

Case Report

# Deworming the Grinder for Successful Extrication of a Mangled Hand: A Case Report

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## Article Info

Article history:

Received: 8 July 2021

Accepted: 10 October 2021

Published: 1 February 2022

Academic Editor:

Sharifah Najwa Syed Mohamad

Malaysian Journal of Science,  
Health & Technology

MJoSHT2022, Volume 8, Issue No. 1

eISSN: 2601-0003

<https://doi.org/10.33102/2022226>

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**Abstract**— Grinding machine injuries are known to cause severe mutilating injuries of the upper limb. In some cases, the machinery equipment may still be attached to the limb when the patient reaches the hospital. In treating these injuries, the patient's hemodynamic status should be the first priority of resuscitation. Following this and whenever possible, a reversal of the grinding mechanism should be done to free the limb. This would allow assessment of the extent of zone-of-injury prior to starting the surgical procedure. We report a case of a 28-year-old male who sustained a mangled hand injury that was successfully extricated from an industrial grinding machine, thereby allowing preservation of precious length of the limb during surgery. This case highlights the importance of adhering to safety precautions at the workplace to reduce the risk of potential occupational hazards when dealing with machinery equipment.

**Keywords**— Hand Injuries; Mangled Hand; Occupational Injury; Grinding Machine; Occupational Hazard

## I. INTRODUCTION

Mangled injuries of the upper limb are rare, accounting for only about 5% of all hand injuries [1]. The definition of mangled hand is injuries whereby there is significant damage to multiple structures, which threaten the function and viability of the limb. Grinding machine injuries can be potentially devastating causes of mangled limbs. This case reflects our experience of extricating a mangled hand stuck in a grinder without causing further trauma to the limb. Successful extrication lessened the degree of hand disability for the patient. We also draw attention to the safety aspects of operating dangerous machinery equipment to avoid such injuries from reoccurring.

## II. CASE REPORT

A 28-year-old factory worker sustained a crush injury of his right hand after the limb had become stuck in an industrial grinding machine. The local firefighters were the emergency service personnel that attended to the patient at the scene. They succeeded in disconnecting the machine from its base, but the grinder was still attached to the patient's right hand (Fig. 1). Upon arrival to the hospital, the patient was donning normal working clothes without any safety gear or protective gloves.

On clinical examination, the patient was alert and conscious, with a blood pressure of 170/110 mm Hg, pulse rate of 124 beats per minute, and respiratory rate of 16 breaths per minute. The patient's right hand was stuck in the grinder, with one



Fig. 1 Picture showing the right hand stuck in a grinder with a metal tray stuck in the arm



Fig. 2 Radiograph of right hand demonstrating the grinder over the right hand

mangled finger jutting out from the disconnected end of the grinder. It was impossible to see any other fingers as the hand was stuck at the level of the mid-palm onwards distally. The forearm and elbow were intact, but there was another metal tray part of the machine stuck at the arm. Clinical radiographs of the hand were not useful as the metal tray projected a large opacification obscuring the hand from the distal part to just proximal of the radiocarpal joint (Fig. 2).

As the grinder and the metal tray were forged from roughly a 2 cm thick piece of metal, the firefighting team and hospital maintenance department did not have any equipment capable of cutting through it. There was a possibility of causing further injury to the patient's hand or wrist in attempting to remove the grinder. It was thought at this point that wrist articulation was required. We searched medical literature prior to bringing the patient in for surgery to find a possible solution that would be more favourable for the patient. We found three similar cases for which successful extrication of the hand from similar types of

grinders was done by reversing the shank using a wrench [2-4].

The patient was served intramuscular tetanus prophylaxis, intravenous cefuroxime, and gentamicin prior to emergency surgery. After induction of general anaesthesia, the limb was prepared with an antiseptic solution and draped up to the shoulder level. A wrench was attached to the shank, and anticlockwise turns were done gently by the surgeon while an assistant supported the limb and metal piece (Fig. 3). The hand was eventually delivered without causing further injury to any structures proximally.

