



## Pattern of hand injuries during peace time activities in troops and their management at a tertiary care hospital

### KEYWORDS

epidemiology, hand injuries, training, troops

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**ABSTRACT** **Introduction :** Hand injuries resulting from work, training and sports related accidents are daily happening in troops. Management of hand injuries are important to preserve the complex functions of hand & its social importance.

**Material and methods :** A retrospective analytical study design was used to evaluate our experience. All patients reporting to Plastic & Reconstructive surgery department of the hospital during Apr 2014 to Mar 2016, including transfer in from other zonal and forward hospitals were included in the study. The injured hands were assessed for cause of injuries, involvement of skin, soft tissues, bones, joints and neurovascular bundles, and final outcome after standard management protocols.

**Results :** A total of 278 patients with different hand injuries were treated during the study period. The most common mechanism of injury was crush resulting from handling of machinery and heavy equipment during routine working. Sports related injury were second most common cause. There were fair share of trivial accidents at home as well. The median duration of wound to heal and return to work was ten weeks.

**Conclusion :** Hand injuries are common in men and most are occupationally related. Needless to say that occupational safety programs must be improved. The characteristics of traumatic hand injuries in our hospital were very similar to those seen worldwide, except for a higher incidence due to flour kneading machine accidents.

### Introduction

"Hand injury can be complicated by deformity from no treatment, stiffness from overtreatment, & both deformity & stiffness from poor treatment". (Swanson 1970).

Traumatic hand injuries are among the principal types of injuries in serving personnel. These injuries refer to any acute damage caused to the hand by an external agent. Any injury to the hand, continues to be a challenge to the treating surgeon, as correct clinical judgment and decision regarding management thereof can affect the final functional outcome<sup>1</sup>. Generally they are managed as a trivial injury and treated accordingly causing permanent deformity and disability. Hands are frequently affected by work, training and domestic accidents<sup>2</sup>. During war/ Counter Insurgency operations scenario hand injuries result from crush, gun shots and blast. These wounds exhibit a spectrum of complexity and may include extensive soft tissue trauma complicated by burns, foreign bodies, fractures and amputations. However, in peace time deployment of the troops, the most common mechanisms of injury are blunt trauma (e.g., crush injury, contusions, and abrasions), laceration, avulsion, ring avulsion, and burns. Besides skin and superficial tissues, many muscles, ligaments, and tendons of the hand are vulnerable to injury, as are the nerves and blood vessels that supply these structures. Damage to these structures may create permanent functional and/or sensory deficits specific to the site of injury. The aim of this study was to determine the characteristics of these injuries in troops during peace time deployment, reporting to a tertiary care hospital and their management. The study is also aimed to find suitable prevention plan to avoid such injuries.

### Material and methods

The study was designed as a retrospective descriptive analytical study. The patients included in the study were serving soldiers referred/transferred from peripheral hospitals or directly admitted to the Plastic and Reconstructive ward of a tertiary care hospital in India. The Centre of the hospital is a 25-bedded unit with 24 hour availability of Operation Theatre. A total of 303 patients with various type of hand injuries were admitted and managed during the study period from April 2014 to March 2016. However, only 278 patients were included in present study as patients who were lost to follow up or where follow up period was less than six months were excluded from the study. The patients managed as out-patients were also excluded from the study, being trivial injuries.

Informed consent was obtained from each patient. A detailed clinical history was recorded. The demographic and epidemiologic data were recorded for each patient. A proper history of trauma would indicate the extent of damage. The hand dominance was recorded and documented for the purpose of rehabilitation and compensation. Thorough examination of all digits for circulation, sensation, ROM of joints, and functioning of intrinsic & extrinsic muscle groups were carried out. A plain radiograph of the injured hand in two different views were taken whenever a joint dislocation or fracture was suspected.

The patients were treated with standard protocol of wound debridement, suturing of lacerations, repairs of tendons, fracture fixation, neurovascular repairs and final cover in form of skin grafts or flaps as deemed necessary for the treatment of injury. The aim was to cover all raw areas within five days of injury to prevent secondary infection. Depending on the injury and wound conditions, tendons and nerves were repaired at the time of primary or secondary skin closure. Although nerves and tendons may be repaired in the primary phase of care, their management was secondary in importance to thorough cleansing and debridement, correct stabilization of fractures and dislocations, and wound closure or coverage with skin grafts or skin flaps. All open contaminated wounds received parenteral or oral antibiotics at the initiation of treatment based on standard hospital antibiotic policy or available culture reports. After initial treatment, the hands were kept elevated and the patients were encouraged to perform movements of the fingers and hand to prevent oedema and stiffness within first 24 hours post- surgery, except in those where split skin grafts were used over the fingers. The patient who underwent flexor tendon repair were placed in Klienert's dynamic splint on first post- operative day. The Kirschner wires (K-wires) for fracture fixation were removed at the end of three weeks, whereas Joshi's External Stabilization System (JESS), used for open fracture fixation, were removed at the end of fourth week.

The end point of treatment was healing of wounds, with or without skin grafts or flaps, healing of fractures and movement regain of small joints of affected digits as the case maybe. Patients were re-assessed at 01 month, 06 months and 12 months of injury for complete functional recovery or any residual disability.

