The association of hand and wrist injuries with other injuries in multiple trauma patients. A retrospective study in a UK Major Trauma Centre.

P Tsinaslanidis[a], Toby O Smith[b] ,OS Brown[a], G Tsinaslanidis[c], S Umarji[a], CB Hing[a]

Affiliations:

a. St George's University Hospitals NHS Foundation Trust, London, United Kingdom
b. University of East Anglia, Norwich, United Kingdom
c. George Eliot Hospital NHS Trust, Nuneaton, United Kingdom

Study conducted at:

St George's University Hospitals NHS Foundation Trust, London, United Kingdom

Corresponding Author: Dr Prodromos Tsinaslanidis
Email: p.tsinaslanidis@nhs.net
Telephone number: 020 8672 1255 ext 0295

Other authors:

Toby O Smith: Toby.Smith@uea.ac.uk
Oliver Scott Brown: oliver.scottbrown@nhs.net
Georgios Tsinaslanidis: tsinas93@gmail.com
Shamim Umarji: s.umarji@nhs.net
Caroline B Hing: caroline.hing@stgeorges.nhs.uk

Correspondence address:

Trauma and Orthopaedic Department St George's Hospital Blackshaw Road London SW17 0QT

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Abstract

Background:

Approximately 20,000 major trauma cases occur in England every year. However, the association with concomitant upper limb injuries is unknown. This study aims to determine the incidence, injury pattern and association of hand and wrist injuries with other body injuries and the Injury Severity Score (ISS) in multiply injured trauma patients.

Methods:

Single centre retrospective study was performed at a level-one UK Major Trauma Centre (MTC). Trauma Audit and Research Network (TARN) eligible multiply injured trauma patients that were admitted to the hospital between January 2014 and December 2018 were analysed. TARN is the national trauma registry. Eligible patients were: a trauma patient of any age who was admitted for 72 hours or more, or was admitted to intensive care, or died at the hospital, was transferred into the hospital for specialist care, was transferred to another hospital for specialist care or for an intensive care bed and whose isolated injuries met a set of criteria. Data extracted included: age, gender, mode of arrival, location of injuries including: hand and/or wrist and mechanism of injury. We performed a logistic regression analysis to assess the association between hand/wrist injury to ISS score of 15 points or above/below and to the presentation of other injuries.

Results:

107 patients were analysed. Hand and wrist injuries were the second most common injury (26.2%), after thoracic injuries. Distal radial injuries were found in 5.6%, carpal/carpometacarpal in 6.5%, concurrent distal radius and carpometacarpal in 0.9%, phalangeal injuries in 4.7%, tendon injuries in 0.9% and concurrent hand and wrist injuries in 7.5% cases. There was a significant association between hand or wrist injuries and lower limb injuries (Odds Ratio (OR): 3.84; 95% confidence

intervals (CI): 1.09 to 13.50; p=0.04) and pelvic injuries (OR: 4.78; 95% CI: 1.31 to 17.44; p=0.02). There was no statistical association between hand and wrist injuries and ISS score (OR: 0.80; 95% CI: 0.11 to 5.79; p=0.82).

Conclusions:

Hand and wrist injuries are prevalent in trauma patients admitted to MTCs. They should not be under-estimated but routinely screened for in multiply injured patients particularly those with a pelvic or lower limb injury.

Keywords: Hand Injuries, Wrist Injuries, Injury Severity Score, Polytrauma, Multiple Trauma

Highlights

- The incidence of hand and wrist injuries in multiply injured trauma patients in our series was 26.2%.
- A significant association was found between a hand or wrist injury and a lower limb or pelvic injury.
- Clinical recommendations are made to emphasise careful screening of hand and wrist injuries in this population.

