



Original Research Article

Occupational injuries and hand - An experience of 182 cases

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ABSTRACT

Aims: To observe the demography of hand bone fractures and the surgical procedure outcome and to observe the anatomical site of individual metacarpal and phalangeal fractures with machine related injuries.

Settings and Design: This is a retrospective record analysis of 182 cases of hand bone fractures associated with occupational related injuries.

Materials and Methods: Records of traumatic hand bone fractures irrespective of age and sex referred from the emergency dept were reviewed. The records of pure soft tissue injuries of hand and burns were excluded. Data were analyzed and projected in the form of tables and figures.

Statistical Analysis: Cross tabulation for the entire pattern was done, due to many variables statistical significant analysis could not be derived.

Results: There were total 182 cases of which (90%) males, (9%) females and 2 cases where gender was not mentioned. Most of the age group were young adults (15 to 25yrs) with machine contact related injuries. Of machine related injuries, 29% had cutting machine injuries followed by press punching machine (27%). The most common phalanx involved in all categories of occupational injuries was distal phalanx.

Conclusions: Most of the hand bone fractures were noted in the right hand of young males with compound fracture of distal phalanx being more commonly involved; most of them had multiple finger involvement. Cutting and press punching machines caused severe crush injuries, ending up in high number of revision amputation than concrete mixer and heavy objects fall on hand. Hence extra care and safety features with supervision by experts are required while operating these types of machines.

Shaft of metacarpal and proximal phalangeal fracture were more commonly involved as per individual site analysis.

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1. Introduction

Hands are very important for our daily living, they are injured in many ways due to changing human lifestyle and occupational related, mainly by machine contact, the disability arising out of such hand injuries are immense.^{1,2} Occupation related hand injuries have more serious consequences than any other organs.³ Hand injuries occur mainly during industrial activities, but they can occur at various venues also.⁴ The present study aimed to

collect data on hand bone fractures like age, sex, site, side, fingers involved, surgical procedures done and the specific anatomical sites involved in occupational related injuries.

2. Materials and Methods

This is a retrospective record (descriptive) analysis of 182 cases of hand bone fractures. All the records of traumatic hand bone fractures irrespective of age and sex were reviewed. The records of pure soft tissue injuries of hand without bone fractures and hand burns were excluded from the study. All the data were analyzed and projected in the

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form of tables and figures.

Table 1: Gender distribution in occupational injuries

| Gender | Number | Percent |
|---------|--------|---------|
| Male | 164 | 90% |
| Female | 16 | 9% |
| Unknown | 2 | 1% |
| Total | 182 | 100% |

Table 2: Age distribution – Occupational injuries.

| Age | Number | n% |
|---------|--------|-----|
| 0-14 | 10 | 8 |
| 15-25 | 84 | 40 |
| 26-35 | 40 | 20 |
| 36-45 | 19 | 11 |
| 46-55 | 9 | 5 |
| 56-65 | 4 | 4 |
| >65 | 2 | 3 |
| unknown | 14 | 9 |
| total | 182 | 100 |

Table 3: Mechanism of injury

| Type of machines | Number | Percent |
|----------------------------|--------|---------|
| Press punching | 34 | 19 |
| Concrete mixer | 15 | 08 |
| Heavy objects fall on hand | 27 | 15 |
| Moulding machine | 5 | 3 |
| Vehicle related injury | 3 | 2 |
| Machine belt injury | 6 | 3 |
| Door crush | 11 | 6 |
| Unknown | 44 | 24 |
| Total | 182 | 100 |

Table 4: Anatomical site of fractures- occupational injuries

| Anatomical site | Number | Percent |
|-----------------|--------|---------|
| Metacarpal | 8 | 4 |
| Proximal Phx | 32 | 17 |
| Middle phx | 11 | 6 |
| Distal phx | 78 | 43 |
| Multiple | 32 | 17 |
| Unknown | 21 | 18 |
| Total | 182 | 100. |

Table 5: Type of injury (Closed or Open)

| Type | Number | Percent |
|---------|--------|---------|
| Closed | 1 | 0.5 |
| Open | 160 | 88 |
| Unknown | 21 | 11.5 |
| Total | 182 | 100 |

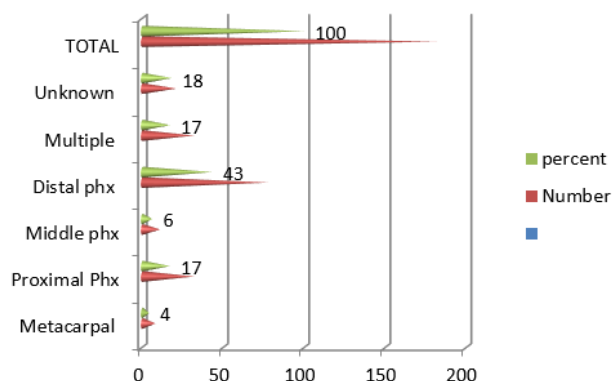


Fig. 1: Anatomical site of fractures

Table 6: Side of hand injured– Right or Left

| Side | Number | Percent |
|---------|--------|---------|
| Right | 78 | 43 |
| Left | 64 | 35 |
| Both | 0 | 0 |
| Unknown | 40 | 22 |
| Total | 182 | 100 |

