Case Report

DOI: 10.15386/cjmed-631

FUNCTIONAL SALVAGE OF A HAND AFTER UNSUCCESSFULL ATTEMPT OF REPLANTATION

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Abstract

Amputation by crush injuries generally represents a contraindication for replantation, and especially when the lesion is caused by the summation of multiple concomitant traumatic mechanisms.

We present the case of a 22 year- old female who arrived in our service with a crush/torsion amputation of all long fingers at the metacarpo-phalangeal level of the right hand. After the unsuccessful attempt of replantation, the functional reconstruction of the hand was achieved by using a double free flap transfer: anterolateral thigh perforator flap (ALT) and digital block transfer of second and third toes.

Keywords: amputation, replantation, necrosis, double free flap transfer, flow-through flap

Background

Traumatic amputation represents one of the most devastating injuries of the hand [1-4]. They can be produced by various mechanisms, but the crush injuries are the most common and can result in significant tissue damage and injury [3]. The association of crushing with other mechanisms, i.e. elongation, torsion, adds more severity and represents a relative contraindication for replantation. But, sometimes, in very young and healthy patients the indication for replantation becomes an absolute one even in this type of cases. The success rate in these cases increased over the years, being more than 80% with experienced surgeons [4].

A lot of problems appear when necrosis of the replanted segment occurs, especially from reconstructive and rehabilitation points of view [1,2]. Generally, after necrosis of the replanted segment, not only this one is lost, but remains also a smaller or larger skin defect. Therefore, the surgeon will have to reconstruct both the skin defect and the prehensile function of the hand. The reconstruction is generally performed in two independent steps, in the first the skin defect being covered by using skin grafts or flaps, and in the second step (after 2-3 months) the functional reconstruction of the hand will be attempted, mainly by using toe transfers [5-9]. The advances in vascular anatomy knowledge and the new very performing technology in microsurgery allowed the surgeons to find more aggressive, but suitable surgical techniques to solve this problem [10-18].

The description of axial flaps allowed their use as flow-through flaps [19], which means using the vascular pedicle of the flap to revascularize an amputated segment or a second flap. This offers the advantage of performing fewer vascular anastomoses and contributes to the surgical time shortening. One of the flaps that can be successfully used in this attempt is the ALT perforator flap [2].The source artery of the perforator that nourishes the flap, the descendent branch of the lateral circumflex femoral artery, can be used as source artery for vascularizing a second flap.In these conditions, it would be much easier to try to do everything in one step (the so called all-in-one reconstruction [6]), by using the ALT flap to cover the defect, and, as flow-through flap, to revascularize a second flap. The most indicated flap to reconstruct the amputated fingers is certainly the toe transfer [10,11,14,17,18]. If all the long fingers are amputated, it would be more reasonable to use a digital block transfer, including the second and third toes as a single anatomical unit [7].

We present a case with necrosis after unsuccessful

Manuscript received: 05.01.2016
Accepted: 19.02.2016
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attempt of replantation of a hand at the metacarpo-phalangeal joint, in which the ALT flap was used to cover the skin defect, and a digital block was transferred for reconstruction of the prehensile function of the hand.

Case presentation

A 22 year-old female presented to our service 4 hours after suffering an amputation by crushing and torsion of all long fingers at the metacarpo-phalangeal level of the right hand (Figure 1). The patient was in a very good health status, and so, after clinical and biological investigations, we decided the surgical intervention. Taking into account the age of the patient and despite the relative contraindication due to the complex mechanism of injury, we tried the replantation of the amputated segment. Unfortunately, necrosis of the replanted segment appeared in the 4th postoperative day (Figure 2), which determined the re-amputation. Seven days later, after obtaining a relatively good granular bed (Figure 3), the reconstruction of the hand was decided. A free flow-through anterolateral thigh flap was performed to cover the defect (Figure 4), associated with a digital block transfer of the second and third toes from the right foot (Figure 5).

Figure 1. preoperative aspect showing the large crushed area and the torsion of the amputated part.

Figure 2. Necrosis of the replanted segment.

Figure 3. Aspect of the hand after necrectomy and granulation.

