

Epidemiology of Hand Injuries That Presented to the Emergency Department of a Tertiary Care Facility in Suburban Mumbai, India: A Study Including 489 Patients

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Abstract

Background: Hand injuries are very common and responsible for a significant number of emergency department (ED) visits, most of which are not to hand specialists [1]. The functionality and outcome of hand injuries can vary significantly depending on the mechanism and pattern of injuries, which is why it is imperative for emergency physicians to recognize the complexities, and the potential repercussion of missed injuries in such cases. **Objective:** The aim of this study is to provide epidemiological information on hand injuries and their patterns. The objective is 1) to assess whether most hand injuries are superficial (simple), or involve underlying deeper structures (complex) and 2) to assess whether most hand injuries presented to the emergency department were managed by the emergency physician or plastic/orthopaedic surgeon. **Methods:** This retrospective single-centre observational study conducted at an emergency department in a tertiary care hospital in Mumbai, India collected data from hand trauma patients using a standardized documentation form. Demographic data, trauma-related data, and disposition plans were analysed. **Results:** A total of 489 cases sustained hand injuries over a period of one year. The patients were predominantly males in the 20 - 30 year age group and injuries were mainly sustained over the right hand. Most of the injuries were sustained at home (42%). The most common mechanism (34%) was sharp object injury (including needle-stick and other sharps in hospital), followed by blunt injury (30%). Among grievous hand injuries, door jamb was a mechanism noted in 11% of patients, accounting for 50% of all crush injuries. Lacerations were the most common pattern (24.7%) noticed, followed closely by fractures (23.3%). Digits II - IV were injured most

commonly (54%), followed by carpals (14%) and the thumb (10%). Nearly 80% of the hand injuries were managed by emergency physicians alone, with 61% of cases involving superficial structures. Though 14% of the cases required plastic surgery intervention, the initial evaluation of all these patients was performed by the emergency physician. **Conclusions:** Our study highlights the burden of hand injuries on the emergency physician, as well as the odds of missed injuries, directly indicating the necessity of a thorough anatomical knowledge of the structures of the hand, and in turn, a proper physical examination. A dedicated registry for hand trauma would help quantify the mechanism and pattern of injuries, and formulate preventive strategies.

Keywords

Emergency Department, Hand Trauma, Trauma Registry, Emergency Medicine

1. Introduction

The hand is one of the most commonly injured body parts [2], with accidental hand injuries being very common. Hand injuries alone account for 5% - 10% of cases of annual ED visits [3]. Owing to the complexity and intricacy of the structures involved, even seemingly minor injuries can significantly hamper the functionality of the hand, and thereby the individual [4]. This is especially important when the dominant hand is affected [5].

After a grievous hand injury, the functionality of the hand can be so impaired, that it works as little more than an assist limb if all fingers and thumb have been amputated. If the digital length is maintained but the opposable function of the thumb is lost, the hand functions broadly is a sensate hook [6] [7]. It is only with the return of the opposable thumb that prehensile motion (*i.e.* the ability to reach out and grasp) is restored. Reconstructive efforts can restore partial or complete function of the hand to a much greater degree than lower extremity reconstruction can restore function of the foot and leg [8]. But while prosthesis is extremely functional in the lower extremity, native functional sensate tissue is irreplaceable in the hand [9]. This is precisely why mutilating hand injuries are known to significantly affect the quality of life index [10].

There are not many injuries that rival the injured hand in complexity and intricacy [11]. Accidental injuries of the hand, are unfortunately common. Initial assessment and pattern of injuries can give a clue as to whether underlying deeper structures such as tendons and nerves are damaged. Furthermore, the mechanism of injury itself can predict the pattern and depth of injury [12]. Therefore, history-taking and initial assessment are crucial in the management of hand injuries. Although definitive management of hand injuries involving damage to deeper structures is usually managed by plastic surgeons, all injuries presenting to the ED are initially reviewed by the ED physician. This is why thorough knowledge of the hand anatomy, and an understanding of the pattern

and mechanism of injury is crucial from an emergency physician's perspective.

