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Case Report

The use of pedicled abdominal flaps for coverage of acute bilateral circumferential degloving injuries of the hand

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ABSTRACT

Reconstruction of bilateral soft tissue defects in hand and distal third of the forearm, is a challenge for any reconstructive surgeon. When there is circumferential skin loss affecting the whole hand and fingers as in major degloving injuries, the extent of tissue required for reconstruction narrows down the choice of flaps. When the injury affects both hands the magnitude of the problem becomes compounded. There is no report in the literature of free skin flaps to cover circumferential degloving injuries in both hands. We are presenting the technical considerations and outcome of pedicled abdominal flaps used for immediate coverage of circumferential degloving injuries of both hands.

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Introduction

Circumferential degloving injury of the entire hand is a rare entity [1]. It leaves large raw area that needs to be covered with flap dimensions exceeding 25 to 30 cm on one side and a total area of at least 600 cm². When the thumb also needs cover, the flap requirement becomes excessive. The thumb will require a different flap because it has to be oriented in a different plane from the rest of the hand. The task becomes much more challenging when there is bilateral degloving injury with skin loss. Few solutions have been presented in the literature for bilateral hand defects. Although there is not systematic approach for upper limb reconstruction, free flaps are considered to be the first option [2,3]; a wide variety of free flaps has been described [4], being the adipofascial flaps the most common option. Some bilateral hand defects have been successfully covered

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using free flaps such as bilateral temporoparietal fascia [5–7] or omental flaps [8]; both flaps allow a thin coverage that permits tendon gliding as well as secondary procedures. They in addition leave non-noticeable donor site scars. Temporal artery free flaps cannot cover major defects, and the omental flap is not popular since it involves a laparotomy [8].

Few multiple finger unilateral defects have been reconstructed successfully using an ultra-thin free latissimus dorsi perforator flap [9].

We have not been able to find references in the literature of any technique that simultaneously covers circumferential degloving injuries of both hands at the same sitting. We are presenting the management and outcome of a patient that sustained bilateral degloving injuries using bilateral abdominal flaps. These flaps are considered classical flaps [10–12] and are still extensively used all over the world [13].

Case report

The patient was a 23 year old female who sustained avulsion injury to both hands by working in a rubber machine. The degloved parts of the skin were not available for replantation as they were lost during the accident. On examination, the patient presented total circumferential degloving injury of the entire left hand from the level of the wrist to the tips of the fingers with amputation of the distal phalanx of the thumb, middle and ring fingers. All fingers including the thumb had lost skin cover exposing the tendon sheaths and nerves. The entire area required flap cover (Fig. 1a and b).

On the right side, she had avulsion amputation of all the fingers distal to the PIP joint, with degloving injury extending up to the mid palm level (Fig. 2a and b).

Both hands required primary flap cover. We decided to provide skin flap from the lower part of the abdomen.

For the left side, a flap measuring approximately 600 cm² was raised incorporating the superficial circumflex iliac artery (SIEA), the superficial inferior epigastric artery (SCIA) and the superficial external pudendal artery (SEPA) (Fig. 3). We planned a separate flap for the thumb, but that was not marked in the beginning. After the flap for the fingers and the hand was raised, the donor defect was narrowed and the skin anchored to the abdominal wall with interrupted sutures. The flap was raised temporarily, attached to the left hand using few sutures. In that position, the flap for the thumb was planned such that positioning and suturing will be easy. This flap was based on the para umbilical (PU) perforators. After the flap to the thumb was designed, the hand was detached from the flap and, raw areas were narrowed to be covered using split thickness skin graft (SSG).

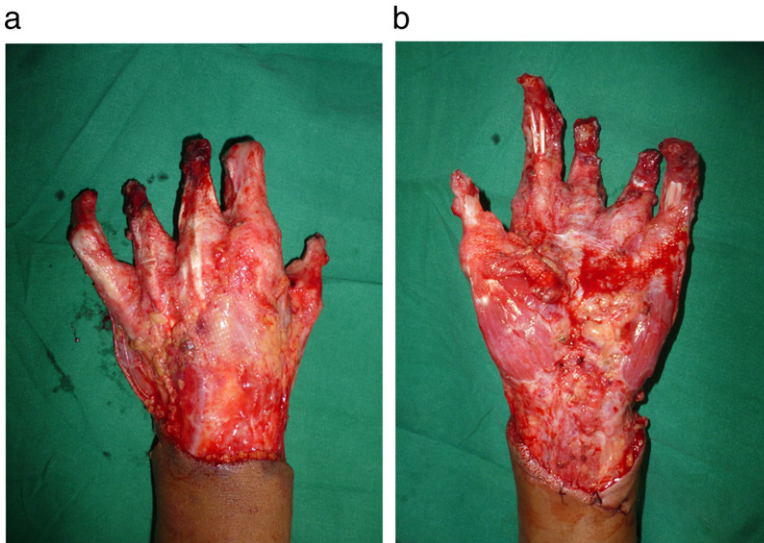


Fig. 1. a and b Dorsal and volar aspect of the left hand after debridement.

