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ORIGINAL ARTICLE

The treatment of perilunate ligament injuries in multiply injured patients

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Abstract

Purpose   Perilunate injuries are rare, severe injuries of the carpus. They can present as isolated injuries or in the polytraumatised patient. This is the first documented series of these injuries treated in a Major Trauma Centre. The aims were to assess the management, treatment algorithm and outcomes, of perilunate injuries in our department, review whether concomitant polytrauma affected those outcomes and identify if delay to definitive treatment had a significant effect on overall outcome.

Methods   Perilunate injuries admitted to the Royal London Hospital between Oct 2011 and March 2016 were identified. All definitive surgical procedures were performed by the senior author; hand therapists supervised patient rehabilitation. Outcomes were assessed by Mayo Wrist and Quick-DASH scores.

Results   We identified 23 perilunate injuries (22 patients). There was an associated nerve injury in 10 cases with other system injuries present in 12 cases. At final review, the mean carpal height ratio was 0.56, Mayo Wrist score was 81 and QuickDASH score was 16.4. There were no differences when comparing the outcomes of patients who had early against those with more delayed definite treatment or when comparing patients with isolated wrist injuries against polytrauma patients.

Conclusion   Satisfactory outcomes can be achieved, even in the presence of other injuries, if initial treatment is prompt and follows a clear management protocol. Prompt early reduction and neurological decompression followed by subsequent accurate definitive fixation leads to good outcomes. A delay of definitive fixation of up to 18 days does not appear to have a deleterious effect on outcome.

Keywords   Perilunate · Injury · Polytrauma · Treatment

Introduction

Perilunate dislocations (PLD) and fracture-dislocations (PLFD) are rare [1]. They have been previously well described with regards to their presentation, classification of the fracture morphology [2–7] and appropriate management [2, 8–12]. Outcomes are improved by early diagnosis and treatment [3, 9, 13, 14]. The mechanism of injury is usually one of high energy and it has been previously noted that up to 26% of these patients present with polytrauma [3]. To date, case series have been published from specialist hand units with no detailed description of associated limb or torso injuries. This is the first documented review of a series of these injuries in a Major Trauma Centre in the UK. Our first aim was to evaluate our treatment algorithm for these injuries using patient-related outcome measures, well-established radiological parameters and clinical examination. Considering that a large percentage of these patients will present with severe concomitant or life threatening injuries (in our series 45%) and the importance given to perilunate injuries management may lose priority, we aimed to determine whether concomitant injuries would impair the final wrist functional outcome. We also hypothesised that delay to definite treatment of these injuries would not affect the outcome. All wrists were classified according to Herzberg [3] and their management was assessed. The outcomes were further compared to those achieved in previous studies and

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were analysed with regards to presence of other injuries and time from injury to definite treatment.

Methods

All perilunate injuries admitted to the Royal London Hospital (RLH) between October 2011 and March 2016 were retrospectively identified from the orthopaedic trauma database and cross referenced with the contemporaneous logbook of the senior author who performed or supervised all interventions. The inclusion criteria were all patients who had sustained a perilunate injury. The exclusion criteria were any patients with a follow-up of less than 6 months, and patients who presented with an already established post traumatic wrist arthrosis. Data were collected from medical records and radiographic imaging. The cases were analysed for patients age, time from injury to reduction and definite treatment, presence of abnormal neurology on admission, concomitant injuries and relevant procedures, Injury Severity Score (ISS), surgical approach and findings during definite treatment, complications, rehabilitation follow-up, and outcomes at final clinical review.

All patients presented through the Emergency Department (ED). The RLH is a Major Trauma Centre (MTC), and therefore, management of any polytrauma patients followed the Advanced Trauma Life Support protocol, led by the Emergency Department with specialist input from the relevant clinicians and trauma surgeons. With respect to the perilunate injuries, management followed the well-established protocol of early reduction performed by the on-call orthopaedic team either in the ED or in the Operating Theatres with concomitant decompression of neurological structures, if necessary.

Twenty-two perilunate injuries met the inclusion criteria in 22 patients (all male), with a median age of 34 (age range 18–57). The dominant wrist was injured in nine patients (41%); one patient had a bilateral injury. The mechanism of injury and associated injuries are detailed in Tables 1, 2 and 3. There were three open injuries (13%).

