Volume : 5 | Issue : 11 | November 2016 • ISSN No 2277 - 8179 | IF : 3.508 | IC Value : 69.48

Original Research Paper

Reconstruction of Hand Injuries Caused by Wood Working Machines

Plastic Surgery

KEYWORDS :

Dr Sheeja Rajan T M — Associate Professor,Department of Plastic Surgery,Govt Medical College, Kozhikode * Corresponding Author

ABSTRACT

Powered tools employed in wood working industry can result in a spectrum of hand injuries.75 cases of hand injuries reporting to the plastic surgery department over a 2 year period were evaluated. The injuries involved mostly right dominant hand of young men (16-25 years) in the volar aspect involving Verdan flexor zones II or V . 18% had multiple level injuries, which were cut injuries in 40%, crush in 23% and avulsion in 20%. Index finger was most susceptible to amputation (n=11). Meticulous repair of tendons, nerves and blood vessels were needed. Wound closure was done either primarily (n=38) or with skin graft and flap reconstructions (n=34). Wood planer machines used without safety precautions as well as personal factors were implicated as risk factors for the injuries. A classification system to document and report the injuries and provide a protocol for proper management, as well as to spread awareness to prevent such injuries and is proposed.

Introduction :

The Malabar coast of Kerala is renowned for its exotic locales, rich culture and vibrant history as well as its traditional timber industry. Kallai was the bustling nerve centre of timber trade but equally famous are Beypore for its wooden ships called Urus, Nilambur for its teak reserves and Kottakkal for its furniture exports. The busy timber trade involves non ergonomic working conditions with many powered tools. Needless to say, hand injuries in woodworkers are considered to be an occupational hazard.

The powered tools commonly employed in timber trade include- Wood planers, Sanding machines, Shapers, Jointers, Routers, Band saws and circular saws.A variety of hand injuries are possible with these machines.For eg: high speed metal saws with narrow set of teeth cause clean cut injuries whereas the table rip saws and chain saws with their blunt teeth cause more of crush avulsion injuries.A spectrum of injuries to the volar and dorsal aspects of both dominant and non dominant hands are possible with these machines. A study was done to analyse the aetiology ,the nature and predisposing factors resulting such injury. The magnitude of the injuries as well as the surgical management was also considered in each case.

Materials and Methods :

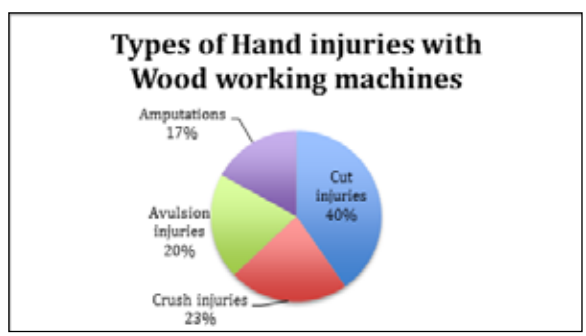
75 cases of hand injuries reporting to the plastic surgery department over a 2 year period were selected for the study.Evaluation of the injuries were done on the basis of the parameters of age ,sex, socioeconomic class, hand dominance, comorbid conditions & risk factors, nature of injury-Cut /Crush /Avulsion or Amputation, location as well as the structures involved –Skin/Soft tissue/nail tendon/ nerve/vessel/bone/joint.

Results :

Considering the mean age distribution, 33 % of our patients were in the 16-25 years age group,18% were between 26-35 years,16 % between 36-45 years and 7% in the 46-55 years age group .82 % injured their dominant hand, 18% injured the non dominant hand.

26% patients had injuries in the volar aspect, 9% in the dorsum and 18% had combinations of volar and dorsal injuries. In 18% cases, injuries were located at the wrist level whereas the rest had sustained digital injuries. Index finger was injured in 21% cases, middle and ring fingers in 18% followed by little finger in 12% cases. The thumb was injured only in 11 %.

18% cases had either Verdan's flexor zones II or V injuries followed by Zone I at a close 17%. Midpalm was spared in most cases with a Zone III and Zone IV injuries at 2% and 3% respectively.However 18 % patients had injuries at multiple levels. A large majority had clean cut injuries (40.3%),followed by crush(22.7%), avulsion(20%) and amputations(17%)(*figure 1*).Index finger suffered the most amputation injuries (n=11),middle (n=3) ring (n=2) and one case of partial thumb amputation.



