JSES International 5 (2021) 320–327

Contents lists available at ScienceDirect

JSES International

journal homepage: www.jsesinternational.org

Floating forearm associated with terrible triad injury and Essex-Lopresti injury: a case report and literature review

Issei Shinohara, MD [a], Shunsuke Takahara, MD [a,*], Atsuo Uefuji, MD [a], Atsuyuki Inui, MD [b], Yutaka Mifune, MD [b], Katsuhito Ichimura, MD [a], Hirotaka Nishihara, MD [a], Kenta Kishimoto, MD [a], Kenji Aoki, MD [a], Hiroyuki Takayama, MD [a], Natsuko Nakagawa, MD [a], Toshihiko Harada, MD [a]

[a] Department of Orthopaedic Surgery, Hyogo Prefectural Kakogawa Medical Center, Hyogo, Japan
[b] Department of Orthopaedic Surgery, Kobe University Graduate School of Medicine, Hyogo, Japan

ARTICLE INFO

Keywords:
complex elbow fracture dislocation
terrible triad injury
Essex-Lopresti injury
floating forearm
perilunate dislocation
distal radioulnar joint

Complex elbow dislocations are injuries in which there is a significant risk of long-term disability. The combination of elbow dislocation with both radial head and coronoid process fracture is particularly challenging to treat and, as such, has been termed terrible triad injury (TTI) of the elbow.[23] TTI is typically caused by high-energy falls onto an outstretched hand.[16] Although the treatment of TTI has evolved over the last decade, clinical results are still unsatisfactory.[38]

Essex-Lopresti injury (ELI) is also a severe upper limb injury that is difficult to manage. ELI consists of a characteristic triad: a comminuted radial head fracture, disruption of the distal radioulnar joint (DRUJ), and tearing of the interosseous membrane (IOM).[15] Similar to TTI, ELI occurs when a high-energy load is axially applied to the forearm, usually as a result of a fall on an outstretched hand.[15]

In recent years, a rare pattern of a whole forearm injury, that is, floating forearm—the ipsilateral bipolar dislocation of the forearm—has been described.[3,22] This injury involves a combination of elbow dislocation and ipsilateral perilunate dislocation.[22] TTI and ELI are both relatively rare injuries; therefore, floating forearm is extremely rare. We present the first case report of floating forearm associated with both TTI and ELI.

Case report

A 38-year-old man presented at our emergency department with right elbow pain after a fall from a height of three meters. There was no complaint of pain around the right wrist. Physical examination revealed swelling, tenderness, and a wound on the medial side of the right elbow. Swelling and tenderness were unclear around the right wrist. The extremity was neurovascularly intact. Plain radiographs revealed posterior dislocation of the elbow with radial head comminuted fracture (Fig. 1a). Three-dimensional and plain computed tomography of the forearm were requested, which revealed a coronoid tip fracture, displaced radial head fracture, distal radius avulsion fracture, and ipsilateral DRUJ incompatibility (Fig. 1b-e). The small coronoid tip fragment (Regan-Morrey Type IA, O'Driscoll type I, subtype 1)[19,24] was located anteriorly to the elbow joint. The radial head showed a three-part fracture with a shortened radial length (Mason-Morrey type III).[14] The distal radial fracture presented as a dorsal ulnar avulsion fracture, partially extending to the DRUJ.

Owing to the presence of an open fracture, immediate surgery was performed. The open wound that extended from just distal to the medial epicondyle of the humerus to the elbow joint was used to perform débridement and irrigation of the elbow joint. An external fixator (Hoffman 3 External Fixation System, Stryker, Kalamazoo, MI, USA) was positioned to stabilize the elbow joint, particularly because the elbow joint was easily redislocated after reduction. The unstable DRUJ was temporarily fixed with 1.5 mm Kirchner wire (Fig. 2). The TTI with unstable DRUJ was scheduled for a subsequent surgery after

No institutional review board approval was required for this case report.

* Corresponding author: Shunsuke Takahara, MD, Department of Orthopaedic Surgery, Hyogo Prefectural Kakogawa Medical Center, 203 Kanno, kanno-cho, Kakogawa, Hyogo 675–8555, Japan.
E-mail address: shunsuketakahara@gmail.com (S. Takahara).

https://doi.org/10.1016/j.jseint.2020.09.017
2666-6383/© 2020 The Author(s). Published by Elsevier Inc. on behalf of American Shoulder and Elbow Surgeons. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

Figure 1 (**a**) Initial radiographs of the elbow revealed posterior dislocation of the elbow with the comminuted radial head fracture. (**b**–**d**) Three-dimensional computed tomography of the forearm revealed: (**b**) Regan-Morrey Type IA, O'Driscoll type I (subtype 1) coronoid tip fracture (⬇). (**c**) Mason-Morrey type III, 3-part radial head fracture (⬇). (**d**) Avulsion fracture of the distal radius (white arrow). (**e**) Computed tomography axial view of the wrist revealed disruption of the DRUJ (white arrow). DRUJ, distal radioulnar joint.