2. Aim & Objectives

The aim of the study was to assess the common mechanisms and patterns of hand injuries presented to the emergency department of a tertiary care hospital in suburban Mumbai, India. The primary objective was to assess whether most hand injuries were superficial (simple), or involved underlying deeper structures (complex). The secondary objective was to assess whether hand injuries presenting to the emergency department of a tertiary care hospital are predominantly managed by the emergency physician or the plastic/orthopaedic surgeon.

3. Materials and Methods

1) Study design

The study was designed as a retrospective single-centre observational investigation. It was conducted at an emergency department of a level 1 hospital in India (Kokilaben Dhirubhai Ambani Hospital and Medical Research Institute, Mumbai). Data was collected on attendance of the primary author (F.V.) over a 12-month period during the years 2016 to 2017. Prior to initiation, ethical approval was granted by the Institutional Review Board of Kokilaben Dhirubhai Ambani Hospital, Mumbai. The study was performed according to the principles of the Declaration of Helsinki 1996. The rights of the participants were not violated, and sufficient measures were described in the protocol for protecting confidentiality of data and privacy of each research participant. Since this is a strictly epidemiological and retrospective study, waiver of consent was applied for, and obtained.

2) Selection criteria

Patients of all age groups with any hand injury who presented to the emergency department (Kokilaben Dhirubhai Ambani Hospital, Mumbai) within the time period of this study, and for whom documentation with the "Hand Trauma Pro-forma" sheet (**Table A1**) was available, were included. Re-admissions were not included.

3) Data collection

A "Hand Trauma Pro-forma" documentation sheet (**Table A1**) was designed by the primary author (F.V.) of the Department of Emergency Medicine, Kokilaben Dhirubhai Ambani Hospital, Mumbai, to specifically document data of hand trauma patients. Data collection was done retrospectively from the emergency department census register, and discharge papers. The following variables were selected from this paper-based documentation sheet: "age" (metric), "gender", "occupation", "handedness" (right/left), "injured hand" (right/left/both), "circumstance of injury" (occupational/leisure/sport/domestic), "mechanism of injury" (grinder/door jamb/sharp object/animal bite/burns/road accident), "type of injury" (laceration/puncture/crush/avulsion/amputation/fracture), "zone of injury", "affected structures" (superficial tissue/nail bed/tendon/vessel/bone), "intervention

by” (emergency physician/plastic surgeon), and “disposition” (admitted/discharged/discharged against advice).

4) Data analysis

A descriptive analysis of the data was done by invoking frequency of the parameter. The results are presented in chart and tables using Microsoft Excel software.

The numeric data is summarized by descriptive statistics. For ordinal type data, the analysis was done by the Wilcoxon rank-sum test. For statistical significance of numeric data, t-test has been used. The categorical data is summarized by frequency count and percentage, and significance is analysed using Fisher’s exact test. Correlation analysis has been done using the Pearson and Spearman correlation test. A *p* value less than 0.05 has been considered statistically significant.

4. Results

1) Demographic data and patient characteristics

A total of 489 patients (male 276, female 213) with a mean age of 21.05 ± 9.69 years (Range: 1 - 100) presented to the emergency department during the study interval and were included in this investigation. The distribution of age with regards to gender of patients is shown in **Figure 1**.

