Original Paper

Bone Injuries in the Hand and Forearm: Prevalence and Psychological Ramifications

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ABSTRACT: Complex bone injuries in the hand and forearm pose considerable physical and psychological challenges to patients. However, there is limited research on the psychological effects of these injuries. This study seeks to clarify the psychological impact and frequency of injuries in various hand bones. This cross-sectional study included 166 patients with complex hand and forearm injuries. Injuries were classified based on amputations and fractures involving phalanges, fingers, and other bones. Psychological assessments utilised standardised tools to gauge post-traumatic stress disorder (PTSD) levels. Our findings suggest that injury rates differ among the phalanges and individual fingers. The intermediate phalanx (P2) of the thumb had the most injuries, while no injuries were found in the proximal phalanx (P1) of the small finger. Amputations and fractures were found to be positively associated with increased symptoms of PTSD. This study emphasises the importance of recognising the psychological effects of hand and forearm bone injuries. The data indicate the need for a multi-disciplinary treatment approach that includes psychological interventions for optimal patient care. The study emphasises the necessity for additional research to further investigate these matters.

KEYWORDS: *Hand trauma, bone injury, fracture, amputation, PTSD.*

Introduction

The human hand is an intricate anatomical structure that allows people the ability to perceive tactile sensations, execute precise movements with fine motor control, exhibit dexterity, and actively participate in various daily tasks [1].

Hand injuries are widely recognised as the most prevalent form of injuries, and there has been a notable rise in the incidence of traumatic hand injuries being reported to emergency services on a global scale [2].

The occurrence of a hand injury results in the experience of pain and trauma, subsequently leading to various physical, psychosocial, and social ramifications. These consequences can potentially result in a temporary or permanent deterioration in hand functionality [3].

Moreover, the psychological impact of a hand injury on an individual's total rehabilitation is substantial, as it encompasses the financial strain associated with interventions, time taken off from work, and the potential loss of employment [4].

Therefore, it is imperative for healthcare practitioners to adopt a holistic approach while caring for patients, taking into consideration all relevant components that contribute to their well-being, rather of solely focusing on biomechanical and physical aspects.

Hand trauma, when considered with its physiological consequences, has the capacity to elicit significant psychological and emotional anguish. Individuals who have sustained an injury may exhibit symptoms indicative of anxiety, depression, and post-traumatic stress disorder (PTSD).

The psychological consequences may stem from the traumatic incident itself, the physiological and functional alterations caused by the injury, and the difficulties linked to the process of recuperation [5].

Psychological assessment and intervention play a crucial role in the comprehensive management of hand trauma, as they are vital in addressing the emotional well-being of patients.

PTSD is a mental condition that may manifest in individuals who have been exposed to or observed a distressing event. The condition is distinguished by a range of symptoms including intrusive thoughts, nightmares, flashbacks, heightened vigilance, and avoidance of stimuli associated with the traumatic event [6].

Recent investigations have identified the high occurrence of post-traumatic stress disorder in patients who have had hand trauma, with reported rates ranging from 8% to 24% [7].

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The cognitive, emotional, and psychosocial components of hand trauma patients might be profoundly affected by the existence of PTSD.

Bone injuries in the hand and forearm resulting from trauma are not only debilitating physically but also carry significant psychological consequences.

A myriad of studies has focused on the physical rehabilitation aspects, from fracture types to surgical interventions, but the psychological toll-such as the risk of developing conditions like PTSD-often remains underexplored.

Researchers have identified that fractures to specific bones are associated with varying levels of psychological distress, potentially impacting both short-term recovery and long-term well-being [8].

Understanding the interplay between physical trauma and psychological outcomes is essential for comprehensive patient care and targeted interventions.

The objective of the study was to assess the degree of bone injury among patients with hand and forearm trauma and examine the potential impact on their psychological well-being.

Material and Methods

A prospective study was performed at the Plastic Surgery of the Emergency County Clinical Hospital in Craiova, spanning the period from November 1, 2021 to March 31, 2023.

The selection criteria for our study were primarily focused on two factors: the presence of hand and/or forearm damage and an age range of 18 to 70 years at the time of surgical intervention.

The study eliminated those who exhibited chronic illnesses and those with pre-existing psychiatric conditions or a history of psychological disorders unrelated to hand trauma.

During the three-month post-discharge follow-up, participants were instructed to fill out the PCL-5 questionnaire, which is a tool used to evaluate symptoms of PTSD.