Considering the structures involved,we found that 33% cases had injured their flexor tendons and 7% their extensor tendons. Being the most superficial tendon, Palmaris longus was involved in most cases followed by Flexor digitorum superficialis, flexor carpi radialis, flexor digitorum profundus, Flexor pollicis longus and flexor carpi ulnaris. Among the extensor tendons, the extensor digitorum communis was injured in 5 % cases ,the first compartment tendons in 1% cases.17 cases had nerve injuries, 7 were ulnar nerve injuries, 6 were median nerve injuries and 4 cases had digital nerve injuries. There were 12 cases of vascular injuries, 7 sustained cut injuries to ulnar arteries, 4 to radial arteries. There was an isolated case of superficial palmar arch injury.33% of our patients had some sort of skeletal fractures, there were a lesser frequency of dislocated or open joints, 3% had sustained bone loss.

Management protocols in each case was influenced by the number & nature of structures damaged. Priority was given to the preservation or restoration of length of fingers, joint movements, mechanical stability of hand, retention of protective sensations and early return to work.

Wound closure was attempted with Primary repair in 72 cases and delayed repair in 3 cases. 38 of the injuries could be closed primarily, 34 needed tissue cover with grafts or a various types of flap reconstruction.(Table 1)

Volume : 5 | Issue : 11 | November 2016 • ISSN No 2277 - 8179 | IF : 3.508 | IC Value : 69.48

Types of Reconstructive surgery used for Repair of Hand injuries caused by wood working tools	
Primary wound closure	38
Skin grafting	11
Cross Finger Flaps	8
V-Y advancements	6
Reverse Cross finger flap	2
Thenar flap	2
First dorsal metacarpal artery (FDMA)flap	2
Oblique triangular flap	2
Fillet flaps	2
Posterior interosseous flap	1
Hypogastric flap	1
Random abdominal flap	1

Standard techniques of repair of all injured structures were done *(Figures 3&4).* Flexor tendons were repaired by Modified Kessler Core suture & epitenon sutures, while Extensor-tendons were repaired by continuous suture technique. Nerve injuries were managed by epineural coaptation sutures, with cable grafts whenever necessary. Revascularisations were done with micro vascular sutures for arteries and veins, with vein grafts in select situations. Bone reconstruction involved open reduction and internal fixation, K wiring with iliac crest bone graft in areas with segmental bone loss. Most of the surgeries were done under axillary block though wrist and digital nerve blocks were also attempted wherever appropriate. Early Active mobilization could be instituted in 75% patients . Rest received delayed mobilization especially in bone fixations .Average hospital stay of these patients were less than 1 week in 89%. 11% were adviced longer hospitalisations due to minor dehiscences, infections or to facilitate physiotherapy.

Figure 2 : Planer machine cut injury wrist involving multiple flexor tendons, nerves and arteries

Figures 3 & 4 : Postoperative hand with functional recovery after revascularisation and repair of nerves and tendons

Discussion :

Human hand is an evolutionary miracle. With its unique engineering and prehensile abilities, hand helps us undertake a variety of intricate and complex tasks. We use our hands to explore our environment. Unfortunately, this unique dexterity makes our hand prone to one among the most frequent injuries worldwide, constituting between 6.65% to 28.6% of all injuries and 28% of injuries to the musculoskeletal system (1). These occur at workplace, home and in traffic accidents. Workplace injuries to the hand most commonly occur while operating a machine (2)

According to Garg et al, Occupational hand injuries refer to all hand injuries suffered by manual workers (skilled/semiskilled/unskilled) while on duty. [3] Such injuries can result in permanent or temporary disabilities leading to the loss of productive working hours and impose a heavy burden on the society. This is especially so because, most of the victims are young males who are quite often, the sole breadwinners of the family. In our study, all the patients were exclusively males with majority of injuries in 16-25 years age group, probably because they are less familiar with the job's nature and could be more reckless. This is consistent with findings in epidemiologic studies from around the world regarding risk of injuries at work. (4-10)

Five transient risk factors in the causation of occupational acute traumatic hand injury are unusual performing equipment/materials, using a different work method to do a task, doing an unusual task, being distracted, and rushing to get work done.(3) Personal risk factors like smoking and regular alcohol consumption, medical illnesses, poor eyesight, long working hours and somnolence are also pose significant risk. (1-5) We found that none of our patients were using personal protection like gloves or employing safety devices on the machines like guards or automatic arresting devices.