Upon removal of the hand from the worm mechanism (Fig. 4), we noted the index and middle fingers were already detached at the level of the metacarpophalangeal joint. The ring finger was not viable due to severe mutilation and comminution of bone (Fig. 5). Thorough washing with copious amounts of antiseptic solution and normal saline was done prior to wound debridement.

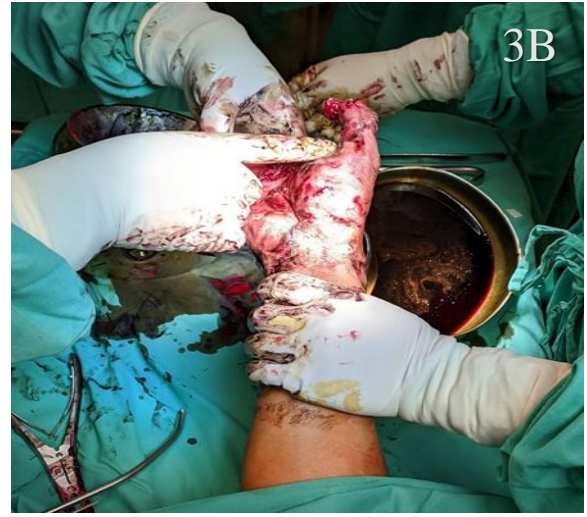


Fig. 3 Picture (A) demonstrating the wrench used to disengage the hand and picture (B) showing the hand after extraction



Fig. 4 Picture showing the worm mechanism and remnants of the severely crushed digits



Fig. 5: Pictures (A) and (B) show the appearance of the hand after thorough washing



Fig. 6 Radiograph of right hand postoperatively

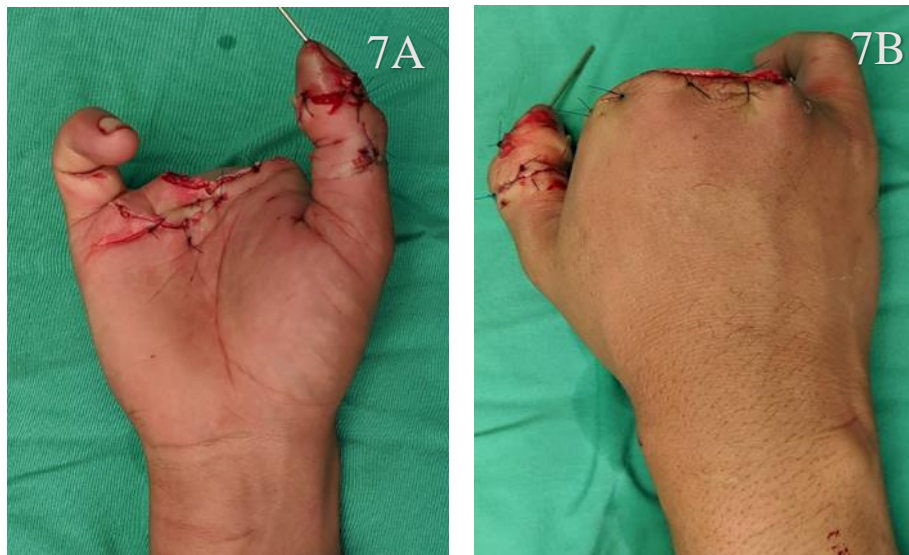


Fig. 7A-B Pictures (A) and (B) of hand after completion of wound debridement and wound closure

There was near-total amputation at the level of distal phalanx of the thumb proximal to the nail bed, with only pulp remaining attached. K-wiring was done to immobilize the distal phalanx (Fig. 6). The little finger was intact and preserved. Disarticulation of the index, middle, and ring fingers was done in a manner to ensure adequate skin flap for wound closure with minimal skin tension (Fig. 7).

The patient completed 72 hours of intravenous antibiotics after surgery and was discharged on postoperative day 3. The patient's wounds were clean, and the thumb and little finger remained viable prior to discharge. A clinic review was planned in one week; however, the patient did not attend.

