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Case report

A rare case of bilateral complex wrist injury in a professional motocross rider

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Summary. We describe the treatment of a 29 year-old professional motocross rider, who sustained a perilunate dislocation in his right wrist and a distal radius fracture and dorsal dislocation of his left wrist during a race. Both wrists were treated acutely during a single operating session. Surgery consisted in open reduction, k-wire fixation and mini-anchor repair of the scapho-lunate and luno-triquetrium ligaments on the right wrist, while closed reduction and percutaneous k-wire fixation was used in the left wrist. Follow-up at 6 months has shown satisfying radiological and functional outcomes in both wrists. The rider ultimately returned to motocross 5 months following surgery. (www.actabiomedica.it)

Key words: perilunate dislocation, distal radius fracture-dislocation, complex wrist injury, motocross

Introduction

Perilunate dislocation and distal radius fracture-dislocation are high-energy trauma, which occur during motor vehicle accidents (MVA) or after landing on the palm or dorsum of the hand from a fall higher than 1 meter from the ground (1).

Also, these complex injuries can occur during sport activities that impose strong solicitations of the distal upper limb such as in speed racing and off-road motocross (2-5).

Rarely these injuries occur bilaterally and simultaneously in the same patient. Only a few similar cases are reported in the literature, and are related either to repetitive stress traumas (7-9) or high-energy traumas (6).

In any event, and more likely in high-level athletes, a prompt and accurate management is essential to ensure a full and rapid recovery (10). It is important to stress that despite treating a young healthy population of patient with higher healing capacities, these complex injuries often result in long-term disability and career-ending injuries.

We describe the case of a professional motocross rider, which sustained a perilunate dislocation in his right wrist and a distal radius fracture-dislocation in his left wrist. In this specific case, the medical management allowed the rider to return to his sport in less than 6 months from injury.

Case report

E.P., a 29 year-old male, fell to the ground with his wrist flexed during a motocross race and sustained a volar perilunate dislocation on his right side (Fig. 1) and a fracture of the distal radius and dorsal dislocation of the carpus on his left side (Fig. 2). The patient was admitted at our Emergency Room (ER) with complaints of bilateral wrist pain in absence of movement. Conventional radiographs were done in antero-posterior (AP) and latero-lateral (LL) views, which presented the above-mentioned lesions in the right wrist and an interruption of the Gilula arches (11) in the left wrist. An attempt to manually reduce the dis-

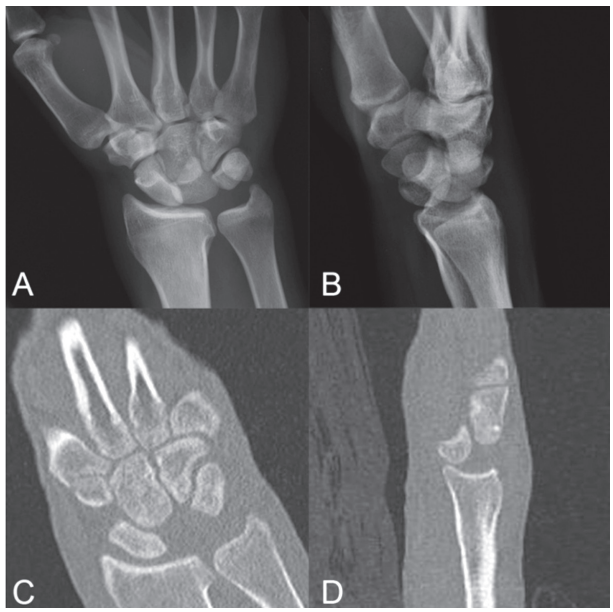

Figure 1. Lunate dislocation of the right wrist; preoperative x-ray (A and B) and CT (C and D)

