The Dorsal Metacarpal Artery Perforator Flap: A Case Report Utilizing a Quaba Flap Harvested from a Previously Skin-Grafted Area for Dorsal 5th Digit Coverage

Steven H. Bailey · Danielle Andry · Michel Saint-Cyr

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Abstract Burns to the hand are common in burn victims. These burns often leave complex wounds that require local flaps for coverage. Local flaps are often excluded because they lie within the zone of thermal injury. The purpose of this case report is to report the successful use of a Quaba flap harvested from a previously burned and skin-grafted area. The patient's medical record including pre-operative, intra-operative, and post-operative photographs were reviewed and utilized as sources of data. The patient tolerated the procedure well and was able to return to his previous hand therapy regimen without adverse event and with an acceptable cosmetic result. The Quaba flap can be a safe and effective option for local hand coverage even in previously burned and skin-grafted areas.

Keywords Quaba flap · Dorsal hand flaps · Burned hand coverage · Quaba flap for burned hand coverage

Introduction

According to some reports, greater than 80% of burn victims have burns to the hand [6, 11]. These burns to the hand can result in a broad spectrum of injury which often

requires some level of reconstruction. A reliable local option for complex wound coverage is the Quaba flap which is a variation of the dorsal metacarpal artery flap based on the Quaba perforator. Unfortunately, burn patients often are unable to take advantage of these local options due to the extent of the thermal injury and must rely on skin grafts for coverage of simple defects and regional and or distant flaps for coverage of complex defects. This is a case report of the use of a Quaba flap for coverage of a dorsal small finger wound, harvested from the dorsum of a hand that was previously burned and grafted.

Relevant Hand Anatomy

The radial artery enters the dorsum of the hand and branches into the dorsal carpal arch and first dorsal metacarpal artery (DMA) before entering the palm between the two heads of the first dorsal interosseous muscle. The second, third, fourth, and fifth dorsal metacarpal arteries, however, branch from the dorsal carpal arch. The first through third dorsal metacarpal arteries are present greater than 95% of the time, while the fourth and fifth are more variable originating from the palmar system when the dorsal system is not present [8]. The dorsal metacarpal artery system courses distally and anastomoses with the palmar system. At the junction of these two systems, there is a perforator that branches to supply the skin on the dorsum of the hand. This is the perforator from the dorsal communicating branch of the common digital artery also known as the Quaba perforator (Fig. 1). Flow through this perforator can be antegrade through the DMA or retrograde from the palmar system or the dorsal digital arteries.

S. H. Bailey · M. Saint-Cyr (✉)
Department of Plastic Surgery,
UT Southwestern Medical Center Dallas,
1801 Inwood Road,
Dallas, TX 75390-9132, USA
e-mail: michel.saint-cyr@utsouthwestern.edu

D. Andry
UT Southwestern Medical Center Dallas,
Dallas, TX, USA

Figure 1 Cadaver dissection of the quaba flap with extension down into the web space dissection. Note the metacarpal heads labeled MP and their relationship to the Quaba perforator.

Case Report

Patient History

The patient is a 45-year-old male who received a 57% total body surface area burn, secondary to a work-related flash burn in October 2007. The burn was distributed over the face, neck, both upper extremities, and the torso. The patient underwent initial resuscitation and routine tangential excision and skin grafting of his burned areas at our institution. The patient subsequently developed a boutonnière deformity of the proximal interphalangeal (PIP) joint of the right small finger. This deformity was treated with progressive extension splinting, volar plate release, central tendon reconstruction, open capsulotomy, and percutaneous pinning. Over the course of his therapeutic regimen, the patient developed an open wound over the dorsum of the PIP joint and middle phalanx of the right small finger

which did not heal (Fig. 2). Evaluation revealed a 1×1 cm defect with exposed tendon at the base of the wound. The remainder of his hand exam revealed 90° of flexion at the metacarpophalangeal (MP) joints, 80° of flexion at the PIP joint of the index finger, 90° at the 3rd finger, and 70° at the 4th finger. The patient was also noted to have a swan neck deformity of the 3rd and 4th digit. After evaluation, it was deemed that the patient would require coverage of this wound. There were several options considered, but for this patient, with extremely limited options and concern for increasing stiffness, the Quaba flap was chosen to provide stable coverage of the wound and allow a prompt return to physical therapy.

Operative Technique

A hand-held Doppler was used to find the Quaba perforator between the right 4th and 5th metacarpal heads. An elliptical flap was designed by pinching the skin over donor site as means to determine if the donor site could be closed primarily. The dimension of the flap measured 8 cm in length by 1.5 cm in diameter (Fig. 2). The distal apex of the flap/pivot point was planned over the perforator localized with the Doppler. An uncut 2-0 Silk suture was used to approximate the reach of the flap to assure adequate coverage of the wound. An Esmarch was used to exsanguinate the right upper extremity, and the tourniquet was inflated to 250 mmHg. The open wound was debrided making sure to remove all scar tissue and leave healthy bleeding edges. The flap was then elevated from proximal to distal using a No. 15 blade and bipolar cautery. A suprafascial dissection was performed proximal to the distal edge of the junctura tendinea. A very generous cuff of fibro-fatty tissue was left surrounding the pedicle to prevent injury to the pedicle and allow retrograde flow from the dorsal branches of the digital artery of the small finger.

Figure 2 Non-healing wound over the dorsum of the PIP joint and middle phalanx of the right small finger with exposed tendon at the base.

Figure 3 Other small perforators may be ligated to increase the reach of the flap once the main pedicle is identified.