During the initial assessment, all patients were evaluated for possible nerve injury and any neurological deficit was

Table 1 Mechanism of injury

MOI	Number (%)
Fall from own height	3 (13.5)
Fall from height	9 (41)
Road traffic accident	7 (32)
Assault	1 (4.5)
Fall from bike	2 (9)

Table 2 Associated injuries

Associated injuries	Number (%)
None	10 (45.5)
Minor associated injuries	2 (9)
Polytrauma	10 (45.5)

recorded, specifying sensory (altered sensation) or motor (reduction/absence of power) involvement.

Emergent reduction was undertaken with the patient under intravenous sedation alongside appropriate cardiovascular monitoring and supplemental oxygen delivery. The arm was first suspended in longitudinal traction, with the wrist extended. Whilst maintaining traction, the surgeon's thumb was placed palmarly against the lunate and used to apply a dorsally directed force. Simultaneously, the wrist was progressively brought into flexion maintaining the dorsally directed force against the lunate to aid reduction of the base of the capitate onto the lunate. Excessive force over the palmar aspect of the lunate was avoided and the reduction technique focuses on reduction of the capitate onto the lunate, with avoidance of repeated attempts at closed reduction to prevent further compromise to median nerve function. If closed reduction was not possible, open reduction was performed as described in the "first stage" of surgery. Depending on the availability of a specialist hand surgeon, or the presence of other more urgent intervention required in the setting of a polytrauma patient, the palmar wound may be closed and the wrist splinted in a palmar plaster slab not including the thumb, and elevated once reduction and neural decompression is achieved. In the presence of multiple injuries, initial reduction is achieved and definitive management is delayed.

All the definitive surgical procedures were performed by the senior author (LDM) or under his supervision. The timing of the operation was dependant on whether there was need for other life or limb-saving surgery. A combined palmar and dorsal approach was utilized for definitive treatment of all cases. If a specialist hand and wrist surgeon was unavailable and closed reduction not possible, the first stage of this technique was used to gain safe reduction and decompression of neurological structures. Pre-operative and Post-operative radiographic examples are demonstrated in Fig. 1.