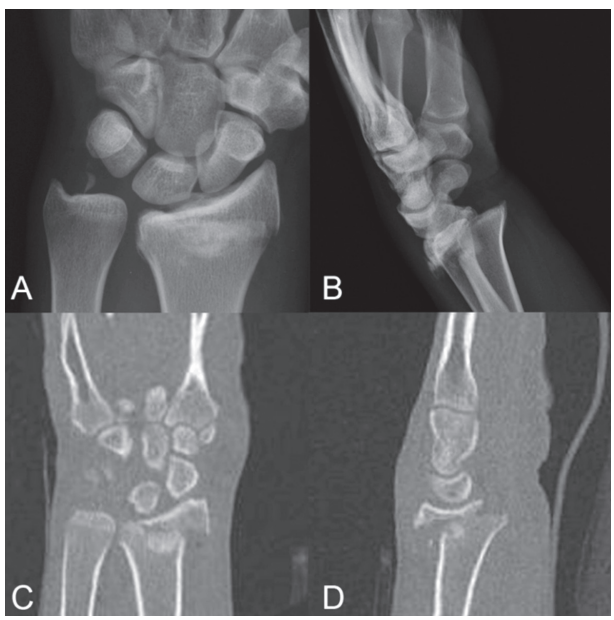

Figure 2. Fracture of the distal radius of the left wrist; preoperative x-ray (A and B) and CT (C and D)

locations in the ER was made but was unsuccessful in either wrist. As per guidelines, a CT scan was then ordered to plan the surgical treatment (12). Surgery was done under general anaesthesia because both wrists were operated in the same theatre session. Antibiotic prophylaxis was administered with cefazolin sodium.

The first surgery was done on the right wrist and lasted roughly 40 minutes. Access to the carpus was done dorsally between the 3rd and 4th extensor compartments with the use of a tourniquet. Once the dislocated lunate was located, it was reduced and stabilized with 3 Kirschner wires (k-wires) under fluoroscopy. The first k-wire pinned the radius, lunate and capitate bones together, the second pinned the triquetrium, lunate and scaphoid bones, while the third pinned the triquetrium and lunate bones (Fig. 3 A-B). The scapho-lunate and luno-triquetrium ligaments were then reconstructed with a single micro-anchor (De Puy Synthes, Raynham, MA, USA) and reinforced successively by a dorsal capsulodesis.

Surgery on the left wrist lasted roughly 30 minutes and consisted in closed reduction through the Kapandji percutaneous technique (13) using fluoroscopy and without tourniquet. Stabilization was achieved with 3 k-wires (Fig. 3 C-D).

Post-operative cast slabs were applied to the wrists and radiographs were taken. The slabs were replaced with wrist cock-up orthoses 2 weeks later, and the patient pursued with finger, thumb, elbow and shoulder active exercises. K-wires were removed at 4 weeks post-operatively in the left wrist while those in the right wrist were removed 2 weeks later.

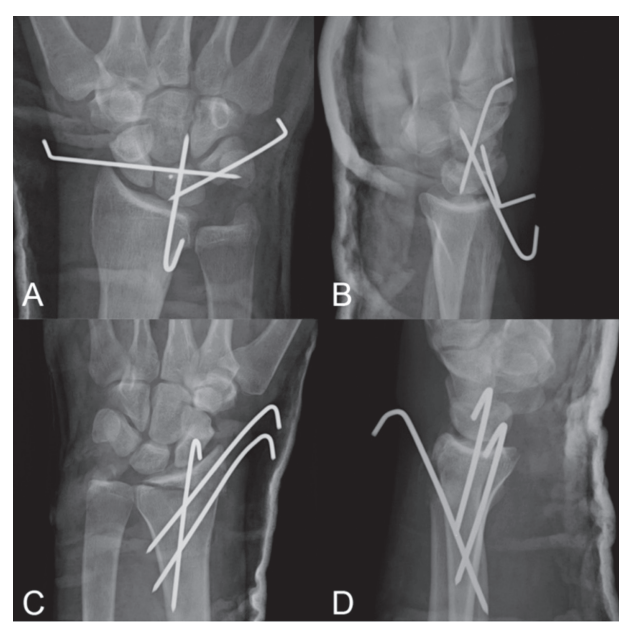

Figure 3. Postoperative x-ray of the right (A and B) and left wrist (C and D)

