



Supercharged dorsoulnar island flap: a case report and review of the literature

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Complicated hand and wrist defects require durable and pliable tissues which are offered by flaps, instead of skin grafts. Various dorsoulnar flap options have been used in the regional flap armamentarium of the upper limb. Poor venous drainage may be a considerable handicap when moderate to large skin paddle dorsoulnar flaps are used. In the present case, we aimed to reduce the risk of necrosis by supercharging the dorsoulnar island flap. The current literature regarding dorsoulnar island flap has also been reviewed with focus on this flap. This technique has successfully been used for a complex wrist defect in a 48-year-old man. Postoperative follow up was one year. The flap survived completely with perfect hand function. We think this modification can prevent possible venous stress in the pedicled and free dorsoulnar flaps by obtaining extravenous drainage. The method is simple, does not need sophisticated microsurgical procedure and longer operative time.

Key words: Dorsoulnar; flap; forearm; hand; supercharge; wrist.

Soft-tissue repair of the complex hand defects exposing bone, tendons, nerves, and arteries is a challenge for reconstructive surgeons and often requires skin or fasciocutaneous flaps. Flaps have some superiorities over skin grafts such as opportunity for late reconstruction of underlying vital structures as well as immediate coverage, chance to provide sensate skin in specialized areas, and possibility to present a tissue which can grow normally without contraction. Adequate size, facility to close donor site, constant and long pedicle, pliability and thickness are the most considerable characteristics of an ideal flap in the hand.

However, regional flap options in hand are not many because of limited donor sites. Use of the dor-

sal ulnar skin territory for the reconstruction of dorsal and palmar defects of the hand as an island flap based on the dorsal branches of the ulnar artery and nerve has been previously reported.^[1,2] Although it has some recognized advantages, we encountered vascular problems particularly related to venous outflow, as a drawback of this flap, when we used moderate to large skin paddle dorsoulnar flaps. In the present case, we aimed to reduce the risk of necrosis by supercharging the dorsoulnar island flap. The current literature regarding dorsoulnar island flap has also been reviewed with focus on this flap.

Case report

A 48-year-old man sustained a complex volar wrist defect exposing all flexor tendons and median nerve,

caused by a traffic accident. After serial debridements, dorsoulnar flap was planned to cover the resultant defect (Fig. 1a).

Under pneumatic tourniquet control and axillary block anesthesia, an island fasciocutaneous flap 8x4 cm in dimensions at dorsoulnar site of the forearm was raised through the deep forearm fascia. The antebrachial vein and a cutaneous medial forearm nerve were also found, dissected approximately upto 5 cm and included in the flap (Fig. 1b). The flap's pedicle was placed just dorsal to the flexor carpi ulnaris tendon, ascending end-branch of the dorsal branch of ulnar artery and antebrachial vein were identified and preserved. Dissection was continued up to 2-3 cm proximal to the wrist crease (pivot point) where the dorsal ulnar branch ramifies into ascending and descending end-branches. Because the flap was nourished by antegrade flow (ascending branch), tourniquet was deflated and the flap was observed for perfusion. Bleeding was also inspected at the end of the antebrachi vein. The flap was then transferred to the defect through a subcutaneous tunnel. No venous congestion was seen during either harvest or inset. On the radial aspect of the wrist, a cutaneous branch of the radial nerve and a branch of the cephalic vein were identified and prepared for microsurgical anastomoses. Then, an end-to-end nerve coaptation and venous anastomosis were performed under microscope (Fig. 1c). In order to prevent vascular kinking, vessels should not be left too long or in right angled orientation at the anastomoses site. The flap covered all the vital tissues including flexor tendons and median nerve (Fig. 1d). The donor site was covered with a split thickness skin graft from the right thigh (Fig. 1e). Meticulous hemostasis was achieved without the need for drain placement.

The flap survived completely and no early complications such as infection, hematoma and necrosis developed. Post operative follow up was one year. In late postoperative course, function of wrist and all the fingers is normal. Adaptation of the flap to the defect site was perfect in terms of texture and color harmony (Fig. 2). Flap sensation returned 4 months following operation. Two point discrimination was 11 mm on the flap one year postoperatively.

