

CASE REPORT **HAND**

Free ulnar artery perforator flap for reconstruction of traumatic hand injuries: a case report

Saiuj Bhat MD, BPhil (Hons)  0000-0002-8746-4259,^{1,2,a}

Jeremy Rawlins MBBS (Hons), MPhil, FRACS (Plast)^{1,3,4}

¹Department of Plastic and Reconstructive Surgery, Royal Perth Hospital, Perth, Western Australia, AUSTRALIA.

²School of Medicine, The University of Western Australia, Crawley, Western Australia, AUSTRALIA. ³Department of Plastic and Reconstructive Surgery, Fiona Stanley Hospital, Murdoch, Western Australia, AUSTRALIA. ⁴Wexford Medical Centre, St John of God Hospital, Murdoch, Western Australia, AUSTRALIA.

Keywords: reconstructive surgery, free tissue flaps, microsurgery, hand injuries

Submitted: April 27, 2024 AEST Revised: June 28, 2024 AEST Accepted: October 10, 2024 AEST

DOI: 10.34239/ajops.124586

Australasian Journal of Plastic Surgery

Vol 8, Issue 1, 2025

Introduction

Traumatic hand injuries pose significant challenges for reconstructive surgeons. Complications associated with traumatic hand injuries, such as fractures, underlying joint exposure and tendon or neurovascular injuries, along with insufficient coverage, poor cosmesis and long-term functional limitations, often prohibit the use of simpler reconstructive techniques in complex hand trauma.

Three main pedicled forearm flaps have been described for larger hand defects: the radial forearm flap,¹ ulnar forearm flap² and posterior interosseous flap^{3,4} based on the radial artery, ulnar artery and posterior interosseous artery, respectively. The radial forearm flap is associated with significant donor site morbidity, including poor skin graft healing over the flexor tendons, injury to the radial nerve or its branches resulting in paraesthesia or cold intolerance, fracture of the radius if bone is harvested with the flap, wrist stiffness, reduced grip and pinch strength, poor cosmesis and compromised vascularity of the hand.⁵⁻¹⁴ Harvest of an ulnar artery flap requires sacrifice of a major artery. While this may not cause ischaemia of the forearm and hand, alternatives that preserve the ulnar artery are preferable. The posterior interosseous flap has marked vascular variability and discontinuity, making the flap less reliable. The first dorsal metacarpal artery flap offers another locoregional reconstructive option in hand injuries. However, the major disadvantage of this flap is the requirement of a full thickness skin graft over the exposed index finger extensor tendon, which may impact function and cause ungainly scarring.

Herein, we report the use of a free ulnar artery perforator (FUAP) flap in a patient with a complex soft-tissue injury of the thumb and perform a literature review investigating other reported cases of the FUAP flap in hand injuries.

^a Corresponding author: Saiuj Bhat MD, BPhil (Hons); saiuj.bhat@gmail.com

Case

The patient was a 20-year-old, right hand dominant, male bricklayer who was transferred to our centre with flexor tenosynovitis of the left thumb secondary to a suspected insect bite. His medical history was significant for a bicuspid aortic valve and gastro-oesophageal reflux disease. He was a polysubstance drug user and an active smoker. Intravenous cefazolin was commenced on arrival and the patient taken to theatre for debridement. His antibiotic regimen was subsequently changed to clindamycin, given the growth of methicillin-resistant *Staphylococcus aureus* (MRSA) from intraoperative specimens. The patient had a repeat debridement five days after the index operation. The originally planned full-thickness skin graft was unable to be performed due to extensor pollicis tendon exposure (**Figure 1A**). An FUAP flap was chosen for wound coverage.

The ulnar artery perforators were surface marked using thermal and colour Doppler imaging. The operation was performed under general anaesthesia. A radial incision was made through fascia to identify the ulnar artery perforators (**Figure 1B–C**). The flap was measured according to the size of the defect (**Figure 1D**). The flap was islanded and the vessels were ligated under microscopy (**Figure 1E**). The flap was raised on a 2–3 cm pedicle to the ulnar artery (**Figure 1F**). The thumb radial digital artery did not have a reliable blood flow, therefore an end-to-side vein graft was used to anastomose the ulnar perforator to the radial artery. Venous anastomosis was performed via the venae comitantes. The flap was well contoured to the recipient site (**Figure 1G**). The donor site was closed primarily (**Figure 1H**).