Introduction

Hand or wrist injuries have an incidence of 28% of all injuries in a general trauma population [1,2]. Approximately 20,000 major trauma cases occur in England every year yet the association with concomitant upper limb injuries is unknown [3]. These injuries can cause serious functional impairment, decreased quality of life and confer a significant economic burden to healthcare systems [4-7]. Multiple trauma is more common in people aged between 20-40 years, with raised incidence of hand injuries in patients specifically involved in motorcycle accidents [8]. Few studies have evaluated the incidence and injury pattern of hand and wrist injuries in multiple trauma patients.

Previous studies have suggested that multiply injured trauma patients suffer poorer clinical outcomes than patients with an isolated injury [9-11]. Polytrauma patients with other life-threatening injuries, lower level of consciousness and intensive care unit (ICU) admission have a higher chance of a missed injury in the extremities, usually hand and foot, which could explain the delayed treatment and potentially the worse functional outcome in this group [12-16]. Even though mortality rates have improved significantly the last 40 years, these patients still face severe functional limitations after major trauma for many months after their initial injury [17,18]. Apart from the wounds and physical pain that polytrauma patients face, there are also significant social and emotional problems that they may encounter during their rehabilitation [19]. Injuries associated with trauma are a compelling cause of permanent handicaps in young patients, as they affect their ability to work and can even lead to occupational disability [20-23]. Patients involved in road traffic accidents have a higher prevalence of extremity injuries and common concomitant injuries included head/face/neck/lower extremities and chest [24-25]. Data on the hand and wrist injuries in multiple trauma patients would improve awareness of their incidence, reducing the possibility of a missed diagnosis and delay to treatment in this specific category of patients.

This study aims to determine the incidence, injury pattern and association of hand and wrist injuries with other injuries and the Injury Severity Score (ISS) score in multiply injured trauma patients in a UK major trauma centre (MTC).

Materials and Methods

This was a single centre retrospective study at a level one MTC in London**.** St George's University Hospitals NHS Foundation Trust is a major trauma centre that serves a population of 2.6 million in the southwest London and Surrey trauma network and treats around 120 trauma patients every month [26]. TARN is the National Clinical Audit for traumatic injuries and the largest European Trauma Registry that collects data from 220 hospitals in England, Wales, Northern Ireland and the Republic of Ireland [27]. The hospital's trauma database was examined by our trained local TARN team. Patient details were anonymised automatically after being inserted into a secure web-based data collection system. Data included: age, gender, mode of arrival, time of arrival, injuries to the head, face, thorax, abdomen, spine, pelvis, lower limb, hand and/or wrist, type and timing of surgery. The mode of arrival was classified into ambulance, helicopter, car/personal vehicle, walking and other. The mechanism of injury was categorised as: vehicle incident or collision, fall more than 2m, fall less than 2m, stabbing, shooting, crush, blow(s) and other. The hand and/or wrist injuries comprised of fractures, dislocations, fracture-dislocations and soft tissue injuries (skin-vessel-muscle-nerve-tendon injuries). Additionally, the central TARN team coded the injuries, assigned the ISS score and then provided the final data in Excel spreadsheets.

Study Population

TARN eligible multiple trauma patients that were admitted between January 2014 and December 2018 were included. The inclusion criteria for the database was: a trauma patient of any age who was admitted for 72 hours or more, or was admitted to intensive care, or died at the hospital, was transferred into the hospital for specialist care, was transferred to another hospital for specialist care or for an intensive care bed and whose isolated injuries met a set of criteria. TARN does not include patients who died on the way to hospital [28]. Patients were considered polytrauma when

the ISS was 16 or higher as a result of injury in at least two body regions [29]. The ISS was calculated by the central TARN team using the Abbreviated Injury Scale (AIS) scores [30].

Outcome Measurement

Our primary outcome was the proportion of multiple trauma patients with hand and/or wrist injuries that presented to a London MTC. Secondary outcomes included the association of hand and/or wrist injuries of those patients with other body injuries and the ISS score.