Table 3 Neurological injuries

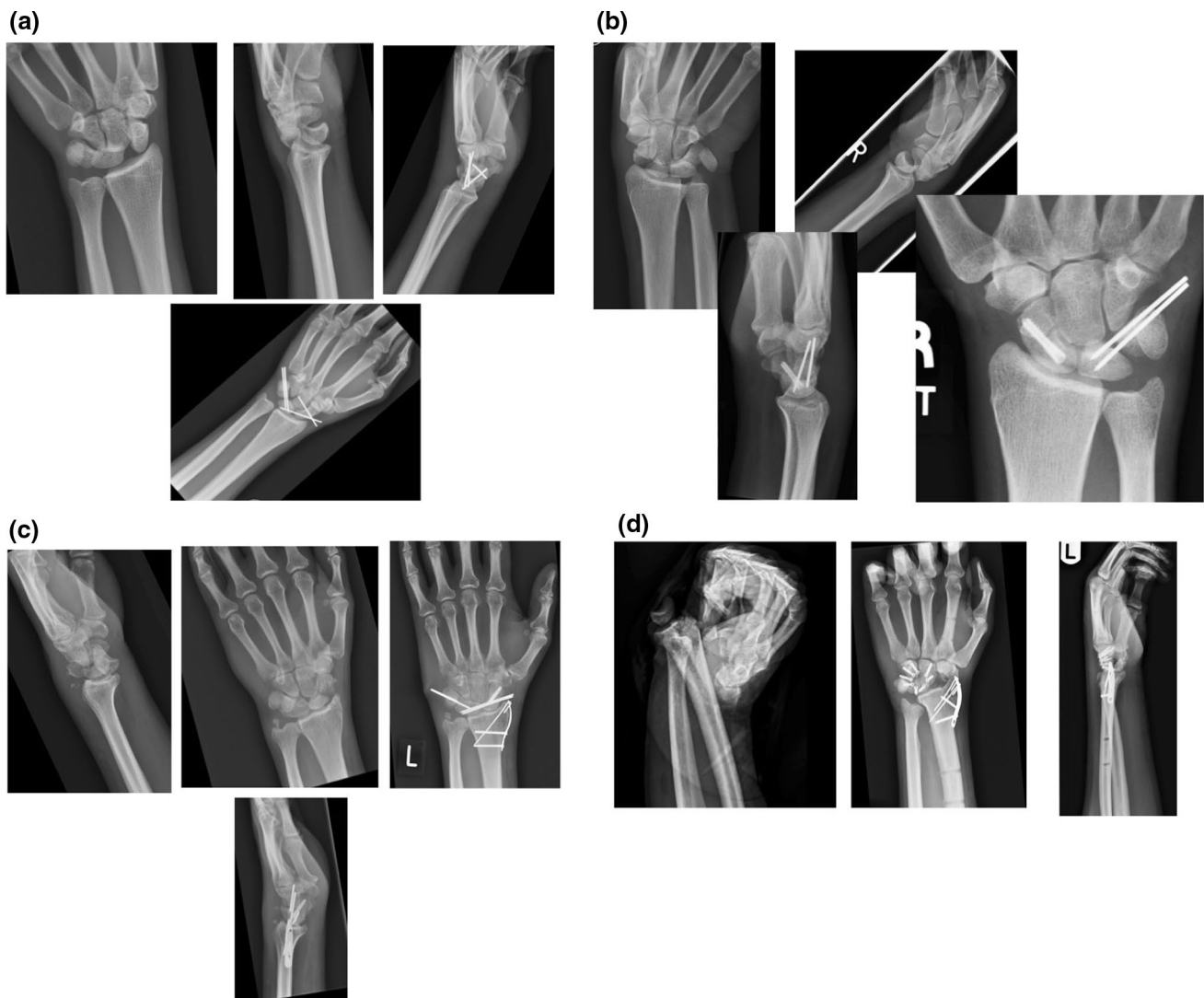| Neurological injury	12/23 wrists
Median	7 (30%)
Ulnar	1 (4%)
Combined median and ulnar	1 (4%)
Brachial plexus injury	2 (8%)

Fig. 1 Pre and post-operative radiographic examples. **a** Basic perilunate dislocation. **b** Trans-scaphoid perilunate fracture dislocation. **c** Trans-scaphoid perilunate fracture dislocation with associated scaphoid ligaments injury. **d** Open transtyloid, transcaphoid perilunate dislocation with wrist dislocation

First stage (reduction and neural decompression)

Extended carpal tunnel decompression is performed under tourniquet control. A longitudinal carpal tunnel incision was curved in an ulna direction into the distal forearm, to avoid injury to the palmar cutaneous branch of the median nerve. The carpal tunnel is released, thus decompressing the median nerve. A broad Langenbach is then introduced to the floor of the inlet of the carpal tunnel, retracting the flexor tendons and median nerve in a radial direction, thus eliminating tension on the palmar cutaneous or motor branch of the median nerve. The floor of the carpal tunnel is exposed demonstrating the constant rent within the Space of Poirier, where the lunate is displaced through during the dislocation. If a closed reduction had previously been unsuccessful, the lunate is reduced under direct vision through this curved defect in the palmar wrist capsule. If an experienced hand and wrist surgeon was not available, the wound was now closed, a palmar supporting slab was applied and the arm elevated. Reduction and decompression of neurological structures had been achieved, and therefore, definitive treatment could be postponed until the next available specialist operative list.

Second stage (reconstruction/fixation)

When definitive management is performed, via the extended carpal tunnel decompression approach, the palmar aspect of the lunotriquetral (LT) articulation at the ulnar border of the curved rent in the Space of Poirier in the palmar

wrist capsule is identified. Coronal plane reduction of the LT articulation is easily identified on Posteroanterior (PA) image intensification. A thumb is then placed over this articulation to ensure correct alignment of the lunate and anatomical reduction of the LT joint in the sagittal plane. Two parallel 1.4 mm K-wires are then passed via percutaneous stab incisions from the ulnar border of the wrist. The wires are passed, protecting underlying cutaneous nerves to stabilize the LT interval anatomically. Image intensification is used to ensure correct positioning of the wires and appropriate reduction and orientation of the lunate. The wires are cut deep to the skin. The ulnar aspect of the rent within the palmar capsule is then repaired with two or three deep 3–0 Ethibond interrupted sutures, thus repairing the damaged palmar component of the LT ligament.