Postoperatively, the patient was commenced on aspirin and a heparin infusion, and the hand was



Fig 1. Use of free ulnar artery perforator flap for reconstruction of traumatic thumb injury: (A) wound post-debridement; (B–F) harvest of flap; (G–H) flap inset and donor site closure

kept elevated and warmed with a Bair Hugger. Hand therapy was commenced on postoperative day two and a resting thermoplastic splint fashioned for support. The patient's postoperative course was complicated by a haematoma, which required evacuation in theatre on postoperative day two. The remainder of his stay in hospital, which lasted a total of 18 days, was unremarkable. Three weeks following surgery, the patient had full extension of the interphalangeal joint and approximately 50 per cent flexion. The patient was last followed-up 4.5 years after his procedure and had full function of the thumb, having successfully returned to work. He reported persistent hypersensitivity of the thumb to cold and pain, however this did not affect his quality of life.

Two further FUAP flaps were performed on male patients (aged 36 and 38) with traumatic skin loss and extensor pollicis longus tendon exposure as a result of motor vehicle trauma. Both underwent uncomplicated flap reconstruction. The princeps pollicis artery was used for the arterial anastomosis and a cutaneous vein. Both patients reported good active range of motion subjectively in the thumb on discharge but were lost to follow-up.

Literature review

A literature search was conducted in PubMed since its inception without language restrictions using the following search terms: 'free ulnar artery perforator flap' and ('hand*' or 'finger*' or 'digit*') and 'trauma*'. We identified seven studies that met the inclusion criteria (**Table 1**).^{15–21} Most studies were based in China (n = 5). The number of patients ranged from five to 75 with a mean age between 30 and 39. Only one study¹⁹ explicitly reported associated injuries. In this study, 40 per cent of patients had an underlying fracture, approximately half experienced tendon injuries, and 60 per cent had arterial and nerve injuries. Mean operative time ranged from 120 to 187 minutes. Three studies reported the procedure being done under regional anaesthesia for all cases.^{15,18,19} Primary closure at the donor site was achieved in all patients in three studies^{15,16,21} and ranged between 40 and 87.5 per cent in the remainder. Complete flap loss was not reported by any study. One case of partial flap necrosis was reported by Jihui and colleagues¹⁶ and Zheng and colleagues.¹⁹ Donor site complications included mild scar formation (n = 1 case), numbness over the medial wrist (n = 1 case), and partial necrosis of the skin graft to the donor site (n = 3 cases). Cold intolerance was the main complication reported

Table 1. Demographic characteristics of included studies and reported outcomes of free ulnar artery perforator flaps

Study	Country	Patients (n)	Mean age (y)	Age range (y)	Males (%)	Females (%)	Follow-up range (months)	Trauma (%)	Primary closure (%)	Partial necrosis (n)	Complete flap loss (n)	Donor complications (n)	Recipient complications (n)
Inada and colleagues, 2004 ¹⁵	Japan	13	38	18–64	84.6	15.4	–	53.8	100	0	0	1	0
Jihui and colleagues, 2009 ¹⁶	China	75	31	20–45	54.7	45.3	6–24	100	100	1	0	0	0
Kim and colleagues, 2013 ¹⁷	Korea	5	39	15–57	100	0	11–31	60	40	0	0	0	0
Liu and Zheng, 2014 ¹⁸	China	8	32	21–45	62.5	37.5	4–18	87.5	87.5	0	0	0	0
Zheng and colleagues, 2014 ¹⁹	China	15	35	19–57	53.3	46.7	7–20	100	73	1	0	1	1
Wu and Zhao, 2016 ²⁰	China	35	–	19–62	–	–	6–28	100	49	–	0	3	0
Tu and colleagues, 2019 ²¹	China	12	30	18–47	66.7	33.3	–	100	100	0	0	0	5

at the recipient site (n = 6 cases). Between 25 and 40 per cent of patients required a debulking procedure in two studies.^{17,18} Only one study²¹ reported time to return to work of 13 weeks. Another study reported on return to presurgical occupation or activities of daily living and in that study all patients returned to premorbid function.¹⁸

Discussion

Free ulnar artery perforator flaps can be useful in the reconstruction of complex traumatic hand injuries with good long-term functional outcomes and acceptable donor site morbidity. To our knowledge, this is the first reported case of the use of a FUAP flap for hand injury in Australia.

