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Side swipe injury elbow with fixed object collision in mountain region: Presentation and management

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Abstract
Introduction: Side swipe injury is a subgroup of complex elbow trauma. Management of such injury is a formidable challenge to the orthopaedic surgeon. There is no fixed management protocol that is followed due to different presentation which results in poor functional outcome. We have presented a series of rarely reported side swipe injury elbow with fixed object collision in mountain region.
Material and method: A prospective study of elbow trauma of eight patient sustaining sideswipe injuries to the upper limb. Seven patients were male and one was female. Mean age was with a range of 24 to 45 years. Five were left sided non dominant and three were right dominant limb. In six patient's injury were confined to limb and among rest two who were sustained associated injuries. One patients required immediate vascular repair followed by debridement, external fixation than definitive fixation. One patient was unusually presented with open fracture humerus with brachial plexus injury and 3 patients required external fixation, open reduction and internal fixation for open fractures of the humerus, ulna and radius. Internal fixation was used in 3 patients as primary stabilization. Complications and outcome were recorded in follow-up at outpatient department up to 1 year. Results were evaluated using the Mayo elbow performance score.
Results: The injury severity scores ranged from 9 to 22. The average Mayo elbow performance score was 47.5. Good results (score 75-89) was seen in 12.5% patient. Fair (60-74) and poor results (Less than 60) were seen in 25% and 62.5% patients respectively.
Conclusions: Initial assessment and staged protocol management may be needed to achieve functional result in side swipe elbow injury with fixed object in mountain region which can be presented from mild to complete loss of limb function.

Keywords: Side swipe injury, traffic elbow injury, fixed object collision, open elbow injury mountain area

Introduction
Person can sustain sideswipe injuries of the elbow while travelling with resting their elbow on the car window or protruding their arm from an open window either from a collision with a passing vehicle or from the exposed arm striking a fixed object [1]. Vehicle-to-vehicle collisions are the most common types of side-impact collisions, fixed-object collisions account for 37 percent of the serious-to-fatal injuries in side-impact collisions [2].
Most all of these are high energy trauma 3 and were a common challenge to orthopaedic surgeons [3, 4]. These accidents result in severe soft-tissue injuries combined with open fractures or partial amputation of the upper limb; often complicated by neurovascular injuries [5]. These injuries have a high complication rate and poor outcome. Complications such as stiffness, contractures, nonunion, deformity and loss of function are common [4, 6, 7]. There is no fixed management protocol that is followed in the earlier studies due to different presentation. A staged surgical protocol with initial soft tissue debridement closed joint reduction and external fixation of the extremity followed by secondary reconstructive surgery after soft tissue recovery is suggested [3]. The most important variables that affected the final clinical outcome are presentation, meticulous assessment and staged surgical protocol.
We have presented a rarely reported side swipe injury elbow with fixed object collision in mountain region where deep excavation, rivers; forests on one side and projecting rocks on other side of the road (Figure 1).

Material and Method

Total 275 motor vehicle accident from mountain region were admitted between April 2014 to May 2016, seven among them presented with injury to arm, elbow and forearm due to side swipe vehicle accident. They have sustained injury while travelling with protruding their elbow from window and striking a mountain rock coming suddenly due to poor vision during sunset. Two patients were sustained injuries while riding pilon on two wheeler and vehicle got imbalance, striking opposite side to mountain. All patients sustained injury between 1700hrs to 1900 hrs and presented within 5-7 hrs of accident to emergency reception. Patient's particulars name, age, sex, handedness, date, time and place of incident were noted. Exact mode of injury, patients position while incident, weather and intoxicated status were documented.

On arrival all patient were manages as per advanced trauma life support guidelines [8]. Severity of injury (ISS) [9], extent of soft tissue damage, fracture pattern, whether close or open, and associated injuries were documented by surgical and orthopaedic team. Four patients required immediate surgical intervention and three required urgent intervention.All patients prospectively enrolled in the study and informed consent was obtained. Initial intervention documented followed by events in management of concomitant injuries, antibiotics, and repeated procedures; specific investigations required for further evaluation were noted. Complication and outcome recorded in follow-up at outpatient department up to 1 year.

