The Supraclavicular Artery Island Flap in Head and Neck Reconstruction
Applications and Limitations

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**IMPORTANCE** The supraclavicular artery island (SAI) rotational flap may have advantages compared with free-tissue transfer in head and neck reconstruction. Because this flap has not been extensively described for head and neck reconstruction of oncologic defects, guidelines for its indications would benefit the reconstructive surgeon.

**OBJECTIVE** To describe the applications and limitations of the SAI flap as an alternative to free-tissue transfer in reconstruction of head and neck defects.

**DESIGN, SETTING, AND PARTICIPANTS** Retrospective case series of 45 patients with defects related to malignant and nonmalignant disease undergoing reconstructive surgery from August 18, 2010, through September 28, 2012, at an academic, tertiary referral center. Each defect was deemed unsuitable for primary or local flap closure and would require regional tissue or free-tissue transfer. Mean follow-up was 10.3 (range, 1-31) months.

**INTERVENTION** Use of the SAI flap for reconstruction of soft-tissue defects of the head and neck.

**MAIN OUTCOMES AND MEASURES** Defect site, flap dimensions, time to raise the flap, and complications.

**RESULTS** Defects of the oral cavity, oropharynx, laryngopharynx, esophagus, trachea, temporal bone, and cervicofacial skin underwent reconstruction. Mean flap dimensions were 6.1 cm wide and 21.4 cm long, with a mean skin paddle length of 7.9 cm. Harvest time was less than 1 hour. Donor-site complications included minor dehiscence in 6 patients and prolonged wound care in 2. Partial skin flap necrosis occurred in 8 patients, whereas 2 had complete loss of the skin paddle. Seven patients developed a salivary fistula, 4 of which healed spontaneously. Flap length greater than 22 cm correlated with flap necrosis ($P = .02$). A history positive for smoking correlated with an increased risk of flap dehiscence ($P = .02$).

**CONCLUSIONS AND RELEVANCE** The SAI flap provides an alternative to free-tissue transfer for soft-tissue reconstruction after head and neck oncologic surgery. This flap is easy to harvest and versatile. However, the SAI flap has limitations in length and, because it is a rotational flap, is less capable of reconstructing some complex head and neck defects.
Oncologic surgery of the head and neck frequently requires flap reconstruction of mucosal or skin surfaces to restore functional and aesthetic outcomes. For many years, reconstructive surgeons used regional flaps, such as the pectoralis major myocutaneous, trapezius, latissimus dorsi, or deltopectoral flaps for closure of oncologic defects. Although these regional flaps are easy to harvest and very reliable, they are not ideal. Regional flaps are often bulky and lead to significant donor-site morbidity from a functional and aesthetic perspective. When used for skin resurfacing, distant tissue provides a poor color match. Application of microvascular free-tissue transfer techniques for head and neck reconstruction expanded the options available to the reconstructive surgeon. For soft-tissue reconstruction, the radial forearm and anterolateral thigh (ALT) free flaps have become the standard flaps for many reconstructive surgeons. These flaps are versatile and reliable and provide well-vascularized tissue to head and neck defects that frequently have poor vascularity after radiotherapy or chemoradiotherapy. However, free-tissue transfer requires specialized expertise that may not be readily available in all centers, longer operative times, and extensive postoperative monitoring. Flap failure occurs in 2% to 5% of cases owing to vascular compromise.

