

Perforator-Based Reverse Radial Adipofascial Forearm Flap to Reconstruct Palmar Traumatic Defect

Yousef Shafaei Khanegah ^{1*}, Shokoufe Mortazavi ²

1. Yousef Shafaei Khanegah ¹

Assistant Professor of Plastic & Reconstructive Surgery, School of Medicine, Hazrat-e Fatemeh Hospital, Iran University of Medical Sciences.

2. Shokoufe Mortazavi ²

Resident of reconstructive, burn and plastic surgery, School of Medicine, Hazrat-e Fatemeh Hospital, Iran University of Medical Sciences.

Abstract

Adequate soft tissue coverage is a corner stone for successful hand reconstruction in traumatic patients allowing for hand mobilization and rehabilitation. In this case report, a modified application of reverse radial adipofascial forearm flap for the simultaneous reconstruction of the palm for traumatic defect is presented. The patient was a 42- year-old man with a history of right palmar avulsion trauma in a car accident. Initially, the patient underwent skin grafts twice, but the symptoms did not improve. Then a distally based reverse radial adipofascial forearm flap with a dimension 15*7cm was planned. The flap was transposed to the palmar defect. After the flap is inserted, the donor defect was closed primarily. After 5 days, the patient underwent a split thickness skin graft to cover the flap. After surgery, a satisfactory coverage is observed in the recipient area. Although, longer time will be needed for complete evaluation of hand function but in early post operative period hand function and pain improved with compared to pre operative time. The advantages of this proposed technique are better donor site morbidity, easy implementation, simultaneous coverage of complex defects, primary closure of donor site, avoidance of long-term immobilization and related complication such as shoulder and elbow stiffness, bad hygiene and avoidance of microsurgery and shorter surgery time.

Keywords: Reverse Radial Adipofascial Forearm Flap, Palmar Traumatic Defect, trauma.

Introduction

Hand injury may cause the tendons, cartilage, bones, nerves, and joints to become exposed. To maintain hand function and to protect a hand's vital structures, good coverage must be achieved as part of the repair process (1, 2). Appropriate skin coverage protects the vital structures of the hand through which hand function is maintained (3). Adequate soft tissue coverage is a cornerstone for successful hand reconstruction in traumatized patients which provides the possibility of hand mobilization and rehabilitation. Reverse radial forearm flap is a reliable option used to cover hand defects with small to medium-sized (4, 5). The reverse radial forearm flap has been used for soft-tissue hand defect surgical procedures worldwide. However, the one of the major drawbacks of the flap is donor site morbidity, as the donor site is closed with a skin graft (1). The reverse radial forearm flap became very popular in the reconstruction of soft tissues of hands and fingers due to its flexibility and rich vascular network. This technique was first used by Lin et al in 1984 (6). Many types of flaps for dorsal and palmar defects of the hand have been described in the literature (7). The flap preference for hand defects is often related to a surgeon's experience, the injury site, and the vascular form of the patient's hand and forearm. Ideal flap coverage must provide restoration of hand function and minimize donor site morbidity (8). Reverse radial forearm flap construction is not a microvascular technique and is used successfully and effectively for soft-tissue hand defects when deep vital structures such as joints, bones, or tendons are exposed (4, 9-11). In this case report, a modified application of reverse radial adipofascial forearm flap for the simultaneous reconstruction of the palm for traumatic defect is presented.

Case Presentation

In the present study, the patient was a 42- year-old man with a history of right palmar avulsion trauma in a car accident (**Figure 1**). The right palm has been exposed. At first this patient underwent a skin graft twice, Unfortunately, due to lack of muscle bulk, the patient suffered from severe pain and improper function in the right hand. The patient was then candidate for radial adipofascial forearm pedicle flap surgery. Patient hand vascular competencies were confirmed by an Allen's test and a portable Doppler ultrasound scan.



Figure 1. The defect of the right palmar due to car accident trauma in 42- year-old man

Surgical Technique

Before surgery competencies of palmar arch avaluated with Allen's test and a portable Doppler ultrasound scan. A longitudinal line was drown along the radial artery in the forearm representing the axis of the flap. A distally based reverse radial adipofascial forearm flap with a dimension 15*7cm was planned (**Figure 2**). First, the graft was excised on the hand. Then the forearm adipofascial flap without skin was gradually released and elevated in proximal to distal fashion on the distal radial artery and concomitant veins after ligation of vessels at proximal site.