### Results

Only male serving soldier were included in this study. A total of 2189

patients reported to A&E department of the hospital, out of which 278 were included in this study, resulting in an incidence of 12.7%. The age range varied from 17 years to 58 years, with an average age of 28.4 yrs. 43 (15.5%) patients were young recruits. 261 (94%) patients were right-hand dominant, though most common hand injured was left (70%). This is due to usage of left hand holding the object while right hand being used for cutting or hammering. The average delay in transfer and reporting from peripheral hospitals was three days.

The commonest injury in this study was metacarpal and phalanx fractures which was responsible for 80 injuries (28%). This was followed by 68 (24%) flexor tendon injuries, 38 (13%) crush injuries, 38 (13%) traumatic amputations, 26 (9%) burns involving hands, 16 (6%) grenade and cracker blast injuries, 16 (6%) extensor tendon injuries and 6 (2%) electric injuries as depicted in figure 1. The mechanism or cause of injury remained highest during routine working in units in 112 patients, followed by sports related injuries in 72, combat related injuries in 62 and domestic accidents in 32 patients as in figure 2. The main cause of routine working injury was due to lifting of heavy equipment in 61 (22%), working on flour kneading machines in 31 (11%), by broken glass window panes during cleaning activities in 11 (4%) and grass cutting machines in 6 (2%). None of the patients were wearing any protective or industrial grade gloves while moving heavy equipment or boxes. Another glaring observation being all those who have sustained injuries on flour kneading machines were troops returning from leave and during early morning hours, implying poor understanding and training of the machine. Interestingly no cook suffered injury from flour kneading machines, indicative of their better understanding and handling of the machine.

The anatomical distribution as indicated in figure 3. Involvement of thumb and palm results practically in a non-functional hand till wounds heal completely. The duration of wound healing ranged from 02 week to 08 weeks, with an average of 4.4 weeks. The complete functional return averaged 10 months with complex hand injuries. However, in severe hand injuries in 16 patients with multiple bony and tendon involvements, there were incomplete or poor functional recovery even at the end of a year.

The soft tissue coverage has been indicated in figure 4. The lacerations were closed primarily in 62 injuries, split-skin or full-thickness skin graft cover in 78 injuries, local flap cover in 58 injuries and regional/ distant flap cover in 27 injuries. The fracture management is depicted in figure 5. The fractures of phalanges and metacarpals were managed conservatively in 20 injuries, K-wire fixation in 22 injuries, external fixation with JESS in 16 injuries and mini-plate fixation in 22 injuries.

There were a total of 84 tendon injuries, flexor tendon in 68 and extensor tendon in 16 injuries. The management of tendon injuries is indicated in figure 6. Primary repair was done in 27 injuries (31%), delayed primary in 25 (29%), secondary repair in 18 (21%) and secondary reconstruction in 16 (19%) injuries.

The complications are indicated in figure 7. The commonest complication at end of one month follow up being hand stiffness and decreased range of motion of small joints in 46 hands. There was pain at the site of surgery or injury in 26 hands. There were small abscess formations, mostly in palmar injuries in 11 patients. There was failed re-implantation or revascularization resulting in loss of six digits. There was loss of two hands, one because of high voltage electrical injury and another because of a bad crush injury.

## Discussion

Hand injuries are common occurrence and account for 5-10% of cases reporting to emergency departments of most hospitals. The mechanism of injury being work related blunt trauma, road traffic accidents or assaults<sup>3-4</sup>. Similar incidence has been noted as non-combat traumatic hand injury in combat zone<sup>5</sup>. This study has shown

similar results. These injuries results in work hour loss for at least eight weeks<sup>6</sup>. Injuries occurring at home and at work where machines were not involved, were simpler as compared to complex injuries occurring in handling heavy warfare equipment and machines<sup>5</sup>. The routine window pane cleaning activity resulted in cut injuries resulting in tendons and neuro-vascular injuries. Rehabilitation of these patients ranged from eight to twelve months with incomplete sensory recovery<sup>5</sup>.

The commonest injuries were fractures of phalanx and metacarpals as shown in other studies<sup>7,8</sup>. The simple closed fractures had a better outcome than open comminuted fractures<sup>8</sup>. Most of open fractures resulted due to fall of heavy boxes or machinery over the hand resulting in various patterns of crush, laceration, and tissue loss. The management of these injuries involves multiple procedures, immobilization, and rehabilitation<sup>5</sup>. Herein lies the importance of protective industrial grade gloves while handling heavy machinery for the serving personnel. This is more important for recruits of engineer regiments while undergoing bridge laying exercises.

The training of troops in usage of machines needs to be emphasized through administrative channels, as observed from accidents involving flour kneading machines. These flour kneading machine with capacity of 10 to 20 kg are mostly being used at company level cook house or at isolated detachments. Most of the injuries involving these machines were complex resulting in longer time for complete recovery and at time resulting in amputation of digits.

The tendon injuries take more than three to six month recovery period, with some requiring tendon reconstruction prolonging the recovery period up to twelve months. Even after successful tendon repair at surgery, complications commonly occur including adhesion formation, tendon rupture and stiffness of the joints<sup>9,10</sup>.

