Full-Thickness Skin Graft From the Neck for Coverage of the Radial Forearm Free Flap Donor Site

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Purpose: This study describes the use of a full-thickness skin graft (FTSG) from the neck to cover the radial forearm free flap (RFFF) donor site in patients undergoing neck dissection and microvascular reconstruction for ablative head and neck oncologic surgery. The authors propose that an FTSG from the neck provides sufficient tissue quantity and quality, fewer surgical sites, and decreased surgical time and cost compared with other FTSG harvest sites and split-thickness skin grafts (STSGs).

Materials and Methods: This was a retrospective study of 50 patients from 2007 to 2012 who underwent ablative surgery for oral and head and neck cancer with concomitant cervical lymphadenectomy and RFFF reconstruction with repair of the donor site using an FTSG harvested along the neck dissection incision. Patients who underwent donor site repair using other techniques, such as ulnar transposition flaps, were excluded. Medical records and perioperative photographs were reviewed.

Results: Primary closure of the neck without dehiscence was achieved in all cases. There were no recipient site infections. Minor skin graft loss occurred in a minority of patients and was managed with local wound care until healing by secondary intention. No patients required surgical revision of the forearm.

Conclusions: An FTSG from the neck provides adequate coverage for most RFFF harvests and offers favorable functional and esthetic outcomes. The primary advantage is avoiding a third surgical site. Complications were comparable to those using FTSGs from other harvest sites. Importantly, cross-contamination from the head and neck with the forearm was shown not to be an issue.

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First described in 1981,[1] the radial forearm free flap (RFFF) has become the workhorse of free vascularized techniques for reconstructing defects of the mouth, head, and neck. Its popularity is due to its reliable anatomy and fast dissection, a unique dual venous system, and the pliability of volar skin that is particularly well suited for reconstructing oral defects.[2-4] Despite its many advantages, reconstructive difficulty of the donor site defect remains the RFFF's main disadvantage,[3,5-7] as illustrated by the multiple options for repair that have been proposed.

Many methods have been described, but currently the use of a split-thickness skin graft (STSG) from the thigh or abdomen is popular. Unfortunately, this requires a third surgical site, which then demands increased surgical time or personnel, increased cost, and increased patient morbidity. The use of FTSGs from multiple sites has been described,[5,8,9] but none offer adequate tissue quantity and quality without requiring a third surgical site.

It was the authors' goal to develop a high-quality FTSG that provides adequate tissue volume without the need of a third surgical site for reconstructing the forearm donor site defect. Neck tissue is pliable, much like volar skin, and readily accessible from the inferior margin of the neck flap that is previously

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raised for neck dissection. Sufficient volume can be harvested to cover large forearm defects without complicated wound closure of the neck flap. Harvesting this tissue is reliable and fast and does not necessitate a third surgical site.

Materials and Methods

A review of 50 consecutive cases performed from 2007 to 2012 involving the use of an FTSG from the neck for closure of the RFFF donor site was performed. Institutional review board approval was obtained. Patients undergoing repair of the RFFF donor site during this period using regional flap techniques were excluded. Medical records (clinic and operative notes) were reviewed for data regarding medical comorbidities (Table 1) and social history, primary location and diagnosis of tumor, type of RFFF (fasciocutaneous vs osteocutaneous), and the dimensions of the skin graft taken from the neck. Initial and follow-up clinic notes were reviewed for percentage of graft take, subjective patient complaints of the donor site, and the need for additional wound care or revision surgery.