improvement in the condition of the soft tissue. Eleven days after the injury, in accordance with Pugh's strategy for the TTI, plate (LCP Proximal Radius Plates 2.4, SYNTHES, West Chester, PA, USA) and screw (DTJ screw, MEIRA, Aichi, Japan) fixation for the radial head fracture, suture lasso technique for the coronoid tip fracture using nonabsorbable suture material (FiberWire, Arthrex, Naples, FL, USA), and repairs of the medial and lateral collateral ligaments using suture anchors (Corkscrew Anchors, Arthrex, Naples, FL, USA) were performed. To make an anatomical reduction and to prescribe the radial length, the crushed radial head fragments were taken out piece by piece and fixed with the headless screw (on-table reconstruction).[2] Subsequently, screw (ASNIS micro, Stryker) fixation for the distal radius avulsion fracture and restabilization of the unstable DRUJ were performed. At that time, the dorsal perilunate dislocation, which was not apparent at the initial assessment, was revealed, then stabilization of the perilunate by Kirchner wire was also performed (Fig. 3).

Considering bipolar dislocation, external fixation of the elbow was maintained in the neutral position for 3 weeks. The patient then started range of motion exercises with a functional elbow brace. The K-wires used for DRUJ fixation and perilunate stabilization were removed 6 weeks after surgery. Three months after the injury, an artificial radial head replacement (EVOLVE, MicroPort, Shanghai, China) was performed due to breakage of the screw of the radial head plate, displacement of the anterior part of the radial head fracture and incompatibility of the radiocapiteller joint (Fig. 4). Although the function of the elbow improved, instability of DRUJ worsened over time (Fig. 5). One and a half year after the injury, owing to residual painful wrist joint dysfunction, ulnar shortening osteotomy and suture-button reconstruction[17] of the

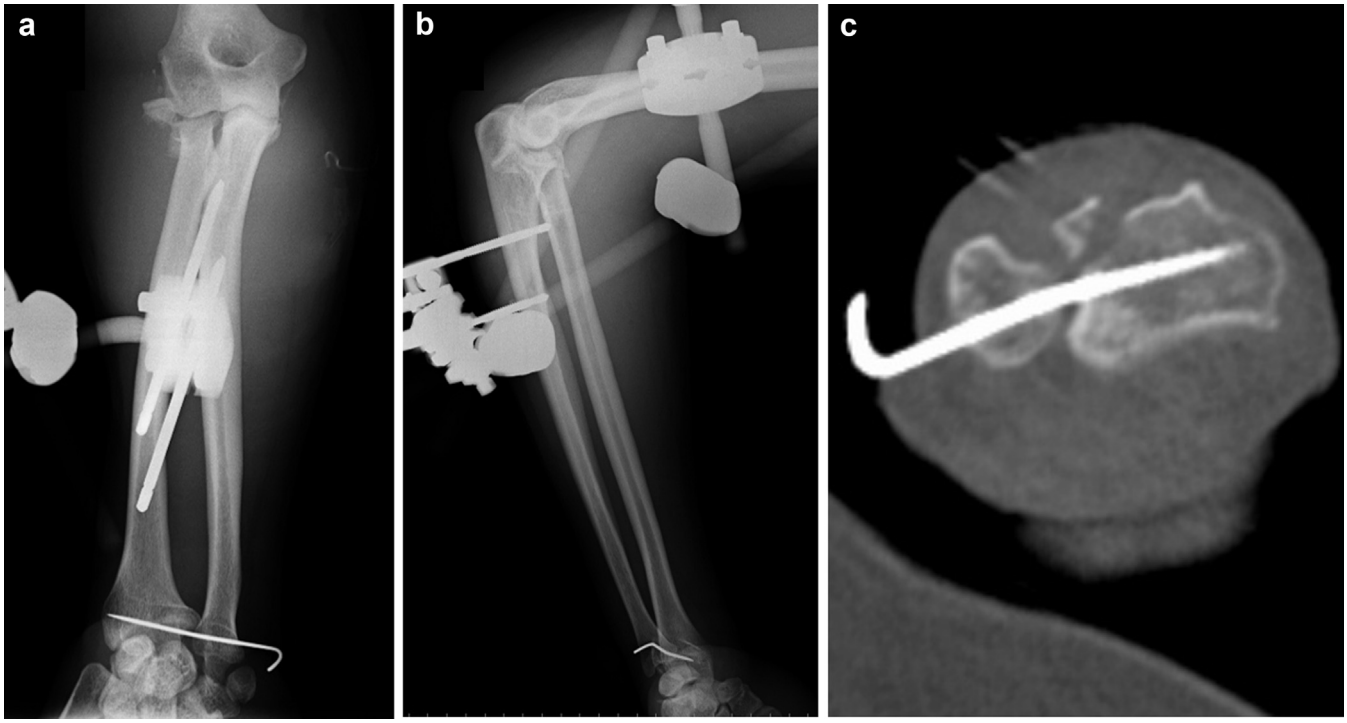

Figure 2 Radiographs immediately after the initial surgery: (**a**) Anterior-posterior view and (**b**) lateral view. Reduction and temporary stabilization of the elbow and pinning for the unstable DRUJ were performed. (**c**) Computed tomography axial view of the wrist after pinning. DRUJ, distal radioulnar joint.

