able to produce good results.

Collectively, the floating elbow is a principally complex trauma (Simpson and Jupiter) and entails the complications like infection, myositis, reduced range of movement, and functional impairment of injured limb. So with time, Simpson and Jupiter attempted to accurate the equivocation of this term [14]. Postoperatively we have give Cap. Indomethacin 25mg TID for 3 months, to prevent myositis ossificans.

Several complications can occur after a floating elbow injury, e.g.,myositis ossificans, infection, non-union, delayed union and malunion of the humerus or forearm bones, as well as vascular and nerve injury, leading to poor functional outcome. One preceding study on 21 patients with floating elbow indicated that only 28% of them had decent results, with residual neurologic disfunction in more than 50% [17].

Floating elbow injury is associated with a bigger rate of compartment syndrome (up to 33%) and the advanced chance of re- displacement of fracture if treated by slab or cast. Rogers JF *et al*., reported that non-union happened in the humerus of all cases of a floating elbow injury if achieved without the rigid fixation. Macini *et al*., reported an increased chance of delayed union in patients suffering from Cushing’s Syndrome [18], however, in our case study, we did not find any evidence of delayed union, and we radiographically reported the union time to be 12 weeks.

Indeed, the connotation of a neurological and vascular injury unfavourably affects the functional outcome after trauma to the upper limb, and neurological injury signifies a negative outcome predictor in the floating elbow [16, 7]. In our patient, there was no evident neurological impairment.

The current case draws considerable attention to the floating elbow injuries. The report advocates that acceptable outcome can be accomplished with an open reduction and internal fixation of fractures combined with an early course of physiotherapy. Pre-operative CT scan and nerve studies can provide assistance for an precise diagnosis and are recommended to plan the final treatment of a floating elbow injury.

Conclusion

The floating elbow is a serious injury with a wary outcome. Injury type is out of the way and treatment commendations are polemic. So it can be emphasised that floating elbow injury can be best managed by belligerent surgical intrusion. Prompt intervention with soft tissue preservation, stable fixation and early rehabilitation offers a better course(outcome) to patients. At the conclusion of this article, we understood that floating elbow injury is a field of large knowledge gap which entails the plentiful space for continuous investigation.

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