

# Crush, degloving, and burns of the upper extremity: a case report

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#### ABSTRACT

Excessive hand injuries are not uncommon in hand surgeon's practice. They are usually caused by various devices such as circular saws, grinders, millers, presses, conveyers, and agricultural machines.

This article reports a case of mutilating injury to the entire upper extremity as a result of crush and burn of IV degree. The right upper extremity of a farmer who attempted to unblock the mechanism of a straw-press was pulled inside the machine. Despite resistance against the pulling force, the extremity was drawn inside the machine up to the elbow, where the cog-wheels started to glide on the exposed bones of the forearm and arm. The farmer

## **INTRODUCTION**

Excessive hand injuries are not uncommon in hand surgeon's practice. They are usually caused by various devices such as circular saws, grinders, millers, presses, conveyers, and agricultural machines.

Degloving and crush injuries are counted among the most severe. The former injury is caused by entrapment of the hand by a fast rotating (swirling) rollers of a crushing machine or a press used for forming metal, cardboard, or other materials. It involves tearing of the hand's soft tissues: skin and subcutaneous tissues, including the nerves and blood vessels, off the bones. The separated tissue complex has the appearance of an old glove (hence, the name of the injury - degloving). Degloving of the entire hand is one of the injuries associated with the poorest prognosis, even worse than total hand amputation [1, 2]. Crush injuries caused by presses are also considered very severe, frequently irreparable injuries. Currently, these severe injuries are less frequently seen in developed countries. This trend results from an improvement in abiding by the rules of work safety in timber industry factories, in which most of these accidents occur. In contrast, there is a problem with maintaining caution in operating smaller cutting devices such as domestic circular saws, grinders, and cutting disks; however, the injuries they cause are not so devastating. There are limited treatment options available to save a mutilated extremity and recover its function. Although these operations are undertaken using advanced microsurgical and reconstructive techniques, their outcomes are variable [3, 4, 5, 6].

This article reports a case of a mutilating injury to the entire upper extremity as a result of crush, whittle, and IV degree burns. The severity and extensiveness of the trauma made it first attempted to cut off the extremity with the pocket knife, following by firing the straw inside the press to draw somebody's attention to his dramatic situation. Eventually, a person who passed by on the road nearby noticed the smoke flying out of the machine, came to the victim, and called for help. Despite the excessive injury of the entire upper limb and bleeding, the condition of the patient on admission was good. The extremity from the level of mid-arm was crushed, whittled, and burned, and the only option was the amputation at the proximal arm level. The post-operative course was uneventful. **Keywords**: mutilating hand injury; irreparable hand injury; work-related accident; upper limb amputation.

impossible to save the limb, but the uncommon circumstances of this accident prompted the author of this paper to describe this case.

### **CASE REPORT**

In 1997, a 42-year-old farmer was delivered to the author's institution with injury to his right (dominant) upper extremity. The entire extremity was crushed, whittled and burned. On admission, the condition of the patient was stable, he was conscious, suffering from pain in the injured extremity, and very frightened. During an interview, he told an unusual and exceptionally grisly story. That day he took the field with the tractor to operate a straw-press (to pick up and compress a straw laying on the field after the harvest). The straw-press was connected with the tractor by the shaft and driven by its motor. In the late afternoon, after several hours spent in the field, the straw-press suffered damage and stopped throwing blocks of compressed straw. The farmer got off a tractor and opened the hatch in the back of the press to look at what had happened. Unfortunately, he did not switch off the motor of the tractor and the straw-press was in motion; this was a cause of the accident. When the farmer opened the hatch and looked inside, he had noticed a skein of the straw blocked the inlet of the stokehole of the press, i.e. the part in which the straw was pulled into the machine and compressed. He attempted to tear out the straw of the stokehole with his hand, without regard to the fast rotating cog-wheels of the feed-mechanism inside the press. The cog-wheels caught first the sleeve of the shirt and next the hand of the farmer. Despite his efforts and resistance against the pulling force, the extremity was drawn inside



the machine up to the elbow, where the cog-wheels started to glide on the exposed bones of the forearm and arm. One can imagine the how terrified was the man and how severe pain he suffered when fighting against the machine which crushed his arm; however it was only prelude of the further nightmare.