IOM using Tight-Rope (Arthrex, Naples, FL, USA) were performed (Fig. 6). The ulna was shortened about 10 mm and fixed with an LCP-small plate (LCP-small plate, SYNTHES, West Chester, PA, USA). Tight-Rope was inserted from 10 cm proximal to the ulnar styloid process to 17 cm proximal to the radial styloid process; thereafter, the rope was tightened at the maximum supination position.

At the time of final follow-up, three years after the injury, the elbow was stable with occasional mild pain; the extension of the left elbow remained limited at -25°, whereas flexion was at 135°. The wrist was also stable with occasional mild pain with flexion (45°), extension (70°), pronation (70°), and supination (50°). The grip strength was 54% of that of the contralateral side (Fig. 7). The Mayo Performance Elbow Score was 85, which indicated a positive functional outcome. The Mayo Wrist Score was 60, indicating a satisfactory functional outcome.

Discussion

Among the various types of injuries associated with elbow trauma, the occurrence of TTI is rare. Injury accounts for only 8–11% of dislocations of the elbow joint and 3.4-10% of all radial head fractures.[11,21,32] Such complex elbow fracture dislocations occur as a result of high-energy trauma, such as falling from a height onto an outstretched hand. ELI is also an uncommon injury. Grassmann et al reported an incidence of 4% (12 of 295 radial head fractures).[8] Each type of injury is individually rare, and reports on the combination of both are extremely uncommon. However, because both TTI and ELI occur by longitudinal axial force in high-energy trauma, they can be caused simultaneously. Seijas et al reported two cases of 18 TTI (11%) with combined ELI.[30] Therefore, in cases of longitudinal axial force injury of the forearm, the combination of elbow and wrist injury should always be considered.[22] In our case, the longitudinal force was applied to the outstretched wrist causing ELI, and further force was transmitted to the elbow resulting in TTI. Notably, it has been reported that ELI can be easily missed during the initial evaluation.[10] Because attention would be primarily focused on the radial head fracture, injury to the DRUJ and the IOM could be missed. Particularly in cases with TTI, although more attention may be focused on the dislocated elbow, the possibility of wrist injury should always be considered. In addition, perilunate dislocation had also occurred in our case. Bipolar dislocations of the forearm, including elbow dislocation and perilunate dislocation, were initially described by Chen et al in 1994 as an extremely rare pattern of injury of the forearm. In our literature review, only 19 cases involving various injury characteristics have been reported (Table I).[1,3–6,13,18,20,22,33,35,36] Our case is the first case report of floating forearm associated with TTI and ELI.

In complex fracture dislocations of the elbow such as TTI, it is almost impossible to achieve stability through conservative treatment.[23] In the surgical management of TTI, owing to recent studies of relevant anatomy and biomechanics of elbow stability, restoration of injured primary and secondary stabilizers of the elbow has yielded excellent results.[12] Operative treatment of this injury has evolved to include the restoration of the radiocapitellar joint (via fixation or artificial radial head replacement), reattachment of the origin of the lateral collateral ligament to the lateral epicondyle, with fixation of the coronoid fracture, and medial collateral ligament repair, when indicated.[37] However, there are still two controversies. One involves the management of coronoid fractures and the other the management of comminuted radial head fractures. Several approaches have been used to address coronoid fractures in TTI; however, a consensus is yet to be reached as to which method provides optimal results. The surgical management of coronoid fractures should be based on the fragment size and fracture location; small coronoid tip fragments are usually repaired using the suture lasso technique or a suture anchor.[12] It has not yet been ascertained whether to perform fixation or artificial replacement for comminuted radial head fractures. Watters et al reported that

