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Appraisal of the Free Ulnar Flap Versatility in Craniofacial Soft-tissue Reconstruction

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Summary: The unique anatomical characteristics of the forearm region make it especially popular as a free flap donor site for craniofacial soft-tissue reconstruction. The free ulnar forearm flap is less hirsute and allows for better concealment of donor site scar as compared with its radial counterpart. Despite these factors, the free radial forearm flap remains more popular among reconstructive surgeons. Through the presented case series, we hope to emphasize the versatile nature of the free ulnar forearm flap in addressing various craniofacial soft-tissue defects. Following institutional review board approval, a retrospective review of the senior authors' clinical experience performing microvascular free ulnar forearm flap reconstruction of craniofacial soft-tissue defects was performed. A total of 10 patients were identified through our review. Soft-tissue defect locations included lower eyelid (n = 2), tongue and floor of mouth (n = 2), lower lip (n = 2), palatopharyngeal area (n = 1), nose (n = 1), and palate (n = 1). Trauma was the most common defect etiology (n = 5), followed by malignancy (n = 4), and iatrogenic injury in 1 case. All patients demonstrated good aesthetic and functional outcomes related to vision, speech, and oral intake at follow-up when applicable. The free ulnar forearm flap is a versatile reconstructive option that can be used to address a wide spectrum of craniofacial soft-tissue defects and offers numerous advantages over its radial counterpart. *(Plast Reconstr Surg Glob Open 2018;6:1863; doi: 10.1097/GOX.0000000000001863; Published online 5 September 2018.)*

INTRODUCTION

The forearm region is a popular flap donor site for craniofacial soft-tissue reconstruction.[1,2] Song et al.[3] initially described the utility of the free radial forearm flap, whereas the free ulnar forearm flap (FUFF) was described in 1984 by Lovie et al.[4]

Proponents of the radial flap cite hand ischemia as a concern after elevation of the FUFF in individuals with an ulnar dominant blood supply.[5] Advocates of the FUFF have challenged this belief, with evidence showing no functional or vascular compromise to the hand following flap elevation.[6] Moreover, many authors argue that the FUFF is less hirsute, allows better concealment of donor site scar when the arm is in repose by the side and improved donor- and recipient-site aesthetic outcomes.[6–8]

In this study, we describe the senior author's experience (E.D.R) in utilizing the FUFF in craniofacial soft-tissue reconstruction and highlight its versatile nature.

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METHODS

A retrospective review of the senior author's (E.D.R) experience reconstructing craniofacial soft-tissue defects using the FUFF at the New York University Langone Health System was performed. The study was approved by the New York University School of Medicine Institutional Review Board, and authorization for use of patient photographs was obtained.

Flap Harvest Surgical Technique

The flap is outlined on the nondominant upper extremity by using a hand-held Doppler to locate the ulnar vascular pedicle while palpating the Flexor Carpi Ulnaris (FCU) muscle and tendon. The pedicle is located deep to the FCU muscle and enters the flap at its central portion.

Following skin incision, dissection proceeds in a suprafascial plane from radial to ulnar sides using needle electrocautery. This prevents tenting of the tendons deep to the muscular fascia and maintains a thin flap. When the central segment of the flap is reached, dissection transitions to the deeper layer until identification of the pedicle deep to the FCU muscle. The forearm distal crease is a common site of skin graft breakdown following donor-site coverage and is avoided during flap harvest. Division of the distal segments of the ulnar artery and venae comi-

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Table 1. Patient Characteristics