The supraclavicular artery island (SAI) flap is a local fasciocutaneous flap taken from skin on the shoulder and supraclavicular area that is gaining popularity for reconstruction of head and neck defects. The application of this flap to the head and neck has evolved and has been controversial at times with respect to its vascularity and reliability. Mütter first described the use of medial-based random shoulder flaps in head and neck reconstruction in 1842. In 1958, Kirschbaum described the utility of the acromial or the “in charretera” flap, representing the ornamental shoulder patch worn on a military uniform. The in charretera flap became known as the cervicohumeral flap as popularized by Mathes and Vasconez. This flap was essentially the lateral trapezius myocutaneous flap with a fasciocutaneous extension. The reliability of the cervicohumeral flap was in question, with as much as 40% distal flap loss, likely owing to the poor understanding of the blood supply to the shoulder region. In 1979, Lamberty described the supraclavicular artery flap, an axial flap taken from the shoulder and supraclavicular area. He described the supraclavicular artery as a distinct branch of the transverse cervical artery in most cases and of the suprascapular artery in a smaller number. Despite the clear description of this flap, reports in the literature disappeared until the late 1990s, when Pallua et al described the SAI flap for reconstruction of cervicomenatal scar contractures and provided a clear anatomic description of the blood supply to this flap. In their study, the supraclavicular artery branched off the transverse cervical artery in all cases. The venous drainage came from paired venae comitantes that jointed the transverse cervical vein or the external jugular vein. The takeoff of the supraclavicular artery was located in the triangle created by the external jugular vein, the posterior border of the sternocleidomastoid muscle, and the clavicle. Pallua et al demonstrated successful flap harvest ranging from 4 to 12 cm in width and 20 to 30 cm in length and found the SAI flap to be safe and reliable.

After the description by Pallua et al of the SAI flap in 1997, much of the literature that followed described its use in treating cervical scar contracture. In 2009, Chiu et al reported their initial experience with the SAI flap for reconstruction of oncologic defects of the head and neck, and their group has reported extensively on its reliability and versatility. Reports from other centers have duplicated their success with reconstruction of head and neck oncologic defects using the SAI flap. In light of these studies, we began using the SAI flap in select cases that would benefit from the pliability of a radial forearm flap but in which the ease of harvest of a regional flap was desired. The objectives of our study were to describe our initial experience using the SAI flap in reconstruction of defects after head and neck oncologic surgery and to evaluate the factors associated with flap failure.

Methods

After approval by the institutional review board, we retrospectively reviewed the medical records of the first 45 consecutive patients undergoing SAI flap reconstruction for head and neck defects related to malignant and nonmalignant disease. All flap reconstructions were performed by one of us (N.K.) from August 18, 2010, through September 28, 2012. Mean follow-up was 10.3 (range, 1-31) months. We recorded demographic data, including age, sex, tobacco and alcohol use, prior treatment, tumor site and stage, and adjuvant treatment. Surgical information collected included the levels of neck dissection, defect location and size, flap size, and time to harvest the flap. In addition, success of flap reconstruction and complications were recorded. Means for continuous data and proportions for categorical data were calculated. We performed the Mantel-Haenszel χ² test to evaluate the correlation between clinical factors and complications (ie, flap necrosis, flap dehiscence, and fistula) and the independent risk factors for complications. P < .05 was considered statistically significant. All statistical analysis was performed using commercially available software (SAS, version 9.1; SAS Institute Inc).

Surgical Technique

The SAI flap is harvested as described previously. In summary, a handheld Doppler ultrasound probe is used to locate the supraclavicular artery in the triangle formed inferiorly by the clavicle, medially by the posterior border of the sternocleidomastoid muscle, and laterally by the external jugular vein (Figure 1). The Doppler signal is traced over the acromion, and the point where the artery takes off is used as the fulcrum for the rotation of the flap. This point is also used as the starting point when measuring the length of the flap. The flap is marked with a 6- to 7-cm width to allow for primary closure and a 20- to 26-cm length from the fulcrum point. Additional length may be designed to help avoid a dog-ear deformity on closure of the donor site. The distal flap is raised with monopolar electrocautery in the subfascial plane off the deltoïd muscle, and perforators from the posterior circumflex humeral artery are ligated or cauterized. Posteriorly the flap is raised to the anterior border of the trapezius, and the spinal accessory nerve
can be identified, although this process is not always necessary. The anterior edge of the flap is raised to the clavicle, and once the acromion is reached, the dissection becomes more meticulous with bipolar cautery. The supraclavicular artery is identified with the Doppler probe or, alternatively, transilluminated. Skeletonization of the vascular pedicle is unnecessary in most cases, but the level V fat and nodal tissue may need to be mobilized around the supraclavicular artery to gain a longer arc of rotation. This mobilization is performed in the subfascial plane to protect the vascular pedicle. If additional length is needed beyond the takeoff of the supraclavicular artery, the distal transverse cervical artery can be ligated and the vascular pedicle can be mobilized to the thyrocervical trunk. The unneeded proximal skin paddle is de-epithelialized with needle tip electrocautery at 10 W or with the scalpel, and the flap is rotated into the defect. The vascularity to the distal tip of the flap is assessed by incising the skin to check for bleeding. If the distal flap has insufficient vascularity, the flap can be trimmed back until the bleeding is deemed sufficient. The flap can be tunneled into the defect, or the proximal skin paddle incision will be continuous with the neck dissection incision.8 The donor-site defect is widely undermined and closed primarily over a drain. The neck and defect site also are typically drained.

