Wrist and hand degloved injuries salvaged with reverse radial forearm flap in the CoVid-19 era

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ABSTRACT

Reverse radial forearm flap is a quick and reliable flap, providing a well-vascularized tissue for coverage of hand defects. It is based on the reverse flow of the radial artery and the only drawback is the proximal ligation of the vessel. Two cases with complex dorsal hand defects were referred with delay to our Hand Unit, due to the CoVid-19 pandemic restrictions. In both cases deep structures of the wrist and fingers were exposed and the wounds were infected. Surgical debridement, skin coverage and reconstruction were decided in a staged approach: The reverse radial forearm flap was first performed, and in subsequent stages, functional restoration with hamstrings tendon grafts and finger joints arthrodesis successfully followed. These two cases highlight the reliability of a traditional pedicled flap in the salvage of complex hand defects, especially when time and resources are limited due to a pandemic.

Introduction

Traumatic complex hand defects involve significant damage and loss of skin, tendon, muscle, bone and neurovascular structures. These injuries usually require a staged approach. In a prospective multicenter cohort study, skin loss after hand trauma was the main factor that increased the risk of infection [1]. Early skin coverage with a locoregional, distant or free flap decreases morbidity and sets the foundation for the final reinstatement of hand function at any possible level.

In CoVid-19 pandemic era, where medical resources are limited, a shift to more “traditional” but reliable flaps with quick harvesting time was noted to reduce operating time, complications and post-operative ICU admissions [2].

The distally based reverse-flow radial forearm flap is a fasciocutaneous pedicled flap indicated for coverage of dorsal and palmar wrist and hand defects [3]. It is based on the retrograde flow through the ulnar artery and palmar arches after ligation of the proximal radial artery [3]. Its main disadvantage is the sacrifice of the radial artery; therefore patency of the ulnar artery has to be confirmed preoperatively and the patients need to be informed about the risk of being injured at the ulnar side of the forearm.

Two consecutive cases with complex dorsal wrist and hand defects were referred, with delay, from District Hospitals during the peak of the COVID-19 pandemic. A reverse radial forearm flap was selected for both defects to save surgical time and successfully.
Cases presentation

Case 1

A 55-year-old male manual worker was referred with a complex left wrist and hand defect after a road traffic accident he sustained ten days ago. There were no other significant injuries apart from a fracture of the ipsilateral clavicle which was treated conservatively. On examination there was loss of skin and soft tissue on the dorsum of the left wrist and hand, with segmental loss of extensor indicis proprius (EIP), extensor digitorum communis (EDC) to middle, ring and little finger, and extensor digiti minimi (EDM) (Fig. 1A). Two metacarpals (third and fourth) and their carpometacarpal joints (CMCJs) were exposed, and cortical loss of the dorsum of capitate was apparent. X-rays were otherwise normal (Fig. 1B). On admission the wound had already been colonized with Enterobacter clocae and appropriate intravenous antibiotic therapy commenced. A staged approach was decided. Surgical debridement and reconstruction with a reverse radial forearm flap were initially performed (Fig. 1C) followed, twelve weeks later, by extensor tendon reconstruction with hamstrings tendon grafts (Fig. 1D). Postoperatively he had an uneventful recovery with no flap or donor site complications (Fig. 1E, F). On final follow-up, 12 months later, he has achieved a well-balanced functional outcome (Table 1) (Fig. 1G).

Case 2

A 64-year-old male, owner of an animal feed manufacture, entrapped his left index and middle finger in a conveyor belt while operating. He was referred two weeks later with significant skin and soft tissue loss on the dorsum of the aforementioned fingers (Fig. 2A). On examination extensive necrosis of the extensor mechanism distal to zone 5 in both fingers was apparent and both proximal and distal interphalangeal joints (PIPJs and DIPJs, respectively) were exposed and had been temporarily stabilized with kirshner wires. In the past the patient had been subjected to 4th ray amputation to the same hand due to a traumatic ring avulsion injury, for which a distant pedicled groin flap was attempted but failed. On admission, microbiology of wound specimen was positive to *Proteus mirabilis* and *Enterococcus faecalis*, and targeted antibiotherapy commenced. An initial surgical debridement and removal of kirshner wires were performed, followed by reconstruction with a reverse radial forearm flap 48 h later (Fig. 2B). The reconstruction resulted in a temporary syndactyly between index and middle finger (Fig. 2C). Six weeks later, the flap was elevated and arthrodesis to PIPJs and DIPJs was performed (Fig. 2D). Division of the flap and release of syndactyly were executed at a third stage. There were no flap or donor site complications after all stages (Fig. 2E, F). The patient was satisfied with the functional outcome and managed to return to his previous work (Table 1) (Fig. 2G).