Patient	Sex	Age (y)	Defect Location	Defect Etiology	Donor Side	Flap Size (cm)	Donor-site Coverage	Recipient Vessels	Secondary Procedures	Complications	FU
1	M	55	Lt lower eyelid	Trauma	Lt	5×3	Lt groin FTSG	STA/STV	Tissue advancement, rearrangement	None	6 mo
2	F	82	Tongue and floor of mouth	Malignancy	Lt	7×4	Lt groin FTSG	FA/FV	None	None	4 mo
3	F	66	Lower lip	Iatrogenic	Lt	6×2	Lt groin FTSG	FA/FV	Tissue advancement, rearrangement	None	2 y
4	F	38	Palatopharyngeal	Malignancy	Lt	6×4	Lt groin FTSG	FA/FV	None	None	2 mo
5	M	35	Nose	Trauma	Lt	8×8	Lt groin FTSG	STA/STV	Ulnar forearm flap de-epithelialization, paramedian forehead flap to nasal defect, costochondral grafts to nose, intranasal flap, complex tissue rearrangement	None	2 y
6	M	46	Tongue and floor of mouth	Trauma	Lt	10×4	Right abdominal FTSG	SThA/FV	Complex tissue rearrangement	Vessel kinking revised successfully	2 y
7	F	68	Lower lip	Malignancy	Lt	7×5	Rt groin FTSG	LA/IJB	Intraoral vestibuloplasty, advancement, rearrangement	None	1 y
8	F	54	Lt lower eyelid	Trauma	Lt	7×4	Rt groin FTSG	STA/STV	Tissue advancement, rearrangement	None	3 y
9	F	46	Palate	Malignancy	Lt	7×2.5	LUE proximal FTSG	FA/FV	Rotational greater palatine artery myomucosal flap	Small residual palatal fistula	3 y
10	F	60	Lower lip	Trauma	Lt	8×2.5	Lt groin FTSG	FA/FV	N/A	N/A	N/A

F, female; FA, facial artery; FV, facial vein; FTSG, full-thickness skin graft; FU, follow-up; IJB, internal jugular vein branch; LA, lingual artery; Lt, left; M, male; LUE, left upper extremity; Rt, right; STA, superficial temporal artery; SThA, superior thyroid artery; STV, superficial temporal vein.

tantes are performed, and attention is turned to identification of the nearby ulnar nerve. Reflection of the ulnar aspect of the flap from the FCU muscle allows better exposure of the pedicle and nerve. Dissection near the ulnar nerve is performed using bipolar electrocautery to avoid iatrogenic injury. The skin incision is then extended over the entire length of the pedicle outline to allow retrograde dissection and separation of the pedicle from the ulnar nerve. The pedicle typically travels in a more radial position, while the nerve lies more ulnar as the dissection proceeds proximally along the forearm.

The pedicle usually measures 10–12 centimeters. Donor-site closure is performed with a full-thickness skin graft with care to approximate the forearm muscles in a manner to protect the underlying ulnar nerve.

RESULTS

Ten patients were identified through our review. Patient and surgical details are listed in Table 1.

Selected Case Reports

Patient 8

A 54-year-old female who suffered from left periorbital injury as a teenager after being struck by a car. She complained of chronic eye dryness and corneal irritation due to lagophthalmos, periorbital soft-tissue hollowness, and lower lid entropion. She had undergone multiple reconstructive facial and periorbital procedures, which only provided temporary relief. She underwent release of the lower eyelid cicatricial entropion, followed by left periorbital reconstruction with a FUFF without complications (Fig. 1).

Patient 9

A 46-year-old female who previously underwent resection of a palatal mucoepidermoid carcinoma, followed by unsuccessful reconstruction with a facial artery musculomucosal flap. She presented with a large central palatal defect and speech difficulties. She initially underwent coverage of her palatal defect with a FUFF. She subsequently developed a small oronasal fistula for which she underwent a rotational greater palatine artery myomucosal flap (Fig. 2).

DISCUSSION

The concern regarding hand ischemia following elevation the FUFF[5] has recently been challenged, with evidence demonstrating no motor, sensory, or vascular disturbances.[6] Multiple studies have suggested that the radial artery carries more blood at the level of the wrist than the ulnar artery.[9–11] It is still critical, however, to perform an Allen's test to determine the dominant blood supply to the hand before flap elevation. Both flaps have comparable dissection times, are thin, pliable, allow sensory reinnervation, and possess long vascular pedicles and reliable perfusion, all of which have contributed to their popularity.[2,7,12–14] However, the FUFF is less hirsute and allows improved concealment of the donor site surgical scar when the upper extremity is in repose by the side of the body.[3,6–8] Additionally, the defect resulting from FUFF harvest exposes flexor muscles, as compared with flexor