**Patient Selection**

Patients were deemed candidates for the SAI flap reconstruction if their defect was not expected to close primarily and was expected to require a regional flap or free-tissue transfer. Furthermore, the defect could not require a flap that was wider than 6 to 7 cm in most cases, and the defect had to be located within 20 to 25 cm from the point in the supraclavicular fossa that was used as the fulcrum when rotating the SAI flap. We found the SAI flap to be most similar to the radial forearm flap with respect to thickness and pliability of the skin in thin patients. In patients with a larger body habitus, the skin might have been more similar to that of an ALT myocutaneous flap. For cervicofacial defects, we believed that the SAI flap was advantageous to cervicofacial advancement in larger defects or in patients who had received prior radiotherapy. The top of the auricle could generally be reached with the flap in cases of temporal bone or parotidectomy defects. In the oral cavity, we used the SAI flap for glossectomy defects involving the floor of the mouth or for buccal defects. Defects more extensive than the hemiglossectomy or extending from the anterior floor of mouth to the tongue base were considered more appropriate for free-tissue transfer. In the oropharynx, we believed the SAI flap was appropriate where no significant extension into the soft palate or tongue base was detected. Finally, for total laryngectomy defects, we considered the SAI flap in the absence of significant extension into the oropharynx, and the height of the defect would match the width of the flap.

**Results**

Among the 45 consecutive patients, 38 underwent ablative surgery for head and neck carcinoma and had an SAI flap as their soft-tissue reconstruction, whereas 7 had an SAI flap for reconstruction of a defect unrelated to cancer. Defects of the oral cavity (n = 13) (Figure 2), oropharynx (n = 7), laryngopharynx (n = 8), esophagus (n = 1), trachea (n = 1), temporal bone (n = 5), and cervical skin (n = 10) (Figure 3) were reconstructed. Fifteen patients (33%) had a history of radiotherapy to the head and neck, and 23 patients (51%) had a history of cigarette smoking. Thirteen patients (29%) received adjuvant radiotherapy alone; 7 (16%), adjuvant chemoradiotherapy; and the remaining 25 (56%), no additional therapy (Table 1). Mean
Flap width was 6.1 (range, 5-9) cm, allowing for primary closure in all cases. Mean flap length was 21.4 (range, 15-28) cm, with the proximal portion of the flap de-epithelialized to match the defect, resulting in a mean skin paddle length of 7.9 (range, 5-15) cm. Mean harvest time was 34.9 (range, 17-60) minutes, and mean time for de-epithelialization was 15.2 (range, 5-40) minutes (Table 2). Minor donor-site dehiscence occurred in 6 patients (13%), whereas dehiscence requiring prolonged wound care occurred in 2 patients (4%). No patients reported severe limitations of arm movement. Partial skin flap necrosis occurred in 8 (18%) patients, whereas 2 (4%) had complete loss of the skin paddle (Figure 4). Dehiscence of the flap anastomosis at the recipient site occurred in 11 patients (24%), whereas 7 (16%) had a salivary fistula developed in 7 patients (16%), in 4 of whom the fistula healed spontaneously. A second reconstructive procedure using an alternate flap was required in 4 patients (9%). Six patients (13.3%) had neck-related complications, including hematoma, seroma, and chyle leak. We found a significant correlation between flap length greater than 22 cm and flap necrosis ($P = .02$) (Table 3). A history of smoking was also correlated with an increased risk of flap dehiscence along the anastomosis at the recipient site ($P = .02$). These 2 factors were independent of each other. No significant correlation between prior radiotherapy, defect location, or levels of the neck dissection and flap necrosis, flap dehiscence, or fistula was discovered. No neck recurrences were found in level IV or V dissections, and no delayed flap failures with adjuvant therapy occurred during the follow-up period. Two perioperative deaths occurred, with both related to cardiac issues.

