

Case Presentation

A Case of a Five-Finger Amputation Pyrotechnical Blast Injury and Subsequent Hand Reconstruction

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Abstract

Pyrotechnical blast injuries most often affect the hand and can result from mild skin and soft tissue damage to extensive tissue loss or amputation. The aim of reconstructive procedures is the restoration of functionality and aesthetics of the injured limb. We present a 30-year-old male patient who suffered a five-finger amputation of the right hand due to a pyrotechnical blast injury. The middle and ring fingers were amputated at the proximal interphalangeal joint level and their length was preserved using pedicled flaps from the left groin. The thumb, second and little fingers were amputated at the metacarpophalangeal joint level. The thumb was reconstructed by a second toe free transfer from the left foot. This procedure resulted in a significant improvement in the patient's overall hand functionality and, by extension, quality of life.

Keywords: Pyrotechnical injury, Finger amputation, Hand reconstructive surgery, Second toe transfer

Introduction

In the past, blast injuries were primarily occurred in warfare and combat. Today, the incidence of such injuries is consistently rising due to wide public access to pyrotechnics. According to a report from 2018 [1], 56% of blast injuries involve the extremities, half of which involve specifically hands and fingers [1]. In mild cases, the injury can cause superficial burns or minimal soft tissue damage. However, more severe cases include complete destruction of the skin and damage to neurovascular structures and muscles of the hand or even the phalanges and metacarpal bones. The most severe outcome of a blast injury affecting the extremities is amputation [2].

The aim of hand reconstructive surgery is to restore the damaged limb functionally and aesthetically to the greatest possible extent. Naturally, this extent varies depending on the localization and severity of the blast. The reconstructive procedure entails emergency revascularization of ischemic tissue, debridement, fracture reduction, or even patient stabilization or resuscitation in severe cases [3]. The thumb is estimated to represent 50% of the hand's total function, making it a priority when it comes to hand reconstruction [4].

One of the primary indications for a toe-to-hand transfer is a traumatic thumb amputation which results in the loss of the pinch and grasp functions [5]. The overall success rate of this procedure is estimated to be around 95% and re-exploration is necessary in about 10% of cases [6] due to venous congestion, arterial thrombosis or bleeding [7].

We present a case of a severe blast injury to the hand which resulted in a five-finger amputation. The aim of this paper is to demonstrate the significant improvement of outcome reconstructive surgery can accomplish regarding the quality of life.

Case Presentation

A 30-year-old man suffered a severe pyrotechnical blast injury to the right hand, which resulted in amputations of the thumb, index, and little finger at the metacarpophalangeal joint level and middle and ring fingers at the proximal interphalangeal joint level (Figure 1). Other notable findings were a palmar laceration in the thenar region, as well as burns on the entire palmar surface of the hand. Two hours after the injury, he was admitted to the emergency department at University Hospital Centre Zagreb.

The patient was taken into surgery on the day of admission. Rem-

nants of the index and little finger which were no longer viable were removed. The following day, the patient underwent further debridement and was subsequently treated with negative pressure therapy. In order to preserve their length, the stumps of the middle and ring fingers were covered with pedicled flaps from the left groin which were divided three weeks later (Figure 2).

Six months after discharge, the patient was admitted for reconstructive surgery of the injured thumb. The second toe was transplanted from the patient's left foot onto the stump of the thumb in order to increase its length and functionality. The metacarpal bone of the second toe was telescopically fixed to the stump of the thumb's proximal phalanx, flexor and extensor tendons were connected and anastomoses were created between the radial artery and dorsal pedal arteries and cephalic and great saphenous veins. Digital nerves of the second toe were anastomosed to the digital nerve stumps of the thumb. The postoperative course was uneventful with good healing of the hand and donor site of the left foot (Figure 3).

At his latest follow-up examination, four months after the thumb reconstruction, the patient continues to show improvement in hand functionality. He was able to perform simple tasks without difficulty, such as a pinch grip or a handshake (Figure 4).



Figure 1: Patient's injured hand upon admission. The thumb, index, and little finger were amputated at the metacarpophalangeal joint level and the middle and ring fingers were amputated at the proximal interphalangeal joint level.



Figure 2: Patient's hand after the first operation. The middle and ring fingers were reconstructed using the pedicled flaps.



Figure 3: Patient's hand after the second operation. The patient's thumb was reconstructed by a second toe free transfer. The middle and ring fingers are at this point completely healed.

Discussion

As noted in many studies, early radical debridement, preservation of length of amputated digits and early reconstruction are of paramount importance in obtaining satisfactory aesthetic and functional result in cases like this. The decision to use pedicled groin flaps to cover the stumps of middle and ring fingers proved a cheap and effective option to preserve the length and PIPJ func-



Figure 4: Patient's hand four months after the second operation. The patient has a restored pinch grip.

tion of these digits, albeit a bit cumbersome for the patient. The thumb reconstruction dictated a microvascular tissue transfer, with a choice between the first or a second toe transfer. The removal of the great toe has been shown to have more of an impact on the function of the foot than the removal of the second toe. Specifically, there is a decrease in the foot's push-off force which can be impactful in, for example, driving. Secondly, there is also the matter of aesthetics, which is more impacted by the removal of the great toe [6].

In research published by Yoshimura M., this procedure was analyzed in 28 patients, involving 33 toe transfers [8]. In these cases, the great toe was used for one graft, the third toe for two, and the second toe for the remaining thirty grafts. The author concluded that the lesser size of the second toe represents no disadvantage for the patient in the context of hand functionality. On the other hand, the second toe is stated to be advantageous regarding opposition, as it has two extensor tendons.

Nikkhah D, et al. [9] published a series of 19 pediatric patients with 31 toe transfers [9]. The pool of patients was selected from the population suffering from congenital defects, specifically missing fingers. Second-toe transfers were used in all patients and provided satisfactory results. After surgery, all of the children had restored grip function in their hands.

Conclusion

Upon admission, the functional capacity of the patient's injured hand was severely compromised. This was in part due to the amputation of all five fingers and extensive injuries of the carpal region, and especially due to the amputation of the patient's thumb. The reconstructive approach of choice, in this case, included the use of pedicled flaps and autotransplantation of the patient's second toe. This procedure restored the function of the thumb as well as the overall functionality of the patient's right hand. On the other hand, the patient's left foot suffered no functional and only minimal cosmetic impairment. Taking this into account, the overall result of the procedure is a significant improvement in the patient's quality of life.

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