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Review Article

An unusual mechanism of sideswipe injury in passengers traveling in a train and review of literature

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Abstract: Introduction: Sideswipe injuries are most commonly described in passengers traveling in a car or bus, but here we report an unusual mode of sideswipe injuries, in passengers traveling in a train sitting on window seats with elbow protruding outside the window. Case series: Four patients reported to our Orthopaedic emergency 2 hours after a railway track accident with more or less similar pattern of injury, an open proximal forearm monteggia fracture-dislocation with bone and soft tissue loss along with closed fracture humerus, and with or without radial nerve palsy and intact distal pulses. We followed a multidisciplinary approach with initial wound lavage followed by wound debridement, stabilization of monteggia and humerus fractures with different justifiable modalities of treatment with an exploration of the radial nerve. Discussion and conclusion: Sideswipe injury is a well-known case entity in literature, classically described mode of trauma is when an elbow protruding out of the window of a vehicle struck by a moving or fixed object. However, in our series patients sitting in a train on window seat with elbow protruding outside sustained sideswipe injury which has not been reported in literature. We also explained the mechanism of impact forces caused bony and soft tissue injury in our series presented in diagrammatic representation. Hence, the purpose of this case series is to spread the awareness regarding such kind of preventable injury which can be easily prevented with awareness, and an appropriate preventive measure can be taken by the local administration.

Keywords: Sideswipe injury, monteggia fracture, dislocation, humerus shaft fracture, railway tract injury, baby car injury

Introduction

Sideswipe injury or baby car injury is a well-known entity the mechanism of injury is described in relation to a car or bus, in which a passenger or a driver resting their elbow on the window, protruding outside of the vehicle sustain high energy trauma to the elbow and/or arm either due to collision with a nearby passing vehicle or a fixed static object [1, 2]. Such injuries occur frequently when a wider car/vehicle passing through a narrow road [3, 4]. Sideswipe injuries are associated with severe soft-tissue injuries in combination with open fractures and/or partial amputation of the upper limb, often complicated with neurovascular injuries. The management of sideswipe injuries involves a multi-disciplinary approach with multiple surgical interventions and a long rehabilitation period [1, 5].

To date, in the literature, the mode of sideswipe injury was described in relation to passenger traveling in a car or bus, and a preventive measure to curtail such injuries has been adopted. However, here we report a series of four cases of an unusual mode of sideswipe injury, in passengers traveling on the window seat of a moving passenger train, while crossing an unmanned railway tack crossing. This unusual mechanism of sideswipe injury was not reported in literature to date. Hence, the aim of this case series is to highlight and spread awareness regarding the occurrence of such a devastating and preventable injury.

Methodology

Case series reports

The study was approved by ethics committee bearing approval number-MC/Ortho/2020/

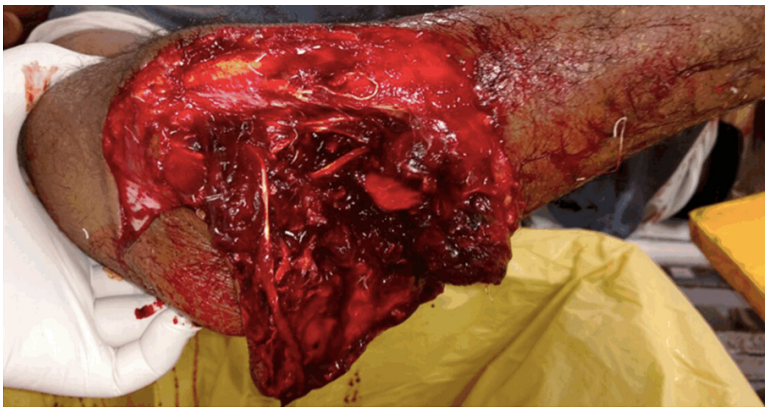

Figure 1. Clinical photograph of the wound at the time of presentation to orthopaedics emergency.