Results

Seven patients were male and one was female. Mean age was with a range of 24 to 45 years. Five were left sided non dominant and three were right dominant limb. Five of these were co driver seat passengers who sustained injury on left side and three were pilon rider who experienced accident on right side. In six patient's injury were confined to limb and among rest two one sustained fracture tibia fibula, other one sustained fracture patella. Two injuries were associated with alcohol intake, one was in pilon rider and other was in co driver seat passenger. The ISS was range from 9 to 22. All accidents were no- life threatening and two patients required resuscitation for hypovolumia. All of these were open injuries from Grade 1 to 3C according to Gustilo and Anderson classification. Four patients were taken for immediate intervention and rest were required washout, debridement and initial immobilization followed by urgent intervention within 24 hrs.

Six patients were required external fixation for contaminated wound. Patient 1, sustained open fracture humerus with degloving injury forearm and PIN injury required external fixation and debridement; wound left open. Subsequently secondary closure was done. Fixator was replaced with plate fixation and bone grafting (Figure 2). Severe limb injury involved in Patient 2, sustained brachial artery injury required repair and compartment syndrome forearm required fasciotomy. Debridement and external fixation were done. Subsequently fasciotomy closure and plate fixation was done. Patient 3, sustained degloving with suspected radial and median nerve injury required exploration, and open fracture humerus required external fixation, subsequently evaluated to have brachial plexus injury. Patient developed skin flap necrosis for which split skin grafting was done followed by external fixator replacement with plate fixation and bone grafting (Figure 3). Patient 5, sustained degloving, open fracture humerus with radial nerve contusion. Later skin grafting, plate fixation and bone grafting was done. Patient 6, had extensive contaminated wound with fracture olecranon required External and limited internal fixation. Three patients developed wound infections for which prolong antibiotics cover were given. They subsequently required split skin grafting.

Patient 4, sustained fracture humerus, ulna with deep laceration required initial debridement followed by ORIF and ILN for fracture tibia fibula. Patient 7, had open proximal ulna fracture required External fixation and debridement. Fracture patella was managed with ORIF. Patient 8, sustained degloving with exposed distal humerus with ulnar nerve division required external fixation, end to end repair; split skin grafting was done followed by external fixator replacement with plate fixation and bone grafting (Figure 4). Five patients underwent multiple procedures among four required ORIF with various plate procedures and other fixations (Figure 5). The average Mayo elbow performance score was 47.5. Two patients (6, 7) recovered fully within 12 weeks after discharge and rehabilitation. In Patients 1, PIN neuropraxia recovered within 3 months. Patients 1, 2; developed decrease range of motion, muscle weakness, at 12 months and not able to resume preinjury function. Patient 1, developed malunion of humerus at 12 month and expected further intervention. Patient 3, had not recovering brachial plexus injury at 3-6 month and awaiting further follow-up. Patient 4, PIN recovered fully at 3 month. Developed decrease range of motion at 12 month. Patient 5, developed wrist drop, muscle weakness, decrease range of motion at 6 month and minimally improved after rehabilitation at 12 month. Patient 8, residual ulnar nerve palsy, decrease range of motion at 6 month and minimally improved at 12 month.

Discussion

Side swipe injury now rare but remain one of the most substantial therapeutic challenges that confront the orthopaedic surgeons. They are defined as complex elbow injuries as standardized concepts usually do not apply [3, 4, 6]. This complex elbow injury often involves multiple bone fracture with variable associated injury. Fracture pattern may be at single or multiple levels with variable soft tissue injury and/or loss. Goal of treatment in such injuries is pain free movements and stable fixation [7, 10-12]. Immediate external fixation, open wound treatment, delayed bone grafting, and late internal fixation led to good to excellent results[7]. Internal fixation is preferred stabilization in closed fractures and in clean open grade one and two injuries; or after a period of soft tissue recovery [4].