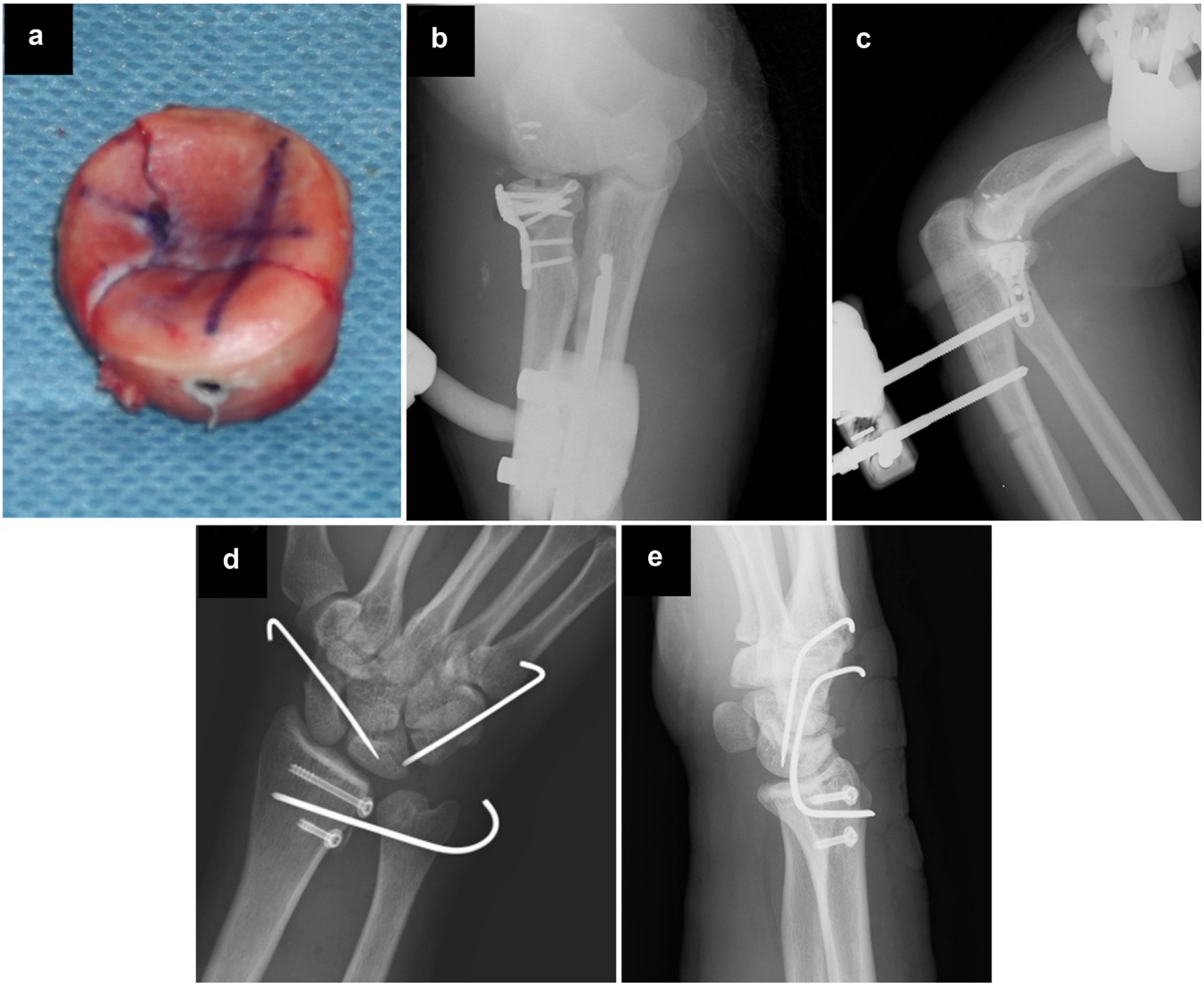

Figure 3 Radiographs after the internal fixation (11 days after injury), (**a**) On-table reconstruction with preliminary fixation, (**b, c**) ORIF for the radial head fracture, suture fixation for the coronoid fracture by lasso technique, medial and lateral collateral ligament repair were performed. (**d, e**) ORIF for the distal radius fracture, pinning for the unstable DRUJ, and pinning for the missed lunate instability were also performed. ORIF, open reduction and internal fixation; DRUJ, distal radioulnar joint.

radial head replacement enabled the achievement of elbow stability with comparable overall outcomes when compared with fixation. However, they also highlighted that longer-term studies would be required to determine whether late complications, such as loosening occurred.[34]

The treatment for ELI is more challenging. Although it is established that the best clinical results are achieved when the radial length is restored and the DRUJ has stabilized acutely, many patients will still experience a residual limitation in forearm rotation and grip strength.[9] However, if treatment is delayed for more than four weeks, outcomes are generally poor.[29] Owing to the PRUJ, IOM, and DRUJ disruption, longitudinal-transverse instability of the forearm could potentially occur in ELI.[31] Proper treatment for ELI should be initiated to achieve forearm anatomical reduction.[10] First, to restore the radial length, open reduction and internal fixation of the radial head or radial head replacement should be performed.[7] Similar to the management in TTI, the management of comminuted radial head fractures remains controversial. Fixation of radial head fractures with more than three parts may result in early failure of fixation, nonunion, and limited forearm rotation during fracture healing.[27] Ricon et al reported satisfactory results when radial head prostheses were used to treat Mason type III radial head fractures with additional elbow fractures and soft tissue injuries.[25] Conversely, potential risk of the radial replacement is that the inserted prosthesis may exceed the radial length, which can lead to stiffness, capitellar wear, subluxation, and pain.[26] Second, stabilization of DRUJ through the temporary K-wire or repair of the triangular fibrocartilage complex, and reconstruction of the IOM should be considered.[7,8] Although the reconstruction of the IOM is controversial, some reports regarding IOM reconstruction demonstrated that the proper tension could be achieved after reconstruction, leading to superior clinical results.[7]

The functional outcomes after TTI and ELI were not satisfactory. In TTI, the functional results in 24 of 69 cases (35%) were reported to be fair to poor.[28] Jungbluth et al reported that the functional outcome of ELI was fair in the elbow, but poor in the wrist.[10]

Figure 4 Radiographs and computed tomography three months after the injury. (**a**) Screw breakage of the proximal radial plate (⬇). (**b**) Incompatibility of the radiocapitellar joint (⬇). (**c**) Displacement of the anterior part of the radial head fracture (white arrow). (**d, e**) An artificial radial head replacement was performed.