Statistical Analysis

We reported demographic results which were analysed by frequency and percentages for categorical data and mean with standard deviation (SD) for continuous outcomes. We reported prevalence of injury using percentages. To assess the association between wrist/hand injury and injury pattern in people who present with multi-trauma, a logistic regression analysis was performed. The association between injury presentation and ISS score, with ISS separated into results less than 15 or 15 and above, was also analysed using a logistical regression analysis. Each analysis was adjusted by age and gender. In each instance, we presented this association data using odds ratio (OR) and confidence intervals (CI) and p-values (a=0.05). Analyses were performed on STATA Version 16.0 (STATA Corp, Dallas, USA).

Results

Demographics

A summary of the characteristics of the cohort are presented in ***Table 1***. In total, 107 patients were included in the analysis. The majority were male (70.1%) with a mean age of 45 (range 2-88.4) years. The mean ISS score was 16 points. The most common mechanism of injury was a vehicle incident or collision in 44%. A fall of less than two, and more than two meters comprised of the second and third most frequent mechanisms of injury respectively, followed by stabbing injuries found in 11% of patients. Shooting, a crush, a blow and other injuries were unusual compared to those above ***(Table 1).***

Primary Outcome: *proportion of multiple trauma patients with hand and/or wrist injuries*

Thoracic injuries were diagnosed in 28% of the patients. This was the most common type of injury in our study. Hand and wrist injuries were the second most common injury found in 26% of patients ***(Table 1).*** Of these, distal radius injuries were found in 6%, carpal/carpometacarpal (CMC) in 7%, concurrent distal radius and CMC in 1%, phalangeal injuries in 5%, tendon injuries in 1% and concurrent hand and wrist injuries in 8% ***(Table 1).***

Secondary Outcomes: a*ssociated injury patterns*

There was a statistically significant association between people experiencing a hand/wrist injury and a lower limb injury (OR: 3.84; 95% CI: 1.09 to 13.50; p=0.04) and pelvic injury (OR: 4.78; 95% CI: 1.31 to 17.44; p=0.02). The association of hand/wrist injury with head, face, thoracic, abdominal and spinal injuries was not statistically significant ***(Table 2****).*

Secondary Outcomes: *ISS Score*

Seventy patients (65.4%) had an ISS<15 and 37(34.6%) had an ISS>15. The association between hand and wrist injuries with the ISS was not statistically significant p=0.82 (OR: 0.80). Furthermore, the association of lower limb, face, spinal and pelvic injuries with the ISS was demonstrated as not statistically significant ***(Table 2).*** However, there was an association between ISS and head, thorax and abdomen injury which was deemed statistically significant p<0.01 (OR: 20.59; 95% CI: 2.61 to 162.21), p<0.01 (OR:47.46; 95% CI: 8.33 to 270.26) and p<0.01 (OR: 2.96; 95% CI: 1.27 to 4.56) respectively ***(Table 2)***.

Discussion

The goal of the present study ss to determine the incidence, injury pattern and association of hand and wrist injuries with other body injuries and the Injury Severity Score (ISS) in multiply injured trauma patients.

The characteristics of this cohort are similar to previous trauma cohorts in respect to gender, age [24,31-32] and mechanism of injury [8,47]. We reported that thoracic injuries were the most common region of injury, seen in 28% of the patients. No significant association was seen between upper limb and thorax injuries in contrast to previous studies which showed that upper limb injuries were often identified in combination with thorax injuries in multiple trauma patients (38% of polytrauma patients with thorax injuries had concomitant upper limb injuries) [33]. However, there are significant differences in the inclusion criteria, as in the previous study the authors investigated specifically polytrauma patients with blunt chest injury [33]. The incidence of hand and/or wrist injuries in multiple trauma patients was 26.2%. This was higher than previous studies, potentially because those studies had more strict inclusion criteria (only included patients with ISS >16, leaving out-patients with upper extremity injuries and other less significant injuries that would have an ISS<16) [24], and showed that the incidence of hand and wrist injuries was actually comparable to that of the general trauma population [1,2]. Carpal and metacarpal bones were frequently affected similarly to the current literature [25]. Hence, hand and wrist injuries in multiple trauma patients are not unusual and should not be under-estimated as even a minor hand injury could cause a poor functional outcome [34]. The plan to manage hand and wrist injuries should start by taking into consideration the history and energy of the trauma. A thorough clinical examination in polytrauma is essential to provide an accurate diagnosis and the best possible treatment in terms of technique and timing [35-37].

