

Dorsal Ulnar Artery Perforator Based Flap For Coverage of Composite Soft Tissue Defects of Hand

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ABSTRACT

Objective To describe the usefulness of dorsal ulnar artery perforator flap for coverage of composite soft tissue defects of the hand.

Study design Descriptive case series.

Place & Duration of study Department of Plastic and Reconstructive surgery, Dow University of Health Sciences & Dr. Ruth KM Pfau Civil Hospital Karachi, from June 2018 to September 2019.

Methodology Patients with composite soft tissue defects of hand were selected. Patients with segmental bone loss and severe co-morbid conditions were excluded. After initial debridement of the defect, perforator was identified with Doppler ultrasound. Flap was raised from proximal to distal direction with deep fascia and inset into the defect. Donor sites were skin grafted in all cases. Patients were followed for three months postoperatively.

Results Total 15 patients with composite soft tissue defects of hand were operated. Mean age of the patients was 22.9 year. In seven patients flap was used to cover the defect on the dorsum of hand, in five for palm, in two for wrist, and one for first web space. In 12 patients healing occurred uneventfully. Partial necrosis was found in one flap which was later skin grafted. Superficial epidermolysis and mild wound site infection was found in one case each and both were managed conservatively. Donor site graft take was 100% and the eventual result was acceptable to the patients.

Conclusion Perforator based dorsal ulnar artery flap is an easy, reliable and single stage option for coverage of composite soft tissue defects of the hand.

Key words Composite hand injuries, Ulnar artery perforator flap, Soft tissue coverage of hand.

INTRODUCTION:

A large number patients of hand trauma with wound ranging from small superficial defects to extensive soft tissue injuries with exposed vital structures are brought to the hospitals worldwide.¹ It accounts for

about 10% of patients presenting in emergency departments.² Early coverage is required for optimal function and rehabilitation and it remains a substantial surgical challenge for the plastic and reconstructive surgeons.³

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The fundamental principle is to provide a durable, stable and pliable coverage to obtain a healed wound with minimal scarring to maintain the form and function of the hand. This can be achieved by various surgical options. Loco-regional options like reverse radial forearm flap in which a major vascular axis is sacrificed.⁴ Posterior interosseous artery flap is rather difficult to execute.⁵ Distant flaps are cumbersome and associated with immobility, stiffness due to delayed rehabilitation and increased chances of infection. Free flaps require microsurgical expertise.

The dorsal ulnar artery flap, also known as the Becker's flap, was first described by Becker and Gilbert in 1988.⁶ It is a fasciocutaneous flap with territory along the ulnar aspect of the forearm that is supplied by the ascending branch of dorsal ulnar artery which is one of the major branches of ulnar artery in the distal forearm. The major advantage of this flap is the possibility of raising a thin, and sturdy and reliable flap without the sacrifice of a major vessel. Due to its vast arc of rotation, it can be reliably and easily used for coverage of a range of defects around the wrist and hand. The objective of this study was to evaluate the clinical application of dorsal ulnar artery flap for the various indications for the coverage of soft tissue defects of hand without necessitating the use of a microvascular flap.

METHODOLOGY:

This descriptive study was conducted at the Department of Plastic & Reconstructive Surgery, Dow University of Health Sciences & Dr. Ruth KM Pfau Civil Hospital Karachi, from June 2018 to September 2019. Total 15 patients with age between 12 year to 36 year, with composite soft tissue defects due to various etiologies including machine injuries, road traffic accidents, burns and post burn contractures involving of dorsum of hand, firearm injuries and post abscess defects were selected using non-probability convenient sampling. Patients with segmental bone loss and severe co-morbid and stiff joints were excluded from the study. Written and informed consent was taken from all patients. The data was recorded in the proforma.

For surgical procedure a line was drawn from the pisiform bone to the medial epicondyle of humerus and perforator of dorsal ulnar artery identified with the help of hand-held Doppler ultrasound between the tendons of flexor carpi ulnaris (FCU) and extensor carpi ulnaris (ECU), approximately 3 to 5cm proximal to pisiform. All operations were performed under general anesthesia with pneumatic tourniquet control and a loupe magnification. After all aseptic measures judicious debridement of the defect was done and flap dimension marked according to the defect. The pivot point of the flap was marked at 4 cm proximal to pisiform bone. Skin incision was made and the flap elevated using sharp dissection from proximal to distal direction with the fascia of FCU and ECU muscles along the ulnar side of forearm and wrist depending upon the pivot point, arc of rotation and required length of flap (Figure I). This flap can be 9cm-20cm long and 5cm-10cm wide. The average flap length in our patients was 9cm x 7cm. The perforator was identified by retracting the FCU tendon radially around 2cm-4cm proximal to pisiform.