Discussion

During COVID-19 pandemic we experienced a significant delay in referrals of acute hand trauma from District hospitals with detrimental sequelae in timing of reconstruction and patients’ management. Injuries resulting to skin and soft tissue loss, with exposed tendons, bones and joints, should be covered promptly to prevent long-term infections, especially osteomyelitis [1]. The delayed referral of both our cases (ten days and two weeks, respectively) necessitated urgent skin reconstruction, consuming the less possible surgical time, with a reliable and well-vascularized flap, such as the reverse radial forearm flap. This flap offers thin and mobile skin with similar characteristics to the skin of the dorsal hand and leaves a satisfactory donor site scar [5]. Skin grafting to the donor site is common and, as demonstrated in our cases, healing is usually uneventful. Therefore, the reliability and the cosmetic satisfaction with this pedicled flap can justify its main disadvantage, which is the sacrifice of the radial artery. The staged approach was decided due to delayed presentation and wound infection in both cases, giving priority to a reliable and adequate skin coverage first, until infection is controlled.

Table 1

|        | Grip strength (lbs) | Key strength (lbs) | Pinch strength (lbs) | Total AROM* | Quick DASH |
|--------|---------------------|-------------------|---------------------|-------------|------------|
| Case 1 | 40                  | 16                | 14                  | IF: 83 %    | 7          |
|        |                     |                   |                     | MF: 70 %    |            |
|        |                     |                   |                     | RF: 60 %    |            |
|        |                     |                   |                     | LF: 72 %    |            |
|        | **42**              | **16**            | **15**              | IF: 33 %    | **16**     |
|        |                     |                   |                     | MF: 33 %    |            |
|        |                     |                   |                     | LF: 63 %    |            |

IF - index finger, MF - middle finger, RF - ring finger, LF - little finger.

* AROM: Active range of motion calculated by a modified version of Strickland formula [4].
controlled, and followed by secondary procedures for tendon reconstruction and finger joints arthrodesis.

The reverse radial forearm flap has a quicker harvesting time and inset when compared to a free flap and it does not rely on microsurgical technique. In contrast to other regional flaps, such as the posterior interosseous artery (PIA) flap, it can cover distal defects in digits as in our second case. Moreover, PIA flap has been criticized as being an unreliable flap, it has not gained popularity and its main complication is venous congestion [6,7]. Distant pedicled flaps, such as the groin flap, offer a valuable reconstructive option and are still used in many centers, especially when free flaps are not possible or they fail [8]. However, a distant pedicled groin flap had already been used in our second case for an old trauma. In addition, we believe that these flaps are not comfortable for patients due to prolonged immobilization and restriction of movement.

In an attempt to overcome the main disadvantage of the reverse radial forearm flap, which is the sacrifice of the radial artery, a modification of a distally based flap with preservation of radial artery has been described [9]. The link-pattern type of this flap is based on perforators from the radial artery and can be pivoted at about 1–2 cm above the radial styloid process. This flap is difficult to reach the distal hand and it is not as reliable as a pedicled flap, hence it has not become significantly popular in hand reconstruction [9,10].

Conclusion

Leaving the free flaps behind, which have dominated in the reconstruction of complex wrist and hand injuries, we believe that the reverse radial forearm flap is a traditionally reliable fasciocutaneous flap for coverage of distal hand defects, especially when time and resources are limited due to CoVid-19 pandemic. It can provide adequate skin coverage with well vascularized tissue, making it ideal for exposed bones and joints and it can successfully withstand secondary procedures for tendon and bone reconstruction.

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Patients’ consent

Written consent was taken from the patients for publication.

Declaration of competing interest

None.

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