Injury with fixed object sustained while in four wheeler is single impact or sustained in two wheeler mean two separate impacts have occurred. The two impacts are first, an impact with a fixed object and second, the final impact with the road. Fixed-object collisions involve serious-to-fatal injuries in side-impact collisions [2]. We have found single impact in six patients among four presented with extensive soft tissue injury and two impacts in patient 1, 4; who had associated lower limb injuries. Alcohol was significant contributory factor in such injuries.

The injuries in our study ranged from grade one and/or two open fractures to extensive soft tissue damage of the elbow combined with severe nerve and vascular injuries. The severity of injuries was reflected in patients required multiple intervention and poor outcome. The most frequent fracture pattern was shaft humerus, distal humerus combined and/or proximal ulna. In earlier report it was combined distal

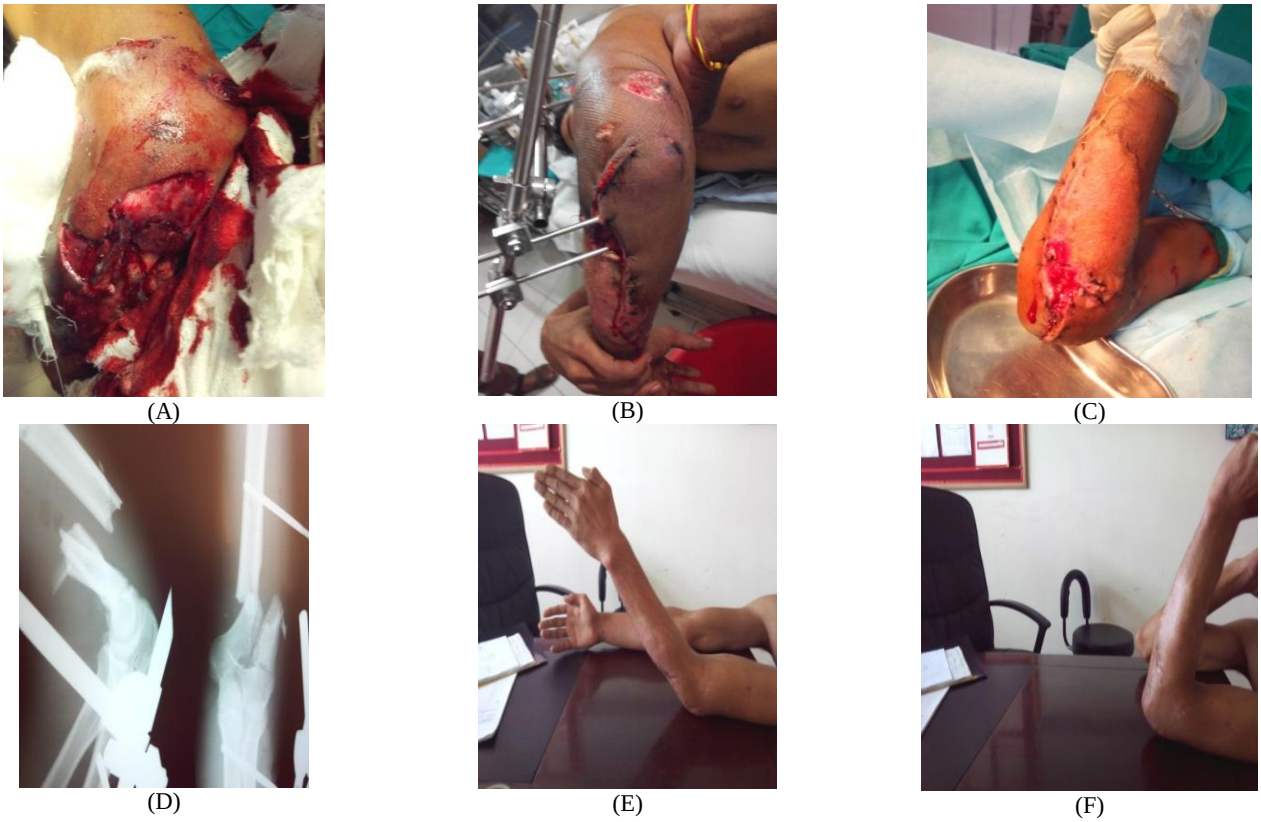
humerus and proximal ulna [4]. We used external fixation in six patients followed by internal fixation in five. We have used internal fixation in two patients. We have achieved primary union with external fixator in one patient. Wild *et al*. in 1982 [13], achieved primary union with the external fixator in 5/16 patients. In our study wound coverage was needed in six patients. We have successfully covered skin within 72 hrs after debridement in two patients and with split skin grafting within 3 week of injury. Radial nerve injury was the most common found in three patients, ulnar nerve injury found in one patient; as oppose to ulnar nerve injury reported common in other series that was not in our series [4]. Brachial plexus injury was found in one patient who was rarely reported in earlier series. Isolated median nerve injury was not encountered in our study. Earlier author reported 63.5% neural complications in high velocity elbow trauma [4]. Vascular injury with compartment syndrome forearm was found in one patient. Compartment syndrome reported in 23.8% and frequently seen in multiple trauma patients [4]. Severity of injury did correlate with poor outcome.