Meticulous blunt dissection was done in the region of perforator to avoid injury. Care was taken to preserve the dorsal ulnar nerve.

In 4 cases the perforator was skeletonized and the flap was completely islanded. Intervening soft tissue bridge was laid open and the flap was rotated at 180 degrees to cover the defect. In rest of the cases the flap was tunneled to the defect. Tourniquet was released to confirm perfusion of the flap. After meticulous hemostasis, flap was inset and sutured using non absorbable sutures. Donor sites were skin grafted taken from thigh. Aseptic dressing was done and a window left open to assess the vascularity of flap. Protective splint was applied.

Postoperatively hand was elevated above heart level. Donor site graft was checked and first dressing done on 5th postoperative day. Patients were discharged after graft check with dressing and splint in place, which was removed after 10 days and physiotherapy initiated. Patients were advised to follow up in the outpatient clinic. Flap outcome and complications associated with it and the wound along with patient satisfaction were carefully observed.

RESULTS:

A total of 15 patients with composite soft tissue defects of the hand were provided soft tissue coverage using ulnar artery perforator flap. There were nine males and six female patients and mean age was 22.9 year. Road traffic accidents were the most common etiology noted followed by machine injury. Demographic data, site of defect, flap parameters, outcome and secondary procedures done are shown in table I. Patients were followed up in the clinic twice weekly for one week, then once weekly for two weeks, and once every month for three months. Out of 15 flaps 12 healed uneventfully. Mild edema settled in about two weeks. Partial necrosis of the flap was managed surgically by skin grafting while superficial epidermolysis and mild superficial wound site infection were managed conservatively. Donor site skin graft take was 100% and the eventual result was acceptable to the patients Figures II & III.

DISCUSSION:

Soft tissue reconstruction of composite defects of hand still poses a challenge to plastic surgeons.^{1,2,7,8} The aim of optimal reconstruction is to provide early coverage preferably in a single stage, using reliable, thin pliable skin with good functional results, minimal morbidity and allows early rehabilitation.^{5,8}

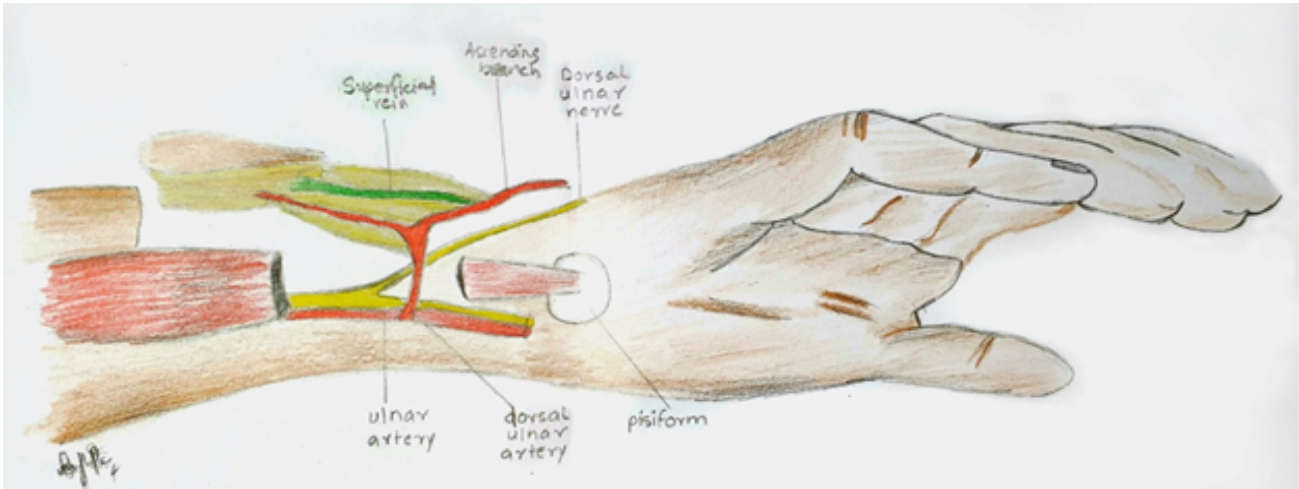


Fig I: Diagrammatic presentation of anatomy and dissection of flap



Fig II: (A) Soft tissue loss at the palmar aspect of hand, thenar area and fingers. (B) Peroperative picture after debridement; showing divided flexor tendon which was repaired primarily. (C) Division of pedicle one month postoperatively (D-F) three months postoperatively well settled flap, complete flexion of fingers and well adherent skin graft at the donor site.