A dorsal approach is then performed via a longitudinal incision. The dorsal wrist capsule is approached though the floor of the third dorsal compartment. A Berger flap was raised allowing access to the dorsal carpus [15]. The preceding palmar approach and repair of the LT interval makes the carpus now very stable, except for the scapholunate (SL) dissociation or fracture. The radiocarpal and midcarpal joints are irrigated to remove any loose cartilage or debris which is often present. The capitate is inspected to identify any osteochondral lesions present. Two 1.6 mm K-wires are then used as joysticks in the scaphoid and lunate to assist anatomical reduction of the SL interval or scaphoid fracture. A 1.4 mm K-wire is then passed from scaphoid to lunate and another from scaphoid to capitate ensuring anatomical reduction and appropriate carpal alignment. These wires are again passed percutaneously ensuring that the branches of the superficial radial nerve are protected. The wires are cut deep to the skin. The scapholunate ligament was then repaired with 3–0 braided non-absorbable suture via bone anchors. If an associated carpal fracture is present, this is stabilised with a cannulated variable pitch headless screw antegrade. Any associated radial fracture is also repaired and associated styloid fractures are treated with column plating via the dorsal approach.

Post-operatively, the wrist is immobilized for 4 weeks in a position of function with slight wrist dorsiflexion, not including the thumb, allowing for immediate full finger and thumb range of motion. From week four, the wrist is placed in a removable thermoplastic splint, allowing for some early wrist motion achieving maximum 40% of normal range. The buried K-wires across the LT and SL intervals are removed under general anaesthesia at 8 weeks. Following this, full range rehabilitation is encouraged avoiding loading in extension for a total of 12 weeks.

All patients included in our study were followed up with regular appointments in our hand therapy unit to optimise outcomes. The radiographs were independently reviewed by three of the authors (KB, DT, LDM) of three different grades (registrar, fellow, consultant) and classified according to Herzberg [3]. There were no disagreements on those injuries that were identifiable within the classification system. Those that were not identifiable were described separately. Any evidence of degenerative change was noted from the final radiographs taken prior to discharge, along with measurement of the carpal height ratio.

Following the definitive surgery and removal of any supporting splint, specialist hand therapists supervised the patient rehabilitation. Patient-reported outcome measures (PROMs) were assessed at their final clinic visit prior to discharge and completion of Mayo Wrist and QuickDASH scores. These outcomes were chosen, to review our findings and compare them with those reported previously in the literature from specialized Hand Units. The measurements were taken by an independent researcher (CG), who was not involved in the care of the patients. Wrist range of motion was measured with a goniometer and grip strength measurements using a JAMAR Hydraulic Hand Dynameter, using the best of three attempts on both injured and uninjured sides.

Results

The injury patterns were classified according to Herzberg; eight were perilunate fracture-dislocations (PLFD), eight were perilunate dislocations (PLD) and seven did not fit any classification group. Rarer variants were identified and are described in Table 4.

The median time to reduction was 6 h (range 1 h–12 days) and the median time from reduction to definitive reconstruction/fixation was 8 days (range 4 h–18 days). Ten wrists (43%) had a successful reduction in the emergency department, five wrists (22%) required an initial emergency surgical reduction (due to neurovascular symptoms and failure to achieve reduction closed), with a subsequent definitive procedure at a later date, and seven wrists (30%) had the surgical reduction immediately followed by subsequent reconstruction/ fixation. One patient (4%) had closed reduction performed on the intensive care unit. This particular injury had been missed during the initial primary and secondary survey and was identified during a routine ward round in a patient with a high spinal cord injury.