The study methodology underwent a comprehensive assessment and received approval from the Ethics Committee in order to assure adherence to the principles outlined in the Helsinki Declaration of 1975.

The research underscored the ethical significance of voluntary participation, and prior to commencing the study, informed agreement was sought from every participant.

The dataset utilised for analysis encompassed a range of characteristics seen during hospitalisation, with a particular focus on bone trauma such as fractures and amputations. Additionally, evaluation scale ratings at the three-month post-discharge follow-up were included in the analysis. In the evaluation of post-traumatic stress disorder in individuals who have experienced hand trauma, standardised measures were employed, such as the Posttraumatic Stress Disorder Checklist for DSM-5 (PCL-5) [9].

The PCL-5 is a powerful tool for evaluating the severity of symptoms encountered in post-traumatic stress disorder by examining four symptom clusters: intrusion, negative modifications in cognition and mood, avoidance, alterations in arousal and reactivity.

Two methodologies were employed in order to establish a probable diagnosis of PTSD. The methodology involved a minimum score of 38 [10], combined with the presence of at least one symptom from category B, at least one symptom from category C, at least two symptoms from category D, and at least two symptoms from category E [11].

Two unique subgroups were identified based on the PCL-5 scores. The first category, referred to as PTSD (+), consisted of patients who satisfied the diagnostic criteria for posttraumatic stress disorder according to DSM-5. The second cohort, referred to as PTSD (-), consisted of patients who did not meet the diagnostic criteria for PTSD.

The data was subjected to processing and statistical analysis in order to ascertain any potential correlations among the parameters. The statistical analysis employed in this study encompassed the application of the Chi square test ($\chi 2$) and T test. The chosen level of significance was established at a p-value threshold of less than 0.05.

Results

The study encompassed a sample size of 166 individuals, ranging in age from 18 to 70 years at the point of diagnosis.

The patient group exhibited trauma aetiology characterised by crush injuries, injuries resulting from tool usage, injuries stemming from road accidents, and injuries caused by glass fragments.

The assortment of tools comprises a grinder, chainsaw, electric scissors, circular saw, knife, cutter, and axe.

In addition to bone trauma, certain patients also presented with injuries to the vessels, nerves, and tendons.

However, this study will just focus on bone trauma.

Out of the entire cohort of 166 cases, a comprehensive assessment and surgical diagnosis revealed that 38 patients presented amputations, while 80 patients presented with fractures at different anatomical sites.

In terms of the extent of partial amputation, it was seen that 6 patients experienced amputation of finger 1, 7 patients experienced amputation of finger 2, one patient experienced amputation of finger 4, while finger 5 was affected in a single patient (Figure 1).

Additionally, 3 patients experienced amputation of a metacarpal bone.

Thirteen patients underwent complete amputation of finger 3, whereas four patients underwent complete amputation of finger 4, and three patients underwent complete amputation of finger 1.

Out of the total sample size of 166 patients examined, 86 individuals, accounting for 51.8% of the participants, were identified as probable having PTSD based on the established criteria.

Conversely, the other 80 patients, constituting 48.2% of the sample, were classified as not having PTSD.

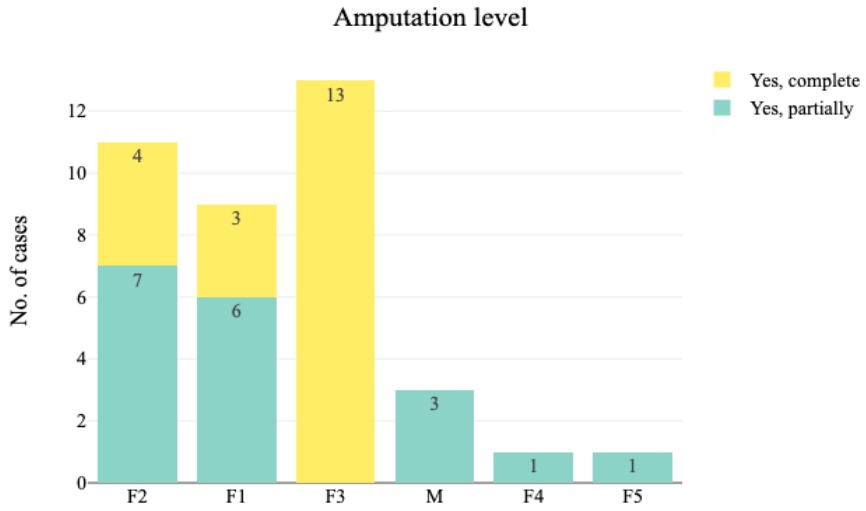

Figure 1. Amputation level. F1=finger 1, F2=finger 2, F3=finger 3, F4-finger 4, F5=finger 5, M=metacarpal.