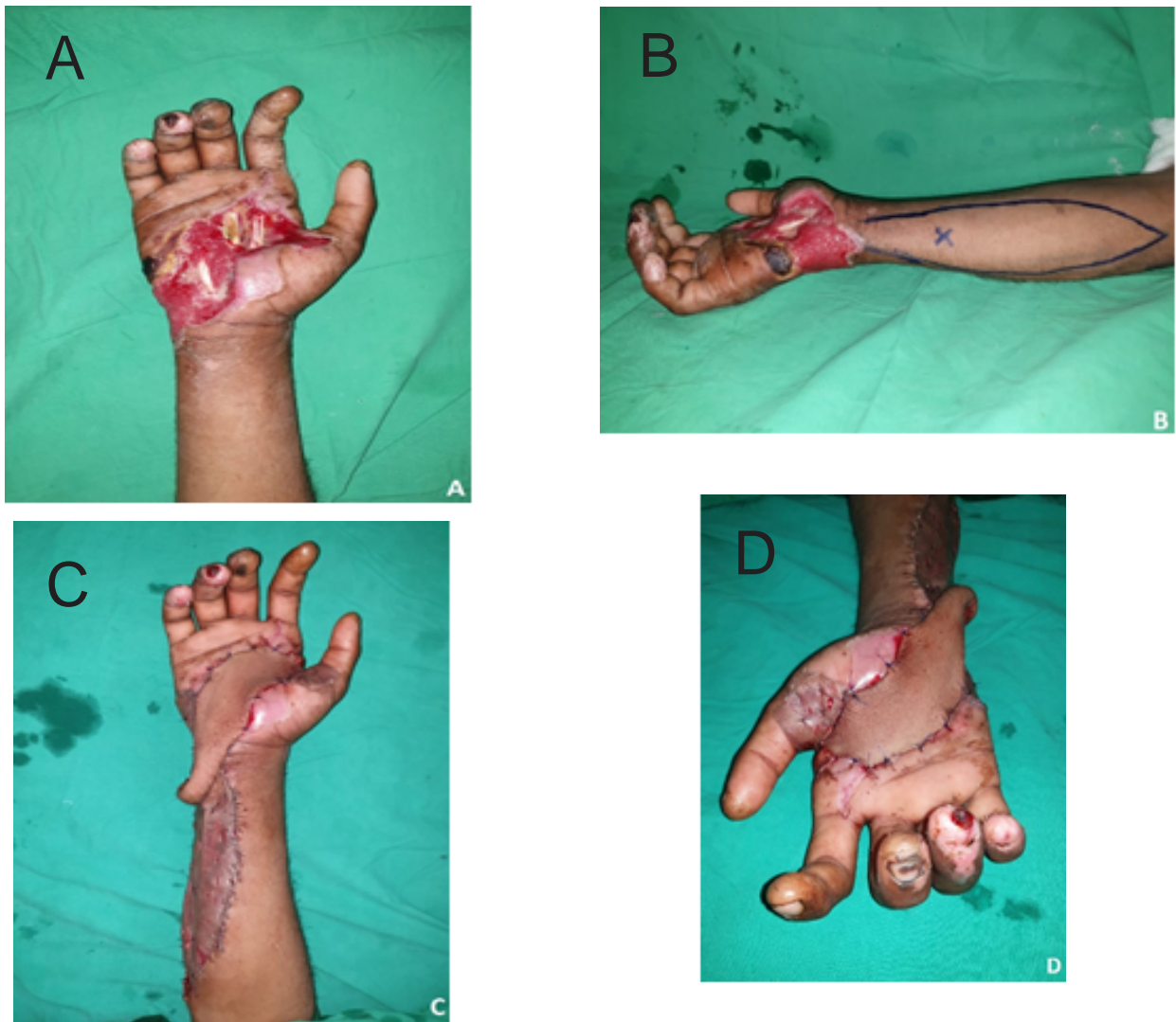


Fig III: (A) Soft tissue loss at the palmar aspect of hand, thenar area with exposed tendons and 1st web space. (B) Preoperative picture after marking of the perforator (C) Postoperative picture with defect covered by the flap and graft placed at the donor site (D) Postoperative picture showing flap covering the defect without tension and reaching up to the 1st web space.