When the situation got stabilized with the patient's arm entrapped in the machine, the farmer realised that probably nobody would help him, as he had been alone in the middle of the large field, far away from the nearest homestead. He could not call for help, because nobody would hear his shouting and he also had not any mobile phone (the author is not sure if in 1997 mobile phones were common in Poland). The situation was dramatic; in the worst scenario, after several hours of tortures, the man would have eventually fainted away and bled to death. Even if the fuel in the tractor had run out and the straw-press stopped, he would not have been able to pull his arm out of the machine. When he realized the seriousness sof his situation, he decided to cut his arm off. He took out a pocket-knife of the pocket, opened it, and started to cut (whittle) the skin and muscles of the distal part of the arm entrapped in the machinery. Unfortunately, as it could be expected, his efforts failed, because he was only able to cut the skin and muscles, but not the bone; instead, cutting the muscles resulted in additional bleeding. The situation became dramatic and hopeless because it was getting dark. Being faced with the perspective of several hours of agony, the farmer decided to fire the straw inside the press, having hopes that smoke would draw somebody's attention to the fire of the agriculture machine. He took a lighter from the pocket (he was a smoker) and fired the straw around him. Unfortunately, the straw was also close at the farmer's entrapped extremity and started to catch fire, too. Moreover, the smoke caused problems with the man breathing (he started to choke). After about half an hour, a woman who passed by on the road 1.5 km from the site of the accident noticed the smoke flying out of the machine and came closer. According to the patient's report, she first put out the fire, switched off the engine of the tractor, fitted provisionally the bleeding arm of the patient, and drove quickly to the nearest house to call for help. Half an hour later, an ambulance came and the crew liberated the man's arm from the machine. After placing a dressing on the injured and burned extremity, they drove the man to the nearest hospital and from there to the author's institution, the Department of General and Hand Surgery at the Pomeranian Medical University.

### **COURSE OF THE TREATMENT**

Surprisingly, on admission the general condition of the patient was stable. Morphology showed anaemia requiring blood replacement. Figure 1 shows the patient's extremity on admission. It was obvious that amputation was the only reasonable option. After admission to the surgical ward, informed consent for the surgery was obtained, and i.v. antibiotic was given followed by transfusion of 2 units of a red blood cell concentrate. Next, the patient was delivered to the operative theatre. The operation was performed under general anaesthesia;

a standard amputation of the extremity at the proximal arm level was performed with the stump closure within the healthy tissue. Postoperative course was uneventful and the patient was dismissed after 1 week for further out-patient care. During his stay in the ward, the author of this paper talked to the patient about the accident. When asked about the severity of pain he experienced, he (surprisingly) had scored the pain at most moderate which could be explained by the enormous stress and fear he experienced. He reported that he had maintained the presence of mind to the end and had not given up in his struggle to get released from the trap. His ingenuity helped in saving his own life. It might also be said that he owed his life to his addition: if he had not been a smoker, he would not have got a lighter in his pocket and would not have been able to fire the straw.



FIGURE 1. View of the injured: a) extremity on admission; b) and c) hand and forearm

#### DISCUSSION

The presented case is interesting and exceptional due to the extremely horrible circumstances of the injury.

a)

As no similar case report was found in the literature, it was difficult to compare it with other reports. An excessive hand injury, crushing and/or degloving with associated bone fractures, damage to the most of structures (tendons, vessels, nerves, and joints), and loss of soft tissue is named "mutilating injury" or "mangled injury". There are available reports in the literature about traumas of this kind, but only about those in which any chance to save the arm ("repairable") [3, 4, 5, 6, 7]. In contrast, irreparable injuries are usually not reported (Fig. 2, 3). Figures 4a, 4b show degloving of the entire hand. Despite such a devastating trauma, the hand was successfully treated with a greater omentum pedicled flap. After several reconstructive surgeries it was functionally impaired, but still useful in the patient's daily life (Fig. 4c). Dozens of degloved hands were saved in the author's institution thanks to the use of this technique [2]. Unfortunately, it was not suitable to employ in the presented case.



FIGURE 2. The wrist and hand crushed by a wheel of the tram



FIGURE 3. The fingers and distal metacarpus crushed in the press



**FIGURE 4.** The degloved hand: a) note the "glove" of the skin torn off the skeleton; b) view from the palmar side; c) after reconstructive surgeries (the hand from Fig. 4a, 4b)

Mutilated upper limb injuries are complex conditions that are associated with many challenges for surgeons. Associated with a considerable loss of various tissues, they are frequently impossible to repair and amputation is the only reasonable option. However, if there is only a shadow of a chance to rescue the hand, efforts are undertaken to achieve it. These procedures require careful planning and meticulous execution. Radical debridement and secure skeletal stabilization must be achieved on the day of admission [5, 6]. It is commonly believed that the first operation is crucial to ensure good vascularity to the salvaged tissue, prevent infection, and achieve bony stabilization [4, 7]. The second-look surgery and definitive reconstruction can then follow. Infection still remains an important negative determinant for the outcome and is prevented by primary radical debridement and antibiotic therapy [5]. Post-operative therapy is an important component of treatment. Dermal substitutes and negative pressure wound therapy are increasingly used but have not substituted regular soft tissue cover techniques. Ability to perform secondary procedures and the increased use of the reconstructed hand with time keeps reconstruction a better option than fitting a prosthesis [7, 8]. Despite best efforts, outcomes vary in these devastating injuries.

In the presented case, there was no chance for rescue of the severely injured extremity in the presented case. However, saving the patient's life could be considered a success, a victory of the unbelievable determination of the man struggling for his life in an apparently hopeless situation.

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