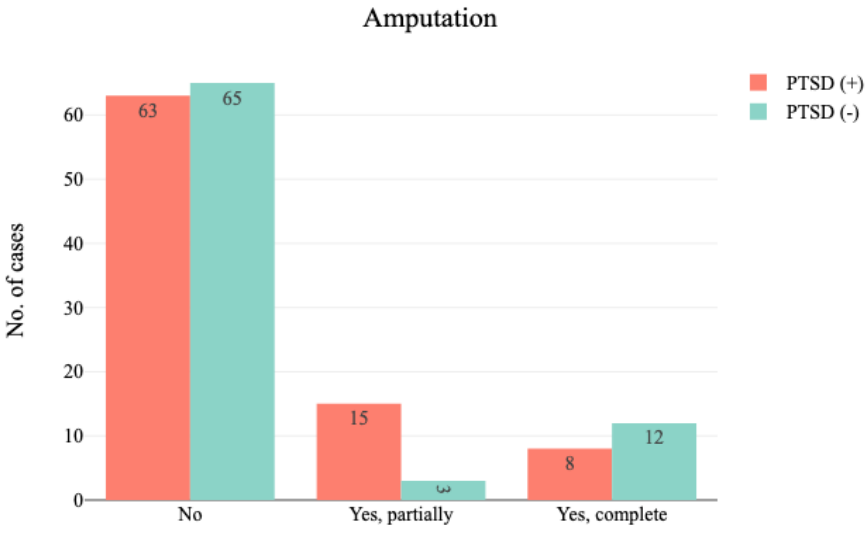

Figure 2. Presence of amputation and probable diagnosis of PTSD.

A chi-square test was conducted to examine the relationship between the probable diagnosis of PTSD and the presence of amputation (Figure 2).

A statistically significant association was seen between the two parameters, as indicated by the chi-square test ($\chi^2(2)=8.63$, $p=.013$), indicating that amputation may play a role in the PTSD development.

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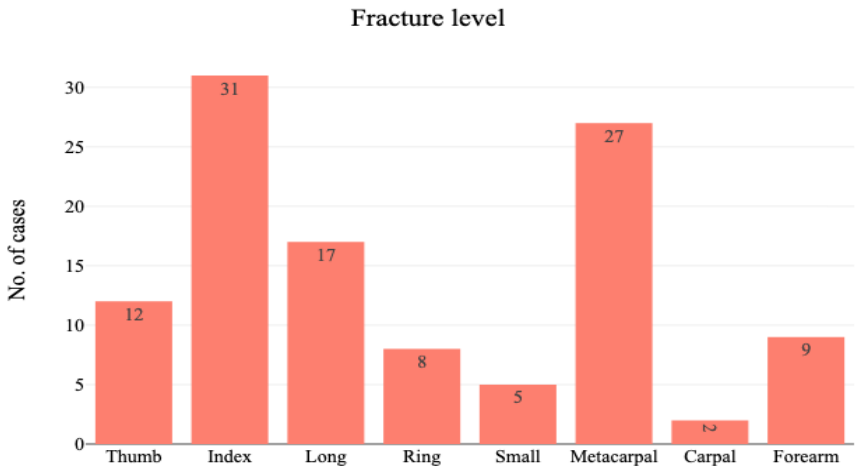

Figure 3. Anatomical site of fracture.

We considered it important to ascertain the precise level where the fractures occurred in patients presenting with complicated trauma (Figure 3).

A total of 12 patients had fracture in the thumb, 31 patients in the index finger, 17 patients in the long finger, 8 patients in the little finger, 5 patients in the small finger, 27 patients in a metacarpal bone, 2 patients in the carpal bone (scaphoid), and 9 patients in the forearm.

Table 1. The phalanges injuried in each finger.

Phalanx / Finger	*Thumb*	*Index*	*Long*	*Ring*	*Small*
P1	6	8	3	5	0
P2	6	20	6	1	2
P3	-	6	5	2	3

The collected data in the evaluation of hand bone injuries distinguishes between the phalanges of individual fingers (Table 1).