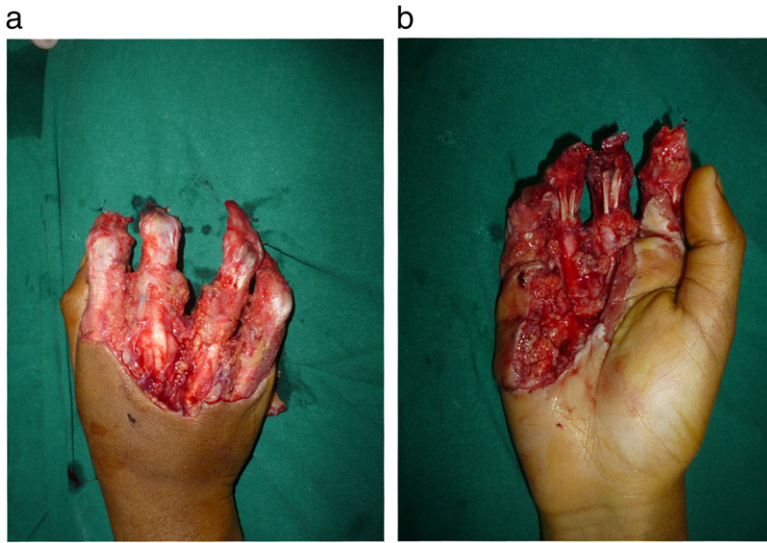


Fig. 2. a and b Dorsal and volar aspect of the right hand after debridement.



Fig. 3. Design of abdominal flap for the left hand. Note that narrow pedicle measuring 6 to 7 cm width includes all three vessels (SCIA, SIEA and SEPA), allowing to raise all the lower abdomen as a single flap.

Now the flap to the right side was designed. The flap measured around 220 cm² was designed incorporating SCIA and SIEA. The size of the flap was smaller since we had to cover only up to the mid palm and the right thumb was spared. The donor areas were covered with SSG and tie over dressings before inseting of the flap and the patient was nursed with special attention. To keep the position of the hand in proper position we follow the Ganga technique of drawing three lines in the forearm and continuing them along the abdomen and thigh and the patient is instructed to keep them aligned at all times [14]. At three weeks, delay of the flaps was done and at four weeks the flaps were totally divided. Both flaps survived entirely.

Since total degloving injury is extremely disabling to the individual, we wanted to separate some digits to improve function and aesthetics. We took up the right side first, opening the flap at the suture line at the tip level and radically thinned the flap, leaving only a thin sub dermal layer of fat. A longitudinal incision was made in the flap at the level of second web space to separate the index finger (Fig. 4a and b). Due to thinning of the flap there was adequate amount of skin to wrap the phalanges. The wound healed uneventfully (Fig. 5a and b). Four weeks later, thinning of the flap was done on the left side in a similar fashion. Here too, the index finger was separated first. There was superficial necrosis of the flap that was used to cover the index finger. Subsequently, spotty raw areas in the flap covering the index finger were covered with split thickness skin graft (Fig. 6a and b).

The patient almost regained most of her regular activities three weeks after the separation of the syndactyly of the right hand. On the left side, she is using the hand as a supportive hand to the right hand (Fig. 7).

Discussion

The best form of reconstruction for total degloving injury of the hand is replantation of the avulsed skin and this has been done successfully on some rare occasions [15–18]. But when the avulsed part is not available, they need to be covered by flaps. Microsurgical options exist, but when a single free flap is used, it shares the same disadvantage of being bulky with pedicled flaps. Even then a single flap may not suffice and multiple free flaps may be needed [19].

We have not been able to find any report in the literature where pedicled flaps have been used for circumferential degloving defects of both hands. In such conditions, our choice has been flaps from the lower abdomen.