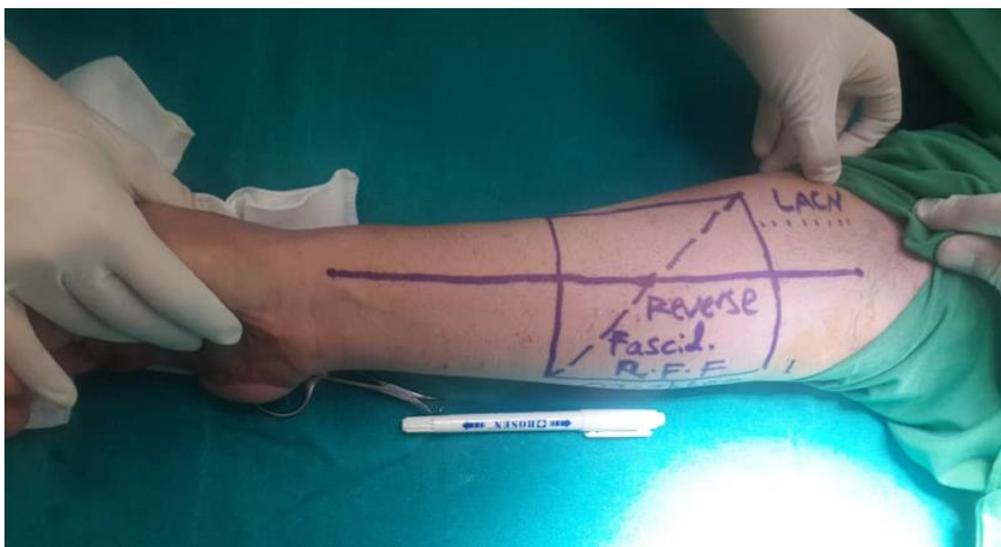


Figure 2. Flap dimensions are designed according to the size of the defect

Then, flap was transposed to the palmar defect area. After that the flap inseting, the donor defect was closed primarily (**Figure 3**). After 5 days, the patient underwent a split thickness skin graft from the right thigh to cover the flap (**Figure 4**).