Similarly, in accordance with the 17 reported cases of floating forearms (two reports showed no clinical result), 11 cases showed some degree of wrist restriction, although only three cases had slight restriction of the elbow (Table I). Furthermore, complication rates were reported to be higher in the wrist than in the elbow.[5]

Figure 5 After the removal of the K-wires, the instability of DRUJ worsened over time. (**a**) One month after the injury. (**b**) Two months after the injury. (**c**) Eight months after the injury. DRUJ, distal radioulnar joint.

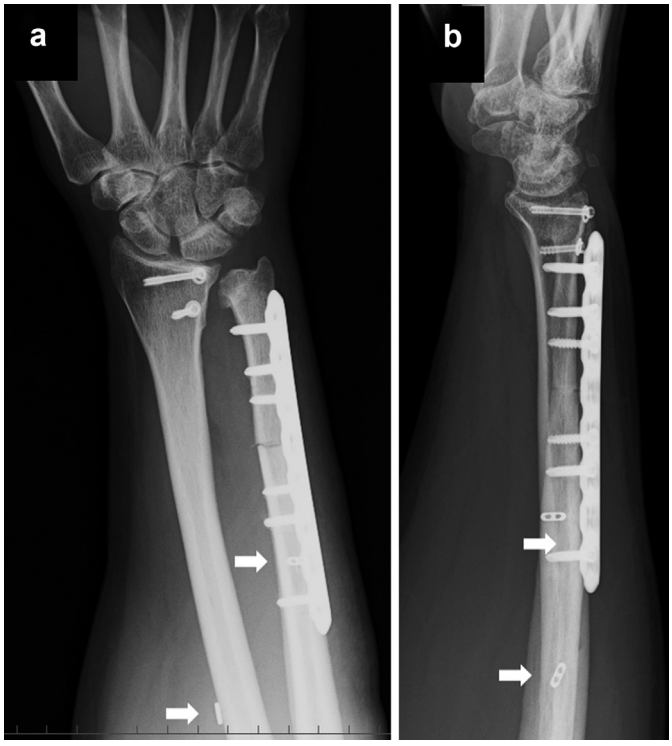

Figure 6 (**a, b**) Radiographs after ulnar shortening osteotomy and reconstruction of the IOM by Tight-Rope (white arrow). IOM, interosseous membrane.

In summary, we encountered an extremely rare case of floating forearm involving TTI, ELI, and perilunate dislocation. In such cases, unstable DRUJ may be overlooked because concurrence with a dislocated elbow is unexpected. Wrist instability and moderate pain persisted despite the stability of the elbow. As a result, although a good functional outcome of the elbow was achieved, mild pain and restriction of the wrist persisted. Hence, we should have keenly focused on achieving a precise anatomical reduction of the forearm to achieve a more favorable wrist functional outcome.

Conclusion

Each type of injury, namely TTI, ELI, and floating forearm is rare. To our knowledge, this is the first case of floating forearm associated with both TTI and ELI. In the case of high-energy longitudinal forearm trauma, surgeons must be careful to consider wrist injuries in patients with elbow dislocations. We suggest that it is necessary to evaluate the alignment of the entire forearm, including the DRUJ and carpal bones, to achieve positive functional results of the elbow and wrist. We must improve the focus on achieving anatomical reduction and fixation of the forearm, especially of the unstable DRUJ.

Disclaimer

The authors, their immediate families, and any research foundations with which they are affiliated have not received any financial payments or other benefits from any commercial entity related to the subject of this article.