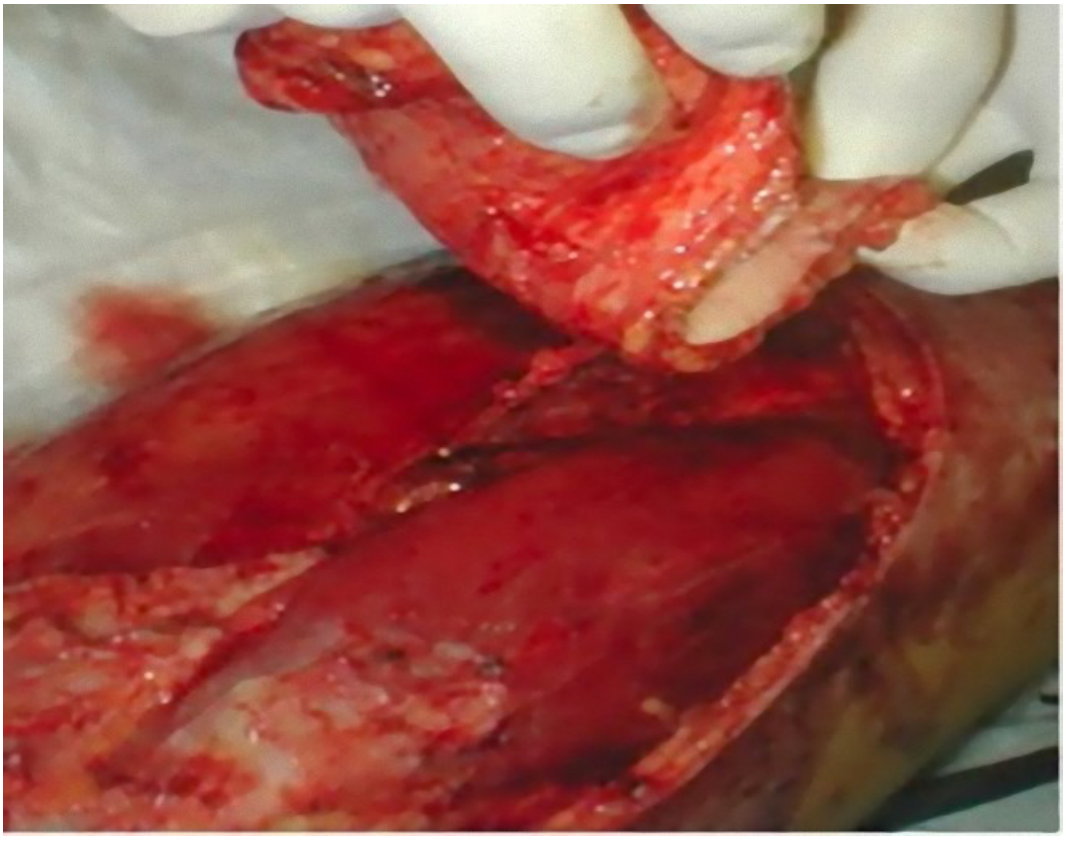


Figure 4. Harvesting of the antero-lateral thigh perforator flap.

