

CORRESPONDENCE: OUR EXPERIENCE

The radial forearm free flap for scalp and forehead reconstruction: A 20-year experience

1 | INTRODUCTION

The skull serves as a bony protective layer for the brain, while the scalp is its thick durable soft tissue covering.^{1,2} The scalp is composed of hair-bearing (temporal, parietal and occipital) and non-hair-bearing skin (frontal), with the underlying occipitofrontalis muscle gliding over a thin sheet of nourishing pericranium. The skin of the scalp is the thickest in the body, varying from 3 to 8 millimetres (mm) in depth.²

Scalp reconstruction can present a challenging endeavour to the reconstructive surgeon. Patient factors such as diabetes mellitus, smoking, corticosteroid use, previous surgical incisions and prior or anticipated scalp irradiation must be carefully evaluated and included in the treatment planning.³ Furthermore, the location of neurovascular structures on the forehead, including the frontal branch of the facial nerve, the supraorbital and supra-trochlear neurovascular bundles should be considered in any reconstruction of forehead defects. These factors, coupled with large sizes of defects, and radiation history often make primary closure of wounds impossible and necessitate the utilisation of skin grafts, allografts, tissue expanders and microvascular free tissue transfer. The surgeon should utilise the reconstructive ladder, employing the simplest form of reconstruction whenever possible. It is paramount to have viable tissue that is pliable enough to match the shape, contour and convexity of the head while remaining durable enough to withstand external stressors such as radiation and trauma. The tissue characteristics providing a challenge are the lack of pliability and the tight adherence to the underlying tissue.¹ The simplest possible method of reconstruction should be considered in all patients while achieving adequate resection and a good functional outcome. Primary closure, skin grafts and local flaps should be considered whenever possible. Excellent cosmetic results can also be achieved with tissue expansion when hair-bearing skin has been lost.⁴ When the defect is too large to be addressed with any of the above modalities, free tissue transfer should be considered. The ideal free flap for scalp reconstruction has adequate thickness, surface area and vascular pedicle length. The need for muscle for reconstructing skull base defects should also be considered in select cases.⁵

There have been many tissue-transfers reported in the literature with good surgical outcomes. The reported tissues are radial forearm flap (RFF), anterolateral thigh (ALT) flap, omental flap, rectus abdominis myocutaneous (RAM) flap, latissimus dorsi flap, scapular flap and serratus muscle flap.^{6,7} The most commonly employed free flap is the latissimus dorsi flap which has a reliable pedicle that provides

excellent cosmetic results. The latissimus dorsi flap requires lateral positioning thereby restricting concurrent harvesting during the resection. The ALT flap has become increasingly popular because of its low donor site morbidity, versatile design and ease of concurrent harvest. However, it is often too thick and has a poor colour match.

In this study, we present the radial forearm free flap as a viable alternative for scalp reconstruction. The RFF provides excellent texture, colour, pedicle length, and reliability. It provides for outstanding coverage of the forehead, temple, vertex and occiput reconstruction. It is thin and pliable, with an excellent colour match. It accepts hair transplants reasonably well.

2 | MATERIAL AND METHODS

Study permission was obtained from the JPS Institutional Review Board. We performed a retrospective analysis of patients with near total or total scalp defects between 1998 and 2016. Age, sex, aetiology, defect size, flap option, flap size, healing time, postoperative radiation and frequency of flap complications were extracted from medical records. Forty six patients who underwent radial forearm free flap and latissimus dorsi free flaps were included in this study. Patients were categorised based on type of free flap received (radial forearm group vs latissimus dorsi).

3 | RESULTS

During the study period, 46 free flaps were performed for scalp defects. Twenty-six of these were radial forearm free flaps, and 20 were latissimus dorsi free flaps. Minimum follow-up was 6 months. In the radial forearm group, there were 20 males and six females. Mean age was 68.1 years (range: 38-92 years). One patient developed epidermolysis and one patient developed partial flap loss of 2.25 cm². Twenty two patients received external beam radiation therapy (EBRT), with two of these patients having delayed partial flap breakdown. (at 3 years and 5 years). Mean skin paddle size was similar in the two groups, with 87 cm² in the RFF group (range: 75-120 cm²), and 92 cm² in the latissimus dorsi group. Mean healing time (without need for dressing changes) was faster in the RFF group at 16 days (range: 10-29 days) compared to 34 days (range: 22-54 days) in the latissimus dorsi group. (Table 1) In the latissimus dorsi group, there were 18 males, and two females. Mean age was 67.2 years (range: 49-88). All latissimus dorsi flaps were harvested as

TABLE 1 Patient Characteristics

	RFFF	LFFF
n	26	20
Mean age (y)	68.1	67.2
Sex M:F	20:06	18:02
Mean flap size (cm ²)	87	92
Healing time (d)	16	34
EBRT	22	17
Delayed breakdown	2	4

muscle only flaps, with additional split-thickness skin grafts harvested. Six patients experienced partial loss of skin graft. There were no flap losses in this group. Seventeen patients received EBRT with four of these patients developing delayed partial flap breakdown (at 3 months, 9 months, 9.5 months and 1 year).