In the definitive procedures, a combined dorsal and palmar approach was performed in 20 wrists; in 1 wrist an acute four-corner arthrodesis was performed via a dorsal approach alone due to identification of a massive osteochondral defect in the presence of an open trans scaphoid perilunate fracture dislocation of the carpus. All wrists had decompression of neurological structures. In eight (33%) cases, fixation of an associated complex distal radius fracture was performed using a fragment specific fixation technique.

Table 4 Anatomical classification of the perilunate injuries

Anatomical classification	Number
PLD	8
PLFD	8
PLD with volar dislocation of scaphoid (includes RSL/RSC ligament injury)	2
PLFD (TS-TC-TT and TS) in the presence of a SL injury	2
PLFD (TS) in the presence of an osteochondral defect in the capitate and a segmental scaphoid injury	1
PLFD in the presence of a distal radial pilon fracture	1
PLFD (TR-TS-TC) with a segmental scaphoid fracture dislocated dorsally and shear injury to the capitate	1

TS trans-scaphoid; *TC* trans-capitate; *TT* trans-triquetral; *TR* trans-radial; *RSL* radio-scapho-lunate; *RSC* radio-scapho-capitate

In the polytrauma cases, the injuries sustained and definitive interventions performed are described in Table 5. Their mean ISS was 32.5 (range 18–50).

There were five complications (20%); three minor complications with cases of premature K-wire loosening and backing out creating soft tissue irritation, a case if recurrent midcarpal instability was revised, while the case of acute four-corner arthrodesis failed, subsequently undergoing a subsequent pancarpal arthrodesis. There were no infections. The median length of follow-up was 16 months (range 6 months–3 years).

Final radiographs showed mid carpal arthrosis in one patient, who had been identified in having a significant chondral defect at the base of the capitate at the time of initial reconstruction /fixation. The mean carpal height ratio at final follow-up was 0.56 (0.42–0.64).

At final follow-up median grip strength of the injured wrist was 86% of the contralateral wrist (range 100–50%). The mean Mayo Wrist score was 74.1 (range 15–90) and the mean QuickDASH score 16.4 (range 0–84.1). Clinically the average wrist total range of movement (ROM) was 78° (38° of flexion and 40° of extension). All patients had no neurological deficit on final follow-up, apart from the patients who presented with ipsilateral brachial plexus injuries.

We compared the outcomes of the patients who had their definite reconstruction/fixation during the first week post injury with those who had their definite operation after 7 days. There was no apparent significant difference in outcome (mean Mayo wrist score was 77 vs 72, mean Quick-DASH 12.1 vs 20.1) when comparing patients who underwent definite reconstruction/fixation during the first week and those fixed 9–18 days after, respectively. Clinically, the mean grip strength was 84% of the contralateral side for the early treated patients vs 88% for the patients treated one week after the injury while the average range of movement was 80° (40° of flexion and 40° of extension) and 75° (35° of flexion and 40° of extension), respectively. Furthermore, looking into the final carpal height ratio for these two groups (early fixation 0.59 vs late fixation 0.52) and other radiographic parameters (i.e. Gilula lines preservation), we did not identify a difference in the quality of reduction.

The three wrists that were found to have sustained significant osteochondral of the capitate at the time of surgical

Table 5 Polytrauma and further interventions performed

Injury	Management
2×maxillofacial fracture	1×orbital floor ORIF, 1×conservative
1×acetabular fracture	Pelvic ORIF (in two stages)
1×scapular fracture	Conservative
1×open patella fracture	Stage 1: washout, debridement, ExFix Stage 2: ORIF patella
1×open tibial fracture	Washout, debridement, IMN tibia
2×brachial plexopathy: one complete, one upper trunk only	Expectant
1×head injury: SAH	Expectant
1×rib fractures with PTX	Expectant
1×complete SCI (C5)	Expectant

IMN intramedullary nail; *ORIF* open reduction internal fixation; *SAH* sub arachnoid haemorrhage; *PTX* pneumothorax; *SCI* spinal cord injury

reconstruction appeared to perform worse with poor clinical and radiological outcomes and poor PROMs.

There was as expected an apparent correlation of increase in ISS with delay to definitive surgical reconstruction/ fixation. The increase in ISS, however, did not seem to effect time to initial reduction.

