

## Full Length Article

# Fractures and dislocations of the hand in polytrauma patients: Incidence, injury pattern and functional outcome



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## ABSTRACT

**Introduction:** Injuries of the hand can cause significant functional impairment, diminished quality of life and delayed return to work. However, the incidence and functional outcome of hand injuries in polytrauma patients is currently unknown. The aim of this study was to determine the incidence, distribution and functional outcome of fractures and dislocation of the hand in polytrauma patients.

**Methods:** A single centre retrospective cohort study was performed at a level 1 trauma centre. Polytrauma was defined as patients with an Injury Severity Score of 16 or higher. Fractures and dislocations to the hand were determined. All eligible polytrauma patients with hand injuries were included and a Quick Disability of Arm, Shoulder and Hand questionnaire (QDASH) and Patient-Rated Wrist/Hand Evaluation (PRWHE) were administered. Patients were contacted 1–6 years after trauma.

**Results:** In a cohort of 2046 polytrauma patients 72 patients (3.5%) suffered a hand injury. The functional outcome scores of 52 patients (72%) were obtained. The Metacarpal (48%) and carpal (33%) bones were the most frequently affected. The median QDASH score for all patients with hand injury was 17 (IQR 0–31) and the PRWHE 14 (IQR 0–41). Patients with a concomitant upper extremity injury ( $p = 0.002$  for PRWHE,  $p = 0.006$  for QDASH) and those with higher ISS scores ( $p = 0.034$  for PRWHE, QDASH not significant) had worse functional outcome scores. As an example, of the 5 patients with the worst outcome scores 3 suffered an isolated phalangeal injury, all had concomitant upper extremity injury or neurological injuries (3 plexus injuries, 1 severe brain injury).

**Conclusion:** The incidence of hand injuries in polytrauma patients is 3.5%, which is relatively low compared to a general trauma population. Metacarpal and carpal bones were most frequently affected. The functional extremity specific outcome scores are highly influenced by concomitant injuries (upper extremity injuries, neurological injuries and higher ISS).

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## Introduction

Fractures of the hand account for up to 20% of all fractures in a general trauma population, in which metacarpal and phalangeal bones are most frequently affected [1–4]. These injuries can cause significant functional impairment, diminished quality of life and delayed return to work [5–7]. However, the incidence, injury

pattern and functional outcome of fractures and dislocations of the hand in polytrauma patients are currently unknown.

There is sparse data on the functional outcome of upper extremity injuries in polytrauma patients [8–10]. The available evidence suggests that in polytrauma patients both injury pattern and functional outcome of a specific injury may differ from patients with a corresponding isolated injury [8–10]. Several explanations can be considered to explain this difference. In polytrauma patients, life-threatening injuries dictate the priority of management. In addition, these patients are frequently admitted to the ICU, undergo prolonged sedation and are at risk for delayed diagnosed injuries of the hands [11,12]. These factors could very well result in a delayed onset of treatment, whether this concerns a surgical intervention or start of rehabilitation. Furthermore, concomitant injuries of the ipsilateral upper extremity, cervical

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spine or brain could obviously also affect the upper extremity functional outcome in these patients.

As mortality rates after severe trauma have decreased over the past decades, increased emphasis on functional outcome and morbidity is warranted [13]. It has been shown that especially severe extremity injuries may cause loss of long term functional capacity in polytrauma patients [8,14]. However, the role of hand injuries specifically has never been assessed. Data on the debilitating long term effects that hand injuries have in polytrauma patients would provide insight on the scale and impact of these injuries. Furthermore, it could serve as a basis for future studies on the role of factors that influence upper extremity outcome in polytrauma patients.

The aim of this study was to determine the incidence, distribution, time of diagnosis and functional outcome of fractures and dislocations of the hand in polytrauma patients.

## Methods

### Study design and setting

An institutional review board waiver was obtained. A single centre (level 1 trauma centre) retrospective cohort study with a follow up by questionnaire was performed. Data from January 2009 until December 2014 were derived from the Dutch National Trauma Database (DNTD) and electronic patient documentation. The DNTD contains prospectively collected documentation on demographics, trauma mechanism, injuries found during admission, findings from radiologic imaging and department of admission. Criteria for HET were according to the Advanced Trauma Life Support guidelines [15]. Delayed diagnosed injuries were identified by review of the electronic patient documentation.

All polytrauma patients aged 18 years and older were included and patients with hand injury were selected for follow up by 2 questionnaires. Polytrauma was defined as an Injury Severity Score (ISS) of 16 or higher, calculated using Abbreviated Injury Scale (AIS) scores [16]. A flowchart of the total number of included patients and lost to follow up is provided in Fig. 1.