Fig. 1. Patient 8. Preoperative image (A). Postoperative image (B). *(Printed with permission and copyrights retained by Eduardo D. Rodriguez, M.D., D.D.S).*

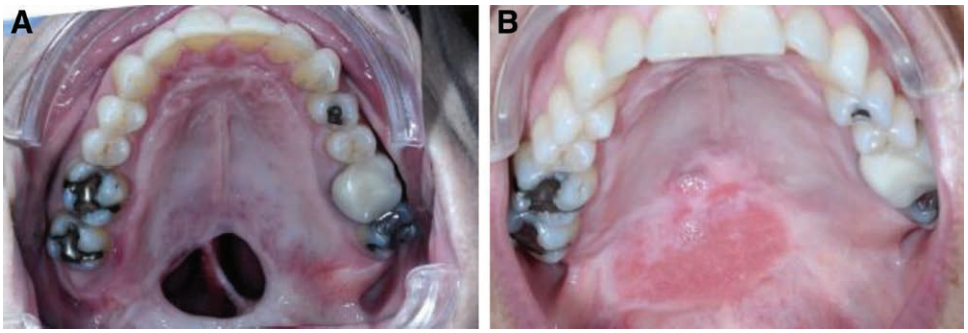

Fig. 2. Patient 9. Preoperative image (A). Postoperative image following palatal fistula coverage with FUFF (B). *(Printed with permission and copyrights retained by Eduardo D. Rodriguez, M.D., D.D.S).*

tendons during elevation of the radial flap, which may lead to fewer donor-site complications and more optimal graft take with the FUFF following skin grafting.[7] These advantages have driven the senior author (E.D.R) to favor the FUFF over its radial counterpart.

Use of the FUFF has previously been described in head and neck,[4,7,12,15–20] tongue,[4,14] pharyngoesophageal,[21] floor of mouth,[4,22] forehead,[6,23] periorbital,[23] eyelid,[23] lip,[23] nasal,[23–26] cheek,[6] lower limb,[4,15,22] upper limb,[18] and penile[18] reconstruction. The reliable vascularity of the FUFF make it particularly useful when reconstructing craniofacial soft-tissue defects, which commonly involve hostile, previously irradiated wound beds. The thin and pliable nature of the flap is also an important consideration, as other popular reconstructive options such as the anterolateral thigh flap, may pose anastomotic challenges in surgical fields with limited exposure[14] and will require at least 1 secondary debulking procedure in most cases to enhance aesthetic outcomes.

Reported flap loss rates following FUFF are generally low.[2] Through a comprehensive literature review, Antony et al.[2] advocate that it provides an excellent alternative to the free radial forearm flap, offers numerous advantages, and should be considered as a preferred flap in head and neck reconstruction. The flap loss rate was reported to be 3.2%, and the FUFF was preferred over its radial counterpart due to decreased hirsutism in 61% of cases and better cosmetic outcomes in 91% of cases.[2]

In our series, all patients who did follow-up demonstrated satisfactory aesthetic and functional outcomes related to vision, speech, and oral intake when applicable.

CONCLUSIONS

The FUFF anatomical features combined with ease of concealment of the donor site, and versatile nature make it a preferred option in craniofacial soft-tissue reconstruction.