There was no significant difference when we compared the outcomes of polytrauma patients with ISS > 16, against patients with isolated wrist injuries. The mean Mayo wrist score was 82 and mean QuickDASH was 16.8 for polytrauma patients, while for patients with isolated wrist injuries the mean Mayo wrist score was 63.5 and mean QuickDASH was 22.4. On examination, the mean grip strength of the injures wrist was 82% of the contralateral side for polytrauma patients and 88% for isolated injuries, while the average ROM was 75° (35° of flexion 40° of extension) vs 80° (40° flexion and 40° extension), respectively. Finally reviewing the final radiographs the mean carpal height ratio was 0.58 for polytrauma and 0.55 for patients with isolated injuries.

Discussion

The management of carpal injuries has been well described with a detailed history and physical examination and identification of associated neurological involvement. It is suggested that outcomes are improved with prompt treatment [2–12, 16]. However, the evidence for this comes from either isolated reports or case series from specialist Hand Units. With the recent advent of trauma care in the United Kingdom being moved to Major Trauma Centres (MTC), it may be that many of these, often high-energy injuries, will be managed in these settings. This is the first documented report on perilunate injuries from an MTC.

As such, it is no surprise that the mechanism of injury in the majority of our patients in this series (83%) was high-energy. This results in a hyperextension of the wrist and propagation of the force through the carpus. The direction of this force will dictate the pattern of injury seen and classifications of perilunate injuries have been based on this. Mayfield was the first to describe four stages of a perilunate injury with Stage I being an injury to the scapholunate ligament, Stage II the midcarpal joint, Stage III injury to the lunotriquetral ligament and Stage IV the lunate itself being dislocated palmarly from the lunate fossa ("spilled teacup"), distinguishing also lesser for greater arc injuries. Further radiographic classifications have been described [6, 17] but a more pragmatic one is that of Herzberg [3] as it includes both perilunate dislocations (PLD) and perilunate fracture-dislocations (PLFD). Even using this classification system, however, Herzberg [18] noted that "almost any combination of middle and/or proximal carpal row fracture

or dislocation is possible". Indeed, we found that 30% of the patients in our series had an injury pattern that did not clearly fit into those previously described. This is not to say, that the classification system is not adequate but due to the enormous variation of injury pattern, particularly in very high-energy injuries, the same would have been true for any classification system. It has already been noted that classification of perilunate injuries is difficult [3] and we did not find that those available were helpful either for descriptive purposes or to guide surgical planning. It is perhaps possible that application of further high-energy force in axial loading beyond a Mayfield Stage IV injury creates variation in the injury pattern and can create associated fractures to the carpus and distal radius. Due to identification of two patients with combined Mayfield stage 4 PLD who also had scaphoid waist fractures, we theorise that additional axial load force beyond a Mayfield four injury can potentially create a scaphoid waist fracture in the presence of a complete disruption of the scapholunate ligament. We would, however, strongly advocate the judicious use of appropriate pre-operative imaging for diagnostic purposes, to plan surgery and to identify occult carpal injuries such as this, and in particular those being critical of the integrity of the proximal capitate articulation.

It is universally recognized that perilunate injuries are devastating injuries to the carpus and the outcomes at best are fair. There is discrepancy in the literature regarding how outcomes are graded but average Mayo Wrist scores range from 66 to 79 [9, 13] and radiographic arthritis observed in most patients, although this does not appear to correlate with function. It has been suggested to date poorer outcomes are seen in open injuries, delay in surgical treatment of greater than 4–6 weeks and osteochondral defects [11]. This correlates well with the outcomes seen in our series demonstrating that we are achieving results that are as good as those observed in previously described. Outcomes were generally good to excellent; however, there were some patients that had poorer outcomes. One patient was observed to have radiographic arthrosis at final follow-up. It had been identified that they had a significant osteochondral injury at the base of capitate at the time of surgical reconstruction/fixation. One open fracture again with a significant osteochondral defect at the base of the capitate had a primary limited intercarpal fusion performed at the time of initial reconstruction/fixation. Unfortunately, this subsequently failed and went on to require subsequent pancarpal fusion, while two more open wrists were treated with wound wash out, debridement and fixation according to the technique we have described. No patient had a delay in definitive treatment of greater than 18 days. Although it is noted that the patients identified to have osteochondral defects (OCD) affecting the capitate appear to have had poorer outcomes, we also note that those patients that had a scaphoid fracture with an

