

CASE REPORT

Successful limb salvage and full functional recovery following severe mechanical hand crush injury

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ABSTRACT

Background: Crush hand injuries are a devastating type of traumatic injury that is particularly difficult to manage due to the complexity and involvement of several affected tissues in such injuries. Additionally, crush injuries represent some of the poorest patient outcomes. The management of such injuries requires immediate limb-saving management and long-term planning for rehabilitation and function preservation.

Case presentation: This case is a 30-year-old male construction worker who suffered a severe occupational crush injury to his right hand due to entrapment in mechanical machinery at a workplace site. Immediately after his admission, he underwent hemorrhage control and medical interventions to manage pain and prevent infection. He underwent radiological assessment and assessment by a multidisciplinary surgical team who performed hand salvage to the patient via definitive hemostasis, revascularization, musculoskeletal repair, and reconstruction coverage. The patient then followed an early tailored occupational rehabilitation program after discharge.

Conclusion: Early hemostasis, multidisciplinary assessment, and management of the limb, followed by early specialist-led occupational therapy, are successful in full limb salvage and functional recovery.

Keywords: Limb salvage, crush hand injury, outcomes, functional recovery.

Introduction

Crush injuries are a devastating type of traumatic injury that has greatly variable presentations [1]. Crush injuries of the hand are particularly difficult to manage due to the high compressive force over a small region of the body [1]. Hand injuries represent 20% of all emergency visits, and occupational hand injuries account for almost 25% of all workplace accidents, with crush injuries representing 15%–20% of such cases [2]. The common features of crushed hand injuries include severe injury, damage to multiple structures, damage to different tissues to varied degrees, and tissue loss [3]. Due to the complexity and involvement of several affected tissues in crush injuries [4], and the fact that crush injuries represent some of the poorest patient outcomes [1], the management of such injuries requires immediate life-saving, limb-saving, and long-term planning for rehabilitation and function preservation [4]. Over the years, the approach to limb salvage has shifted from an isolated surgical decision to a team-based strategy involving a multidisciplinary

team bringing together plastic, orthopedic, and vascular surgeons with trauma specialists and rehabilitation teams, which exhibited promising outcomes [5]. Here, we present a 30-year-old construction worker who presented with a severe occupational crush and underwent hand salvage by a multidisciplinary team.

Case Presentation

Emergency presentation and initial stabilization

A 30-year-old male construction worker was admitted to the emergency department (ED) at Care Medical

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Limb salvage after hand crush injury

Hospital (Al-Malaz) with an acute, severe crush injury to the right hand resulting from mechanical entrapment. The patient presented with an active hemorrhage, severe pain, and considerable tissue disruption (Figures 1 and 2). The activation of trauma code was performed immediately in the ED to mobilize the required surgical and critical care teams. Direct pressure was applied to secure prompt control of the hemorrhage to achieve hemostasis. Also, intravenous analgesia was provided to the patient to control pain, with the provision of broad-spectrum antibiotic coverage and tetanus prophylaxis using tetanus toxoid/immunoglobulin.

Imaging

Radiological assessment was performed on the patient by carrying out urgent X-ray imaging of the right

hand to evaluate bone integrity and joint involvement (Figures 3 and 4).

Multidisciplinary surgical intervention and management

An emergency evaluation was carried out via multidisciplinary professionals owing to the critical nature of the injury and the threat to limb viability. The team included consultants from general, vascular, orthopedic and plastic surgery. Prompt surgical examination was adopted to save the hand. Definitive hemostasis by permanent control of hemorrhage and revascularization via vascular perfusion to the hand was thoroughly re-established under general anesthesia. The damaged tendons and muscles were repaired and sutured to restore motor function. Finally, a skin graft was used to achieve full wound closure over the extensively damaged soft tissues.

Postoperative management and inpatient care

The patient received close monitoring in the inpatient ward by the surgical consultant team. Daily assessments were carried out by focusing on graft viability, microvascular distal perfusion, and early signs of healing. The patient was discharged after two weeks of uncomplicated recovery and stable distal blood flow.