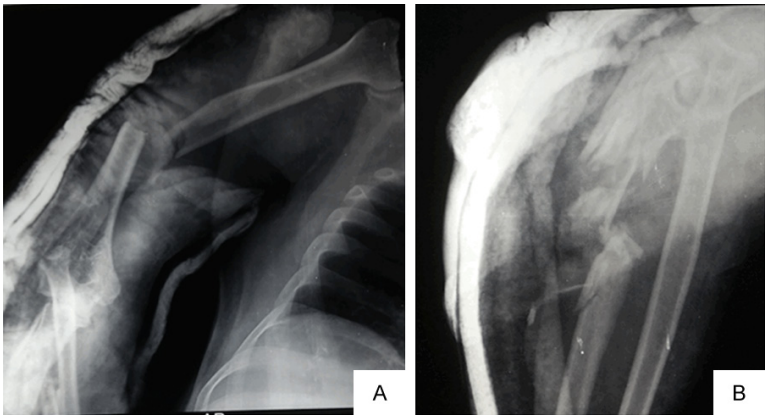

Figure 2. Pre-operative X-rays: (A) Fracture shaft humerus, (B) Monteggia fracture-dislocation.

170A dated 05/03/2020. A prior informed consent was obtained from all the patients.

Case-1: Fifty-two years old male presented to our orthopaedic emergency 2 hours after injury to right elbow following railway track accident. He was sitting on the window seat of the train with the right elbow protruding outside of the window hit by the rear end of a minibus while train was passing through an unmanned railway track crossing. On examination, the patient was conscious, oriented, vitals were stable, had no other associated injury. On local examination of right upper limb, there was a degloving injury around the proximal forearm and elbow with profuse active bleeding, localised pain, swelling, and the fracture fragments of bone visible in the wound. The wound was of around 9 cm long along the posterior and lateral aspect of proximal forearm extending through the elbow to the distal 1/8th of the arm (**Figure 1**). The patient was unable to extend his wrist joint, metacarpophalangeal joint, and thumb with patchy sensation over the hand. Distal pulses were palpable and fingers were well perfused. Thorough wound lavage was done, injection antibiotic (Ceftriaxone 1 g, Metronidalone 500 mg and Amikacin 500 mg), and tetanus toxoid was given as per institutional protocol. A temporary above elbow splintage was given until the patient was taken for definitive intervention.

After radiological evaluation, a diagnosis of open grade-IIIA fracture proximal ulna with radial head dislocation (Monteggia fracture-dislocation) with closed fracture distal 3rd shaft of humerus with radial nerve palsy without vascular injury was made (**Figure 2**).

The patient was taken for emergency surgery under general anaesthesia. Again wound lavage, followed by debridement of the wound was done. Fracture ulna was fixed with a square nail and dislocated radial head was stabilized with a radio-capitellar K-wire. Fracture humerus shaft fixation was done with a limited contact dynamic compression plate through posterior approach (**Figure 3**), radial nerve was identified and explored intra-operatively to look for any break in continuity, the nerve was found intact but contused, suggesting stretching of the nerve. The primary closure of the wound was achieved for both humerus and Monteggia fracture-dislocation.

Postoperatively above-elbow splint, and dynamic cock-up splint was given. Post-operative wound healing was uneventful, suture removed at 2 weeks follow up. Further patient was followed up at 3 weeks, 8 weeks, and 6 months in the outpatient department. Radio-capitellar

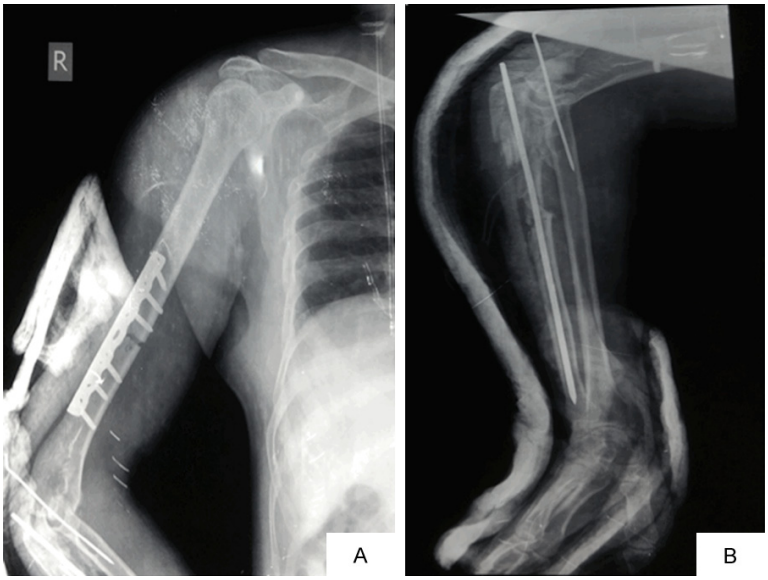

Figure 3. Post-operative X-rays: (A) Open reduction and internal fixation with LCDCP for fracture shaft humerus, (B) Square nail for ulna, and radio-capitellar K-wire for radial head dislocation.