In our study 82% had injured their dominant right hand .In contrast, 42.5% of dominant hand injury and 17.5% of non-dominant hand injury has been reported by R.Prasad et al [1]). In our study, mode of injury was found to be cut injury followed by crush and avulsion injuries, whereas in the aforementioned study, there is a reversal of pattern of injury as crush (33%), cut/slicing (23%) .In comparison in the Hongkong based study, cut injuries formed the highest group followed by crush in power press machine injury (1,3).

Among the wood working tools, hammers, chisels/gouges, and table saws are frequently reported in association with injuries, although the highest tool-specific injury rates were associated with use of jointer-planers. Garg et al in a Hong Kong study estimates the risk as 4.9 injuries per 1000 person-hours of use (3) In our study also, the highest incidence of hand injuries in wood workers were caused by planer machines.

Based on the pattern of injuries, we can propose a Classification System for Planer machine injuries of hand to help with documentation and reporting as follows:

Type I –Skin & Soft tissues only

a) Volar
b) Dorsal
c) Volar & Dorsal

Type II –with Flexor or Extensor tendon injury

A) Isolated (closed ruptures)
B) Combined

Type III – With Neurovascular injury

A) Nerve only
B) Vessel only
C) Both
D) With distal ischemia

Type IV – With Skeletal injury

A) Fractures
B) Dislocations
C) Bone loss
D) Amputations

Conclusion :

Power tools used in wood industry, especially the Planer machines are a serious occupational hazard with predisposition for severe hand injuries. A spectrum of hand injuries of varying severity are possible with the machines in a careless worker which can lead to permanent disability in young workers imposing considerable economic burden on the community. Hence meticulous repair by experienced reconstructive surgeons is mandatory for restoration of functional hand. Strict engineering & administrative controls as well as safety education & training are needed for prevention of such injuries.

References :

1. R Prasad , A Bhamidi. Epidemiology and Sequelae of Workplace Hand Injuries at a Tertiary Trauma Care Centre Surgical Science, 2014, 5, 150-158
2. Davas Aksan A, Durusoy R, Ada S, Kayalar M, Aksu F, Bal E. Epidemiology of injuries treated at a hand and microsurgery hospital. Acta Orthop Traumatol Turc 2010;44:352-60.
3. Garg, R., Chung, J. P.Y., Fung, B.K.K. and Ip, W.Y. (2012) Epidemiology of Occupational Hand Injuries in Hong- kong. *Hong Kong Medical Journal* 2012; 18, 131-136.
4. Becker,Trinkaus et al .Tool related injuries among amateur & professional woodworkers. JOEM Oct 1996;38(10)1032-1035
5. Chau N, Bhattacherjee A, Kunar BM; Lorhandicap Group. Relationship between job, lifestyle, age and occupational injuries. Occup Med (Lond) 2009;59:114-9.
6. Chow CY, Lee H, Lau J, Yu IT. Transient risk factors for acute traumatic hand injuries: a case-crossover study in Hong Kong. Occup Environ Med 2007;64:47-52.
7. Ihekire O, Salawu SA, Opadele T. International surgery: causes of hand injuries in a developing country. Can J Surg 2010;53:161-6.
8. Sorock GS, Lombardi DA, Hauser R, Eisen EA, Herrick RF, Mittleman MA. A case-crossover study of transient risk factors for occupational acute hand injury. Occup Environ Med 2004;61:305-11.
9. Justis el et al..Woodworking injuries: an epidemiologic survey of injuries sustained using woodworking machinery and hand tools. J Hand Surg Am Sep 1987;12(5 Pt 2):890-5
10. Sorock,Lombardi et al. Acute traumatic occupational hand injuries:type,location,&severity. JOEM Apr 2002;44(4):345-351