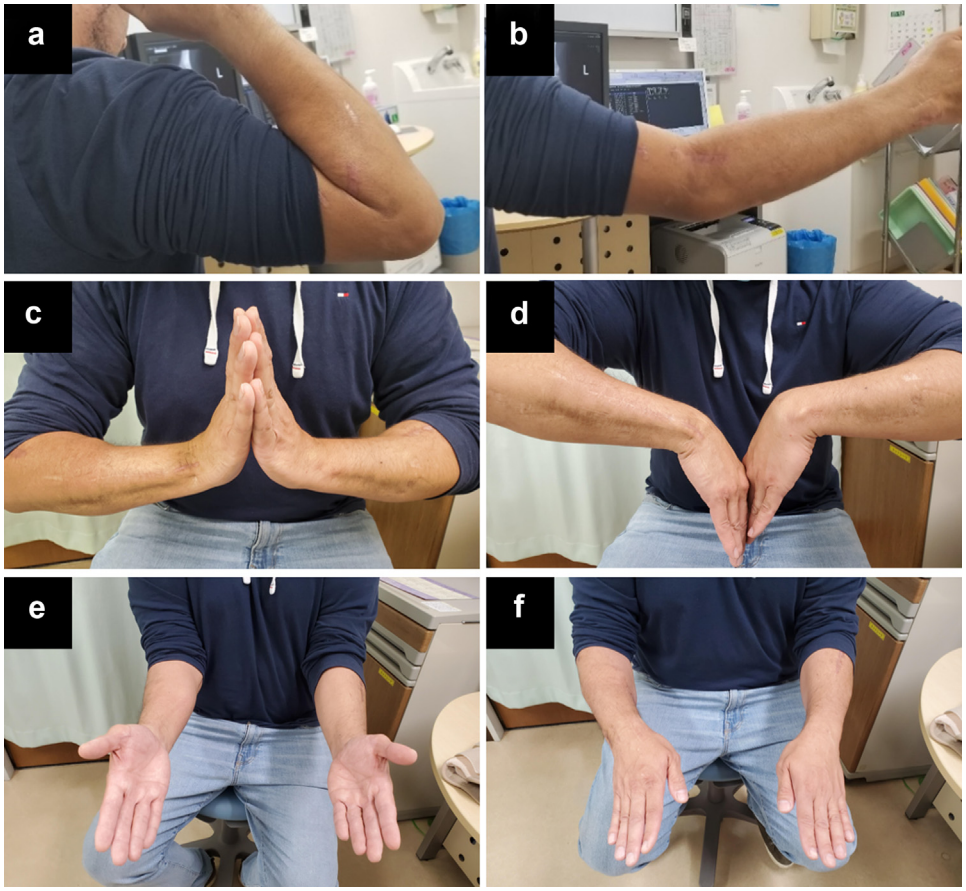

Figure 7 At the final follow-up (three years after the injury), slight restriction of the elbow (**a, b**) and mild restriction with occasional mild pain of the wrist (**c-f**) persisted.

Table I
Summary of the cases of floating forearm reported in the literature.

Authors	Age/ Sex	Mechanism	Injury		Results	
			Wrist	Elbow	Wrist	Elbow
Chen[2], 1995	27/M	MVA	TS dorsal perilunate dislocation	Posterior dislocation	Mild pain F:60°/E: 45°, RT:15°/UT: 30°	Normal mobility
Chen, 1995	32/M	MVA	TS dorsal perilunate dislocation	Posterior dislocation	Mild pain F:5°/E: 30°, RT:15°/UT: 30°	Normal mobility
Chen, 1995	35/M	MVA	Palmar lunate dislocation	Posterior dislocation	Painless F:30°/E: 60°, RT:10°/UT: 20°	Normal mobility
Masmejean and Cognet[12], 2001	29/M	Fall	TRSC dorsal perilunate dislocation	Posterior dislocation	Mild pain F: 50°/E: 30°	Normal mobility
Waaziz[32], 2006	28/M	Fall	TS dorsal perilunate dislocation	Posterolateral dislocation	Mild pain F: 50°/E: 30°, PS: 75°	Normal mobility
Daoudi[3], 2009	46/M	Fall	Pure dorsal perilunate dislocation	Posterolateral dislocation	Mild pain F: 50°/E: 30°, Full PS	Normal mobility
Zejjari[35], 2011 (right side)	22/M	Fall	Palmar lunate TS dislocation	Posterolateral dislocation	Minimal pain F: 45°/E: 40°, PS: 75°	Normal mobility
Zejjari, 2011 (left side)	22/M	Fall	TRSC dorsal perilunate dislocation	Posterolateral dislocation Radial neck fracture	Minimal pain F: 50°/E: 30°, PS: 80°	Slight limitation
Yemlahi[34], 2011	22/M	Fall	TS dorsal perilunate dislocation	Posterolateral dislocation	F: 40°/E: 15°, PS: 70°	Normal mobility
Yemlahi, 2011	30/M	MVA	TS dorsal perilunate dislocation	Posterolateral dislocation	F: 50°/E: 20°, PS: 77°	Normal mobility
O. El Assil[4], 2016	48/M	MVA	Perilunate dislocation DRUJ dislocation	Posterior dislocation	Mild pain F: 55°/E: 35°, PS: 85°	Normal mobility
Hüseyin AŞKAR[1], 2016	28/M	Fall	Palmar lunate dislocation	Posterolateral dislocation	No pain F: 40°/E: 50°	Normal mobility
Prasad[21], 2007	30/M	Fall	Perilinate dislocation	Posterior dislocation	No data	No data
Najeb[17], 2007	23/M	Fall	TS dorsal perilunate dislocation	Divergent dislocation	Painless F: 50°/E: 40°, RT: 15°/UT: 20°	Normal mobility
Chbani[5], 2009	25/M	MVA	TS dorsal perilunate dislocation	Posterolateral dislocation Coronoid fracture	Mild pain F: 45°/E: 40° RT: 20°/UT: 30°, PS: 80°	Normal mobility
Papanna[19], 2011	40/M	Fall	Perilinate dislocation	Posterior dislocation	No data	No data
Reddy[5], 2016	38/M	MVA	Perilunate dislocation	TTI	F: 70°/E: 60°	F:120°/E: 10°
Reddy, 2016	38/M	MVA	TS dorsal perilunate dislocation	TTI	F: 40°/E: 60°	F:120°/E: 10°
Elloumi A[25], 2018	47/M	Fall	Perilunate dislocation	TTI	Mild pain F: 70°/E: 70°	F:110°/E: 10°
Our case	38/M	Fall	Perilunate dislocation	TTI	Moderate pain F: 45°/E: 70°, P: 70°/S: 50°	F:135°/E: -25°