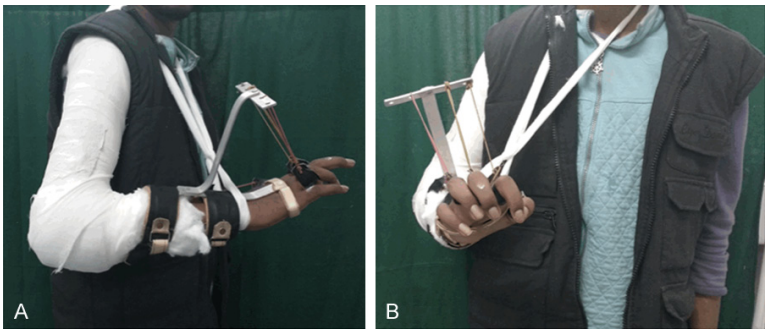

Figure 4. Clinical photographs of the patient showing dynamic cockup splint: (A) Lateral view, (B) Antero-Posterior view.

wire removal done at 3 weeks, postoperatively, there was no recovery of the radial nerve, patient was continued with a dynamic cock-up splint (**Figure 4**). At 6 months humerus and ulna fractures got united with no recovery in radial nerveinjury with stiff elbow (range of motion 20-60°). Further patient was planned for tendon transfer.

Case-2: A 17-year-old male, presented to our orthopaedic emergency 2 hours after an open injury to the right elbow and arm following a railway tract accident. The patient was traveling in the same train on the window seat with elbow protruding outside the window. He sustained injury in the same way as the case-1. On examination patient was conscious, oriented and vitals were stable with no other associated injury. Local examination revealed localised pain, swelling and an open wound with active bleeding with visible pieces bone fragments in the wound. He was unable to use his right upper limb and fingers. There was a patchy sensory perception over the hand and wrist. Wound was present over the right elbow extending up to 5 cm distal to the elbow joint. Distal pulses were palpable and fingers were well perfused. Patient was given injection antibiotics and tetanus toxoid as per institutional protocol. Thorough wound lavage, followed by dressing and above elbow splintage was given.

After radiological evaluation a final diagnosis was open comminuted fracture of proximal 3rd ulna with fracture radial head with closed fracture of distal 3rd shaft of humerus with radial nerve injury without vascular injury.

Patient was taken for emergency surgery under general anaesthesia. Wound debridement followed by partial excision of radial head (due to comminution), square nailing for ulna, and primary closure of wound was done. The fracture shaft humerus was managed non-operatively with a U-slab and dynamic cock-up splint for the radial nerve palsy. Post-operatively patient was followed-up at 3 weeks, 8 weeks, and 6 months. Wound healed uneventful by 3 weeks postoperatively. At 6 months of follow up, humerus got united but ulna did not, and there was no recovery in radial nerve with stiff elbow (range of motion 10-40°). The patient was further planned for bone grafting and open reduction and internal fixation with plating of ununited ulna and planned for tendon transfer for unrecovered radial nerve injury in subsequent stage.

Case-3: A 29-year-old male presented to our Orthopaedics emergency about 2 hours after a railway tract accident with history of open wound to left elbow and forearm. He was travelling in the same train, sitting on a window seat of the train with left elbow protruding outside. Sustained injury with similar mechanism as in case-1. On examination patient was conscious, well oriented, vitals were stable. Injection antibiotics and tetanus toxoid was give as per institute protocol. Local examination revealed an 8 cm long wound present along the posterior aspect of the proximal forearm with profuse bleeding. The fragments of bone were visible through the wound, a localised pain, swelling, and deformity was present over distal 3rd left arm. Patient was unable to use the left upper limb. Distal pulses were palpable with a well perfused finger. A wound lavage and above elbow splintage was given.