Table 7: Fingers injured in occupational injuries.

| Finger | Number | Percent |
|----------|--------|---------|
| Thumb | 21 | 11.5 |
| Index | 34 | 19 |
| Middle | 17 | 9 |
| Ring | 15 | 8.5 |
| Little | 18 | 10 |
| Multiple | 48 | 26 |
| Unknown | 29 | 16 |
| Total | 182 | 100 |

Table 8: Surgical procedures performed

| Procedure | Number | Percent |
|--------------------------|--------|---------|
| ORIF with K wires | 30 | 16 |
| Tacking sutures | 47 | 26 |
| ORIF with rigid fixation | 3 | 2 |
| Revision amputation | 51 | 28 |
| CRIF with k wiring | 0 | 0 |
| C.R with splinting | 0 | 0 |
| SSG and FLAP | 24 | 13 |
| Multiple procedures | 11 | 6 |
| Unknown | 16 | 9 |
| Total | 182 | 100 |

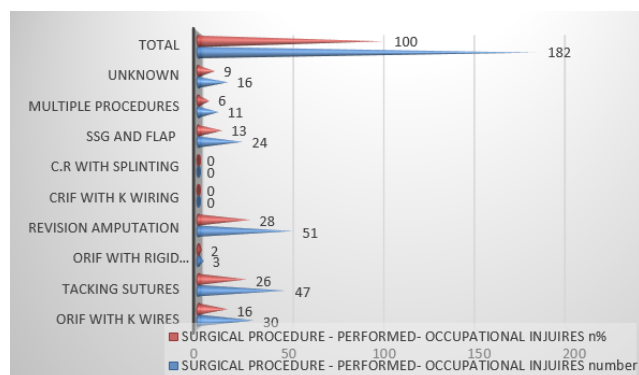


Fig. 2: Surgical procedures performed

3. Results

There were 182 cases, of which males were (90%), (9%) females and 2 cases where gender was not mentioned. The most common age group affected in our study is between 15-25 yrs. In machine related injuries, of the total 127 cases excluding the unknown and door Crush, 29% had cutting machine injuries followed by press punching machine 27% and 12% had heavy objects fall on hand. Anatomical site of fracture showed that the most common phalanx involved in all categories of occupational injuries was distal phalanx. In occupational related injuries, 45.6 % had right hand bone involvement and 34% had left hand bone involvement. on analysis of fingers injured, most commonly, multiple fingers(26%) were involved followed by index finger. Figure 2 shows that cutting machine injuries ended up with revision amputation in 48 % of pts, suturing were done in 19% of pts. In press punching machines, revision amputation were done in 41% of pts followed by multiple procedures to salvage the finger with ssg(split skin grafting) and flap cover in 23% of pts.

4. Discussion

Injuries of the hand are most common³⁻⁶ and are most commonly related to industrial accidents^{3,7} which are grievous injuries and leads to permanent disability.⁸ Young adults employed in industrial areas are bread winners of the family and it is important to devise preventive measures to avoid such incidents. The most common age group affected in our study is between 15-25 yrs [refer Table 2], which resembles the studies done by Rohini et al which showed 54% in the age group of 16 - 25 years. In Canada 44% were in the age group of 10 - 19 years,^{1,9,10} 29% were between the ages of 21 and 30 by the Hong Kong group.¹¹ The hand is one of the most commonly injured body regions in children.² In our study 69% of the total cases were under the age of 35 yrs excluding the unknown cases. In the study by Serinken M, 78% were below 35 yrs.

The mean age in our study is 28 yrs, upon comparison to the study done by Davas et al the mean age is 30 years, Serinken M showed the mean age 27.8 ± 6.1.

Gender distribution in our study had a 90% male preponderance [refer Table 1], studies by Davas et al

shows 83%, by Rohini et al 62% , Hong Kong group 93% , Serinken M 87.2% showed frequencies of male preponderance. Among occupational workers most of the injuries happened due to contact with machinery [refer table 3]. Davas et al showed that 46.6 % injuries had contact with machinery, Rohini et al showed that nearly 80% of hand injuries are work place injuries. Study by Serinken M showed industries involving metal and machinery constituted 41.4% of all injuries.

