Dorsal Ulnar Flap (Becker Flap): Case Report of Reconstruction in High-Voltage Electrical Burn

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ABSTRACT

High-voltage electrical burns pose a substantial challenge for reconstructing wrist defects, often requiring complex microsurgical options. The dorsal ulnar flap is a safe, versatile, and reproducible alternative for covering proximal defects in the hand and distal third of the forearm, with good functional and aesthetic outcomes. A 48-year-old male patient presented with an electrical burn on the right upper extremity, affecting the palm, wrist, and exposing the tendon structures, which required a flap for coverage. The defect was treated with a dorsal ulnar flap (Becker flap), achieving adequate coverage. The dorsal ulnar flap is a reliable and useful tool for reconstructing distal forearm and wrist defects. It can addresses complex defects with good results by use of skin with similar characteristics and without compromising distal blood supply. The dorsal ulnar flap is a viable option for covering complex defects in electric burns of the distal upper limb, avoiding the need for microsurgery.

KEY WORDS: *Dorsal ulnar artery, Electric burn, Forearm reconstruction, Hand burn*

INTRODUCTION

The dorsal ulnar flap (DUF) was described by Becker and Gilbert[1] in 1988 and used to cover small defects on the palm and dorsum of the hand. Subsequent variations have been developed, such as the neurocutaneous flap, which uses the descending branch of the dorsal cutaneous artery and nerve.[2] This versatile fasciocutaneous flap is dependent on the middle branch of the dorsal ulnar artery (DUA) and can be used as a pedicled flap via the ascending branch of the DUA, as an island flap, or as a retrograde flow flap using the descending branch of the DUA and its anastomosis with a deep branch of the ulnar artery on the dorsum of the hand. Initially, disadvantages included the design for small coverage areas, but Antonopoulus and colleagues[3] demonstrated the ability to cover defects up to 20 × 9 cm.

Anatomy of The Dorsal Ulnar Artery

The DUA originates 2 to 4 cm proximal to the pisiform bone and has a diameter of 1 to 1.3 mm; the DUA runs medially deep to the flexor carpi ulnaris tendon. The trunk of the DUA runs from the anterior surface of the forearm obliquely toward the ulnar and distal dorsal surface of the forearm (Figure 1). After a travel distance of 3 to 6 cm, the DUA divides into 3 branches[4]: (1) the proximal branch supplies the flexor carpi ulnaris muscle 4 cm from its insertion on the pisiform bone;[4] (2) the middle or fasciocutaneous branch divides into ascending and descending branches. The ascending branch extends to the upper third of the forearm, supplying the medial and proximal forearm region, approximately 20 cm long by 10 cm wide. The descending branch extends toward the dorsum of the hand below the abductor of the fifth finger and anastomoses with a deep branch of the ulnar artery 1.5 cm from the pisiform bone.[5] (3) The third branch is the distal branch, which is known as the pisiform artery.[5,6]

CASE REPORT

A 48-year-old male patient presented with a high-voltage electrical burn associated with intermediate/deep burns from flash flames, affecting 18% of the body surface, including the face, neck, chest, abdomen, left thigh, and both hands and wrists. Multiple reconstructive surgeries were performed on the described sites. The right upper extremity presented a more complex defect in the volar region of

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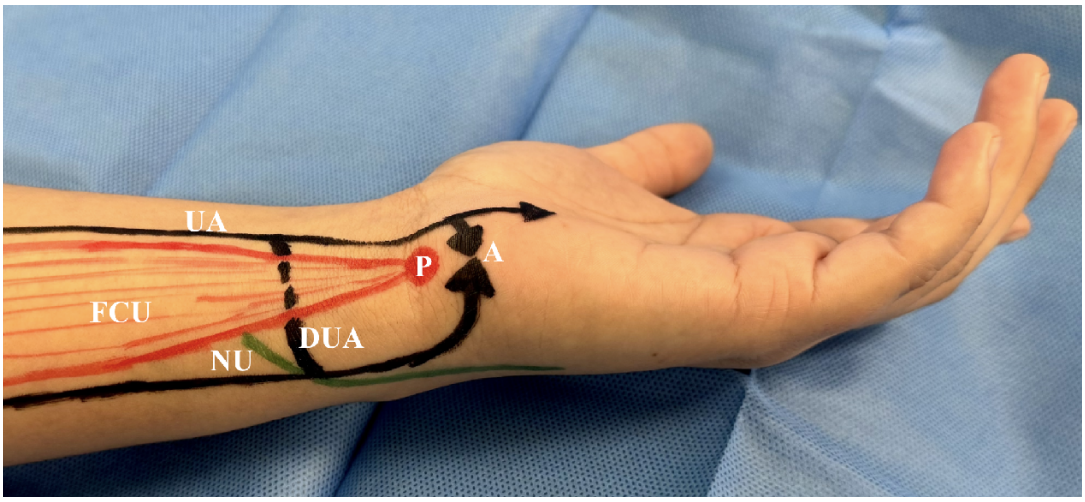
FIGURE 1. Diagram of the Distal Third of the Forearm With the Dorsal Ulnar Artery Passing Beneath the Flexor Carpi Ulnaris Bifurcating Into Proximal and Distal Branches



Abbreviations: A, distal anastomosis; DUA, dorsal ulnar artery; FCU, flexor carpi ulnaris; NU, dorsal branch of the ulnar nerve; P, pisiform; UA, ulnar artery

the distal third of the forearm and palm, with exposure of tendons, nerves, and vascular structures. A plan was made to cover the defect with a regional flap based on the DUA and deferred reconstruction of the median nerve.