**Discussion**

In the current era of head and neck reconstruction, microvascular free-tissue transfer is the standard of care, with the radial forearm and ALT free flaps considered the workhorse soft-tissue flaps. Free-tissue transfer is reliable and offers the most versatility in reconstruction but requires technical expertise and longer operative times. Regional flaps, such as the pectoralis major myocutaneous flap, are reliable and versatile and require shorter operative times. However, the pectoralis major flap is often bulky and provides a poor color match for cutaneous reconstruction. The head and neck surgeon performing the reconstruction would benefit from having a locoregional flap that is reliable, allows a rapid and simple harvest, and is thin and pliable like the radial forearm flap. Our initial experience with the SAI flap has demonstrated this flap to be safe, capable of being harvested easily and rapidly, and useful for reconstructing a variety of head and neck defects. We have encountered some limitations in its applications, particularly in

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**Table 2**

<table>
<thead>
<tr>
<th>Objective</th>
<th>Results</th>
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<tr>
<td>Flap width</td>
<td>6.1 (range, 5-9) cm</td>
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<tr>
<td>Mean flap length</td>
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<tr>
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**Table 3**

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<th>Correlation</th>
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<td>Flap length greater than 22 cm</td>
<td>Flap necrosis ($P = .02$)</td>
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<tr>
<td>History of smoking</td>
<td>Flap dehiscence along the anastomosis at the recipient site ($P = .02$)</td>
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**Figure 2. Reconstruction of the Oral Tongue With the Supraclavicular Artery Island (SAI) Flap**

A. Partial glossectomy defect for squamous cell carcinoma of the oral tongue.
B. The SAI flap measuring 6 × 22 cm marked out for the reconstruction.
C. De-epithelialized flap with 6 × 11-cm skin paddle.
D. Flap inset into the oral cavity defect. Complex defects of the oral cavity and oropharynx can be difficult to reconstruct with the SAI flap because of the tethering effect of the vascular pedicle.
the length of flap that can be reliably harvested. Consequently, we have applied the SAI flap in selected cases, but we consider it to have distinct advantages compared with free-tissue transfer or regional flaps in these select cases.

**Anatomy**

The vascular anatomy of the lower neck has been fairly well studied. In his initial description of the supraclavicular flap, Lamberty\(^5\) found the flap to be supplied by a superficial branch of the superficial transverse cervical artery in 93% of cadaver dissections and by a branch of the suprascapular artery in 7%. Pallua and Magnus Noah\(^8\) dissected bilateral supraclavicular regions in 19 cadavers, and in contrast found the supraclavicular artery arising from the transverse cervical artery in 100% of cases. This finding was confirmed by Vinh et al\(^11\) in 40 flaps dissected from 20 cadavers. However, Tayfur et al\(^22\) found that 62.9% of supraclavicular arteries branched from the transverse cervical artery in 28 dissections from 14 cadavers. The remaining 37.1% came from the suprascapular artery. Although variability exists, the supraclavicular artery will arise from the transverse cervical artery in most patients. These studies show 2 veins draining the flap: one running adjacent to the artery draining into the transverse cervical vein, and the other draining into the external jugular vein.\(^8,11,22,23\) The mean diameter of the artery ranges from 1.0 to 1.5 mm.\(^8,11,22\)

If one uses surface anatomy, the takeoff of the artery is located in the triangle formed by the dorsal edge of the sternocleidomastoid muscle, the external jugular vein, and the medial portion of the clavicle\(^8\) (Figure 1). Relative to the clavicle, Vinh et al\(^11\) found that the supraclavicular artery arose from the middle third of the clavicle in 90% of cases, whereas the remaining 10% arose from the lateral third of the clavicle. Tayfur et al\(^22\) located the supraclavicular artery at the middle third of the clavicle in 33.3% of dissections and at the lateral third of the clavicle in 44.4% of dissections. Tayfur et al also noted that the takeoff of the supraclavicular artery was located 22.2 mm superior to the upper border of the clavicle. Dye injection studies show that the area of the angiosome supplied by the supraclavicular artery ranges from 10 to 16 cm in width and 22 to 30 cm in length.\(^8\)