After radiological evaluation a diagnosis of open Monteggia fracture-dislocation with distal 3rd humerus fracture without distal neurovascular deficit was made. Further wound lavage and debridement was done under general anaesthesia. Square nailing for ulna and parallel plating of humerus fracture was done (fracture was quite low). Unfortunately this patient was lost follow up after 3 weeks postoperatively.

Case-4: A thirty-five years old male sustained injury to his left upper limb in a railway track accident, presented to our emergency about 2 hours after trauma. He was sitting on a window seat of the same train with elbow protruding outside. He sustained injury with the same mechanism as in case-1. On examination patient was conscious, well oriented with stable vitals. Local examination of left upper limb showed an open would of about 10 cm present along the lateral and posterior aspect of the left elbow extending below up to proximal 3rd of the forearm. An active bleeding from the wound was present, with localised pain, and swelling at proximal 3rd forearm and distal 3rd arm. Distal pulses were palpable with well perfused fingers and he was unable to use his left upper limb. As per institutional protocol injection antibiotics and tetanus toxoid was given. A wound lavage and temporary above elbow splintage was given.

After radiological evaluation a final diagnosis of open Monteggia fracture-dislocation with distal humerus fracture without neurovascular injury was made. Wound lavage and debridement was done under general anaesthesia. Square nailing for ulna fixation and parallel plating of humerus with flap coverage with split-thickness skin graft (SSG), for the proximal forearm was done. Patient was followed at 2 weeks, 3 weeks 8 weeks and at 6 months postoperatively. At 6 months of follow up fracture humerus got united but ulna did not unite. Further open reduction and internal fixation with bone grafting has been planned for fracture ulna.

Discussion

Sideswipe injury is a well-defined entity in literature and described mode of injury is, a passenger or driver of vehicle resting his/her elbow on the window protruding outside the vehicle, struck to another moving vehicle nearby or to a fixed object. This has been classically described in relation to a car or bus accident and given many synonyms like a baby car or traffic elbow injuries [1].

Till date in the literature sideswipe injury is not described in a railway track accident. In our series of 4 cases all the patients sustained injury while they were traveling in a moving train at the window seat with elbow protruding outside, hit by the rear end a moving minibus at an unmanned railway track crossing, when the train was passing through this unmanned railway track crossing. While reversing the minibus, it went very near to the railway track which driver could not appreciated, and at the same time a passenger train came on the railway track. The rear end of the minibus struck the elbow of the passengers who were sitting on the window seats with elbow protruding outside of the running train, causing a sideswipe injury to 4 passengers, a diagrammatic presentation of injury shown in **Figure 5**.

We also illustrated the mechanism of injury with a diagrammatic representation and the forces which caused elbow injury shown in **Figure 6**. An initial impact (force F1) was at the anterolateral aspect of the forearm which caused an open fracture in proximal 3rd of the ulna with radial head dislocation and degloving of soft tissue described with force F1 and further as the arm got stuck in the grill a fulcrum was created, a force F2 caused fracture shaft humerus along with tractional injury to the radial nerve.

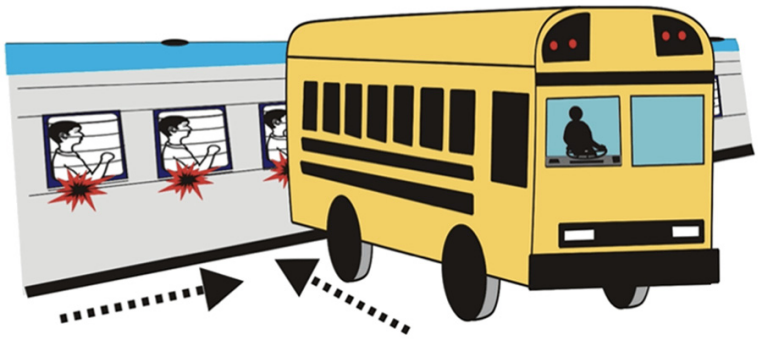

Figure 5. Diagrammatic illustration of the mode of trauma.