Currently, most multiply injured patients will survive but it is unlikely that they will return to their pre-injury level of activity [17-18]. Apart from the impact of these injuries on a patient's physical and mental health, they were also a significant financial burden for the healthcare systems and society at-large [4-7]. It has been shown that a significant percentage of patients did not completely return to work even five years after the injury and approximately 29% have reported financial loss after their accident [22-23,38]. Interestingly, even higher percentages (almost 50%) have been reported to the literature [39-40]. In the Netherlands the cost of hand and wrist injuries was found to be higher than that of knee and lower limb fractures or hip fractures. Hand and wrist injuries annually accounted for $740 million (in US dollars). These calculations took into account the direct healthcare cost and the loss of productivity [7]. There is a paucity of similar studies in the UK to determine the incidence and cost of these injuries to the NHS. Thus, emphasising the need for hand and wrist injuries to be considered in research on trauma outcomes.

The present study has shown that there is an association of hand/wrist injuries with pelvic and lower limb injuries. A similar association of upper extremity injuries with lower limb injuries in multiple trauma patients has also been displayed in a preceding retrospective study with a sample size of 115 patients, where the ipsilateral dyad, an upper and lower extremity fracture on the same side, was shown to occur with statistical significance [41]. Additionally, it has been has demonstrated that those with extremity injuries had poorer outcomes with more operative procedures (4.0 procedures per patient compared to 1.6 per patient without extremity injuries), higher rate of blood transfusion (received almost twice as much packed red blood cell, and plasma) and longer in-hospital stay [24]. Consequently, hand surgeons should discuss early each case with the trauma team and determine the correct timing for hand and wrist treatment according to basic principles [36,42] in order to prevent avoidable poor outcomes. Moreover, in patients with severe lower limb and pelvic injuries, attention should be given to maintain hand and upper limb function in order to ensure the use of walking aids for as long as is needed [35].

Furthermore, where there are concomitant injuries one or more may be missed. Poor clinical examination, other life-threatening injuries, lower level of consciousness and intensive care unit (ICU) admission have been shown to contribute to one or more missed injuries in the extremities [12-16, 43]. Interestingly, a study of CT scans and missed injuries has shown that the detection of an injury from the radiologist could draw their attention from other possible injuries. Predisposing factors included more than two injured body parts on a first CT image, age older than 30 years, and high severity of injury [44]. However, another study has shown that 39-47% of multiple trauma patients that underwent a whole-body CT scan on arrival in a UK MTC did not demonstrate any injury [45]. Thus, the selection of trauma patients that should undergo a whole-body CT and reporting these CT scans remains challenging. This study suggested that in the presence of pelvic and lower limb injuries suspicion of co-existing hand/wrist injuries should be raised. A timely mannered tertiary survey could decrease substantially the percentage of missed injuries [46].

In addition, no association of hand and/or wrist injuries with the ISS score was shown and the association of head, thoracic and abdominal injuries with an ISS>15 was expected due to the design of the ISS score. Abdominal, head and thoracic trauma has been previously reported to be the three most common causes of death in polytrauma patients [32]. However, very few studies have addressed the influence of upper extremity injuries on mortality in polytrauma patients. Previous literature has indicated that head injury mainly determined mortality in patients with severe trauma [47]. Thorax, abdomen, perineum and extremity injury could increase the mortality only if graded AIS (Abbreviated Injury Scale) four or more [47]. Therefore, it cannot be emphasised enough that every trauma patient should be managed according to the ATLS principles in order to ensure the best possible outcome in terms of survival and functional outcome [48].