associated scapholunate ligament injury appeared to achieve poorer outcomes. This is likely to reflect the increased force required to produce this pattern of injury. We have demonstrated as in other series that good to excellent outcomes can be achieved, even in the most severe perilunate injuries, if early reduction is achieved followed by subsequent definitive accurate reconstruction/fixation is performed. It is likely that the latter is more important in achieving a good outcome than timing of definitive reconstruction/fixation.

We, therefore, advocate that management should follow a clear and systematic algorithm—see Fig. 2.

Approximately half of our patients had a successful closed manipulation and half required reduction in theatre. Absolute indication for early surgical intervention is an open injury. The inability to achieve a closed reduction in the presence of a neurological deficit or deterioration in neurological status is also an indication for emergent open reduction as in the first stage of the described technique. However, if a successful early closed reduction has been achieved, there is a reasonable argument for expectant management with serial nerve examinations and high elevation in a plaster splint.

Our findings would support the concept that once emergent treatment has been performed, achieving carpal reduction and decompressing neurological structures, delaying definitive reconstruction for up to 18 days does not seem to have a detrimental effect on final outcome.

It is accepted that there is no role for conservative management with much poorer outcomes demonstrated in comparison to those who had a surgical intervention [3, 19–21].

Much discussion has been given to the surgical approach with some authors preferring a palmar approach [22], some a dorsal approach [13, 14, 23] and some a combined approach [24, 25]. In our series, all but three patients had a combined approach, which is that favoured by the senior author (LDM) as accuracy of reduction can be ensured along with relevant soft tissue repair of primary components of LT ligament and SL ligament.

Up to 26% of patients with perilunate injuries have been previously recorded to have associated polytrauma [3]. In our series, half of the patients had associated polytrauma, emphasizing further that these injuries often present following high-energy trauma and are associated with other skeletal and system injuries. That being the case, this presents a significant risk of the perilunate injury being overlooked in the initial primary and secondary surveys, and therefore, careful assessment and imaging should be scrutinized by experienced practitioners. In a single centre series of 166 perilunate injuries, there was a delay in diagnosis of 25% of cases, even when they were isolated [3]. Another review of major trauma patients showed that minor injuries, which include those to the carpus, were missed in up to 70% of cases [26]. In our series, there was delay in diagnosis in one patient. As previously described this was identified during a routine trauma ward round 3 days following injury, when a tertiary survey was performed on a tetraplegic patient from a high cervical fracture dislocation. Although other surgical interventions were required in our polytrauma patients, they did not cause any delays in treatment both in the emergency setting. There was, however, inevitably some delay