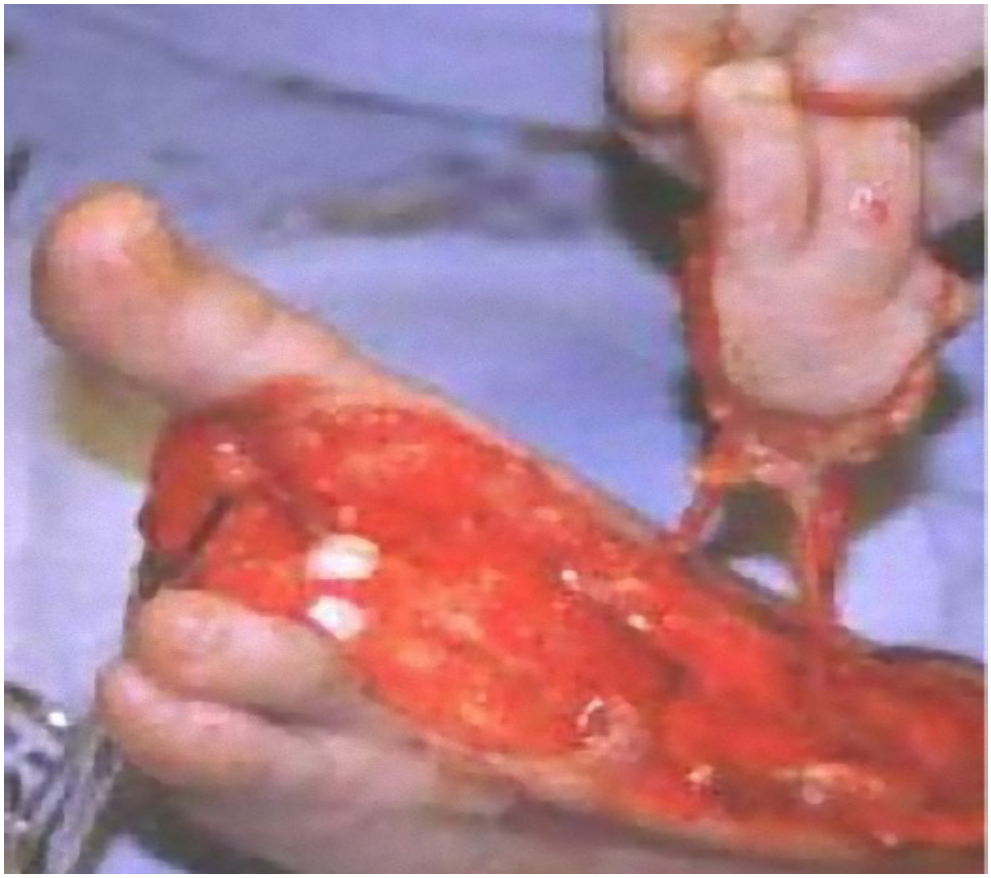


Figure 5. Harvesting of the digital block of second and third toes.

Two surgical teams harvested the flaps:

a. The antero-lateral thigh perforator flap was harvested from the left thigh and measured 15/10 cm. By using a Doppler ultrasound probe, a good perforator was identified approximately at the union of proximal and middle third of the antero-lateral aspect of the thigh. Through an incision on the farther medial edge of the flap, the undermining of the flap was performed and allowed the identification of a good septo-cutaneous perforator (0.8 mm in diameter), 1 cm bellow the point previously marked by Doppler. The flap was designed to be used in a flow-through flap manner, in the attempt to revascularise through it the digital block. So, after dissection and isolation of the perforator till the origin from the descendent branch of the lateral circumflex femoral artery, for 3 cm respectively, the source artery was also isolated for 15 cm, ligated, cut and included in the flap. Then, the flap was completely incised following the design and the flap was harvested. The donor site was partially closed by direct suture and the remaining 6/4 cm defect was covered with split thickness skin graft.

b. The digital block of second and third toes was harvested from the right foot. The design of the flap also included some dorsal and plantar skin, in the attempt to avoid any tension on the vascular pedicle. A short longitudinal incision of 5 cm was first performed on the dorsal aspect of the first web space, through which was discovered the first dorsal intermetacarpal artery and its branches for the big and second toes. Then, the incision was prolonged on the dorsal aspect of the foot, on the projection of the dorsalis pedis artery. After identifying three veins emerging from the second and third toes, they were followed until their joining to a large vein. The incision around the two toes was then performed, and the dissection and isolation of the first dorsal metatarsal artery through the first intermetatarsal muscle was continued until reaching the dorsalis pedis artery. Then, after separating the arterial branch for the big toe, the digital block was harvested at the metatarso-phalaneal joint level. The donor site was partially directly closed and partially covered with split thickness skin graft.