SURGICAL TECHNIQUE

A 2-team approach is typically used. All patients are prepped and draped in a standard sterile fashion while maintaining separation between the head and neck and forearm sites. This separation is breached only when passing the RFFF to the head and neck site and when passing the FTSG from the neck to the forearm. Antibiotic prophylaxis is given to all patients with cefazolin 2 g or clindamycin 600 mg if allergic to penicillin. After harvest of the forearm flap, an FTSG is harvested from the inferior margin of the skin flap

Table 1. COMORBIDITIES OF PATIENTS IN COHORT

Comorbidity	Patients, n
Hypertension	4
Diabetes	13
Hypothyroidism	3
Rheumatoid arthritis	1
Alcoholism	1
Epilepsy	1
Malnutrition	1

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that was raised for the neck dissection (Fig 1). The FTSG should be approximately 75% of the forearm defect's dimensions. For example, a forearm defect of 2 × 4 cm will require a 2- × 3-cm skin graft. If more than 3 cm in width is needed from the neck, then the projected length will be doubled and the skin graft will be cut into 2 strips. These 2 strips can be inset at the donor forearm site adjacent to each other. Limiting the width of the skin graft to 3 cm allows the neck to be easily closed without tension (Fig 2). Typically, the ablative, neck dissection, flap inset team will pass the skin graft to the team that is closing the forearm donor site. Once passed, the skin graft is defatted, thinned, and tailored to fit the forearm defect. The authors prefer to perform this with heavy Mayo scissors while holding the graft between the thumb and index finger of the free hand. Perforations through the cutaneous layer of the graft while thinning can occur, although this is not problematic. The graft is inset with 4-0 chromic gut suture. It is tacked at 4 points around the defect to stabilize it and

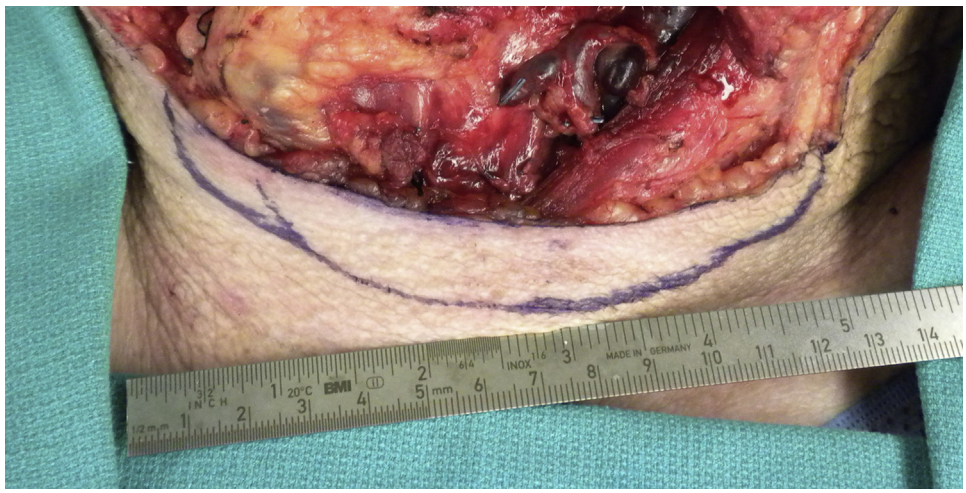

FIGURE 1. The neck full-thickness skin graft donor site is marked.

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FIGURE 2. Primary closure of the neck after harvest of the full-thickness skin graft.

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then a continuous pursestring suture is used around the perimeter in attempt to reduce the defect. The skin graft is under slight tension once complete. The proximal forearm is closed in a layered fashion with 3-0 Vicryl suture and surgical staples or 3-0 nylon (Fig 3). Antibiotic impregnated gauze is placed over the graft, and a short volar splint is applied across the forearm and wrist to immobilize it. The splint and dressing are removed 10 to 12 days after surgery, when the wound is cleaned and healing is assessed (Fig 4). Wound care consists of cleansing twice daily and application of antibiotic ointment covered with a light dressing; this is typically continued for an additional 2 weeks or until healing is complete (Fig 5).