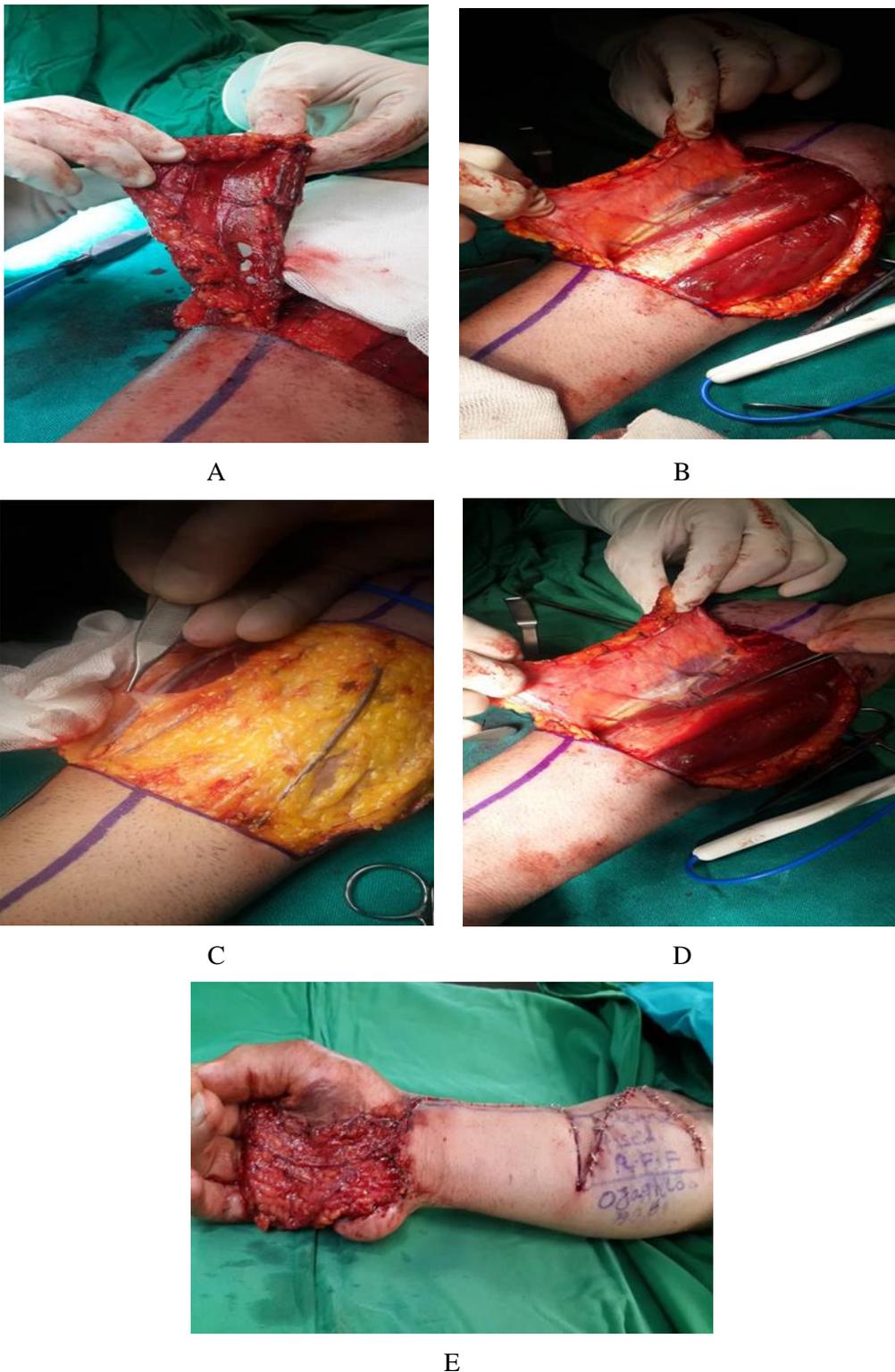


Figure 3. (A)The graft was excised on the hand. (B, C, D) Then the forearm flap was gradually released and was elevated. (E)Then, flap was transposed to the palmar defect area.



Figure 4. After 5 days, the patient underwent a split thickness skin graft from the right groin to cover the flap.

Result

After surgery, a satisfactory coverage is observed in the recipient area. Although, longer time will be needed for complete evaluation of hand function but in early post operative period hand function and pain improved with compared to pre operative time. The advantages of this proposed technique are better donor site morbidity, easy implementation, simultaneous coverage of complex defects, avoidance of long-term immobilization and related complication such as shoulder and elbow stiffness, bad hygiene and avoidance of microsurgery and shorter surgery time. In addition, in this approach donor site is closed primarily and ensures a simultaneous repair of complex wounds with multiple vital anatomical structures (**Figure 5**).



Figure 5. A satisfactory coverage is observed in the recipient areas

Discussion

Hand trauma occurs with considerable frequency in the world. The most common causes of hand trauma are road traffic accidents, fireworks injuries, and industrial trauma (12). Injuries of the hand render deep structures including tendons, nerves, vessels, bone and joints to become exposed (13). Adequate soft

tissue coverage is a cornerstone for successful hand reconstruction in traumatized patients which provides the possibility of hand mobilization and rehabilitation (4, 5). In armamentarium of plastic surgery, reconstruction of soft tissues of hand is a difficult task in order to maintain the good function of the hand as well as cosmesis along with keep the coverage of all vital structures of the hand (14-17). In the literature review, different types of flaps have been described for the dorsal and palmar soft tissue defects of the hand. Options of different local flaps are available in the hand, however, they only provide coverage for small wounds (17). The reconstruction option for soft-tissue hand defects lies between using a distant flap pedicled on the groin and a microsurgical flap using microvascular techniques or local perforator flaps (5). Palmar injuries that involve separate soft-tissue defects challenge reconstruction. In addition, the presence of multiple wounds and complex further highlights this problem of reconstruction. Studies have shown that soft tissue coverage of palmar defects with appropriate tendon reconstruction is the best approach for optimal hand function (5, 18). In this study, we presented reverse flow perforator-based radial adipofascial forearm flap to reconstruct forearm flap and palmar defects after trauma from a car accident. Cutaneous vascular perfusion is accomplished through a layered, three-dimensional network of vessels. The three-dimensional vascular network displays many interconnected branches that link vessels both in a vertical direction i.e. muscular to fascial to subcutaneous to cutaneous and in a horizontal direction i.e. fascial to fascial, subcutaneous to subcutaneous, cutaneous to cutaneous (19, 20). For any wound on any part of the body wound coverage can be done by using local pedicle flaps, distance pedicle flaps or with the free flaps (21). Distant pedicled flaps would also require a long period of immobilization and a two-staged approach for palmar reconstruction with long periods of splinting and physical rehabilitation. Similarly, free flaps are inappropriate compared to the technique presented in this study because of the need for microsurgery and related potential complications (9).

Each technique has its own advantages and limitations. The technique presented in this study is useful because it simultaneously covers the palmar defects. It also avoids immobilization and related complications, i.e. contracture of the involved joints, boutonniere deformity, etc. Split reverse radial forearm perforator-based flap also avoids microsurgery, its related complications, postoperative microsurgery precautions and possible failure of anastomosis. It is also easy to perform this technique because recipient and donor sites are in the same surgical field. The donor site morbidity is acceptable as it is closed primarily. Finally, this approach ensures a simultaneous repair of complex wounds with multiple vital anatomical structures, i.e. bone, tendon, joint, and soft tissue (1, 5).