Fig. 2 Emergent management algorithm for perilunate injury
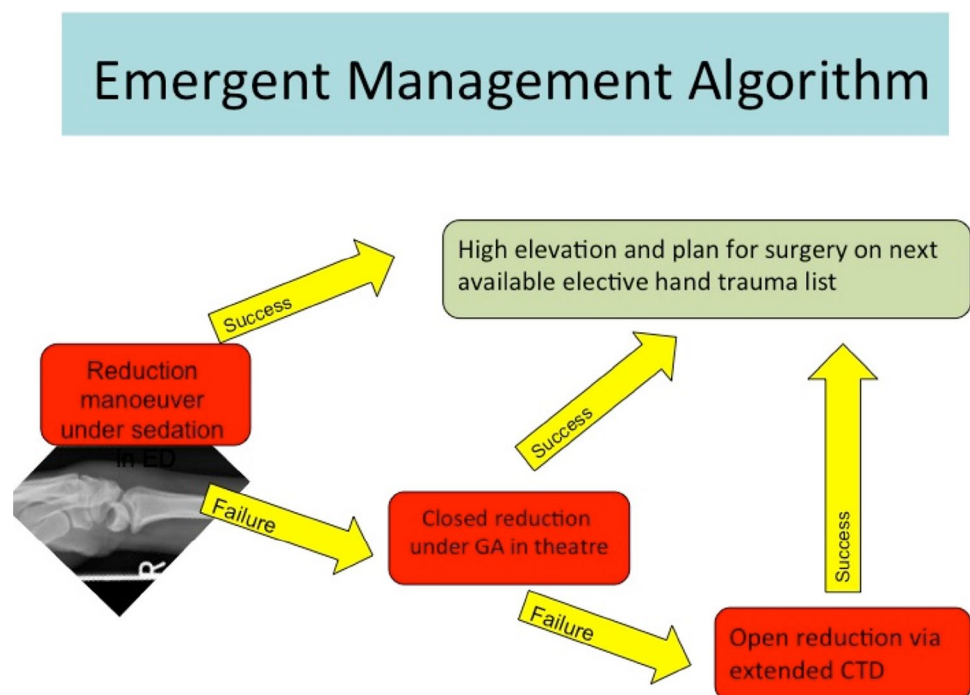
to definitive reconstruction/fixation of the injuries in these patients as other system injuries precluded early management is some cases. In our series, 48% of the patients had polytrauma and the management of their life or limb threatening injuries took priority over their perilunate injury. These patients had more commonly their definite fixation 9–18 days post injury. However, were unable to demonstrate a significant difference in their wrist outcome scores when compared to those patients with isolated injuries that were treated in the first week following injury.

Associated nerve involvement is usually confined to the median nerve. This is hardly surprising when one considers that the lunate will typically dislocate into the Space of Poirier palmarly, thus compromising the carpal tunnel. In our series, a third (seven wrists) of the injuries had some element of median nerve involvement. However, we also noted ulnar nerve involvement in two wrists. In one wrist this was in association with a median nerve injury, manifested preoperatively as paraesthesia in the median and ulnar nerve distribution. This resolved after reduction in the operating theatre. In another wrist, the ulnar nerve injury was isolated and demonstrated as complete motor palsy with preserved sensory function. This was seen in the one open fracture with almost complete dissociation of the carpus from the wrist bar the lunate. The ulnar nerve was explored during the definitive procedure and noted to have a neuroma-in-continuity, As such, treatment was expectant following thorough decompression and neurolysis of the nerve. Finally, one patient suffered brachial plexus palsy due to traction injury which resolved, while a polytrauma patient with ipsilateral scapula and clavicle fracture sustained complete rupture of the brachial plexus.

There are a number of significant limitations to this study. First, this series is a retrospective review at a single centre, and therefore, potentially subject to bias according to the preferences of the treating centre and lead author. There is also a limited number of patients, although this is hardly surprising as it is a relatively rare injury, as has been noted in the previous literature. The was a relatively short length of time to follow-up due to the time point from when we chose to review the patients. Our results, however, were encouraging nonetheless, in particular with regards to the Quick-DASH and Mayo wrist scores. Lastly, we did not perform any comparative statistical analysis as our numbers were too small to gain any meaningful data and also because it was a retrospective review.

Conclusion

The importance of early diagnosis and management, facilitated by meticulous secondary and tertiary surveys, particularly when associated with other significant injuries, is emphasized. We have shown that in our series that perilunate injuries can occur either as an isolated injury, or in the setting of the multiply injured patient.

When the injury exists in the presence of polytrauma, it is essential that a high index of suspicion is maintained, a meticulous examination with secondary and tertiary surveys is performed and imaging is scrutinized as to avoid delay in diagnosis.

A simple treatment algorithm of treatment aimed at achieving early carpal reduction and neural decompression if needed, subsequently followed by accurate reconstruction/ fixation addressing all damaged structures is likely to achieve the best outcomes. Delay in this definitive reconstruction of up to 18 days does not seem to have a deleterious effect on outcome once reduction has been achieved. Poorer outcomes may be expected in the presence of a significant OCD at the base of capitate and in the presence of a scaphoid fracture with associated scapholunate ligament injury. It would seem, however, that in our series that polytrauma patients with a perilunate injury had similar outcomes to patients with isolated perilunate injuries.

Compliance with ethical standards

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