In machine related injuries, we observed that of the total 127 cases excluding the unknown and door crush, 29% had cutting machine injuries followed by press punching machine 27% and 12% had heavy objects fall on hand. Similar observations were done by Hong Kong group which showed cutting injuries as more commonly involved, followed by work with power presses and grinding injuries. In the china group power press injuries were responsible for most crushes 45.2%.¹² Rohini et al showed hydraulic machines were involved in 25%, while cutting and grinding machines were 29%, 18% respectively.

Analysis of occupational related injuries to anatomical site of fracture showed that the most common phalanx involved in all categories of occupational injuries was distal phalanx [refer Table 4, Figure 1], except concrete mixer machines were multiple bones with proximal phalanx and distal phalanges were involved with equal frequency. In cutting machine, press punching machine and heavy objects fall on hand, the distal phalanx is the most common bone injured. Similar observations were seen in studies done by Rohini et al, which showed distal phalanx as the most commonly injured bone in hand at 13%, whereas Serinken M showed that proximal phalanx (23.9%) fractures were most commonly involved. In a study done by van onselen et al phalanges were the highest proportion of fractures in the hand followed by metacarpal.¹³ Anakwe showed that metacarpal bone of the small finger is the most commonly fractured bone in the hand in the United Kingdom.^{14,15}

We observed that not much difference were seen in the side of hand involvement for occupational related injuries with 45.6 % had right hand bone involvement and 34% had left hand bone involvement [refer Table 6]. Similar observations were seen in study by Rohini et al with 42.5% had right hand injury, 17.5% had left hand injury. China group showed that, 45.5% had right hand affection while 52% affection was to the left hand. Amsterdam study also showed that right hand was involved as often as the left. Most of the hand injuries in our study were open injuries accounting to 88% [refer Table 5]. Most of the studies have recorded cut lacerations as the highest frequency injuries

in work place caused by machines e.g. Serinken M, Hong Kong group.

In our study on analysis of fingers injured, most commonly, multiple fingers(26%) were involved followed by index finger (18%)[refer Table 7]. In study done by Rohini et al same observations were done with patients having multiple finger injuries were commonly noted followed by index finger.

Upon detailed analysis of our surgical outcome with specifics of individual machinery, cutting machine injuries ended up with revision amputation in 48 % of pts, suturing were done in 19% of pts.

In press punching machines, revision amputation were done in 41% of pts followed by multiple procedures to salvage the finger with ssg (split skin grafting) and flap cover in 23% of pts. [Refer Table 8, Figure 2]. In concrete mixer machines bony stabilization were achieved in 26% of pts and suturing were done in 33% of pts, revision amputation were done only in 6% of pts (patients). Salvagibility with these type of machine contact were possible in more number of cases. In injuries caused by heavy objects fall on hand, bony stabilization were achieved in 33% of pts and suturing were done in 29.6% of pts, revision amputation were done only in 7% of pts. In the Hong Kong group the commonly performed procedure were suturing (n=372) and dressings, revision amputations were also performed .In the study by Rohini et al 19.7% have undergone simple suturing, bony stabilization were done in 18% and 17.8% had undergone revision amputation. In the study by Trybus 52.8% required revision amputation and staged resurfacing was performed in 18 pts, with bony stabilization done in 10 patients. As there were multiple anatomical site of fractures in individual hand bones, each site were counted and numbered accordingly and have been classified with a detailed analysis in our study.

Among the Metacarpal fractures the most common site of fractures were found in shaft {n=20}.

In the distal phalanx the most common site of fractures were seen in distal part of distal phalanx (n= 51). In the middle phalanx the most common site of fracture were found in the head of middle phalanx (n= 20).In the proximal phalanx the most common site of fracture were found in the shaft n=23.

In the distal phalanx of thumb the most common site of fracture were found in the distal part (n= 12). In the proximal phalanx of thumb the most common site of fracture were found in the head (n= 6). In the metacarpal of thumb the most common site of fracture were found in the shaft (n=3).

5. Conclusion

We conclude that the pattern of fractures noted were in young adult right handed males with compound fracture of distal phalanx more commonly involved followed by

multiple finger involvement. The predominant surgical procedures done were revision amputation in cutting and press punching machines. Bony stabilization and suturing were done more commonly with concrete mixer and heavy objects fall on hand. Hence cutting and press punching machines are very dangerous in causing severe crush and ending up in high number of revision amputation than concrete mixer and heavy objects fall on hand. This shows that extra care and safety features with supervision by experts are required while operating these types of machines. Analysis of individual sites of metacarpal and phalangeal fracture revealed that shaft was involved more commonly in metacarpal and proximal phalanx. The head of middle phalanx and the distal part of distal phalanx were commonly involved.

6. Abbreviations

PTS- Patients, Phx- phalanx.

7. Key Messages

The first step in devising preventive measures for occupational hand injuries is to study the demography of such injuries.

8. Source of Funding

None.

9. Conflict of Interest

None.

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