Conclusion

The use of reverse radial adipofascial forearm flap technique to reconstruct palmar traumatic defect leads to confident coverage of the hand with a strong blood supply and primary closure of the donor site, thereby eliminating complications from the conventional radial forearm flap donor site. This approach ensures a simultaneous repair of complex wounds with multiple vital anatomical structures. Also, the reverse radial forearm flap provides an effective, robust and versatile reconstructive option for upper extremity soft-tissue defects with constant anatomy. In addition, this technique has a good cosmetic result.

Declarations

Conflict of Interest

The authors declare that they have no competing interests.

Funding

None applied.

Reference

1. Akdag O, Karamese M, NebilSelimoglu M, Akatekin A, Abacı M, Sutcu M, et al. Reverse adipofascial radial forearm flap surgery for soft-tissue reconstruction of hand defects. *Eplasty*. 2016;16.
2. Akdağ O, Yıldırım G, Sütçü M, Karameşe M. Posterior interosseous flap versus reverse adipofascial radial forearm flap for soft tissue reconstruction of dorsal hand defects. 2018.
3. Karamese M, Akatekin A, Abac M, Koplay TG, Tosun Z. Fingertip Reconstruction With Reverse Adipofascial Homodigital Flap. *Ann Plast Surg*. 2015 Aug;75(2):158-62. doi: 10.1097/SAP.000000000000137. PMID: 26165570.
4. Liu D-x, Wang H, Li X-d, Du S-x. Three kinds of forearm flaps for hand skin defects: experience of 65 cases. *Archives of orthopaedic and trauma surgery*. 2011;131:675-80.
5. Karacaoglu E, Gokce A. Perforator-based reverse radial forearm flap to reconstruct multiple third-degree burn defects of the fingers. *Journal of burn care & research*. 2008;29:398-402.
6. Berger RA, Weiss A-PC. *Hand surgery*: Lippincott Williams & Wilkins; 2004.
7. Lin S-D, Lai C-S, Chiu C-C. Venous drainage in the reverse forearm flap. *Plastic and Reconstructive Surgery*. 1984;74:508-12.
8. Taghinia AH, Carty M, Upton J. Fascial flaps for hand reconstruction. *The Journal of hand surgery*. 2010;35:1351-5.
9. Yousif NJ, Dzwierzynski WW, Sanger JR, Matloub HS. Sequential transfer of free flap to two defects. *Plastic and reconstructive surgery*. 1998;102:2431-5.
10. Rasheed T, Hill C, Riaz M. Innovations in flap design: modified groin flap for closure of multiple finger defects. *Burns*. 2000;26:186-9.
11. Tsai F-C, Yang J-y, Mardini S, Chuang S-S, Wei F-C. Free split-cutaneous perforator flaps procured using a three-dimensional harvest technique for the reconstruction of postburn contracture defects. *Plastic and reconstructive surgery*. 2004;113:185-93.
12. Crowe CS, Massenburg BB, Morrison SD, Chang J, Friedrich JB, Abady GG, et al. Global trends of hand and wrist trauma: a systematic analysis of fracture and digit amputation using the Global Burden of Disease 2017 Study. *Inj Prev*. 2020 Oct;26(Supp 1):i115-i124. doi: 10.1136/injuryprev-2019-043495.
13. Sajjad Y, Hameed A, Gill NA, Bhutto AW. Use of a pedicled flap for reconstruction of extensive soft tissue defects around elbow. *J Coll Physicians Surg Pak*. 2010;20:47-50.
14. Bilal M, Ahmed TM, Dar MF, Ahmed N. Reverse posterior interosseous flap; useful but problematic flap. *Pakistan Armed Forces Medical Journal*. 2016;66:341-45.
15. AHMAD M. Management of hand trauma. *Journal of Surgery Pakistan (International)*. 2008;13:128-31.
16. Bashir MM, Sohail M, Shami HB. Traumatic wounds of the upper extremity: coverage strategies. *Hand clinics*. 2018;34:61-74.
17. Kaufman MR, Jones NF. The reverse radial forearm flap for soft tissue reconstruction of the wrist and hand. *Techniques in hand & upper extremity surgery*. 2005;9:47-51.
18. Friedrich JB, Katolik LI, Vedder NB. Soft tissue reconstruction of the hand. *The Journal of hand surgery*. 2009;34:1148-55.
19. Chang SM, Hou CL, Zhang F, Lineaweaver WC, Chen ZW, Gu YD. Distally based radial forearm flap with preservation of the radial artery: anatomic, experimental, and clinical studies. *Microsurgery*. 2003;23:328-37.

20. Medalie DA. Perforator-based forearm and hand adipofascial flaps for the coverage of difficult dorsal hand wounds. *Annals of plastic surgery*. 2002;48:477-83.
21. Adani R, editor Dorsal hand coverage. *BMC Proceedings*; 2015: Springer.