Rehabilitation

6 weeks post-operative (Baseline)

At this stage, functional assessments and rehabilitation was introduced in the treatment process. Bilateral wrist active ranges-of-motion (AROM) were measured with a plastic goniometer (North Coast Medical, California, USA) as per ASHT recommendations (14) the day after the last k-wires were removed. Wrist movement throughout the 3 planes of motion (flexion, extension, lateral deviation, hand rotation) in a pain-free range began in a warm pool. Note that the patient sustained a previous biceps distal tendon repair in the left arm with residual limitation in rotation. The early stages of rehabilitation also included proprioceptive exercises of the wrist, which simulated bilateral motocross handle movements. Orthoses were donned at all times except for controlled active motion exercises at home and in the clinic.

8 weeks post-operative (F/U 1)

Control radiographs were done at 2 months from surgery to exclude any abnormal static and dynamic carpal kinematics. Grip strength assessment was then done with a Baseline® hydraulic dynamometer (Fabrication Enterprises Inc., NY, USA) according to the ASHT recommendations (14) and wrist muscle strengthening exercises were introduced using a dart-throwers approach (15). The Patient Rated Wrist and Hand Evaluation (PRWHE) was also administered at this time. Orthotics were dismissed and used only in heavy activity, such as gym (lower extremities training).

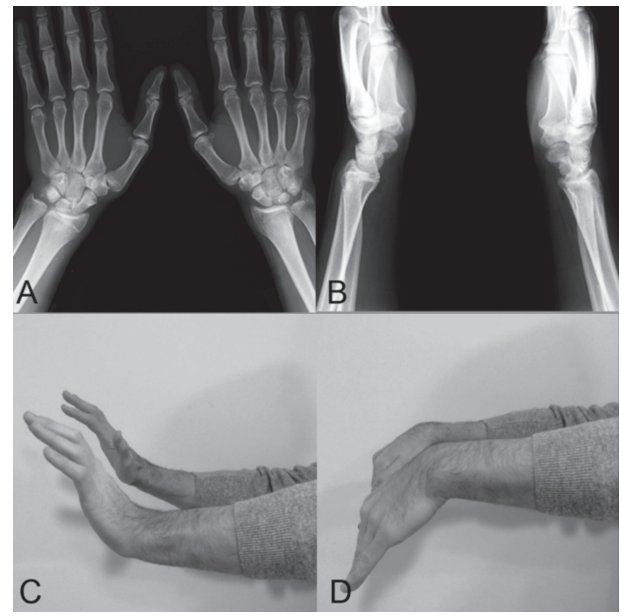

Figure 4. Radiological (A and B) and clinical evaluation 6 months after surgery (C and D)

At 10 weeks from surgery, passive wrist stretching and axial loading were introduced through progressive and pain-free gripping exercises. No mobilization orthotic was needed to improve overall ROM in this patient. The cock-up orthotics were dismissed fully at 3 months from surgery.

The patient began riding his motocross on flat terrain at 4 months, and gradually progressed to more rugged terrain. Return-to-sport occurred at 5 months from surgery and there were no functional impairment (except pronation in the L wrist) or radiographic abnormalities (Fig. 4) at his 6 months follow-up visit (F/U 2).

Table 1 summarizes all recorded assessment values.