The ALT flap was applied on the hand defect and its revascularization was realized by anastomosing termino-terminal the proximal stump of the descendent branch of the lateral circumflex femoral artery to the radial artery, and one of its concomitant veins to the cephalic vein. Then, after insetting the digital block in place of the missing third and fourth fingers by centromedulary pinning, it was revascularized by anastomosing the distal stump of the ALT flap artery to the dorsalis pedis artery, and the vein of the toes to a dorsal vein of the hand. The collateral digital nerves of the digital block were anastomosed to the nerves of the fingers.

Results

Both flaps showed a very good revascularization (Figure 6). The evolution was very good, with complete integration of both flaps. The stiches were released after 14 days, and the cast after 21 days. In the third postoperative day, the patient was encouraged to start both the passive and active mobilization, under the supervision of a physical therapist.

Long term evolution was also a very good one, with S4 sensitive recovery and M3 motor recovery after one year (Figures 7,8,9).

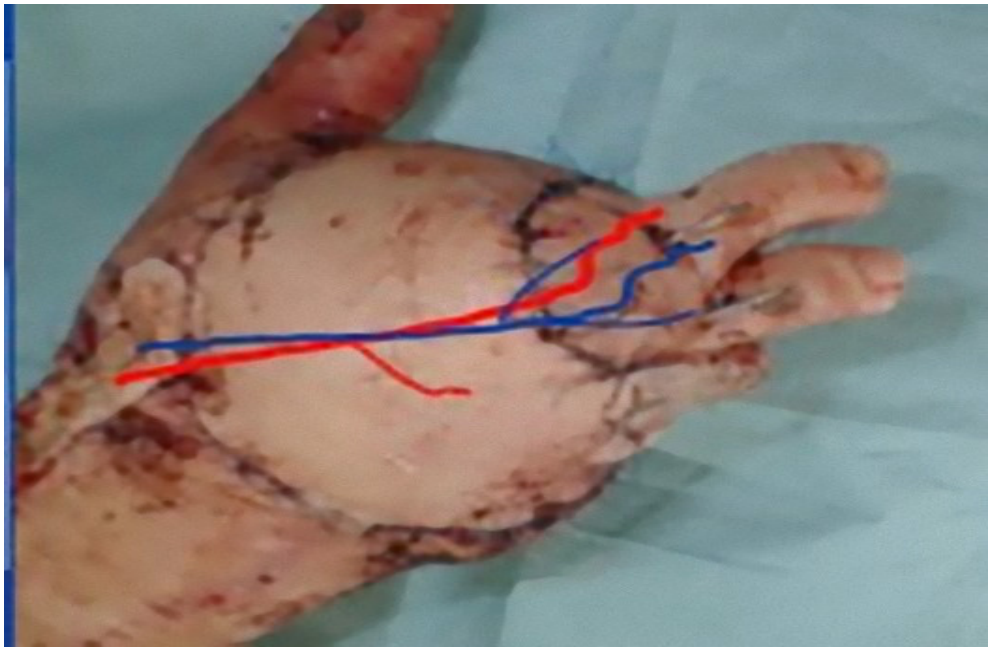
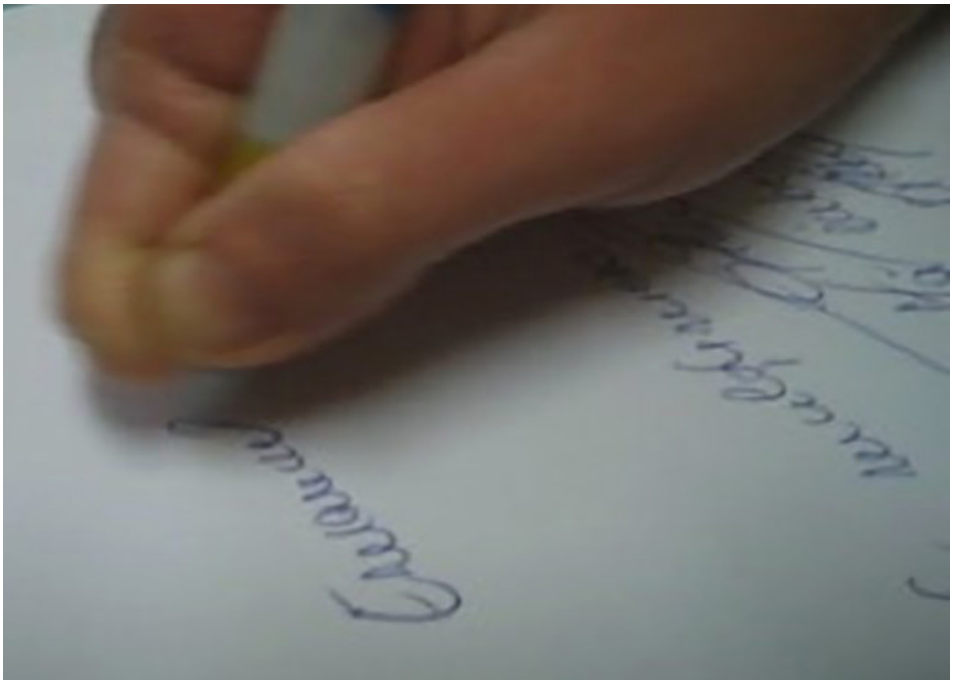