### III. DISCUSSION

According to data from the Department of Occupational Safety and Health Malaysia (DOSH), workplace-related accidents and injuries were between 2.81 to 2.71 per 1000

workers from 2015 to 2019 [5]. When working with machinery equipment, it is the duty of the employee to adhere to the precautions that have been set out by the Occupational Safety and Health Act 1994. This includes wearing protective equipment and taking reasonable care of one's own safety at work [6]. Negligence or failure to adhere to the safety aspects of working with machinery can cause occupational injuries in our patients.

Grinding machine injuries are rare but can cause severe mutilating injuries. Part of the assessment is to define the extent of the zone-of-injury as it may extend beyond the area of the initial injury. Pomares et al. described in their experience on 1132 traumatic hand amputations that grinding machine injuries made up only 0.4% of the total cases [7]. In addition, none of these grinding machine injuries proceeded with replantation surgery of the upper limb.

## V. CONCLUSION

Occasionally, it is impossible to remove any equipment that may still be attached to the patient's limb due to a lack of expertise or proper equipment at the accident site. In these cases, bringing the patient to seek expert medical attention as soon as possible will give the patient the best possible outcome of treatment. For the attending surgical team, there is a dilemma as to whether the limb can be salvaged if the equipment that is stuck does not allow visualization of the limb for assessment. In addition, there may be implications with regards to setting the patient up for general anaesthesia due to the position of the stuck grinding machine. A case reported by Kinoshita et al. showed how they had to induce and intubate the patient in a sitting position due to the stuck position of the meat grinder at the patient's arm [8]. In that case, the patient ended up with a forearm amputation.

Green et al., in 1975, were the first to describe a method of deworming the grinder to free the patient's extremity [4]. In this case, by successfully reversing the grinder mechanism, we were able to preserve the wrist and reassess the extent of tissue injury of the hand. Brandner et al. emphasized this point in their case series on three patients, who all had successfully extricated the affected limb by carefully reversing the grinder machine mechanism while gently withdrawing the extremity [2]. In their series, they described final outcomes with differing degrees of disabilities in their patients, ranging from minimal function for which prosthesis was suggested in a case of amputation of all five digits at the level of carpometacarpal joint, to satisfactory function in an amputated limb with the retained thumb, ring and little finger [2].

The critical goals when treating mangling injuries are to save the patients' life, preserve viable tissue, conserve and restore the function of the affected limb. As there is a wide range of causes of mangling limb injuries, each case must be evaluated individually. However, the general principles of treatment are thorough debridement of devitalized tissue, restoration of the vascular supply, stable skeletal fixation, and stable vascularized soft tissue coverage.

We were able to salvage adequate soft tissue for wound coverage of the defect from the loss of the central digits and stabilize the thumb with a k-wire. As the central three digits were not restored, the little finger would now effectively assume 50% of hand function, with the thumb assuming the other 50%. Resisting these structures leaves the patient with an opposable thumb and one opposing digit to do pinch and grasp movements [9].

Finally, we quote the famous English axiom, "an ounce of prevention is worth a pound of cure." We reiterate the importance of employees taking every possible preventative safety measure in dealing with machinery equipment. Hongaiah et al. discussed in their case study on 12 patients that the most common cause for grinding machine injuries was the usage of the machine without going through the operative manual and accidental injury when machine operators put their hands in the running machine [10].

Should a similar case scenario occur again, we hope that this case can serve as a helpful aid for the treating surgeons on possibly tackling the issue.

Grinding machine injuries can cause devastating mutilation of a limb. However, suppose a mangled limb remains attached to the machinery equipment. In that case, it is likely safer to bring the patient to the hospital for careful extrication of the limb under anesthesia, allowing the surgical team to reassess the limb and preserve viable structures, save the important length of the stump and restoring as much hand function as possible.

## CONSENT TO PARTICIPATE

Our patient gave written informed consent for his anonymized details to be published in this report.

## CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this paper.

## ACKNOWLEDGEMENT

The authors would like to thank the patient who consented to images to be taken prior, during, and post-surgery for the purposes of this publication.

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