In relation to the thumb, the first digit, there were a total of six injuries seen at the proximal phalanx (P1), while a notable count of 20 injuries was recorded at the intermediate phalanx (P2).

The index finger, often known as the second digit, had a total of 8, 6, and 6 injuries at the P1, P2, and P3 phalanges, respectively.

The third digit, sometimes referred to as the "long finger," had a distribution of three injuries at phalanx P1, one injury at phalanx P2, and five injuries at phalanx P3.

The fourth digit, commonly referred to as the ring finger, exhibited damage counts of 5, 2, and 2 along the P1, P2, and P3 phalanges correspondingly.

The fifth digit, sometimes referred to as the "small finger," exhibited no injuries at the proximal phalanx (P1), but presented with injuries at the middle phalanx (P2) and distal phalanx (P3), with two and three injuries respectively.

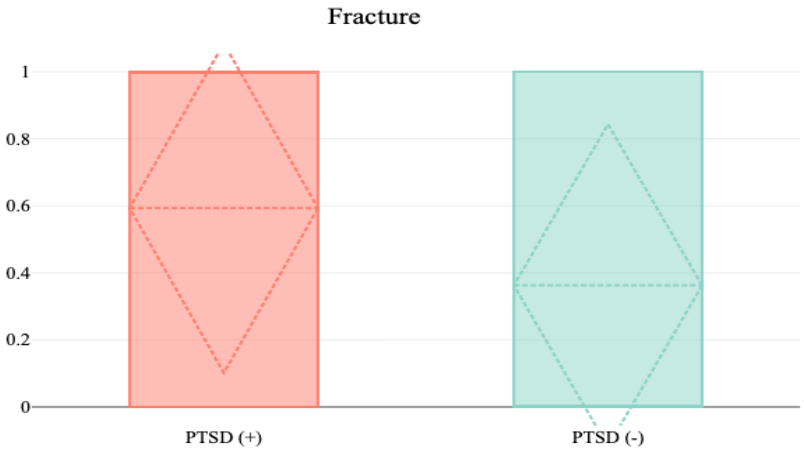

Figure 4. Presence of fracture and PTSD association.

A two-tailed t-test was conducted to examine the statistical significance of the difference between individuals with symptoms of PTSD (+) and without PTSD (-) in relation with the presence of fracture. The results indicated a statistically significant difference, t(164)=3.03, p=.003, with a 95% confidence range ranging from 0.08 to 0.38.

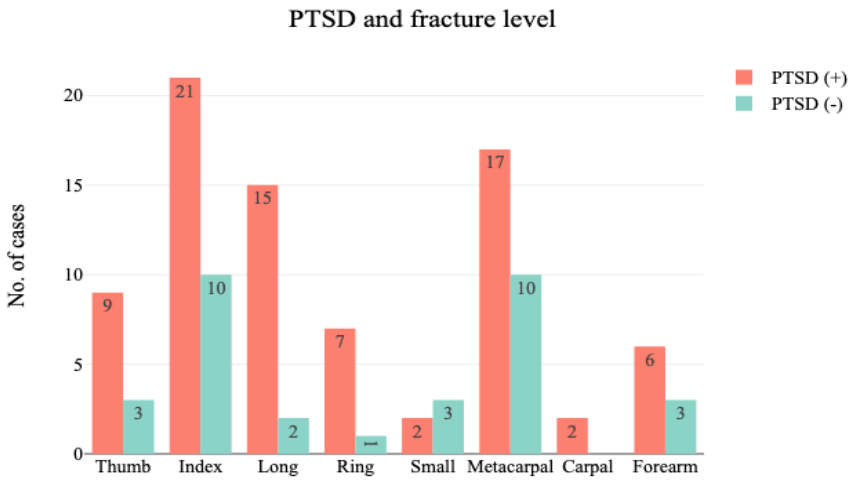

Figure 5. Fracture level and PTSD decision.

A two-tailed t-test for independent samples was conducted to examine the presence of a statistically significant association between the anatomical site of fracture and post-traumatic stress disorder (Figure 5).

The findings indicated that there was a statistically significant difference between individuals with PTSD (+) and those without PTSD (-) in terms of the Index (t(158.58)=2, p=.047, 95% confidence interval [0, 0.24]), Long finger (t(114.69)=3.34, p=.001, 95% confidence interval [0.06, 0.24]), and Ring finger (t(114.01)=2.14, p=.034, 95% confidence interval [0.01, 0.13]).