Figure 6. Immediate postoperative aspect.

Figures 7,8,9. One year postoperative aspect, showing the good functional rehabilitation.



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Discussion

Complex traumatic mechanisms create very difficult injuries, which are demanding in terms of reconstruction, due to the advanced destruction of tissues [1-3,8,9,16]. Even though there are very specific indications regarding the tissue replantation [4], there are a lot of relative indications and contraindications in performing this type of surgeries [4,16], taking into consideration the traumatic mechanism, the age and health status of the patient, his/her profession and desire, the expected potential for rehabilitation and social reinsertion and the estimated patient's motivation for complying with the rehabilitation regimen.

By developing the microsurgical techniques, skills, materials and instruments, the success rate of replantation improved, reaching more than 80% [4].

The bone and soft tissue status are no longer a definite contraindication for replantation, due to the multitude of techniques described for reconstruction [8-12,15,16]. These techniques are equally valuable in cases when the replantation fails, due to the complex mechanism

of injury and severe status of local tissues.

In our case, even if the mechanism of injury was very aggressive, we tried to do the replantation, because the patient was very young, with a good health status and because of the extent of local injury, aiming to offer a chance of survival for at least some tissues. Unfortunately, the replantation failed, so we had to find another reconstructive solution.

There are a lot of possibilities to cover a soft tissue defect, starting with axial flaps [1], loco-regional perforator flaps [1], pedicled distance flaps [1,3] and free flaps [1-3]. But, taking into consideration also the necessity for a functional hand, the prehension had to be reconstructed too.

These procedures can be done in a single or in multiple surgical steps [17,18], the major imperative being the soft tissue coverage to prevent any other tissue loss by desiccation of infection [11,14,15]. In a second step the reconstruction of prehension can be done, by employing reconstruction or prosthesis [3].

We decided to do all the procedures in a single stage, because the tissues were without fibrotic scars or infection, in order to reduce the hospitalization time and costs, to reduce the time lapsed until work and social reinsertion and to start an early and effective program of rehabilitation. Also, the all-in-one reconstruction avoids the need for iterative surgeries and, using two teams significantly reduces the surgical time.

We chose to use the ALT perforator flap because it provides good and sufficient coverage, can be tailored to suit various designs, the flap has a long pedicle [2], which can also be used as a flow-through [19], thus reducing the number of microsurgical anastomoses needed.

Regarding the functional reconstruction, there are also a lot of surgical procedures, such as toe transfers [5-9], bone distraction [20], vascularized composite flaps including bone [1], fasciocutaneous flaps reinforced with cortical/cancellous non-vascularised bone [1], and also the possibility of active or cosmetic prosthesis [3].

We chose the digital block transfer in order to promote a better function in the reconstructed hand, which will allow at least a tripodal pinch.

Conclusion

In all cases the reconstructive surgeon needs to have a pocket filled with solutions, to adapt to the specific requirements of the complex wounds and to choose the most effective one for that specific patient.

In our opinion, this type of one stage reconstruction is beneficial for the patient, because it speeds up the rehabilitation process, has a good functional result, and also reduces the hospitalization time and costs.

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