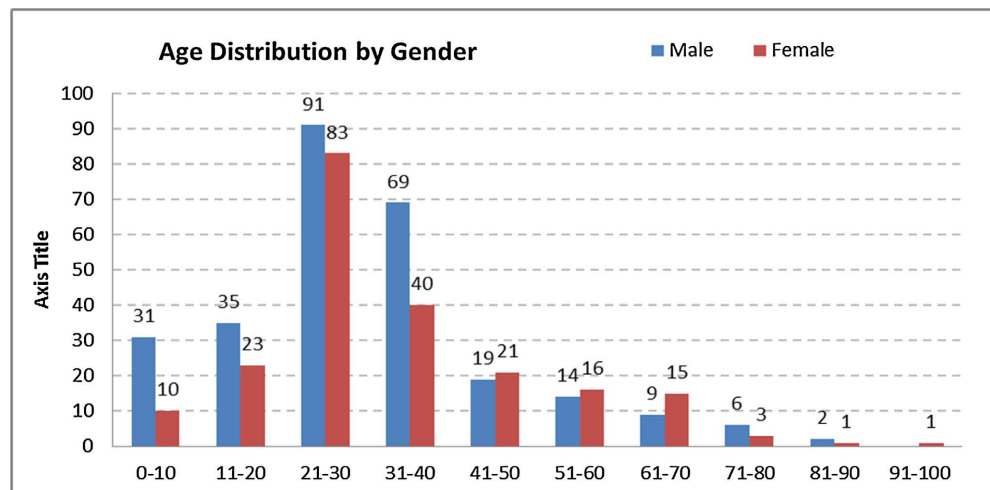


Figure 1. Distribution of age with regards to gender.

2) Trauma and circumstance of accident

While most patients were right-handed (94.8%, $n = 464/489$), both the left and the right hand were injured with similar frequency (left: 42%, $n = 205/489$; right: 57%, $n = 278/489$; both 1%, $n = 5/489$). Domestic household injuries were reported most commonly (42%, $n = 205/489$), followed by outdoor injuries (30%, $n = 146/489$); recreational injuries constituted 10% of the total injuries seen ($n = 49$). Sharp cuts and blunt trauma accounted for nearly equal frequencies of mechanism of injury (34%, $n = 166/489$; 30%, $n = 146/489$) respectively. Need-

dle-stick injuries at the hospital where this study was conducted accounted for 24% of all sharp cuts ($n = 40$). A distribution of the mechanism of injuries is represented in **Figure 2**. Animal bite wounds accounted for 8% of hand injuries ($n = 40/489$), with dog attacks resulting in 66% of these cases ($n = 26/40$). There were 19 cases of burns, majority of which were thermal (55%, $n = 10/19$). A sociocultural pattern was noted in the distribution of burn injuries to the hand, which were predominantly sustained due to bursting firecrackers in the month of November, coinciding with the Indian festival of Diwali.

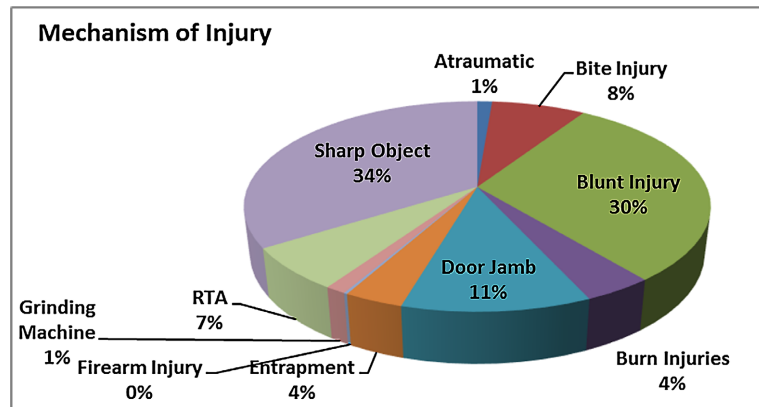


Figure 2. Distribution of the mechanism of injuries.

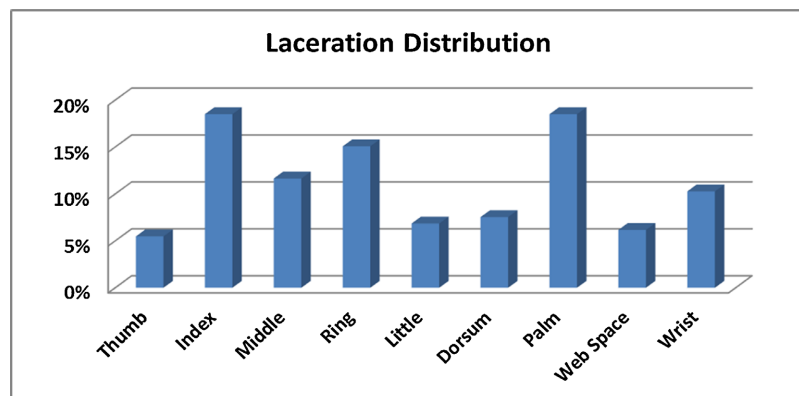


Figure 3. Mechanism of injury causing lacerations.