There was no statistically significant link observed between the Thumb, Small finger, Metacarpal, Carpal, or Forearm bones and symptoms of PTSD.

However, it is plausible that a larger sample size may be necessary to obtain more conclusive results.

Discussion

Hand trauma, particularly when it is complex, encompasses more than just physical harm.

It carries significant psychological ramifications that can have a profound impact on an individual's overall well-being.

The hand, as an essential instrument for human contact, expression, and functionality, occupies a pivotal position in an individual's self-perception and their engagement with the surrounding environment.

As a result, lesions to this essential anatomical location might give rise to a series of psychological difficulties.

The findings of our study indicate a noteworthy association between post-traumatic stress disorder and the occurrence of amputations and fractures specifically affecting fingers 2, 3, and 4 in patients.

The occurrence of amputation is frequently accompanied by significant psychological distress, stemming from both the precipitating factors and the immediate consequences.

The enduring and observable quality of the loss functions as an ongoing stimulus of the trauma, rendering these individuals especially susceptible to the development of post-traumatic stress disorder PTSD [12].

Bone injuries in hand trauma vary in severity and complexity, but certain types are more likely to be psychologically distressing, thereby increasing the likelihood of PTSD development.

The psychological repercussions often hinge not only on the physiological damage but also on the circumstances of the injury, such as high-energy impacts in vehicular accidents, or traumatic experiences like assault.

The present descriptive summary highlights the distribution of bone injuries among individual fingers, emphasising the unique patterns and heterogeneity in the incidence of injuries among the different anatomical site.

Fractures of the phalanges are common in hand trauma and can occur in a variety of settings,

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such as work-related accidents, falls, and sports injuries.

Depending on the severity and the complexity of the fracture, these can be significantly distressing for the individual.

A recent study identified phalangeal fractures as among those injuries that can be associated with the development of PTSD symptoms, especially if they involve dislocation or multiple fractures [12].

Although our study did not yield statistically significant results regarding the relationship between metacarpal, carpal or forearm fractures and symptoms of PTSD, it is important to note that this lack of relevance may be attributed to the relatively smaller sample size of these fractures in our study population.

Metacarpal fractures, particularly of the dominant hand, are often debilitating and require surgical intervention.

These fractures can occur in various circumstances, including blunt force trauma and high-energy impacts.

The degree of debilitation and the need for surgery often contribute to the development of PTSD symptoms, particularly if the recovery is protracted [13].

Fractures involving the joint surfaces (intra-articular fractures) are particularly worrisome both from a functional and psychological standpoint.

They often result in prolonged immobilization and extensive physical therapy, thereby heightening the risk for developing PTSD due to the protracted recovery period and the functional limitations imposed [14].

Injuries involving multiple components, like fractures associated with tendon or nerve injuries, are highly distressing and have a higher likelihood of precipitating PTSD.

The complexity and severity of these injuries often necessitate multiple surgeries and a prolonged period of rehabilitation, which can contribute to the manifestation of PTSD symptoms [15].

Injuries resulting from high-energy trauma, such as car accidents or industrial machines, are not only physically severe but also psychologically distressing.

These circumstances themselves can be traumatizing, and the resultant bone injuries serve as a constant reminder of the traumatic event, thus predisposing the individual to PTSD [16].

Conclusions

The examination of the psychological consequences associated with bone injuries in the hand and forearm has resulted in valuable findings that have substantial implications for clinical practise.

The data highlights the variability in injury patterns among various phalanges and fingers, thereby uncovering both physical and psychological intricacies.

The data presented in our study indicates that there are variations in damage rates among the phalanges, and these frequencies also differ significantly between individual fingers.

The observed heterogeneity underscores the necessity of implementing treatment plans and conducting psychological assessments that take into account the precise anatomical location of the damage.

Considering the constraints of this study, such as the small sample size and the limited range of psychological assessments administered, it is recommended that future investigations endeavour to delve more extensively into these dimensions.

Longitudinal studies that investigate the enduring effects of these injuries have the potential to provide significant and essential insights.

For achieving the best results, it is crucial to adopt a comprehensive approach that combines both physical and psychological care.

The prompt detection of symptoms associated with PTSD and prompt psychological assistance, potentially before surgical reconstruction, can significantly facilitate the process of rehabilitation.

Conflict of interests

None to declare.

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