Strengths and Limitations

One strength of this study was that it provided information regarding the epidemiology and injury pattern of hand and wrist injuries in polytrauma patients in a London MTC. This is important as it help inform front-line emergency and trauma physicians of the complexity of these patients and to consider the presence of hand and wrist injuries in the presence of polytrauma. To our knowledge this was the first study in the UK to determine the association of hand and/or wrist injuries with other injuries and the ISS score in multiple trauma patients. However, this study presented with two key limitations. Firstly, this was a retrospective study that evaluated the trauma population of a single region. Secondly a relatively small number of patients were included that might have caused a type II error. Future research should be based on multi-centre studies including larger number of patients.

Conclusion

The incidence of hand and wrist injuries in multiple trauma patients was 26% similarly to the general trauma population. They were also associated with lower limb and pelvic injuries. This study emphasised that it is crucial to perform a thorough examination of the upper extremities when reviewing multiple trauma patients as hand and wrist injuries could cause detrimental effect on functional outcome and negative socioeconomic ramifications and emotional repercussions.

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Table 1: Demographic and fracture characteristics of the analysed cohort

Table 2: Results of the logistic regression analysis to assess the association between hand/wrist injury and ISS score of 15 points or above/below and other fracture presentations.

Table 1: Demographic and fracture characteristics of the analysed cohort

Characteristics		**Frequency (%)**
N		107
Mean Age (SD)		45.0 (20.0)
Gender (male)		75 (70.1)
Injury profile	Lower Limb	23 (21.5)
	Head	18 (16.8)
	Face	12 (11.2)
	Thorax	30 (28.0)
	Abdomen	8 (7.5)
	Spine	24 (22.4)
	Pelvis	14 (13.1)
	Hand/Wrist	28 (26.2)
Hand and Wrist Injuries	Distal radius injuries	6 (5.6%)
	Carpal/carpometacarpal	7 (6.5%)
	Concurrent distal radius and CMC	1 (0.9%)
	Phalangeal injuries	5 (4.7%)
	Tendon injuries	1 (0.9%)
	Concurrent hand and wrist injuries	8 (7.5%)
Mechanism of injury	Vehicle incident/collision	47 (43.9%)
	Fall more than 2m	17 (15.9%)
	Fall less than 2m	20 (18.7%)
	Stabbing	12 (11.2%)
	Shooting	1 (0.9%)
	Crush	1 (0.9%)
	Blow(s)	2 (1.8%)
	Other	7 (6.5%)
Mean ISS score (SD)		16.0 (11.0)
ISS Score	<15	70 (65.4)
	>15	37 (34.6)

CMC – carpal metacarpal
ISS: injury severity score
N: number
SD: standard deviation

Table 2: Results of the logistic regression analysis to assess the association between hand/wrist injury and ISS score of 15 points or above/below and other fracture presentations.

	Hand/Wrist Injury		**ISS Score (</> 15 points)**	
	OR (95% CI)	**P-Value**	**OR (95% CI)**	**P-Value**
Lower Limb	3.84 (1.09 to 13.50)	0.04	1.19 (0.17 to 8.16)	0.86
Head	0.48 (0.10 to 2.31)	0.36	20.59 (2.61 to 162.21)	<0.01
Face	2.43 (0.47 to 12.50)	0.29	6.04 (0.35 to 104.98)	0.22
Thoracic	0.78 (0.17 to 3.60)	0.75	47.46 (8.33 to 270.26)	<0.01
Abdomen	0.73 (0.11 to 4.94)	0.45	2.96 (1.27 to 4.56)	<0.01
Spine	1.62 (0.48 to 5.40)	0.81	1.90 (0.29 to 12.43)	0.50
Pelvis	4.78 (1.31 to 17.44)	0.02	2.91 (0.35 to 23.81)	0.32
Hand/wrist Injury	-	-	0.80 (0.11 to 5.79)	0.82

CI; confidence intervals
ISS – injury severity score
OR; odd ratio