We found nerve injury and extensive soft tissue damage were significant factor in poor outcome of our patients. Seekamp *et al*. [14] have evaluated prognostic criteria for poor functional results in elbow injuries and found nerve lesions as the most significant factor for poor outcome. They evaluated external fixator application was associated with poor outcome. Young male and alcohol consumption were likely contributing factor in such injury. Apart from severity, our study was not able to detect definitive pattern of injury in fixed object collisions.

(A) (B)

(A), (B) showing projecting rocks on side of the road in mountain region

Fig 1



(A) (B) (C)

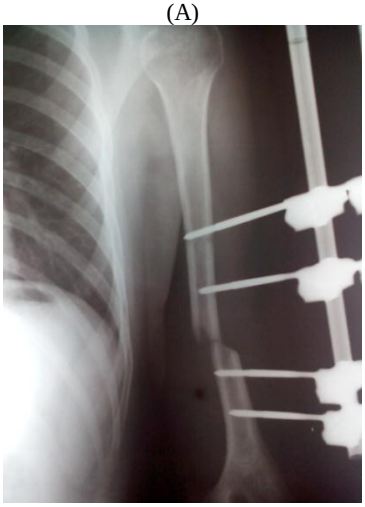
(D) (E) (F)

Fig 2: (A) Clinical photograph showing sideswipe injury with open fractures. (B) Clinical photograph showing fixator in situ.(C) Clinical photograph after fixator removal. (D) Radiographs showing fractured humerus with fixator in situ.(E and F) Clinical photograph showing functional outcome (Patient 1).


(A)


(B)


(C)


(D)


(E)


(F)

Fig 3: (A) Clinical photograph showing sideswipe injury with open fractures humerus with degloving. (B) Intraoperative photograph after debridement and partial closure. (C) Clinical photograph showing closure and fixator in situ. (D) Radiographs showing fractured humerus with fixator in situ. (E) Clinical photograph showing healthy SSG with fixator in situ. (F) Clinical photograph showing functional outcome (Patient 3).


(A)


(B)

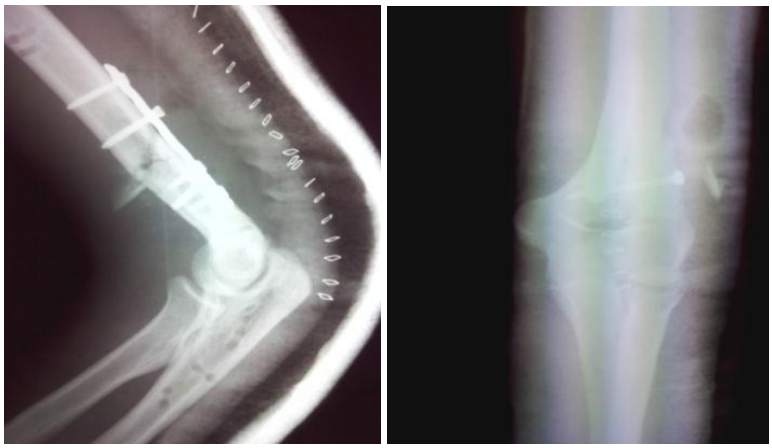

(C)


(D)


(E)


(F)

Fig 4: (A) Clinical photograph showing sideswipe injury with open fractures humerus with degloving. (B) Intraoperative photograph after debridement showing fixator in situ.(C and D) Radiographs showing fractured humerus with fixator in situ.(E) Clinical photograph after debridement.(F) Clinical photograph showing functional outcome (Patient 8).