## Conclusion

Despite standard operating procedures in place at unit and company levels regarding safety during training and routine activities, hand injuries continue to be a major noncombat issue in most militaries of the world<sup>5</sup>. The famous military saying of "you lose less blood in war, if you sweat more in peace" aptly applies here. The standard of safety at training is paramount to avoid unnecessary man hour loss during peace time deployment.

Having said that it is also important for residents and young surgeons to learn and practice the nuances of surgery of hand injuries as delay in treatment will result in poor outcome<sup>11,12</sup>. With increasing urbanization and mechanization hand injuries are going to increase further and so does need to provide treatment for functional recovery at the earliest.

## Conflicts of interest

Authors has none to declare.

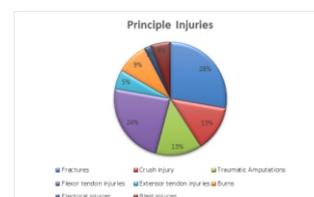


Figure 1 Distribution of principle injuries

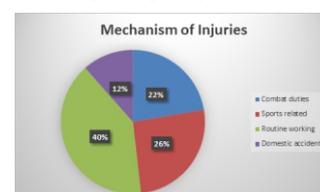


Figure 2 Distribution of mechanisms of injuries

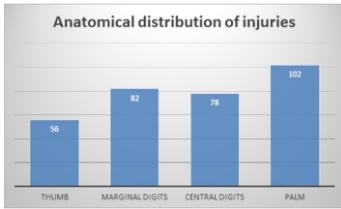


Figure 3. Anatomical distribution of injuries

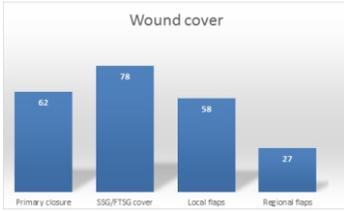


Figure 4. Wound cover

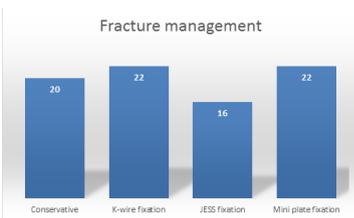


Figure 5. Fracture management

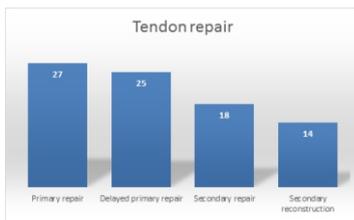


Figure 6. Tendon repair

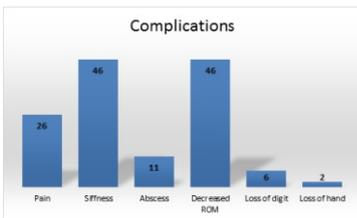


Figure 7. Complications



Figure 8. Grass cutting machine accident and its management.



Figure 9. Crush injury of hand with complex injury and its management

References

- Chong KS. Principles in the management of a mangled hand. *Indian J Plast Surg* 2011;44:219-26
- Chau N, Bhattacharjee A, Kunar BM. Lorhandicap Group: Relationship between job, lifestyle, and age and occupational injuries. *Occup Med (Lond)* 2009;59(2):114-9.
- Trybus M, Lorkowski J, Brongel L, Hladki W. Causes and consequences of hand injuries. *Am J Surg*. 2006 Jul;192(1):52-7.
- Hung LK, Choi KY, Yip K, Chan J, Leung PC. Recent changes in the pattern of hand injuries in Hong Kong: A regional hospital survey. *Hong Kong Med J*. 1997 Jun;3(2):141-148
- COL Michael A. Miller, MAJ Brian T. Hall, CPT Francis Agyapong, CAPT Kenneth J. Kelly, CPT Todd McArthur. Traumatic Noncombat-Related Hand Injuries in U.S. Troops in the Combat Zone. *MILITARY MEDICINE* 2011; 176, 6:652.
- Wong JY: Time off work in hand injury patients. *J Hand Surg [Am]* 2008; 33(5):718-25.
- Ghosh S, Sinha RK, Datta S, Chaudhuri A, Dey C, Singh A. A study of hand injury and emergency management in a developing country. *Int J Crit Illn Inj Sci* 2013; 3:229-34.
- Pun WK, Chow SP, So YC, Luk KD, Ip FK, Chan KC, et al. A prospective study on 284 digital fractures of the hand. *J Hand Surg Am* 1989;14:474-81
- Ting J. Tendon injuries across the world. *Injury*. 2006; 37:1036-42.
- M Griffin, S Hindocha, D Jordan, M Saleh, W Khan. An overview of the management of flexor tendon injuries. *Open Orthop J*; 2012; 6:28-35.
- Anakwe RE, Standley DM: Hand injuries at a British Military Hospital on operations. *J Hand Surg Br* 2006; 31(2):240-3.
- Smurr LM, Robinson M, Smith-Forbes E: Treating the war casualty: case reports of polytrauma. *J Hand Ther* 2008; 21(2):177-87.