4 | DISCUSSION

Most studies looking at the use of free tissue flaps for scalp reconstruction involve a cohort of patients with a variety of different flaps used. In one series involving 65 patients undergoing reconstruction for scalp and lateral temporal bone defects, 46 latissimus flaps and 4 RFF were performed.¹ In another series involving 34 free flap reconstructions, 24 latissimus flaps were used while 3 RFF were used.⁴ One study in Korea looked at several flap options for scalp reconstruction in 18 patients including the latissimus flap in 11 patients and the RFF in one patient.⁶ In another series involving 30 free flaps, the RFF and latissimus flap were employed in 15 and 10 cases, respectively.⁸ Another series involving 31 free flaps utilised the latissimus flap and RFF in 27 and three patients, respectively.⁹ Radial forearm free flap appear to be underutilised in scalp reconstruction. As reported in the literature, most scalp reconstructions use a latissimus dorsi free flap (49% n = 280/567), followed by rectus abdominis (17% n = 96/567) and anterolateral thigh (14% n = 77/567) free flaps. The radial forearm free flap is less frequently reported at 8% (n = 44/567).¹⁰

Some of the concerns expressed in the literature regarding the radial forearm free flap include lack of adequate surface area, and lack of bulk, easily leading to flap breakdown. In our cohort, there was no statistically significant difference in flap size and rates of flap breakdown in RFF compared to latissimus dorsi free flap. The concern of a disproportionately high likelihood of flap breakdown after radiation therapy has also been put to rest, as the RFF group in our cohort experienced similar rates of flap breakdown compared to the latissimus dorsi group.

Radial forearm free flap confers various advantages over other free flap options. Sweeny et al¹⁰ reported that RFF resulted in shorter duration of hospitalisation and fewer complications requiring surgical intervention. This study adds to the literature by showing that radial forearm free flaps heal significantly faster at 16 days on average, compared to latissimus dorsi at 34 days.

Keypoints

- The ideal free flap for scalp reconstruction has adequate thickness, surface area and vascular pedicle length.
- The simplest possible method of reconstruction should be considered in all patients while achieving adequate resection and a good functional outcome.
- The radial forearm free flap provides excellent texture, color, pedicle length and reliability. It provides for outstanding coverage of the forehead, temple, vertex and occiput reconstruction.
- In our experience, it is as hardy as the latissimus dorsi flap in withstanding postoperative adjuvant radiation, and confers multiple advantages over the latissimus dorsi free flap including faster healing times and shorter hospital stays.

Weaknesses of this study include the fact that this is a single surgeon experience, with possible lack of external validity; as well as a possible introduction of bias favouring a specific operative technique. The retrospective nature of this study also potentially limits its significance. Prospective studies are needed to better delineate the findings reported in this study.

5 | CONCLUSION

The radial forearm free flap provides an excellent skin paddle, with adequate surface area and thickness. It is as hardy as the latissimus dorsi flap in withstanding postoperative adjuvant radiation, and confers multiple advantages over the latissimus dorsi free flap including faster healing times and shorter hospital stays. This versatile free flap should be frequently considered in patients with scalp defects.

CONFLICT OF INTERESTS

None of the authors have any relevant conflict of interests to disclose.

ORCID

Mofiyinfolu Sokoya  <http://orcid.org/0000-0002-4294-8532>

Mofiyinfolu Sokoya¹ 
 Arash Bahrami²
 Jason Cohn²
 Raja Sahwney³
 Scott Kohlert⁴
 Yadranko Ducic⁵

¹Department of Otolaryngology, University of Colorado School of Medicine, Aurora, Colorado

²Philadelphia College of Osteopathic Medicine, Philadelphia, Pennsylvania

³Department of Otolaryngology-Head/Neck Surgery, University of Florida College of Medicine, Gainesville, Florida

⁴Department of Otolaryngology-Head/Neck Surgery, University of Ottawa, Ottawa, Canada

⁵Department of Facial Plastic and Reconstructive Surgery, Otolaryngology and Facial Plastic Surgery Associates, Ottawa, Canada

Correspondence

Yadranko Ducic, Department of Facial Plastic and Reconstructive Surgery, Otolaryngology and Facial Plastic Surgery Associates, Fort Worth, TX

Email: yducic@sbcglobal.net

REFERENCES

- O'Connell DA, Teng MS, Mendez E, Futran ND. Microvascular free tissue transfer in the reconstruction of scalp and lateral temporal bone defects. *J Craniofac Surg*. 2011;22:801-804.
- Ducic Y. Reconstruction of the scalp. *Facial Plast Surg Clin North Am*. 2009;17:177-187.
- Desai SC, Sand JP, Sharon JD, Branham G, Nussenbaum B. Scalp reconstruction: an algorithmic approach and systematic review. *JAMA Facial Plast Surg*. 2015;17:56-66.
- Beasley NJ, Gilbert RW, Gullane PJ, Brown DH, Irish JC, Neligan PC. Scalp and forehead reconstruction using free revascularized tissue transfer. *Arch Facial Plast Surg*. 2004;6:16-20.
- Larrañaga J, Rios A, Franciosi E, Mazzaro E, Figari M. Free flap reconstruction for complex scalp and forehead defects with associated full-thickness calvarial bone resections. *Craniomaxillofac Trauma Reconstr*. 2012;5:205-212.
- Oh SJ, Lee J, Cha J, Jeon MK, Koh SH, Chung CH. Free-flap reconstruction of the scalp: donor selection and outcome. *J Craniofac Surg*. 2011;22:974-977.
- Fowler NM, Futran ND. Achievements in scalp reconstruction. *Curr Opin Otolaryngol Head Neck Surg*. 2014;22:127-130.
- Lutz BS. Aesthetic and functional advantages of the anterolateral thigh flap in reconstruction of tumor-related scalp defects. *Microsurgery*. 2002;22:258-264.
- Ioannides C, Fossion E, McGrouther AD. Reconstruction for large defects of the scalp and cranium. *J Craniomaxillofac Surg*. 1999;27:145-152.
- Sweeny L, Eby B, Magnuson JS, Carroll WR, Rosenthal EL. Reconstruction of scalp defects with the radial forearm free flap. *Head Neck Oncol*. 2012;4:21.