MVA, motor vehicle accident; *M*, male; *TS*, trans-scaphoid; *TRSC*, trans-radio-scapho-capitate; *DRUJ*, distal radioulnar joint; *TTI*, terrible triad injury; *F*, flexion; *E*, extension; *RT*, radial tilt; *UT*, ulnar tilt; *PS*, pronation–supination; *P*, pronation; *S*, supination.

References

1. Askar H, Erturk C, Altay MA, Bilge A. Bipolar dislocation of the forearm (floating forearm). Acta Orthop Traumatol Turc 2014;48:102-5. https://doi.org/10.3944/AOTT.2014.2824.
2. Businger A, Ruedi TP, Sommer C. On-table reconstruction of comminuted fractures of the radial head. Injury 2010;41:583-8. https://doi.org/10.1016/j.injury.2009.10.026.
3. Chen WS. Concurrent perilunate dislocation in patients with elbow dislocation: case reports. J Trauma 1994;37:504-7.
4. Daoudi A, Elibrahimi A, Loudiyi WD, Elmrini A, Chakour K, Boutayeb F. Bipolar forearm dislocation or floating forearm (a case report). Chir Main 2009;28:53-6. https://doi.org/10.1016/j.main.2008.11.006.
5. El Assil O, Tatar M, Uzel AP. Floating forearm with pure dislocations. Hand Surg Rehabil 2016;35:225-8. https://doi.org/10.1016/j.hansur.2016.01.004.
6. Elloumi A, Mihoubi M, Abdelkafi M, Kedous MA, Mahjoub S. Floating forearm with terrible triad injury of the elbow: a case report. J Orthop Case Rep 2018;8:38-41. https://doi.org/10.13107/jocr.2250-0685.1248.
7. Fontana M, Cavallo M, Bettelli G, Rotini R. Diagnosis and treatment of acute Essex-Lopresti injury: focus on terminology and review of literature. BMC Musculoskelet Disord 2018;19:312. https://doi.org/10.1186/s12891-018-2232-2.
8. Grassmann JP, Hakimi M, Gehrmann SV, Betsch M, Kropil P, Wild M, et al. The treatment of the acute Essex-Lopresti injury. Bone Joint J 2014;96-B:1385-91. https://doi.org/10.1302/0301-620X.96B10.33334.
9. Hutchinson S, Faber KJ, Gan BS. The Essex-Lopresti injury: More than just a pain in the wrist. Can J Plast Surg 2006;14:215-8. https://doi.org/10.1177/229255030601400410.
10. Jungbluth P, Frangen TM, Arens S, Muhr G, Kalicke T. The undiagnosed Essex-Lopresti injury. J Bone Joint Surg Br 2006;88:1629-33. https://doi.org/10.1302/0301-620X.88B12.17780.
11. Kaas L, van Riet RP, Vroemen JP, Eygendaal D. The incidence of associated fractures of the upper limb in fractures of the radial head. Strategies Trauma Limb Reconstr 2008;3:71-4. https://doi.org/10.1007/s11751-008-0038-8.
12. Liu G, Ma W, Li M, Feng J, Xu R, Pan Z. Operative treatment of terrible triad of the elbow with a modified Pugh standard protocol: Retrospective analysis of a prospective cohort. Medicine (Baltimore) 2018;97:e0523. https://doi.org/10.1097/MD.0000000000010523.
13. Masmejean E, Cognet J. Bipolar dislocation of the forearm: elbow and perilunate dislocation. Rev Chir Orthop Reparatrice Appar Mot 2001;87:499-502.
14. Mason ML. Some observations on fractures of the hand of the head of the radius with a review of one hundred cases. Br J Surg 1954;42:123-32.
15. Masouros PT, Apergis EP, Babis GC, Pernientakis SS, Igoumenou VG, Mavrogenis AF, et al. Essex-Lopresti injuries: an update. EFORT Open Rev 2019;4:143-50. https://doi.org/10.1302/2058-5241.4.180072.
16. Mathew PK, Athwal GS, King GJW. Terrible triad injury of the elbow: current concepts. J Am Acad Orthop Sur 2009;17:137-51. https://doi.org/10.5435/00124635-200903000-00003.
17. Meals CG, Forthman CL, Segalman KA. Suture-button reconstruction of the interosseous membrane. J Wrist Surg 2016;5:179-83. https://doi.org/10.1055/s-0036-1584547.
18. Najeb Y, Essadki B, Latifi M, Fikry T. Bipolar dislocation of the forearm. Chir Main 2007;26:62-4. https://doi.org/10.1016/j.main.2006.09.003.
19. O'Driscoll SW, Jupiter JB, Cohen MS, Ring D, McKee MD. Difficult elbow fractures: pearls and pitfalls. Instr Course Lect 2003;52:113-34.
20. Papanna MC, Al-Hadithy N, Sarkar JS. Concurrent palmar lunate dislocation and posterior elbow dislocation: a case report. J Orthop Surg (Hong Kong) 2011;19:367-9. https://doi.org/10.1177/230949901101900322.
21. Pierrart J, Bégué T, Mansat P. Terrible triad of the elbow: treatment protocol and outcome in a series of eighteen cases. Injury 2015;46:S8-12. https://doi.org/10.1016/s0020-1383(15)70004-5.