Rehabilitation and Final Outcomes

The patient followed an outpatient program following discharge; the program was specialized in occupational injuries and was followed under the direct supervision of a consultant in Occupational Rehabilitation Medicine. The patient completed a structured physical therapy and hand rehabilitation regimen. The patient successfully achieved complete wound healing, good graft integration, and full restoration of hand range of motion and grip strength. The patient fully resumed his job duties with normal hand function 45 days from the date of the injury.



Figure 1. The affected right hand.



Figure 2. The physical examination of the hand.



Figure 3. X-ray of the hand.





Figure 4. X-ray of the hand displaying the fingers.

Discussion

The initial presentation and stabilization of crush injuries to the hand vary depending on the mechanism of injury [1]. Therefore, there is no standard operating surgical intervention for such injuries due to their varying patterns, and the treatment can be individualized for each patient. However, the principles of management involve wound management, antibiotic therapy, osteosynthesis, microsurgery, tissue transfer, and rehabilitation [3]. Similarly, the management of our patients followed such principles, starting from hemostasis, antibiotic provision, and the surgical management of the patients, followed by rehabilitation.

Our patient received broad-spectrum antibiotics and tetanus prophylaxis, as there is an elevated risk of open-hand fractures being infected with several pathogens,

especially in construction settings [6]. Intravenous antibiotic therapy should be given in the ED itself, which involves broad-spectrum coverage for gram-positive, gram-negative, and anaerobic organisms [3], and this was in agreement with the initial management of our patient.

X-ray is essential in all cases of crush hand injuries [3], to identify dislocations or fractures of the hand, forearm, and wrist [3, 7]. Similarly, our patient underwent urgent X-ray to evaluate bone integrity and joint involvement to help decision-making and surgical planning.

The hand is a complex structure comprising several tissues, including skin, tendons, bones, intrinsic muscles, nerves, and blood vessels that are closely packed in a small space. Additionally, crush injuries of the hand can present with a wide range of patterns and generally involve multiple tissues. Therefore, the optimal management of such injuries requires a clear comprehensive understanding of principles of management, correct decision-making, and a wide repertoire of surgical techniques [3]. This can be achieved by the involvement of a multidisciplinary team of general surgery, orthopedic, vascular, and plastic surgery specialists, and this was adopted for the best decision-making and management for our patient.

Additionally, the prevention of severe complications and optimization of functional outcomes in crush injuries greatly rely on the timing of surgical intervention [7]. Therefore, all interventions for our patient were performed as immediately as possible, and the success of the precise and immediate interventions can be confirmed by the successful outcomes of our patient.

Our patient underwent vascular perfusion under general anesthesia; successful revascularization necessitates adequate debridement of the vessels and approximation of healthy ends [3]. Additionally, it was stated that skin flaps with a narrow base are unlikely to survive and need to be replaced with skin grafts [3], and skin grafting is essential if the blood vessels are exposed [8]. Therefore, our patient underwent skin grafting to achieve complete wound closure over the highly damaged soft tissue after managing the damaged tendons and muscles.

Rehabilitation in crush injuries may be complex and requires tailoring to each injury and case. It can be influenced by several elements such as stability and strength of the skeletal fixation, combined extensor and flexor injuries in the same digit, and repaired ligaments such as collateral ligaments [3]. Therefore, a structured physical therapy and hand rehabilitation regimen was provided to our patient.

Focusing on hand function following injury is critical for the ability of the patient to perform daily living activities and return to work [9]. Our patient was successfully managed as he exhibited a full restoration of hand



range of motion with grip strength and could fully resume his job duties.

Poor decision-making and poor performance of surgery for crushed injuries of the hand may result in prolonged recovery time and poor outcomes for the patient [3]. However, our patient represents a case that was well and successfully managed based on decision-making and performance of surgery based on timely interventions performed by the multidisciplinary team. Therefore, our patient successfully restored his functions and fully returned to work in a relatively short duration.

Conclusion

Crush hand injury is a critical emergency; however, timely interventions and management provided by a multidisciplinary team, followed by a tailored rehabilitation program, achieved successful full limb salvage and functional recovery in a relatively short duration.

Conflict of interest

None.

Funding

None.

Informed consent

The patient provided informed consent to publish the case and confidentiality and anonymity were guaranteed.

Ethical approval

An ethical approval was obtained from xxxx before collecting the data of this case.

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