The FUAP flap preserves the ulnar artery and has a number of benefits compared to the radial forearm flap, including:

1. less obtrusive and hirsute donor site
2. lower incidence of sensory deficits and cold intolerance
3. preserved grip and pinch strength
4. if a skin graft is required to close the donor site, it is applied over muscle bellies rather than exposed tendons.

The ulnar artery perforator has a diameter similar to the proximal proper digital artery and the flap contains both the accompanying vein and subcutaneous superficial veins that can improve flap survival. This anatomic feature reduces the technical complexity of anastomosing the vessels between the flap and the recipient site. The flap also contains the forearm medial cutaneous nerve or the dorsal branch of the ulnar nerve, which favours sensory recovery when used as a sensate flap. Furthermore, it allows for the use of the vascularised partial flexor carpi ulnaris tendon as part of the flap to repair tendon defects.

The FUAP flap procedure has relatively few complications and is tolerated well by patients. Complete flap loss has not been reported in the literature and only two cases of partial flap loss have been described.^{16,19} Hypersensitivity/cold intolerance at the recipient site is the main side effect of the procedure, being reported in six cases. Our patient reported similar symptoms at 4.5 years, although this did not affect his overall hand function or quality of life. Despite these inconveniences, patient satisfaction in studies that report this outcome is relatively high.^{17,18}

Conclusion

Findings from our case report and narrative synthesis suggest that FUAP flaps are a feasible and useful reconstruction option for complex defects of the hand. The flap has minimal donor and recipient site morbidity and limited data to date suggest acceptable functional outcomes.

Patient consent

Patients/guardians have given informed consent to the publication of images and/or data.

Conflict of interest

The authors have no conflicts of interest to disclose.

Funding declaration

The authors received no financial support for the research, authorship and/or publication of this article.

References

- 1 Soutar DS, Tanner NSB. The radial forearm flap in the management of soft tissue injuries of the hand. *Brit J Plast Surg*. 1984;37:18–26. [https://doi.org/10.1016/0007-1226\(84\)90035-3](https://doi.org/10.1016/0007-1226(84)90035-3)
- 2 Altun S, Uraloğlu M, Kerem M, Alhan B. Anatomical study of the ulnar dorsal artery and design of a new retrograde ulnar dorsal flap. *Plast Reconstr Surg*. 2009;123:1888–1889. <https://doi.org/10.1097/PRS.0b013e3181a3f4b2>
- 3 Kelada MN, Salem RR, Eltoha YA, Ghazlan NA, Kholosy HM. Posterior interosseous artery flap for hand reconstruction: anatomical basis and clinical application. *BMC Musculoskelet Disord*. 2022;23:662. <https://doi.org/10.1186/s12891-022-05630-0>
- 4 Pan ZH, Jiang PP, Wang JL. Posterior interosseous free flap for finger re-surfacing. *J Plast Reconstr Aest*. 2010;63:832–837. <https://doi.org/10.1016/j.bjps.2009.01.071>
- 5 Bardsley AF, Soutar DS, Elliot D, Batchelor AG. Reducing morbidity in the radial forearm flap donor site. *Plast Reconstr Surg*. 1990;86:287–292; discussion 93–94. <https://doi.org/10.1097/00006534-199008000-00014>
- 6 Swanson E, Boyd JB, Manktelow RT. The radial forearm flap: reconstructive applications and donor-site defects in 35 consecutive patients. *Plast Reconstr Surg*. 1990;85:258–266. <https://doi.org/10.1097/00006534-199002000-00016>
- 7 Timmons MJ, Missotten FEM, Poole MD, Davies DM. Complications of radial forearm flap donor sites. *Brit J Plast Surg*. 1986;39:176–178. [https://doi.org/10.1016/0007-1226\(86\)90078-0](https://doi.org/10.1016/0007-1226(86)90078-0)



CC-BY-4. This is an open access article distributed under the Creative Commons Attribution 4.0 International License (CC-BY-4) which permits unrestricted use, distribution and reproduction in any medium, provided the original work is properly cited. View this license's legal deed at <http://creativecommons.org/licenses/by/4.0> and legal code at <http://creativecommons.org/licenses/by/4.0/legalcode> for more information.