Once the main pedicle was isolated, other small perforators tethering the flap were ligated to increase the reach of the flap (Fig. 3). Once freed, the flap was able to be easily rotated 180° into the defect without kinking (Fig. 4). Skin flaps were elevated at the recipient site and the Quaba flap was set in place using a Bruner's incision. After hemostasis was achieved, the donor site was closed primarily. The flap was trimmed according to the defect and was inset within the area of the defect with minimal tension (Fig. 5). On post-operative evaluation, the dorsal small finger wound was well covered with the Quaba perforator flap. The donor site was closed primarily with minimal tension with an acceptable aesthetic result. The flap remained viable and there was no incidence of flap loss or venous congestion noted after the case. At the 2-week and 2 month follow-up visits, the flap remained soft and showed no evidence of contracture or wound breakdown (Fig. 6).

The patient was able to continue his home physical therapy routine within 2 weeks. Of note, the patient's range of motion post-operatively was similar to pre-operative range of motion with 90° flexion at the MP joint, 80°

flexion at the PIP joint of the index finger, 90° at the 3rd finger, and 70° at the 4th finger with a swan neck deformity of the 3rd and 4th digit.

Discussion

Origins of the Quaba Flap

The reverse dorsal metacarpal flap was first reported in 1990 by Lu and Wan in Chinese and by Quaba and Maruyama in the English literature [7, 9]. The dorsal metacarpal artery flaps and variations on this flap have become popular with plastic surgeons and hand surgeons because they provided a reliable skin paddle that is well matched in quality and color [1–5, 10, 12, 13]. The Quaba flap is based on perforators from the dorsal metacarpal artery that occur primarily distal to the junctura tendinea in the distal one third of the dorsum of the hand [9]. The location of this perforator allows the Quaba flap to be quite useful in local reconstruction with the ability to cover

Figure 4 The flap was able to be easily rotated 180° into the defect without kinking.

Figure 5 The flap was trimmed according to the defect and was inset within the area of the defect with minimal tension.

Figure 6 At the 2-week and 2 month follow-up visits, the flap remained soft and showed no evidence of contracture or wound breakdown.

defects on the dorsum of the hand and fingers to the PIP joint, as well as, the distal palm and web spaces [9]. The Quaba flap, as originally described, is based on the cutaneous branches of the DMA. Though versatile, this flap had some limitation with regards to extent of the reach. This limitation spurred continued study of the dorsal vascular supply. A variation of the Quaba flap uses the Quaba perforator at the junction of the dorsal metacarpal artery and the dorsal communicating branch of the common digital artery as the main pedicle of the flap (Fig. 1). This location allows for a reverse flap supplied by the palmar system increasing the reach of the flap. This increases the ability to cover dorsal finger wounds reliably down past the level of the PIP. Although this strong and abundant blood supply allows for great variation in designing flaps, the viability of the arterial network is considered questionable in previously burned and grafted areas. This case demonstrates that the Quaba flap can be a viable option even in a thermally challenged area. Instead of making an assumption that the dorsum of the hand could not be used, we used some more reliable parameters to decide if this area was a viable option (1) his skin graft was well healed, (2) the patient did not have problems with skin graft taken during his initial operation, and (3) his perforators were easily localized with a Doppler between the metacarpal head, and there was audible signal along the course of the DMA. His

flap functioned quite well and provided excellent coverage without complication.

Conclusion

Burn patients with burns to the hands often require coverage for complex wounds. These wounds, after debridement, often leave nerves, tendons, and blood vessels exposed. Typically, local flaps are used to cover these wounds in a non-burn setting but, in burn patients, these options are often avoided because of the concern of thermal injury. This case shows that the Quaba flap can be a viable option for hand coverage even when based in areas that have been previously burned and grafted, provided the patients has signs of viable blood supply.

References

1. Dautel G, Merle M. Dorsal metacarpal reverse flaps. Anatomical basis and clinical application. *J Hand Surg Br.* 1991;16(4):400–5.
2. Dautel G, Merle M. Direct and reverse dorsal metacarpal flaps. *Br J Plast Surg.* 1992;45(2):123–30.
3. Earley MJ, Milner RH. Dorsal metacarpal flaps. *Br J Plast Surg.* 1987;40(4):333–41.
4. Koch H et al. Extended reverse dorsal metacarpal artery flap: clinical experience and donor site morbidity. *J Plast Reconstr Aesthetic Surg.* 2007;60(4):349–55.
5. Lai-jin L, Xu G. The reverse dorsal metacarpal flap: experience with 153 cases. *Ann Plast Surg.* 2006;56(6):614–7.
6. Luce EA. The acute and subacute management of the burned hand. *Clin Plast Surg.* 2000;27(1):49–63.
7. Maruyama Y. The reverse dorsal metacarpal flap. *Br J Plast Surg.* 1990;43(1):24–7.
8. Omokawa S et al. The anatomical basis for reverse first to fifth dorsal metacarpal arterial flaps. *J Hand Surg Br.* 2005;30(1):40–4.
9. Quaba AA, Davison PM. The distally-based dorsal hand flap. *Br J Plast Surg.* 1990;43(1):28–39.
10. Small JO, Brennen MD. The first dorsal metacarpal artery neurovascular island flap. *J Hand Surg Br.* 1988;13(2):136–45.
11. Smith MA, Munster AM, Spence RJ. Burns of the hand and upper limb—a review. *Burns.* 1998;24(6):493–505.
12. Yang D, Morris SF. Reversed dorsal digital and metacarpal island flaps supplied by the dorsal cutaneous branches of the palmar digital artery. *Ann Plast Surg.* 2001;46(4):444–9.
13. Yousif NJ et al. The versatile metacarpal and reverse metacarpal artery flaps in hand surgery. *Ann Plast Surg.* 1992;29(6):523–31.