Many reconstructive options are available including free flaps, distant and regional options having own merits and demerits. Free flaps provide the flexibility of shape and size but are time consuming and dependent on microsurgical expertise. Distant flaps like groin or abdominal flaps have been widely used for coverage of such defects but are usually two-staged, require immobilization for a prolonged period making rehabilitation difficult, these are bulky and do not provide a good color match. Regional options are limited in which posterior interosseous artery flap is one option but its vascularity jeopardizes in defects involving the wrist and dissection of the vascular pedicle is complex and tedious.^{9,10} Reverse radial flap is a good reliable option but it involves sacrificing of a major vascular axis.¹¹

for coverage of small defects of hand.¹² It provides robust, thin and pliable soft tissue cover, dissection of the flap is easy, it is based on a perforator rather than a major vessel itself.¹³ It is a single stage procedure that aids in rehabilitation and shortens hospital stay which is another advantage of this flap. Donor sites can be closed primarily if the defect is less than 5cm.^{14,15} The disadvantages include short pedicle, limited arc of rotation and relatively small defects which can be covered with this flap.¹⁶ Both Becker and Gilbert and Holevich-Madjarova et al have indicated that the maximum size of the dorsal ulnar artery flap should be only 10cm x 5cm.¹⁷ In their study authors also suggested that it should only be used for coverage of small defects over the volar or dorsal aspect of the wrist and ulnar palmar

The dorsal ulnar artery perforator flap is a local flap

Table I: Demographic Data, Site of Defect, Flap Dimensions, Outcome and Secondary Procedures

S.No	Age (years)	Gender	Location of defect	Size of flap (cm)	Outcome	Secondary procedure
1	36	M	Dorsum of hand	9 x 7	Flap survived	-
2	22	M	Palm	11 x 6	Flap survived	-
3	18	F	Dorsum of hand	9 x 7	Partial flap necrosis	Debridement & skin grafting
4	21	F	1 st web space	10 x 8	Flap survived	-
5	12	M	Palm	8.5 x 5	Flap survived	-
6	17	F	Dorsum of hand	9 x 7.5	Flap survived	-
7	35	M	Palm	16 x 8	Flap survived	-
8	15	F	Dorsum of hand	10.5 x 6	Wound site infection	Managed conservatively
9	19	F	Dorsum of hand	15.5 x 9	Flap survived	-
10	23	M	Wrist	7 x 5	Flap survived	-
11	27	M	Palm	12.5 x 9	Superficial epidermolysis	Managed conservatively
12	31	M	Wrist	9.5 x 5	Flap survived	-
13	34	F	Palm	14 x 7	Flap survived	-
14	18	M	Dorsum of hand	19 x 10	Flap survived	-
15	16	M	Dorsum of hand	16.5 x 7	Flap survived	-

surface. In the literature, use of dorsal ulnar artery flap as osteocutaneous and neurocutaneous variations has also been defined.^{18,19} In a study osteocutaneous flap harvested by including a 3-cm segment of cortex of the ulnar bone at the insertion of FCU and ECU, resulted in good bone healing and a best functional result of the metacarpal joint postoperatively.¹⁹

The aim of this study was to explore the potential of this flap in our practice for the coverage of complex soft tissue defects of hands with exposed, tendon, joints and important neurovascular structures. The results of our study were comparable with those reported in literature in terms of patient satisfaction, functionality of the hand and the aesthetic outcome of both donor and recipient sites. Studies have found that by using this flap the functional recovery of the hands was good as well as satisfactory cosmetic results of donor and recipient sites.^{20,21} Although the flap was aesthetically good, the scar formation at the donor site was a true drawback of this technique.²² Aesthetic results were subjectively assessed in studies and reported that more than 80% of patients

were satisfied with the cosmetic outcome of the scar.^{10,15} Due to long length of flap, defects involving the dorsum of hand, wrist or even first web space can be covered. Harvesting of forearm fascia with the flap aided in tendon gliding in cases of dorsal defects where tendons were exposed. The flap was based distally so it is imported undamaged to the damaged area which was well vascularized and robust. Islanding the flap avoided the pedicle kink even when the flap was rotated at 180 degrees. It not only increased the reach of the flap to more distal defects, but also made the inseting and contour better. We recommend this flap as an easy, safe and reliable option based on our experience.

CONCLUSIONS:

Dorsal ulnar artery perforator flap is a convenient, versatile and a safe single stage option for the coverage of composite defects of hand that has good aesthetic and functional outcomes and does not require sacrifice of a major vascular axis.