3) Type and pattern of injury

Lacerations and fractures were the most common types of injuries (24.7%, $n = 121/489$; 23%, $n = 114/489$) respectively. **Figure 3** and **Figure 4** show the mechanisms causing lacerations and fractures, respectively. Amputations constituted 5% of the total injuries; **Figure 5** shows the distribution of amputation injuries to the hand. Among the 489 patients in the study, 7 cases had developed cutaneous abscesses as a complication of the hand injury within 72 hours of sustaining the trauma (1.43%) (**Figure 6**). 1 patient had a missed hamate fracture, and 1 patient had a missed tendon injury. Both these cases were subsequently seen in the plastic surgery OPD. Re-implantation surgeries were done in 3 cases, with favourable outcomes. Amputations were most commonly sustained over

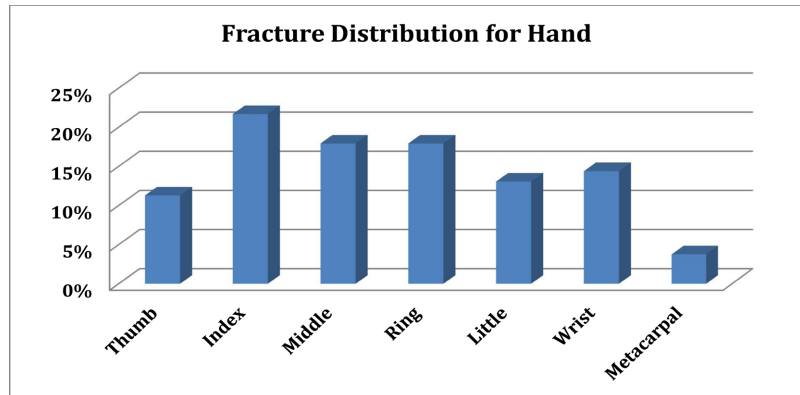


Figure 4. Mechanism of injury causing fractures.

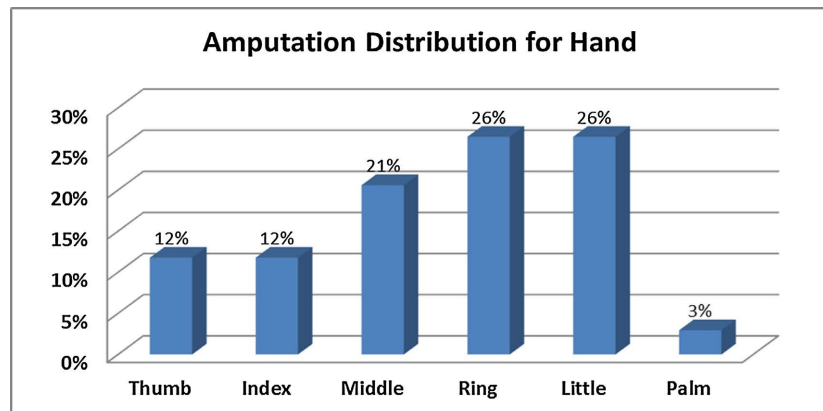


Figure 5. Distribution of amputation injuries to the hand.