Discussion

Coverage of the distal upper limb, which includes forearm, wrist and hand, defects has remained a challenge for reconstructive surgeons. The wrist is a junctional zone through which many vital structures of the hand such as flexor tendons, radial, median and ulnar nerves, and radial and ulnar arteries pass. This area has also a considerable role in hand functions. From this point, reconstruction of the complicated wrist defects require durable and pliable tissues which are offered by flaps, instead of skin grafts.

The pedicled groin^[3] and latissimus dorsi flaps^[4] have successfully been utilized as popular distant flaps in the literature. However, two-staged procedure and long duration of immobilization are the major handicaps of all distant pedicled flaps used in the forearm and hand reconstruction. Although free flaps are a good choice, their success rates decrease when problems related to the recipient vessels accompany the injury to the extremity. Local and regional flaps, which have short operation and hospitalization times, and no need for sophisticated microsurgical procedures, are more advantageous than the former options.

The reverse posterior interosseous flap has commonly been used in coverage of palmar and dorsal hand defects in adults^[5] and even in children.^[6] As in our case, however, flap perfusion may be disturbed in volar defects of the wrist itself, because anastomoses obtaining reverse-flow between the anterior and posterior interosseous arteries are likely to be injured from trauma. Moreover, this flap can not reach to the distal surface of the hand such as the fingers. In this region, reverse phalangeal flaps^[7] are fairly popular and the choice of treatment. The distally based radial forearm flap^[8] has been the main flap used in palm reconstruction, but sacrifice of the radial artery and major donor site scar has diminished its popularity. In our wrist defect, we did not prefer this flap because of the above reasons as well as a high risk of necrosis. The same handicaps were valid for the reverse ulnar artery forearm flap^[9] using the main ulnar artery, despite the fact that free version of this flap has reliably been harvested for head and neck reconstruction.^[10]

The ulnar flap proximally based on the dorsal branch of the ulnar artery has been first reported by



Fig. 1. Operative stages of the procedure. **(a)** Preoperative aspect of the wrist defect after serial debridements. **(b)** Raising of the dorsoulnar island flap. The antebrachial vein (V) and a cutaneous medial forearm nerve (N) (5 cm each) were also included in the flap. **(c)** Venous anastomosis (Va) and nerve coaptation (Nc) were performed end-to-end at radial aspect of the wrist. **(d)** Immediate appearance of coverage. **(e)** Image of the donor site after coverage with split thickness skin graft. [Color figure can be viewed in the online issue, which is available at www.aott.org.tr]

Becker and Gilbert^[1] in 1988. Because of its short pedicle; this flap was only indicated in reconstruction of the anterior aspect of the wrist. In an attempt to lengthen the pedicle, Bertelli and Pagliei^[11] then described the reverse flow neurocutaneous dorsal ulnar flap based on the anastomoses of the dorsal branch of the ulnar artery with the dorsal inter-

metacarpal arteries and with the digital arteries in their anatomical and clinical studies. In 1999, Karacalar and Özcan^[12] suggested a similar flap, which was called distally pedicled dorsoulnar forearm flap, supplied by the dorsal carpal arch in order to reach more distant defects of the hand. Choupina and co-workers^[13] introduced an osteofasciocuta-