22. Prasad K, Dayanandam B, Gakhar H, Attarwala U, Karras K. Concomitant elbow and perilunate dislocation: floating forearm. Internet J Orthop Surg 2007;8.
23. Pugh DM, Wild LM, Schemitsch EH, King GJ, McKee MD. Standard surgical protocol to treat elbow dislocations with radial head and coronoid fractures. J Bone Joint Surg Am 2004;86:1122-30. https://doi.org/10.2106/00004623-200406000-00002.
24. Regan W, Morrey B. Fractures of the coronoid process of the ulna. J Bone Joint Surg Am 1989;71:1348-54.
25. Ricon FJ, Sanchez P, Lajara F, Galan A, Lozano JA, Guerado E. Result of a pyrocarbon prosthesis after comminuted and unreconstructable radial head fractures. J Shoulder Elbow Surg 2012;21:82-91. https://doi.org/10.1016/j.jse.2011.01.032.
26. Ring D. Displaced, unstable fractures of the radial head: fixation vs. replacement–what is the evidence? Injury 2008;39:1329-37. https://doi.org/10.1016/j.injury.2008.04.011.
27. Ring D, Quintero J, Jupiter JB. Open reduction and internal fixation of fractures of the radial head. J Bone Joint Surg Am 2002;84:1811-5. https://doi.org/10.2106/00004623-200210000-00011.
28. Rodriguez-Martin J, Pretell-Mazzini J, Andres-Esteban EM, Larrainzar-Garijo R. Outcomes after terrible triads of the elbow treated with the current surgical protocols. A review. Int Orthop 2011;35:851-60. https://doi.org/10.1007/s00264-010-1024-6.
29. Schnetzke M, Porschke F, Hoppe K, Studier-Fischer S, Gruetzner PA, Guehring T. Outcome of early and late diagnosed Essex-Lopresti injury. J Bone Joint Surg Am 2017;99:1043-50. https://doi.org/10.2106/JBJS.16.01203.
30. Seijas R, Ares-Rodriguez O, Orellana A, Albareda D, Collado D, Llusa M. Terrible triad of the elbow. J Orthop Surg (Hong Kong) 2009;17:335-9. https://doi.org/10.1177/230949900901700319.
31. Soubeyrand M, Lafont C, De Georges R, Dumontier C. Traumatic pathology of antibrachial interosseous membrane of forearm. Chir Main 2007;26:255-77. https://doi.org/10.1016/j.main.2007.09.004.
32. van Riet RP, Morrey BF. Documentation of associated injuries occurring with radial head fracture. Clin Orthop Relat Res 2008;466:130-4. https://doi.org/10.1007/s11999-007-0064-8.
33. Waaziz A, Moujtahid M, Bendriss A. The floating forearm: elbow and perilunate dislocation. Chir Main 2006;25:54-7. https://doi.org/10.1016/j.main.2005.11.001.
34. Watters TS, Garrigues GE, Ring D, Ruch DS. Fixation versus replacement of radial head in terrible triad: is there a difference in elbow stability and prognosis? Clin Orthop Relat Res 2014;472:2128-35. https://doi.org/10.1007/s11999-013-3331-x.
35. Yemlahi C, Aitsoultana A, Elmchiouit R, Elhaoury H, Chafik R, Madhar M, et al. Avant bras flottant. À propos de deux cas. Chirurgie de la Main 2011;30:475-6. https://doi.org/10.1016/j.main.2011.10.154.
36. Zejjari H, Louaste J, Chkoura M, Rachid K. Bilateral floating forearm: a case report. Chir Main 2011;30:155-8. https://doi.org/10.1016/j.main.2011.02.002.
37. Zhang D, Tarabochia M, Janssen S, Ring D, Chen N. Risk of subluxation or dislocation after operative treatment of terrible triad injuries. J Orthop Trauma 2016;30:660-3. https://doi.org/10.1097/BOT.0000000000000674.
38. Zhou C, Lin J, Xu J, Lin R, Chen K, Sun S, et al. Does timing of surgery affect treatment of the terrible triad of the elbow? Med Sci Monit 2018;24:4745-52. https://doi.org/10.12659/MSM.907146.