Pedicled flaps are not popular because of their disadvantages, like being uncomfortable to the patient, their bulkiness and the need of multiple stages. With the technical refinements, much of these disadvantages can be overcome. The important factor is to raise adequate big flaps but keeping the base narrow. It has been found that the vessels supplying the lower abdominal flaps are very constant in location and at the site of their entry into the flap the distance between them is only about 6 to 7 cm. Keeping the base this narrow, allows us to tube the flap comfortably. Just adequate amount of pedicle is kept in the bridge segment so that we ensure the viability of the distal part of the flap.

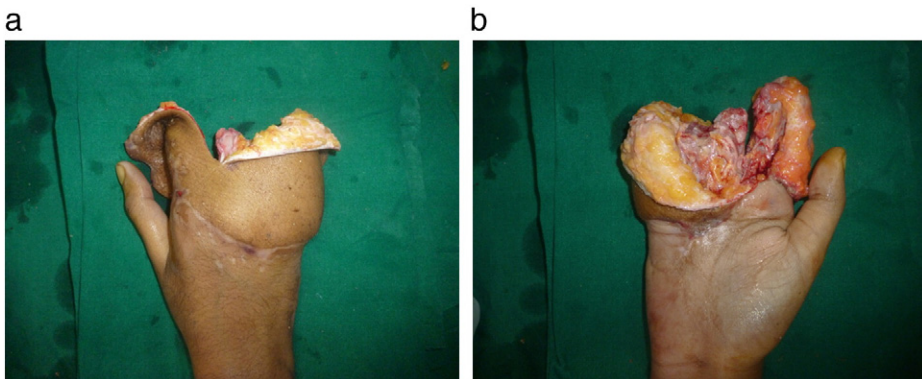


Fig. 4. **a and b** Thinning of the flap and creation of second web space in right hand performed three weeks after division of the flap.

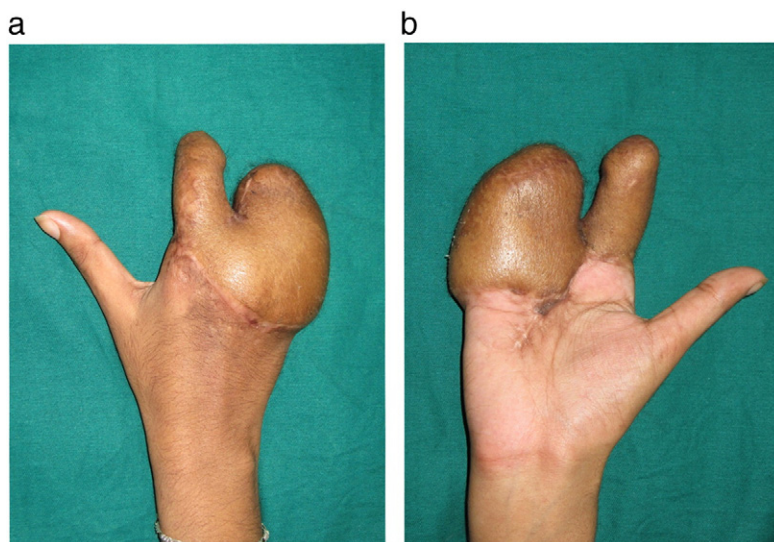


Fig. 5. a and b Outcome of the right hand two months after thinning of the flap and creation of a second web space.

Proper design of the flap position avoids future complications and makes the pose more comfortable for the patient. To avoid increased tension at the border of the flap and subsequent unsightly suture marks, the fat at the skin edge of the flap is trimmed and bevelled [14].

When multiple flaps are required for the same side (as in thumb reconstruction), the second flap has to be designed only after the first flap has been raised and the donor area narrowed. The first flap is attached by few anchoring sutures to the hand, and then designing the second flap followed; if it is not done this way, after elevation of the flap, it may be impossible to attach both flaps. The same thing is done to the opposite site: design of contralateral flap has to be done after provisional attachment and narrowing of the first flap.