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REFERENCES

1. Eckardt A, Meyer A, Laas U, et al. Reconstruction of defects in the head and neck with free flaps: 20 years experience. *Br J Oral Maxillofac Surg*. 2007;45:11–15.
2. Antony AK, Hootnick JL, Antony AK. Ulnar forearm free flaps in head and neck reconstruction: systematic review of the literature and a case report. *Microsurgery*. 2014;34:68–75.
3. Song R, Gao Y, Song Y, et al. The forearm flap. *Clin Plast Surg*. 1982;9:21–26.
4. Lovie MJ, Duncan GM, Glasson DW. The ulnar artery forearm free flap. *Br J Plast Surg*. 1984;37:486–492.
5. Little JM, Zylstra PL, West J, et al. Circulatory patterns in the normal hand. *Br J Surg*. 1973;60:652–655.
6. Rodriguez ED, Mithani SK, Bluebond-Langner R, et al. Hand evaluation following ulnar forearm perforator flap harvest: a prospective study. *Plast Reconstr Surg*. 2007;120:1598–1601.
7. Sieg P, Bierwolf S. Ulnar versus radial forearm flap in head and neck reconstruction: an experimental and clinical study. *Head Neck*. 2001;23:967–971.
8. Hekner DD, Abbink JH, van Es RJ, et al. Donor-site morbidity of the radial forearm free flap versus the ulnar forearm free flap. *Plast Reconstr Surg*. 2013;132:387–393.
9. Tonks AM, Lawrence J, Lovie MJ. Comparison of ulnar and radial arterial blood-flow at the wrist. *J Hand Surg Br*. 1995;20:240–242.
10. Haerle M, Häfner HM, Dietz K, et al. Vascular dominance in the forearm. *Plast Reconstr Surg*. 2003;111:1891–1898.
11. Patsalis T, Hoffmeister HE, Seboldt H. [Arterial dominance of the hand]. *Handchir Mikrochir Plast Chir*. 1997;29:247–250.
12. Hakim SG, Trenkle T, Sieg P, et al. Ulnar artery-based free forearm flap: review of specific anatomic features in 322 cases and related literature. *Head Neck*. 2014;36:1224–1229.
13. Avery CM. Review of the radial free flap: is it still evolving, or is it facing extinction? Part one: soft-tissue radial flap. *Br J Oral Maxillofac Surg*. 2010;48:245–252.
14. Salibian AH, Allison GR, Krugman ME, et al. Reconstruction of the base of the tongue with the microvascular ulnar forearm flap: a functional assessment. *Plast Reconstr Surg*. 1995;96:1081–1089; discussion 1090.
15. Tan ST, James DW, Moaveni Z. Donor site morbidity of free ulnar forearm flap. *Head Neck*. 2012;34:1434–1439.
16. Yu P, Chang EI, Selber JC, et al. Perforator patterns of the ulnar artery perforator flap. *Plast Reconstr Surg*. 2012;129:213–220.
17. Gabr EM, Kobayashi MR, Salibian AH, et al. Role of ulnar forearm free flap in oromandibular reconstruction. *Microsurgery*. 2004;24:285–288.
18. Christie DR, Duncan GM, Glasson DW. The ulnar artery free flap: the first 7 years. *Plast Reconstr Surg*. 1994;93:547–551.
19. Wax MK, Rosenthal EL, Winslow CP, et al. The ulnar fasciocutaneous free flap in head and neck reconstruction. *Laryngoscope*. 2002;112:2155–2160.
20. Van Cann EM, Koole R. The ulnar forearm free flap for the reconstruction of soft tissue defects in the head and neck area: free flap outcome and donor site outcome. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod*. 2009;108:851–854.
21. Li KK, Salibian AH, Allison GR, et al. Pharyngoesophageal reconstruction with the ulnar forearm flap. *Arch Otolaryngol Head Neck Surg*. 1998;124:1146–1151.
22. Koshima I, Iino T, Fukuda H, et al. The free ulnar forearm flap. *Ann Plast Surg*. 1987;18:24–29.
23. Muresan C, Hui-Chou HG, Dorafshar AH, et al. Forehead reconstruction with microvascular flaps: utility of aesthetic subunits. *J Reconstr Microsurg*. 2012;28:319–326.
24. Haack S, Fischer H, Gubisch W. Lining in nasal reconstruction. *Facial Plast Surg*. 2014;30:287–299.
25. Walton RL, Burget GC, Beahm EK. Microsurgical reconstruction of the nasal lining. *Plast Reconstr Surg*. 2005;115:1813–1829.
26. Hsiao YC, Huang JJ, Zelken JA, et al. The folded ulnar forearm flap for nasal reconstruction. *Plast Reconstr Surg*. 2016;137:630–635.