Results

Thirty-two male and 18 female patients (average age, 61.2 yr; range, 24 to 88 yr) were included in this study. The most prevalent site for the primary tumor was the oral tongue followed by the buccal mucosa (Fig 6). Seventy-six percent of radial forearm flaps were fasciocutaneous and 24% were osteocutaneous (Fig 7). The average FTSG size harvested from the neck was 28.4 cm^2 (range, 8 to 60 cm^2). Fifty-two percent of patients were tobacco users (Fig 8). Fifteen (30%) had less than 100% take and required additional local wound care. Fourteen of these 15 patients required additional antibiotic dressing changes twice daily until epithelialization was complete, whereas 1 patient required minor debridement of the skin graft recipient site in the office setting. Nine patients (18%) had a history head and neck radiation, and only 1 of these patients required additional antibiotic dressing changes (Fig 9). All other previously radiated patients healed without complication. No revision of the RFFF donor site was required in any patient.

FIGURE 3. Full-thickness skin graft in place at the forearm donor site.

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FIGURE 4. Two-week postoperative image of a forearm donor site reconstructed with a full-thickness skin graft from the neck.

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Discussion

Developed in the People's Republic of China in 1978 and first reported in the literature in 1981 by Yang et al,[1] the RFFF has become the work horse of vascularized free flaps for oral and head and neck reconstruction during the past 3 decades. Its original applications were for resurfacing post-burn neck contractures[2]; however, in 1983 Soutar and McGregor[3] in Scotland championed its use for reconstruction of the oral cavity.

The popularity of this flap is due to multiple factors. First, its reliable anatomy allows for consistent and relatively fast dissection. Second, it offers a dual venous system by the cephalic vein and the venae comitantes and can be drained by either. Third, the thin and pliable nature of the volar forearm skin allows for excellent adaptability and moldability to oral structures, particularly tongue and floor-of-mouth defects.[2,3,5,10]

Although the flap has gained wide acceptance among microvascular reconstructive surgeons, consensus on addressing the donor forearm site remains elusive.[7] Primary closure is ideal; however, closure of the wound should be as tension free as possible and this is often difficult using only local advancement flaps.[4,6,11,12] Even when a modest-size skin paddle is harvested, excessive tension across the forearm donor site can lead to excessive tension and dehiscence or vascular compromise of the hand.[4,6]

Surgeons continue to seek alternative techniques to achieve *tension-free* donor site closure that would meet the functional and cosmetic demands of the forearm.[7] These include the use of an STSG from the thigh or abdomen, primary closure using an ulnar transposition flap or a V-to-Y closure technique,[6,12-14] preoperative tissue expansion,[15] artificial dermis and allogenic dermal matrix grafts,[16] wound vacuum-assisted closure,[7] suprafascial dissection,[17,18] and FTSGs from the groin,[11] abdomen,[19] and arm.[8,9]

Ulnar transposition flaps and V-to-Y closure techniques offer primary closure, but these are only possible when reconstructing smaller defects.[6,12] Even then, they have an increased dehiscence rate owing to excessive wound tension. Tissue expansion also can allow primary closure, but the expansion device must be worn for 14 to 20 days before surgery, which may not be feasible in the oncologic patient. In addition, they are cumbersome and painful for the patient and have many associated complications, such as infection and extrusion of the