Figure 6. Diagrammatic illustration of the mechanism of injury.

Although the sideswipe injury is well known entity however, it gives very little information regarding the post trauma impact it has on the patient's life or severity of the injury. This cannot be classified into any single type of injury so the general term of complex elbow injury is applied to this entity [6-9]. A various patterns of fracture configuration may involve single or multiple bones. Similar to any high-velocity trauma, extensive bony comminution, skin and soft tissue loss, with or without neurovascular injury can occur in sideswipe injury too, which poses a great challenge for the surgeons to manage.

Kharbanda et al. described a series of 34 cases of sideswipe injury with treatment algorithm according to different grades of open fracture, a multidisciplinary combined effort required to provide some salvageable results, however, the mode of injury in his series was road traffic accident (RTA) and not a single case was due to railway track accident [10].

Various modalities of internal and/or external fixation with soft tissue procedure have been described for this complex injury, external fixation being preferred considering the extensive soft tissue injury [6, 11, 12], however, in our series we did square nailing for ulna along with above elbow slab application as the fracture was open with soft tissue loss and any further internal fixation was not plausible, humerus fracture was closed hence managed accordingly. Similarly, different methods of wound coverage were used from SSG, fasiocutaneous flap to muscle pedicle transfer. Some surgeons preferred pedicle latissimus dorsi flap for small wounds around the elbow [13]. One of our patients too required a SSG for the wound coverage.

As evident from the above case scenario, sideswipe injury is associated with many grave areas like bone and soft tissue loss, nerve injury which make the outcome very poor in such cases, nerve injury is considered the most important factor for dismal results [14].

In this series we tried to explain the mechanism behind such injuries leading to humerus fracture along with radial nerve injury which we encountered in two cases of our series. Apart from radial neve other nerves (median and ulnar) involvement have been reported in literature [8], but in our series, only the radial nerve was involved. Nerve injured in such cases has a very poor chance of recovery as these are the result of tractional injury leading to overstretching of the nerve hence neurontemesis. Similar thing had happened to radial nerve in two cases of our series too. Additionally, we did a literature review through MEDLINE (PubMed) database with specific keywords to summarise the different modes of sideswipe injury, which is shown in **Table 1**. We found RTA

Table 1. Mode of sideswipe injury in previously published literature

Sl no.	Study with year	Type of study	Number of cases	Age (Years)	Sex (M/F)	Mode of injury
1	Larue 1946 [15]	Case series	7	Mean 25	NR	An automobile accident in all cases
2	Aufranc 1963 [16]	Case report	1	43	M	Road traffic accident in all cases
3	Aufranc 1964 [3]	Case report	1	17	M	Road traffic accident
4	Kuur 1988 [17]	Case report	1	34	M	Road traffic accident
5	Nikitins 2003 [18]	Case series	7	Mean-25	6/1	Road traffic accident in all cases
6	Kinzel 2006 [19]	Case series	11	Mean-34	10/1	Road traffic accident in all cases
7	Musa 2006 [20]	Case report	1	34	M	Road traffic accident
8	Ditsios 2013 [21]	Cohort study	2 of the 19 cases	NR	NR	Road traffic accident in both the cases
9	Kharbanda 2013 [10]	Prospective case study	34	Mean-30	32/2	Road traffic accidents in all patients
10	Nwadinigwe 2013 [5]	Case series	3	??	2/1	Road traffic accident in all cases
11	Said et al. 2013 [22]	Case series	1 of the 4 cases	55	M	Road traffic accident
12	Sivakuma 2020 [23]	Case Report	1	41	M	Road traffic accident
13	Present study 2021	Case series	4	33.5	All male	Railway track injury

M: Male, F: Female, NR: Not Reported.

as the most common cause of sideswipe injury but none of the reported literature mentioned railway tack accident as one mode of sideswipe injury.

Conclusion

Authors want to convey the severity of these injuries, and its impact on the individual's life as a whole, leading to life-long disabilities. Hence, we report this case series to spread the awareness regarding this preventable mode injury, which can be easily prevented if people are aware that such an entity exists and local administration and government should take proper measures to prevent such an accident with appropriate measures.

Disclosure of conflict of interest

None.

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