The surgery was performed under general anesthesia because simultaneous interventions were needed on other burns. Landmark points were marked, including the distal ulnar epiphysis, pisiform bone, and the flexor carpi ulnaris tendon. Under elevation ischemia, a fasciocutaneous flap was dissected in an anterograde manner until the vascular pedicle of the DUA was visualized beneath the deep fascia about 4 cm proximal to the pisiform bone and dorsal to the flexor carpi ulnaris tendon. After the vascular pedicle was dissected retrogradely under magnification with loupes, the flap was rotated in a peninsula fashion, without requiring a distal skin incision, achieving complete coverage of the defect. The donor area was partially closed, covering the flexor ulnar carpi tendon, and the remaining defect was immediately covered with a split-thickness graft. Adequate flap perfusion was confirmed after ischemia was relieved, with an ischemia time of approximately 30 minutes. The flap evolved satisfactorily, providing stable, functional, and aesthetically acceptable coverage (Figure 2).

DISCUSSION

Covering distal defects of the upper extremity is a challenge for reconstructive surgeons, particularly for complex defects from electrical burns. The frequent tendon exposure in these cases necessitates coverage with flaps that provide stable, movable, durable coverage with thin skin, ideally with similar characteristics, in a safe manner that does not interfere with distal perfusion and allows for early rehabilitation of the limb. Various flaps have been described for covering complex defects of the hand and wrist, especially when tendons, joints, and/or neurovascular structures are exposed. Options include regional flaps (distal pedicle radial flap, perforator radial flap, posterior interosseous flap, and DUF), pedicled distant flaps (McGregor pedicled inguinal flap), and free flaps with microsurgery (skin, muscle, or free microvascularized fascia).

The McGregor flap is a distant pedicled flap that involves tissue from the groin for defect coverage. An advantage is ease of execution. Disadvantages include the need for prolonged immobilization of the limb and a second surgical stage to detach the coverage from its pedicle, as well as a large thickness with abdominal hair and minimal sensitivity, which can hinder rehabilitation and hand functionality.[7,8]

The reverse radial flap is based on the communication between the main vascular axes of the limb. Advantages include reliability, moderate technical difficulty, thin thickness, and use of skin similar to the required area, making it a good option in selected cases. A disadvantage is compromise of the radial axis, requiring the integrity of the ulnar axis to maintain distal perfusion.

The posterior interosseous flap is widely used. Advantages include a long pedicle, no compromise of a main vascular axis, and aesthetically adequate appearance. A disadvantage is the technically complex dissection, requiring longer training and learning curve.[9]

Free flaps are an excellent option for complex distal upper extremity reconstruction, although they require trained

FIGURE 2. Dorsal Ulnar Flap (Becker Flap) Construction

a, Preoperative cleaning and escharotomy. **b,** Postoperative cleaning and escharotomy. **c,** Immediate postoperative coverage. **d,** Postoperative evolution at 1 week. **e,** Postoperative evolution at 2 months.

times, and high failure risk in trauma and electrical burns cases. Although they are the most versatile option with regard to type of reconstruction and defect size, in selected cases, their use can be replaced by regional options with equivalent results in a more expedient and cost-effective manner.[9,10]

The DUF is a valuable tool among upper extremity reconstruction options. This reproducible technique has low or moderate difficulty, with few anatomical variations and clear anatomical references for vascular dissection. The DUF can be performed with regional anesthesia, under magnification with loupes, and with brief ischemia time; in addition, its dissection does not compromise the distal perfusion of the limb. The DUF can be raised in cutaneous, myocutaneous, or osteomyocutaneous form, depending on the defect's needs. The donor site generally does not present hair, and the skin is similar to that required for distal forearm and wrist defects, allowing for aesthetically acceptable coverage and early rehabilitation. The final appearance can be optimized by raising the island flap. Although the donor site of the DUF is located in a more concealed area compared with the radial or posterior interosseous flaps, its more distal location complicates primary closure and may require grafting depending on the flap dimensions and local skin laxity. Early rehabilitation and mobilization are possible since no microanastomoses are involved in this technique.

We recommend including the DUF as part of the options for reconstructing complex distal defects of the upper extremity, as it is a safe, low-complexity alternative that allows for efficient use of available resources in most hospital settings.

CONCLUSIONS

The DUF is a safe and low-complexity option for reconstructing complex distal defects of the upper extremity, whether from trauma or burns. The DUF provides coverage with similar tissue, low morbidity, and without the need for microanastomoses, allowing for early rehabilitation in complex injuries.

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