Table 1. Functional assessment of both wrists throughout the rehabilitation process and at final follow-up

		Flexion/Extension	Ulnar/Radial Deviation	Pronation/Supination	Grip Strength	PRWHE Score
Baseline	R	40°/-30°	10°/10°	45°/35°	NA	NA
	L	25°/40°	25°/15°	10°/40°	NA	NA
F/U 1	R	30°/35° (30°/40°)	25°/15° (30°/20°)	65°/50° (65°/50°)	19 kg	51
	L	35°/50° (45°/55°)	30°/20° (35°/25°)	30°/40° (30°/45°)	53 kg	31
F/U 2	R	40°/50° (45°/60°)	25°/15° (30°/20°)	80°/70° (65°/50°)	33 kg	19
	L	50°/65° (60°/75°)	40°/25° (45°/30°)	40°/50° (50°/55°)	50 kg	10

Legend: F/U 1 = 2 month follow-up; F/U 2 = 6 month follow-up; R = Right; L = Left; PRWHE = Patient Rated Wrist and Hand Evaluation; (**/**) = Passive Range Of Motion

Discussion

Fracture-dislocation of the wrist and carpal dissociation are complex injuries that can challenge even the most experienced surgeons. The high-energy impact that characterizes these injuries nearly always causes damage to multiple soft-tissue structures and results in multiple fragmented fractures, which negatively influence outcomes. The lesions sustained by our motocross rider were indeed severely disabling and required careful anatomical reduction and stabilization (16). The most appropriate treatment to maximise prognosis in such a case is surgical (17).

The keystone for a successful outcome lies in early diagnosis and reduction and stabilization of the lunate (18). Dorsal capsulodesis in the right wrist was inevitable to maximise stabilization in a patient that happens to be a professional motocross rider, and this could explain the limited flexion of the right wrist in our case. This may affect the rider's ability to quickly accelerate after a jump but no modifications were needed on the rider's motorcycle to pursue his sport. In the left wrist, it was not possible to treat the radius fracture with a plate in order to allow early motion because the fragment was too small. The only alternative to wire fixation was an external fixator but this solution would have nonetheless hindered early motion. Despite having to immobilize both wrists for 6 weeks, outcomes at 6 months are satisfying from a ROM, grip strength, functional point of view.

Range of motion

Active ROM at baseline was the poorest of all assessment times. At final follow-up, both wrists demonstrated functional ROM values according to Ryu et al. (19) and Morrey et al. (20). Final forearm rotation on the left side was poor but similar to pre-injury according to the patient's report. Indeed, biceps distal tendon tenorrhaphy may result in limited forearm rotation (21). Passive ROM was slightly better than active indicating the presence of joint stiffness. This complication is common after perilunate- or fracture-dislocations of the wrist (22).

Grip strength

Grip strength also improved with time. The left hand displayed greater force throughout all assessments than the right but both hands presented functional outcomes at final follow-up. The patient's handgrip was exceptionally high in the right hand just 1 month after removing the k-wires and this may be occupation-biased. Normal grip strength in motocross riders is known to be higher than average (22). Although the right arm is the dominant side in this patient, the injury was slightly more complex than in the left and a slightly longer period of immobilization was required in the former. This could explain lower grip values in the right hand in comparison to the non-dominant left hand. A longer follow-up period is needed to ascertain whether this discrepancy will remain throughout time.

As per ROM, grip strength does not normally return to pre-injury levels (22-25) following these complex injuries. For both outcomes, it is impossible to determine the amount of residual deficit since both sides were involved. Similarly, norms cannot be applied with our patient because of the peculiar sport he practices and because of a history of biceps injury in his left arm.

PRWHE

Pain and function were not measured at baseline because the patient had just removed the k-wires and casts, and did not have sufficient time to use his hands. The first data was collected 2 weeks later and there was significant pain and disability. However, both subjective measures significantly improved (23-25) throughout the rehabilitation process with values close to normal at 6 months from injury.

Conclusions

Functional and radiographic outcomes are satisfactory at 6 months. Most of all, the patient was able to return to his professional sport in less than 6 months mainly due to sufficient ROM and grip strength in both wrists, which are essential to manage the acceleration handle, clutch and front brake levers while ap-

plying high loads on the wrists and forearms during jumps and turns.

Time will tell if the right lunate bone will suffer from the stresses caused by the patient's sport practice and if secondary arthritis will develop in either wrist. We nonetheless consider these short-term results to be very encouraging but they need to be re-assessed in the long-term.

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