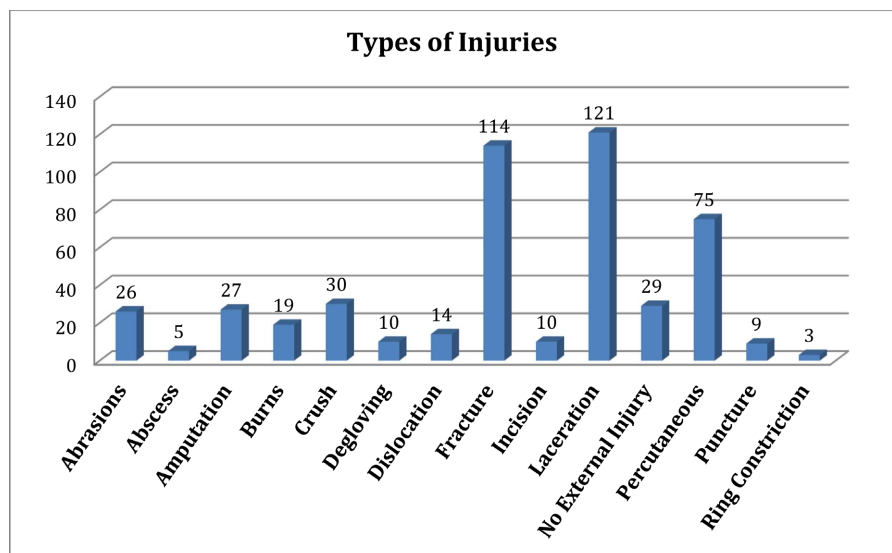


Figure 6. Pattern of hand injuries.

the ring and little fingers, followed next by the middle finger. Most amputations were sustained at the level of the terminal phalanx (Zone 1). Least common site of amputation among the study population was at the mid-palmar level (Zone 3). Door jamb injuries were the most common cause of amputations (33%, $n =$

8/24), comprising more than one-third of all cases, followed by entrapment (22%, $n = 5/24$). All patients with amputation were advised admission under plastic surgery for wound revision and closure. Re-implantation surgeries were successfully performed in 3 cases, mainly to preserve the hallux.

4) Distribution of injuries

The index finger (18%, $n = 88/489$), middle finger (15%, $n = 73/489$), and ring finger (14%, $n = 68/489$) were noted to be most frequently injured; as shown in **Figure 7**.

5) Structures involved

Skin and soft tissue involvement were the most frequent (61%, $n = 298/489$). Fractures constituted one-fourth of all cases (25%, $n = 122/489$) **Figure 8**.

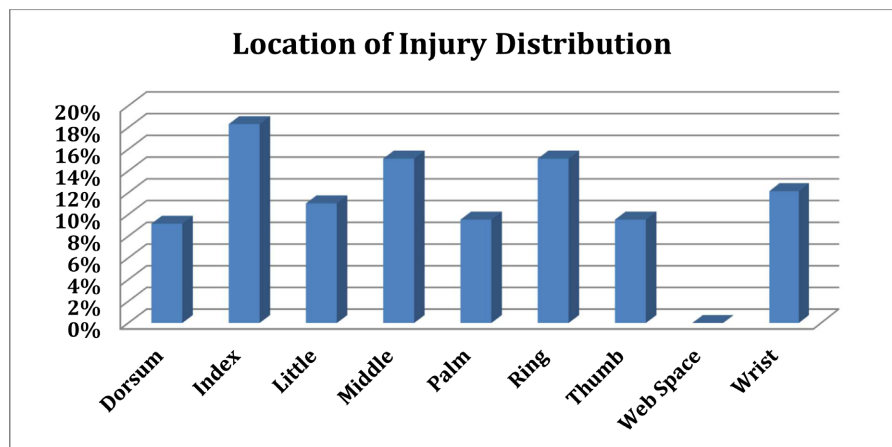


Figure 7. Distribution of injuries.