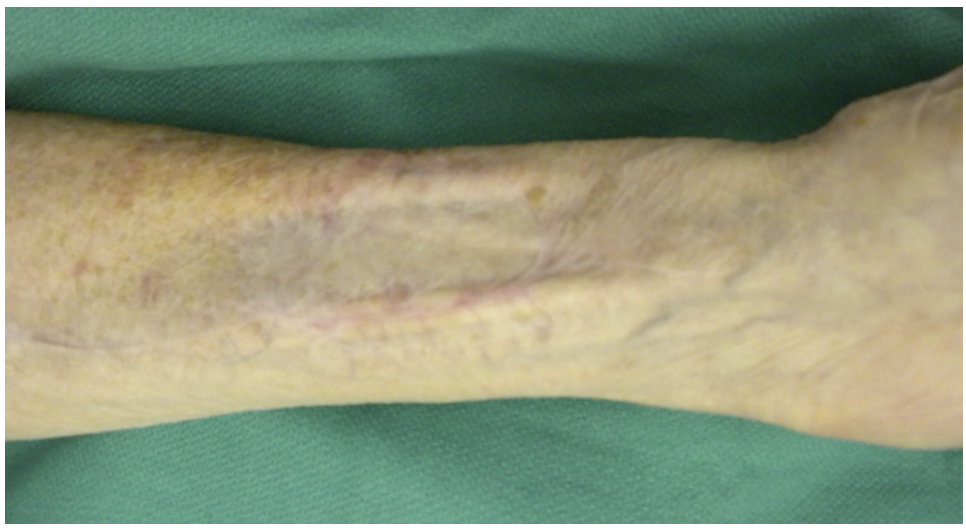

FIGURE 5. Two-year postoperative image of a forearm donor site reconstructed with a full-thickness skin graft from the neck.

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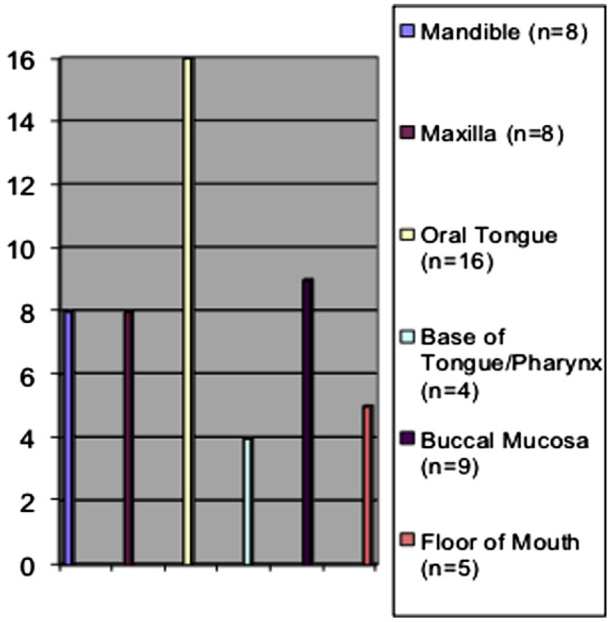

FIGURE 6. Location of primary tumor.

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expansion device.[7] Wound vacuum-assisted closure is time consuming and costly, and the functional and cosmetic outcomes are debatable.[7] Dermal matrix and artificial dermis grafts are plagued by severe wound contracture and the need for extensive wound care to facilitate graft take.[7,16] They also can take as long as 12 to 16 weeks to heal versus 4 to 6 weeks required for an autogenous graft.[7,16]

The use of an STSG from the thigh or abdomen is currently the most popular method of covering the forearm defect.[7] This requires using a third surgical site and has been known to have many functional complications and morbidities, including dehiscence, tendon exposure, decreased range of motion of the wrist and forearm, decreased sensation over

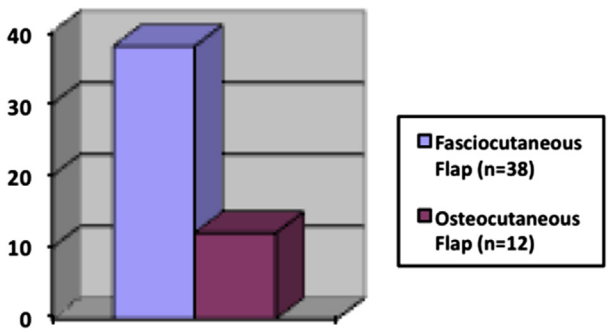

FIGURE 7. Type of radial forearm free flap (fasciocutaneous vs osteocutaneous).