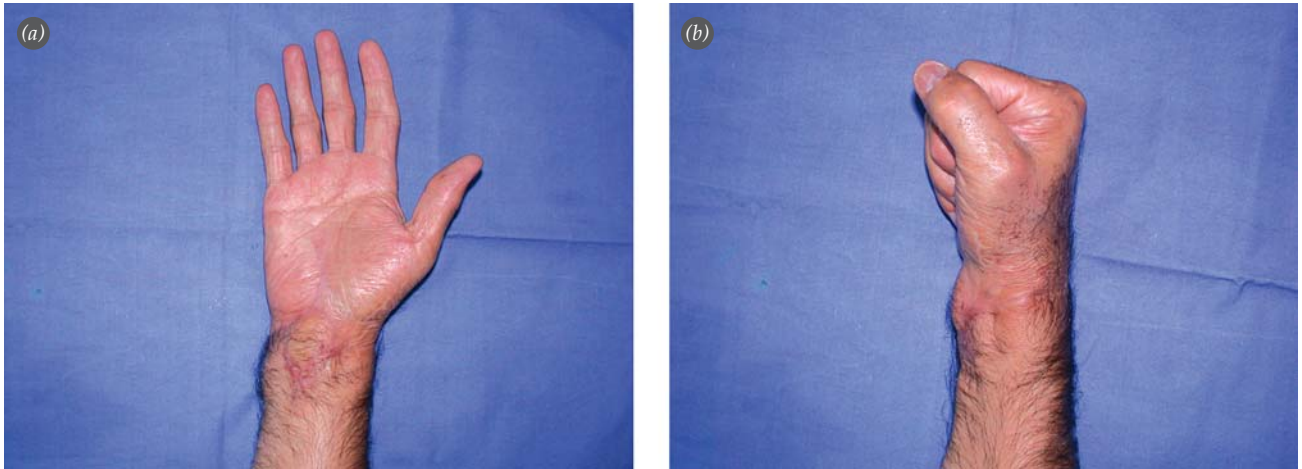


Fig. 2. Postoperative outcome. **(a)** Anterior view. Good adaptation of the flap to the wrist is noted with an acceptable scar. **(b)** Lateral view shows full flexions of the fingers. The flap seems fairly thin and does not require any debulking procedure. [Color figure can be viewed in the online issue, which is available at www.aott.org.tr]

neous form of the first described flap as a new option for composite hand defects. Lastly, the free dorsoulnar flap was applied to severely injured digits and postburn contractures of the fingers by Inada et al.^[14] and Ülkür and colleagues,^[15] respectively.

In the present case, we outlined the flap more proximally than that of Bertelli and Pagliei,^[11] which was similar to that of Karacalar and Özcan,^[12] on the dorsoulnar aspect of the distal forearm. By this way, the ulnar aspect of the wrist was preserved and donor site closure was more readily achieved, resulting in a concealed donor scar. However, on the contrary to the distally pedicled dorsoulnar forearm flap described by Bertelli and Pagliei,^[11] and Karacalar and Özcan,^[12] we preferred a proximally (antegrade) pedicled flap based on the dorsal branch of the ulnar artery, because flap's pedicle was enough to reach to the defect located in the wrist.

We obtained sensation to the flap by including the medial forearm cutaneous nerve rather than the dorsal branch of the ulnar nerve as previously described.^[11] This presents supplement advantages which include not to destroy the arterial pedicle associated with the nerve, facility of coaptation by harvesting the nerve segment in desired length, and to leave less numbness at the donor site.

However, in addition to some disadvantages of the dorsoulnar island flap which involve transferring hair-bearing and darker skin to the volar site, and limited arc of rotation, its' nourishment problems

should also be taken into consideration. Although high survival rates for the dorsoulnar flap have been reported in clinical series, capacities of arterial and venous nourishment of this flap have not been clearly mentioned. Antonopoulos et al.^[16] encountered superficial necroses resulting from poor venous drainage in two of six cases where larger flaps were harvested. They suggested some modifications such as inclusion of superficial veins in the pedicle or anastomosis of these veins to the dorsal venous arch in such cases. Karacalar and Özcan,^[12] and Ülkür et al.^[17] reported partial flap necroses in one out of two and eight cases, respectively. We also experienced some venous congestions and distal loses in our previous dorsoulnar flaps. Perhaps, wider patient series and more anatomical studies can clarify this issue.

In our case, we thought that complicated volar wrist defect located close to the flap's pedicle would have disturbed perfusion, especially venous circulation, of the flap. Thus, in order to enhance venous flow, we supercharged the dorsoulnar flap by anastomosing its main vein, the antebrachial vein, to a branch of the cephalic vein.