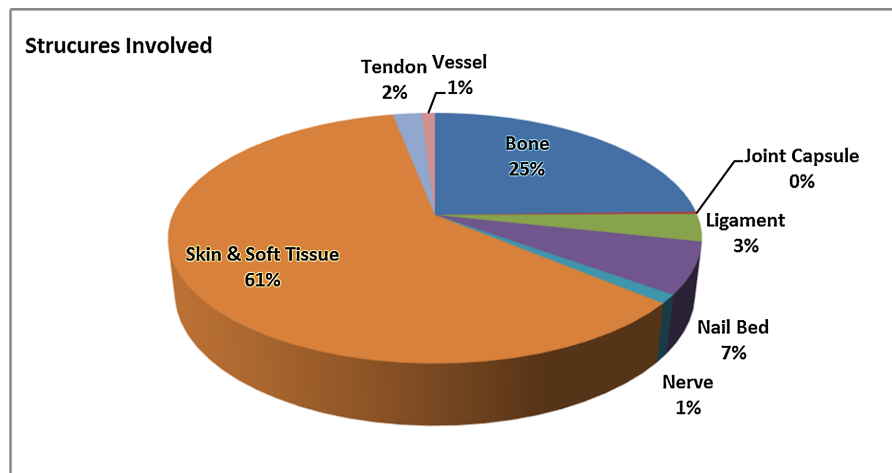


Figure 8. Structures involved.

6) Disposition

Of the total 489 patients presenting to the emergency department, 391 patients were managed independently by emergency physicians **Figure 9**. 68 patients required admission under a plastic surgeon, but primary assessment and management were performed by emergency physicians. There was one case of a

missed hamate fracture, and one case of a missed tendon injury, both of which were subsequently picked up on follow-up by plastic surgery. 39 patients requiring wound revision left against medical advice, and 1 patient was referred to a Burn Centre owing to extensive thermal burns concomitant with the hand injury.

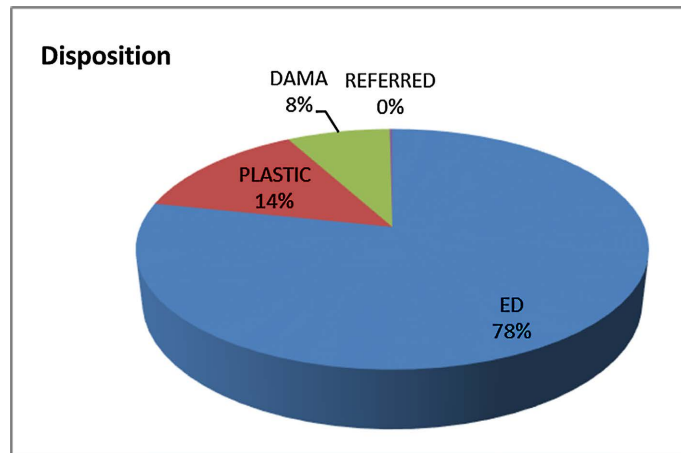


Figure 9. Disposition from the emergency department.

5. Discussion

Despite the burden of hand injuries, there is a paucity of studies conducted in the Indian subcontinent. Globally, a significant number of studies pertaining to hand injuries have been conducted at industrial work places, which restricts the pool of patients, and has an intrinsic bias in terms of the demographics and occupation, and thereby the mechanism, pattern and severity of injuries. It is essential to understand that the pattern of hand injuries will vary greatly according to the given population and place where the study is conducted. Even within a given social strata, different subsets will sustain different injuries. Also, no studies have been done at a tertiary care hospital in suburban Mumbai. A lack of epidemiological studies hampers hospitals from formulating protocols and also underestimates the burden of grievous hand injuries in a given society or a subset of the given society.

To date, there is a lack of standardized guidelines for documenting hand injuries in an acute setting [13] [14]. Due to the insufficient documentation, data on hand injuries are not readily available in order to perform detailed epidemiological analysis, patterns of injuries or their localizations. The aim of this study was to determine injury patterns, frequency, severity and localization of injury in hand trauma patients who referred to a single-centre emergency department of a level 1 hospital in Mumbai, India. In addition to this, the study aimed at depicting differing situational causation of injuries to the hand, with their disposition from the emergency department.