**Flap Characteristics**

We have used the SAI flap to reconstruct a variety of head and neck defects related to malignant and nonmalignant disease.
The most common defect reconstructed was in the oral cavity (29%) followed by cervicofacial skin (22%), with roughly equal numbers of laryngopharyngeal (18%) and oropharyngeal defects (16%). These indications are similar to those of Alves et al., who reconstructed mostly oral cavity (40.4%) and cutaneous (51.1%) defects in 47 patients. Chiu and his group from Tulane University have reported use of the SAI flap for reconstruction of a variety of defects, including the oropharynx, laryngopharynx, temporal bone, and parotid defects. Chen et al. exclusively reconstructed defects of the oral cavity and oropharynx, whereas Sandu et al. used the SAI flap for cutaneous defects in 84% of cases. Our results, as well as others, point to the versatility of the SAI flap in reconstructing head and neck oncologic defects. We found no association between the location of the defect and flap-related complications.

However, we believe that the location of the defect affects the utility of the SAI flap. For example, reconstruction of complex 3-dimensional defects with an SAI flap may be limited by the rotational nature of the flap. This limitation is particularly evident in defects of the tonsil that extend to the tongue base or palate, where folding of the flap needed to optimally reconstruct these defects may not be possible with a tethered rotational flap. Likewise, this problem can be encountered in large defects of the anterior floor of the mouth and the oral tongue, with extension to the tongue base. In cervicofacial defects, the skin paddle must be rotated 180° at its base to place the skin paddle externally. This rotation must be performed loosely so that no kinking of the vessels occurs. If the flap stretches to reach the defect, tension coupled with the rotation at the base may lead to further compromise of the vascularity. Finally, tunneling of the flap is another potential method of vascular compression that can lead to flap compromise. For cervicofacial defects, we generally recommend passing the flap pedicle over the sternocleidomastoid muscle, whereas the flap usually passes deep to the muscle in defects of the oral cavity, oropharynx, or laryngopharynx. Passing the flap deep to the mandible is usually required for most oral cavity and oropharyngeal defects, but the technique also offers a potential site of compression. In defects of the buccal mucosa, passing the flap over the mandible may be more beneficial.

Our mean flap dimensions were 6.1 (range, 5-9) cm in width and 21.4 (range, 15-28) cm in length. All donor-site defects were closed primarily. These flap dimensions are similar to those of other reports using the SAI flap for reconstruction of oncologic defects of the head and neck. Other studies examining the SAI flap for neck and mentosternal contracture af-
ter burn injuries have used much larger flaps and with preoperative expansion have raised flaps to 14 cm wide and 35 cm long. Di Benedetto et al.\textsuperscript{13} required skin grafting to close the donor site in 3.8% of patients; otherwise, all donor sites are closed primarily. Before designing our flap, we identified the triangle formed by the posterior border of the sternocleidomastoid muscle, the external jugular vein, and the clavicle, and we located the supraclavicular artery with a Doppler probe in this triangle in all but 1 patient. Once the flap was raised, we were able to identify the artery entering the flap with the Doppler probe in all cases. Our flap harvest time was 34.9 minutes, and the time to de-epithelialize the unneeded skin was 15.2 minutes. Other studies\textsuperscript{14,19,20} report flap harvest times of less than 1 hour, but they do not distinguish between the time needed to raise the flap and the time needed to de-epithelialize the proximal skin. Undoubtedly, de-epithelializing the unnecessary proximal skin is the most pain-taking portion of the operation.

Complications

Donor-site complications with the SAI flap are minimal. Six patients with minor wound dehiscence required local wound care.