REFERENCES:

- 2011;1:131-44.
1. Unal C, Ozdemir J, Hasdemir M. Clinical application of distal ulnar artery perforator flap in hand trauma. *J Reconstr Microsurg.* 2011;27:559-65.
 2. Khan AZ, Khan IZ, Khan A, Akhter J, Choudhry AM. Audit of occupational hand trauma presenting in the accident and emergency departments of two major hospitals. *Ann King Edward Med Coll.* 1998;4:14-6.
 3. Becker C, Gilbert A. The cubital flap. *Ann Chir Main.* 1988;7:136-42.
 4. Ali H, Zulfiqar B. Reverse radial forearm flap; management of soft tissue defects of dorsum of hand and wrist using reverse radial forearm flap. *Professional Med J.* 2018;25:1791-5.
 5. Shahzad MN, Ahmed N, Qureshi KH. Reverse flow posterior interosseous flap: experience with 53 flaps at Nishtar Hospital, Multan. *J Pak Med Assoc.* 2012;62:950-4.
 6. Becker C, Gilbert A. The ulnar flap-description and applications. *Eur J Plast Surg.* 1988;11:79-82.
 7. Battiston B, Artiaco S, Antonini A, Camilleri V, Tos P. Dorsal metacarpal artery perforator-based propeller flap for complex defect of the dorsal aspect in the index finger. *J Hand Surg Eur.* 2009;34:807-9.
 8. Ahmad M. Management of hand trauma. *J Surg Pak.* 2008;13:128-31.
 9. Khan R, Shah H, Gul H, Khan MS, Khan A. Posterior interosseous artery flap in soft tissue reconstruction of forearm and hand injuries: Prospects and perspectives. *Pak J Surg.* 2018;34: 313-8.
 10. Tan O. Reverse posterior interosseous flap in childhood: a reliable alternative for complex hand defects. *Ann Plast Surg.* 2008;60:618-22.
 11. Otene C, Achebe J, Ogbonnaya I. The radial forearm flap in reconstruction of upper limb injuries: a case series. *J West Afr Coll Surg.* 2011;1:131-44.
 12. Antonopoulos D, Kang NV, Debono R. Our experience with the use of the dorsal ulnar artery flap in hand and wrist tissue cover. *J Hand Surg Br.* 1997;22:739-44.
 13. Mahmoud WH, El Hawary Y. The use of dorsal ulnar artery flap in coverage of wrist defects. *Egypt J Plast Reconstr Surg.* 2017;41:1-6.
 14. Karki D, Singh AK. The distally-based island ulnar artery perforator flap for wrist defects. *Indian J Plast Surg.* 2007;40:12-7.
 15. Bartelli JA, Pagliei A. The neurocutaneous flap based on the dorsal branches of the ulnar artery and nerve: A new flap for extensive reconstruction. *Plast Reconstr Surg.* 1998; 101:1537-43.
 16. Khan MM, Yasen M, Bariar LM, Khan SM. Clinical study of dorsal ulnar artery flap in hand reconstruction. *Indian J Plast Surg.* 2009;42: 52-7.
 17. Holevich-Madjarova B, Paneva-Holevich E, Topkarov V. Island flap supplied by the dorsal branch of the ulnar artery. *Plast Reconstr Surg.* 1991;87:562-6.
 18. Karacalar A, Ozcan M. Preliminary report: the distally pedicled dorsoulnar forearm flap for hand reconstruction. *Br J Plast Surg.* 1999;52:453-7.
 19. Choupina M, Malheiro E, Guimaraes I, Pinho C, Silva P, Ferreira P, et al. Osteofasciocutaneous flap based on the dorsal ulnar artery. A new option for reconstruction of composite hand defects. *Br J Plast Surg.* 2004;57:465-8.
 20. Ulkür E, Açikel C, Eren F, Celiköz B. Use of dorsal ulnar neurocutaneous island flap in the treatment of chronic postburn palmar contractures. *Burns.* 2005;31:99-104.
 21. Uygur F, Uygur M, Ulkür E, Sever C. Versatility of the reverse dorsoulnarfasciocutaneous flap in coverage of hand defects: clinical experience with 36 cases. *J. Hand Surg Am.* 2009; 34:1327-33.

22. Al-Moktader MA. Superficial dorsal ulnar artery flap for hand and wrist coverage. Egypt J Plast Reconstr Surg. 2010;34:219-22.

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Sabeen Hyder: Manuscript writing and statistical analysis.

Mujtuba Pervez: Drafting of manuscript.

Waqas Sami: Final approval of manuscript.

Conflict of Interest:

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