Exclusion criteria for follow-up by questionnaire were: patients deceased during or after admission, traumatic amputation of any part of the affected upper extremity and when residing abroad.

Patients who did not respond within three weeks were contacted by telephone to verbally administer the questionnaires.

### Outcome parameters

All fractures and dislocations distal to the radius were included. Fractures and dislocations were described per region: carpal, metacarpal or phalangeal. To assess functional outcome, patient reported outcome measures were used (PROM). The Dutch language version of the Quick Disability of Arm, Shoulder and Hand questionnaire (QDASH) and Patient-Rated Wrist/Hand Evaluation (PRWHE) were used. The PRWHE is a hand and wrist specific questionnaire and has good measurement properties for the evaluation of hand injuries. It contains 15 items that cover two domains: pain (5 items) and functionality (10 items) [17,18]. The QDASH is an 11-item questionnaire that addresses physical function and symptoms, of the preceding week, in patients with musculoskeletal disorders of the entire upper limb [19]. It has similar precision compared with the regular DASH (30 items) [20,21]. Both scores range from 0 to 100, a score of 0 indicating no pain or disability and 100 severe disability.

For potentially confounding factors the association with the PROM scores were assessed. The selection of these factors was based on previous studies that assessed factors associated with functional outcome in polytrauma patients [14,22].

### Statistical analysis

The Shapiro-Wilk test and Q-Q plots were performed to determine if continuous variables were normally distributed. Nonparametric tests were used for further statistical analysis. Continuous variables were presented as medians with interquartile range (IQR). Categorical variables were presented as frequencies with percentages. For analysis of dichotomous variables, the chi-square test was used. The Fisher exact test was used when a cell count of 5 or less was observed. Mann-Whitney *U* test was used for analysis of continuous variables with dichotomous variables and the Kruskal–Wallis test for analysis with categorical variables. For continuous variables, Spearman's rank correlation was used. A *p*-value of  $\leq 0.05$  was considered significant. Statistical analysis was performed using SPSS version 21 (IBM Corp., Armonk, NY) for Windows.

## Results

A total of 2046 polytrauma patients were included in this study and 72 (3.5%) sustained a fracture or dislocation in the hand. Of these 72 patients 6 died after trauma and 2 were unable to participate due to severe cognitive impairment. Fifty-two patients, of the 64 available for follow up, (81%) completed the questionnaire with a median follow up of 54 months (IQR 32–71) (Fig. 1). Demographics, trauma mechanisms and concomitant injuries of polytrauma patients with and without hand injuries are shown in Table 1.

Seventy-two patients sustained 119 injuries. Sixty-two patients (86%) sustained a fracture, 9 (12.5%) both a fracture and a dislocation and 1 (1.4%) only a dislocation. Metacarpal fractures were the most prevalent (48%). Twenty-four patients (33%) had multiple fractures and 11 patients (15%) had fractures in multiple regions. Sixty-four injuries (39%) were treated surgically. Indications for surgery were displacement, rotation or angulation deformity in 67% and a dislocation in 22%. The remaining indications were; severe soft tissue injury in 2 cases, a scaphoid non-union in 1 case and an internal fixation of 2 metacarpal fractures were performed to enable placement of an external

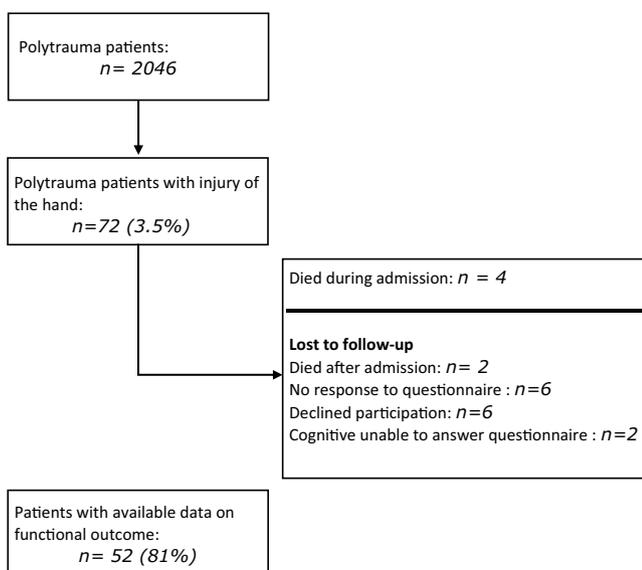


Fig. 1. Flowchart of in- and excluded patients.

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