"Supercharging" means vascular augmentation of the flap by anastomosing an unrelated distant vascular source to the flap, while "turbocharging" involves anastomosing a vascular source already present within the flap's pedicle to the flap. Supercharge obtains extra drainage of superficial venous system of the forearm to the flap, in addition

to that of accompanied veins to the artery in the pedicle. Supercharging is a precaution to avoid venous congestion in risky patients as in our case. Thus, this procedure should be applied initially without waiting for congestion in such cases. We think that this method can prevent possible venous stress in the pedicled dorsolateral flap. Furthermore, supercharging can also be used in the free dorsolateral flap for the same purpose. In our previous study,^[18] we obtained successful results by applying the same modification to the sural flap in lower extremity reconstruction.

Finally, we believe that by means of this surgical maneuver, perfusion problems may be decreased and the dorsolateral flap may become much more popular in distal upper limb restorations. We suggest supercharging in suitable cases since it is simple, does not need sophisticated microsurgical procedure and longer operative time.

Conflicts of Interest: No conflicts declared.

References

1. Becker C, Gilbert A. The ulnar flap - description and applications. *Eur J Plast Surg* 1988;11:79-82.
2. 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.
3. McGregor IA, Jackson IT. The groin flap. *Br J Plast Surg* 1972;25:3-16.
4. Tan O, Atik B, Ergen D. Versatile use of the pedicled latissimus dorsi flap as a salvage procedure in reconstruction of complex injuries of the upper extremity. *Ann Plast Surg* 2007;59:501-6.
5. Zancolli EA, Angrigiani C. Colgajo dorsal de antebrazo (en "isla"): (pedículo de vasos interóseos posteriores). *Revista Asociación Argentina Ortopedia Traumatol* 1986;51:161-8.
6. Tan O. Reverse posterior interosseous flap in childhood: a reliable alternative for complex hand defects. *Ann Plast Surg* 2008;60:618-22.
7. Tan O. Reverse dorsolateral proximal phalangeal island flap: a new versatile technique for coverage of finger defects. *J Plast Reconstr Aesthet Surg* 2010;63:146-52.
8. Song R, Gao Y, Song Y, Yu Y, Song Y. The forearm flap. *Clin Plast Surg* 1982;9:21-6.
9. Guimberteau JC, Goin JL, Panconi B, Schuhmacher B. The reverse ulnar artery forearm island flap in hand surgery: 54 cases. *Plast Reconstr Surg* 1988;81:925-32.
10. Rodriguez ED, Mithani SK, Bluebond-Langner R, Manson PN. Hand evaluation following ulnar forearm perforator flap harvest: a prospective study. *Plast Reconstr Surg* 2007;120:1598-601.
11. Bertelli JA, Pagliei A. The neurocutaneous flap based on the dorsal branches of the ulnar artery and nerve: a new flap for extensive reconstruction of the hand. *Plast Reconstr Surg* 1998;101:1537-43.
12. Karacalar A, Özcan M. Preliminary report: the distally pedicled dorsolateral forearm flap for hand reconstruction. *Br J Plast Surg* 1999;52:453-7.
13. Choupina M, Malheiro E, Guimarães 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.
14. Inada Y, Tamai S, Kawanishi K, Omokawa S, Akahane M, Shimobayashi M, et al. Free dorsolateral perforator flap transfers for the reconstruction of severely injured digits. *Plast Reconstr Surg* 2004;114:411-20.
15. Ülkür E, Uygur F, Karagöz H, Çeliköz B. Use of free dorsolateral perforator flap in the treatment of postburn contractures of the fingers. *Burns* 2006;32:770-5.
16. 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.
17. Ülkür E, Açıkkel C, Eren F, Çeliköz B. Use of dorsal ulnar neurocutaneous island flap in the treatment of chronic postburn palmar contractures. *Burns* 2005;31:99-104.
18. Tan O, Atik B, Bekerecioğlu M. Supercharged reverse-flow sural flap: a new modification increasing the reliability of the flap. *Microsurgery* 2005;25:36-43.