The collected data portrays that the majority of hand injuries occur during domestic household activities. According to statistical analysis from the Federal Institute for Occupational Safety and Health of Germany, it is confirmed that

accidents occurring during leisure time or at home, account for as much as 72% of a total of 9.73 million injuries [15]. There are no such studies nor data available currently from the Indian subcontinent. These findings are confirmed by other studies conducted in Europe, where household accidents alone accounted for 39% and leisure accidents for 36.3% of all injuries [15].

Hand injuries can result in significant disability limiting participation in societal activities and work. An evaluation of hand trauma in France for the year 2008 showed that 35% of injuries resulted in incapacity for work [16]. The importance of recording the epidemiological differences throughout this data is imperative in order to highlight the relevance of improvement of preventive measures and allocation of health care services and thus, to reduce the socio-economic costs of medical care and sick days due to incapacitation.

From the data, it appears that the “typical patient” presenting to the emergency department had no gender disparity. The male-to-female sex ratio was approximately 1.3 to 1, which was not similar to another study conducted by Hill *et al.* who analysed data from 4873 hand and wrist injuries of Northern Ireland’s Trauma Centres (2.2:1) or Butala *et al.* (1.5:1) from the U.S. who described 1147 cases from a Level 1 trauma centre [17] [18]. The mean patient age of the study population in this investigation was 21.05 ± 9.69 years, as against the mean age of 39.46 ± 17.69 years, which we found in the literature available [19]-[21]. However, data can vary, as studies reporting sports injuries show younger study populations [22], compared to those reporting work-related injuries exclusively [23]. Our study highlighted a broad range of age in the population presenting to the emergency department, further emphasizing the challenges in coping with young children with hand injuries, and how they can never be underestimated.

The importance of training emergency medicine residents in the basics of hand surgical examination needs to be further emphasized. Clinical examination revealed a “superficial wound” without damage of any imperative anatomic structures, with 14% of patients being admitted for hand surgery under a plastic surgeon. The rate of missed tendon/bony injury was 0.40%. However, it is important to note, that from the patients with injury to deeper structures (tendon/bone), 3% of injuries were missed.

6. Limitations

One of the major limitations of the study was the area where the study was conducted *i.e.* a tertiary care hospital in an upscale suburban locale. This has a bias in terms of the socioeconomic class of the patients seen, the mechanism and hence the pattern of injury. The results of this study therefore, cannot be extrapolated to other areas. The other limitation of the study is that since this was a retrospective study, the hand dominance and occupation of all the patients could not be ascertained. Since the study had a significant number of injuries to the left hand as well (44%), it would have been noteworthy to see the hand domi-

nance in the study population.

7. Conclusions

Considering the enormous burden and the complex nature of hand injuries, a better understanding of the behavioural and socioeconomic risk factors potentially associated with these kinds of injuries can help identify individuals most at risk, and thereby formulate preventive measures to reduce their occurrence. In this regard, a dedicated registry for hand trauma would help quantify the mechanism and pattern of injuries, and formulate preventive strategies.

It is the understanding of the authors that most emergency physicians with exposure to hand injuries must have a wide base of knowledge when it comes to the complex anatomy of the hand, as well as a thorough clinical examination of hand injuries. The combination of these two factors will ensure prompt evaluation, and reduce the chances of missed injuries.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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Appendix

Table A1. Hand trauma pro-forma documentation sheet.

UHID:		Date:
Age:	Gender:	Occupation:
Injured Hand:		Dominant Hand:
Place of Injury: Home/Outdoors/Occupational/Recreational/ Other		Mechanism of Injury: Grinder/Do Jamb/Animal Bite/MVA/ Burns/Sharps
Type of Injury: Amputation/Avulsion/Fracture/Crush/ Laceration/Puncture		Location of Injury: Right/Left Palm/Dorsum/Thumb/Index/ Middle/Ring/Little Finger/Terminal Phalanx/Wrist
Structures Involved: Soft Tissue/Nail Bed/Bone/Tendon/ Nerve/Vessel		
Intervention by: EM Physician/Plastic/Orthopaedics		
Disposition: Discharge/Admission/DAMA		