- 8 Richardson D, Fisher SE, Vaughan DE, Brown JS. Radial forearm flap donor-site complications and morbidity: a prospective study. *Plast Reconstr Surg*. 1997;99. <https://doi.org/10.1097/00006534-199701000-00017>
- 9 Brown MT, Couch ME, Huchton DM. Assessment of donor-site functional morbidity from radial forearm fasciocutaneous free flap harvest. *Arch Otolaryngol Head Neck Surg*. 1999;125:1371–1374. <https://doi.org/10.1001/archotol.125.12.1371>
- 10 McGregor AD. The free radial forearm flap—the management of the secondary defect. *Brit J Plast Surg*. 1987;40:83–85. [https://doi.org/10.1016/0007-1226\(87\)90016-6](https://doi.org/10.1016/0007-1226(87)90016-6)
- 11 Fenton OM, Roberts JO. Improving the donor site of the radial forearm flap. *Brit J Plast Surg*. 1985;38:504–505. [https://doi.org/10.1016/0007-1226\(85\)90009-8](https://doi.org/10.1016/0007-1226(85)90009-8)
- 12 Jones BM, O'Brien CJ. Acute ischaemia of the hand resulting from elevation of a radial forearm flap. *Brit J Plast Surg*. 1985;38:396–397. [https://doi.org/10.1016/0007-1226\(85\)90250-4](https://doi.org/10.1016/0007-1226(85)90250-4)
- 13 Lutz BS, Wei FC, Chang SC, Yang KH, Chen IH. Donor site morbidity after suprafascial elevation of the radial forearm flap: a prospective study in 95 consecutive cases. *Plast Reconstr Surg*. 1999;103:132–137. <https://doi.org/10.1097/00006534-199901000-00021>
- 14 Schoeller T, Otto A, Wechselberger G, Lille ST. Radial forearm flap donor-site complications and morbidity. *Plast Reconstr Surg*. 1998;101(3):874–875. <https://doi.org/10.1097/00006534-199803000-00077>
- 15 Inada Y, Tamai S, Kawanishi K, Omokawa S, Akahane M, Shimobayashi M, Tsuruzono M, Takakura Y, Inada M. Free dorsoulnar perforator flap transfers for the reconstruction of severely injured digits. *Plast Reconstr Surg*. 2004;114:411–420. <https://doi.org/10.1097/01.PRS.0000131881.42438.93>
- 16 Jihui JU, Liu Y, Hou R. Ulnar artery distal cutaneous descending branch as free flap in hand reconstruction. *Injury*. 2009;40:1320–1326. <https://doi.org/10.1016/j.injury.2009.04.009>
- 17 Kim SW, Jung SN, Sohn WI, Kwon H, Moon SH. Ulnar artery perforator free flap for finger resurfacing. *Ann Plast Surg*. 2013;71:72–75. <https://doi.org/10.1097/SAP.0b013e31824681cc>
- 18 Liu J, Zheng H. Free distal ulnar artery perforator flaps for the reconstruction of a volar defect in fingers. *J Plast Reconstr Aes*. 2014;67:1557–1563. <https://doi.org/10.1016/j.bjps.2014.05.060>
- 19 Zheng DW, Li ZC, Sun F, Shi RJ, Shou KS. Use of a distal ulnar artery perforator-based bilobed free flap for repairing complex digital defects. *J Hand Surg Am*. 2014;39:2235–2242. <https://doi.org/10.1016/j.jhsa.2014.08.019>
- 20 Wu SJ, Zhao MX. [Repair of the finger proximal and middle segment soft tissue defect with flap transplantation]. *Zhongguo Gu Shang*. 2016;29:1053–1057. <https://doi.org/10.3969/j.issn.1003-0034.2016.11.016>
- 21 Tu Q, Liu S, Chen T, Li S, Yan H, Li Z. A comparative study of finger pulp reconstruction using free distal ulnar artery perforator flaps and reverse dorsal homodigital island flaps. *Ann Plast Surg*. 2019;83:650–654. <https://doi.org/10.1097/SAP.00000000000002106>