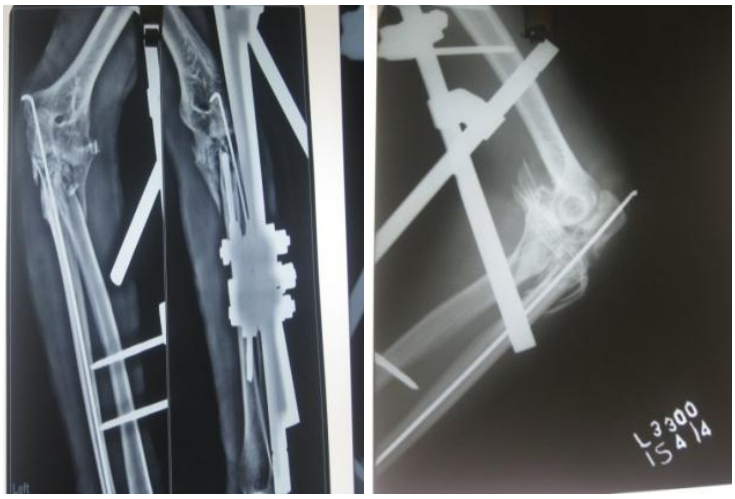


(A) ORIF of humerus (Patient 1)

(B) ORIF of distal humerus and ulna, (Patient 4)

(C) ORIF of distal humerus (Patient 8)

(D) ORIF of distal humerus and ulna (Patient 5)



(E) (F)

(E and F) External fixation with limited internal fixation (patient 6)

(G) **(H)**

(G and H) ORIF of shaft humerus (Patient 2, 3).

Fig 5: Various fixation procedures

Table 1

Case No	Age/Sex	Handedness/ Presentation	Initial management	Subsequent management	Functional recovery/outcome
1	24/M	Left-Open fracture Humerus Degloving injury forearm PIN Lesion	Debridement External Fixation	Secondary Closure ORIF	Reduced Range of motion Muscle weakness PIN Recovery
2	32/M	Right-Open fracture Humerus Brachial artery injury Compartment syndrome forearm Degloving injury	Artery repair External Fixation Fasciotomy	Fasciotomy closure ORIF	Reduced Range of motion Muscle Weakness
3	28/M	Left-Open fracture humerus Degloving injury Panbrachial plexus injury	External fixation Partial closure	Split Skin Grafting ORIF	Partial recovery Awaiting more surgery
4	45/F	Right-Open fracture humerus Open olecranon, ulna PIN injury Fracture Tibia- Right	Debridement	ORIF	Reduced range of motion PIN full recovery
5	42/M	Left-Open humerus fracture Degloving injury Radial Nerve injury	ORIF	Split skin grafting	Wrist drop awaiting surgery
6	36/M	Left-Open olecranon fracture Laceration forearm	External fixation Flexible IMN ulna		Full functional recovery
7	26/M	Right-Open proximal ulna Fracture patella Right	External fixation	ORIF patella	Full recovery
8	36/M	Right-open humerus fracture Ulnar nerve injury	Debridement External Fixation Ulnar nerve repair	Split Skin Grafting ORIF	Ulnar nerve partial recovery Reduced Range of motion Muscle Weakness

Conclusion

Initial assessment and staged protocol management may be needed to achieve functional result in side swipe elbow injury with fixed object in mountain region which can be presented from mild to complete loss of limb function. Larger study is further required to define fixed pattern of injury in such type of injury.

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