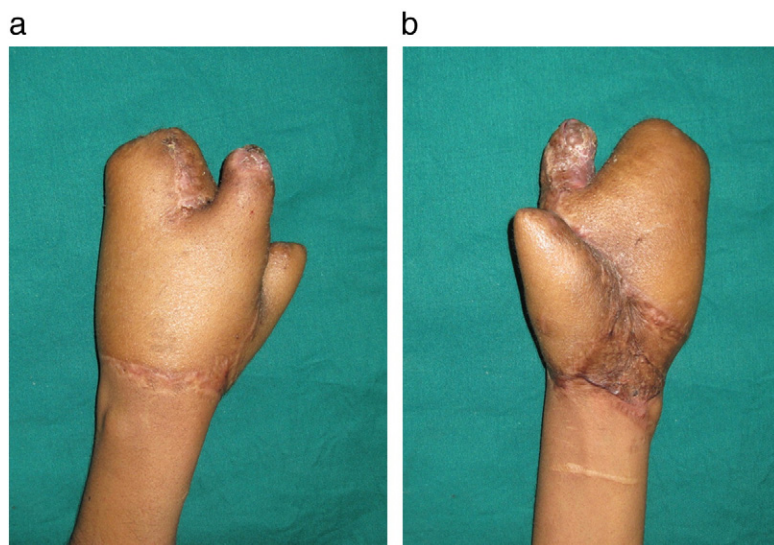


Fig. 6. a and b Outcome of left hand one month after thinning of the flap and creation of second web space. The patient underwent a secondary procedure for skin grafting of a small area due to skin necrosis.

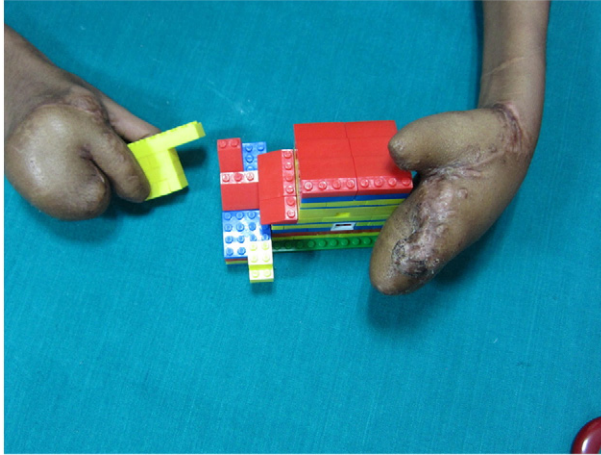


Fig. 7. The patient uses her left hand to assist the right hand on daily living activities.

Pedicated flaps have an inherent advantage due to their vascularity pattern: radical thinning is possible during secondary procedures. The skin attachment is maintained as far as possible and the flap can be thinned almost to the sub dermal level. In this case, this was done three weeks after flap division for the right hand, and one month later on the left hand; in addition, the flap itself was divided to separate the index finger. The right hand was immediately used by the patient for her day to day activities. Subsequently, other fingers could also be separated and we recommend a gap of 6 weeks between the procedures. On the left side, we didn't have major problems when the flap was divided and index finger was trimmed; but the patient presented partial necrosis over the dorsal side of second finger, we think this was a problem due to a technical issue rather than inherent property of the flap.

When large area is required for cover, territories of SCIA, SIEA and SEPA can be incorporated [20], which is what we had done for the left hand; to make the tubing comfortable, it is mandatory to keep the base as narrow as possible.

In our studies we have found that regardless of body weight of the individual, the distance between the point of entry of SCIA, SIEA and SEPA into the flaps is only about 6 to 7 cm; by narrowing the pedicle, the whole of the infra umbilical part of the abdomen can be raised as a single flap.

When planning for soft tissue cover for this type of injuries it is better to provide cover on the healthy skin edge. Some people cover the fingers with the flap and use SSG for the dorsal and palmar aspects of the hand. We do not advice this because if the patient subsequently requires a microsurgical procedure like a toe transfer a skin flap is required till the skin margin for the passage of vessels [21,22].

Harvesting of distant pedicated flaps for bilateral hand reconstruction can be done under brachial plexus and subarachnoid block; which avoids complications and costs derived from general anaesthesia, as well as complications of an sudden awakening of the patient, who with his or her movements can shear the recently inset flap [23].

One of the drawbacks of pedicated flap cover is its lack of sensation. This is particularly disabling if both the thumb and all the fingers are involved, and these patients may require subsequent microsurgical procedures like wrap around flap or plantar sensated skin transfers.

A well designed pedicated flap is a good foundation to make any secondary procedures possible. They also score relatively well when compared to other free skin flaps like ALT, which also would be very bulky when used for circumferential defects.

In addition, free flaps cannot be thinned as well as the pedicated flaps as it is more difficult to thin a free flap soon after the operation.

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