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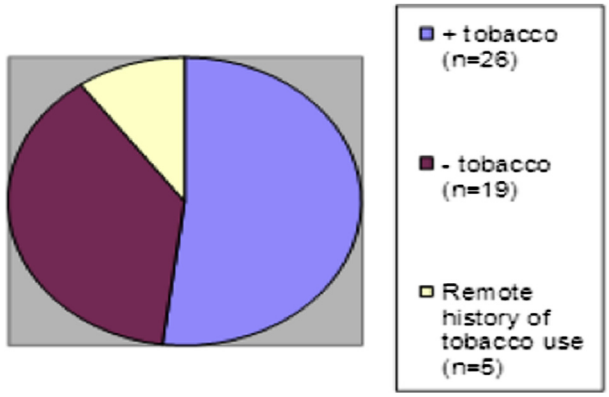

FIGURE 8. Tobacco use in patients.

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the anatomic snuff box, and poor forearm esthetics.[6,11,13,16,17,19-21] In addition, pain, need for prolonged wound care, and poor esthetics at the skin graft donor site (thigh or abdomen) are areas of patient dissatisfaction.[7,16]

FTSGs from the abdomen,[19] forearm (proximal to the flap defect),[9] upper inner arm,[8] and groin[11] have been described for RFFF defect coverage, with good results. FTSGs offer greater tissue bulk than STSGs and are less prone to breakdown and tendon exposure at the forearm flap donor site. The harvest sites for FTSGs are closed primarily so there is less pain and wound care required than with STSGs.[7,11,13,17,20-22]

FTSGs from the abdomen have been criticized for having a poor tissue match to the volar forearm, excessive hair (in men), and requiring a large abdominal scar.[11,13] Despite excellent tissue match, harvesting an FTSG from the proximal volar forearm or the upper inner arm is limited to coverage of small defects.[8,9] The latter also results in an obvious scar. An FTSG from the groin offers good tissue match and quantity,[11] but still requires a third surgical site.

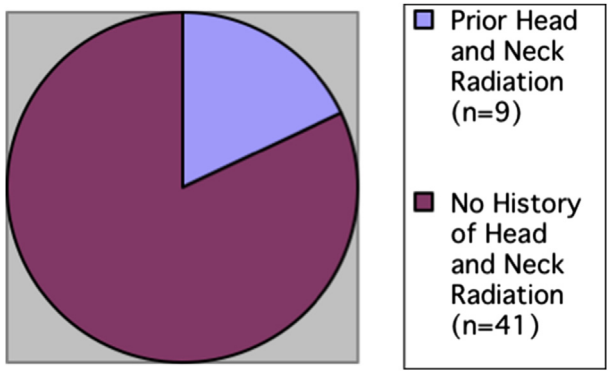

FIGURE 9. Previous head and neck radiation exposure.

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Drawbacks to having an additional donor site include increased patient discomfort postoperatively, additional scars, and increased procedure length or personnel.

After accepting the advantages of an FTSG over an STSG, the authors began using an FTSG from the neck to eliminate the need for this third surgical site. Tissue match between the neck and volar forearm in thickness, pliability, and color is excellent. Moreover, neither area typically bears hair. Defects as large as 60 cm^2 have been reconstructed without complication at the neck or forearm.

This technique provides decreased procedure time, fewer surgical sites, less morbidity and offers excellent functional and cosmetic coverage of the radial forearm. Cross-contamination of the forearm from oral pathogens was not observed despite only basic antimicrobial measures. Previous head and neck radiation did not negatively affect healing at the neck or forearm donor site.

Although the RFFF is a proven and popular method for reconstructing the mouth, head, and neck, addressing the forearm donor site defect is challenging. Previously described harvest sites for FTSGs offer limited tissue quantity and quality or require a third surgical site. The commonly used STSG is associated with several morbidities and requires a third surgical site.

This study suggests that harvesting an FTSG from the inferior margin of the neck flap to reconstruct the forearm flap defect is a novel and appropriate option. Results show this method to offer excellent tissue match functionally and cosmetically, abundant tissue quantity, and few to no complications at either site even in patients who have had prior head and neck radiation therapy. Cross-contamination from oral pathogens has not been an issue. The harvest is straightforward and fast and without the need for a third surgical site. An FTSG from the neck should be considered for coverage of an RFFF defect whenever a skin graft is indicated and a neck incision is performed for vessel access or lymphadenectomy.

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