Complication | No. (%) of Patients
--- | ---
Donor site |  
Minor shoulder wound dehiscence | 6 (13)
Prolonged wound care | 2 (4)
Recipient site by type of complication |  
Salivary fistula | 7 (16)
Flap dehiscence at anastomosis | 11 (24)
Without fistula | 4 (9)
With fistula | 7 (16)
Partial flap skin necrosis (≤50%) | 8 (18)
Without fistula | 4 (9)
With fistula | 4 (9)
Complete flap skin necrosis (100%) | 2 (4)
Without fistula | 1 (2)
With fistula | 1 (2)
Recipient site by location of defect |  
Salivary fistula |  
Oral cavity | 3 (7)
Oropharynx | 1 (2)
Laryngopharynx | 3 (7)
Esophagus | 0
Flap dehiscence at anastomosis |  
Oral cavity | 5 (11)
Cervical skin | 0
Laryngopharynx | 3 (7)
Oropharynx | 1 (2)
Temporal bone | 2 (4)
Esophagus | 0
Trachea | 0
Partial flap skin necrosis (≤50%) |  
Oral cavity | 3 (7)
Cervical skin | 1 (2)
Laryngopharynx | 2 (4)
Oropharynx | 1 (2)
Temporal bone | 1 (2)
Esophagus | 0
Trachea | 0
Complete skin flap necrosis |  
Temporal bone | 1 (2)
Oropharynx | 1 (2)
Neck |  
Hematoma | 3 (7)
Seroma | 2 (4)
Chyle leak | 1 (2)

Two of these patients who were in poor health and at risk for poor wound healing required prolonged periods of wound care. They did not require additional surgery to treat the donor-site wound. Several patients reported tightness in the shoulder, but no patient reported severe limitation of movement. Minor widening of the donor-site scar was not uncommon, especially over the acromion, because this area usually has the tightest closure and the point of maximal movement. The scar was deemed to be acceptable in most cases by the surgeon. One
patient who underwent esophageal reconstruction consistently reported referred sensation to the shoulder when drinking hot or cold beverages, and this effect has been noted by others.19 Overall, our rate of donor-site complications is similar to those of other studies.8,14,19,20

In our series, 8 patients (18%) had partial skin paddle necrosis (<50%) and 2 (4%) had complete flap necrosis. Eleven patients (24%) had dehiscence along the edge of the flap at the recipient site, and 7 (16%) developed a salivary fistula. Four patients required a second reconstructive procedure to salvage the failed SAI flap reconstruction, whereas the other partial failures of flap reconstruction were treated with debridement and local wound care. Other studies using the SAI for reconstruction of head and neck oncologic defects had partial flap necrosis rates of 4.2% to 14.9% and complete flap necrosis rates of 0% to 5.6%. The rates of salivary fistula ranged from 6.4% to 16.7%14,19-21. Our rates of partial flap necrosis, complete flap necrosis, and salivary fistula were in line with the results of these reports. However, if we eliminate the cervicofacial, temporal bone, and tracheal defects in which a fistula rate is not possible, then a fistula occurred in 7 of 29 patients (24%). Fistula occurrence may be related to prior radiotherapy, complex folding of the flap, or other factors that are difficult to determine in a retrospective study. This rate may also be skewed by the small number of patients in our study. We found a significant correlation between a flap longer than 22 cm and flap necrosis (P = .02). No other studies, to our knowledge, have shown a statistically significant correlation between flap length and flap necrosis. Although the SAI flap is an axial pattern flap, the vascularity of the distal tip of the flap depends on the perivascular network, and some authors21,25 have suggested an additional arterial supply to the SAI flap. We also found a history of smoking to be a statistically significant predictor of dehiscence along the flap anastomosis (P = .02). This finding does not surprise us because cigarette smoking is known to be a risk factor for poor postoperative wound healing.24 No other studies have shown smoking to be associated with complications. Because of the retrospective nature of the study, we could not determine the number of patients who were actively smoking at the time of surgery. Factors that showed no correlation with flap complications included age, Karnofsky performance status, the site of the defect, and levels of the neck that were dissected. In the current era of head and neck surgery, selective neck dissections are more commonly performed. Neck dissection ranged from levels I to IV in 60% of cases; if the ablative surgeon is careful to preserve the transverse cervical artery, the SAI flap can still be used for reconstruction. If a level V neck dissection is performed, even more care must be taken to preserve the supraventricular artery. If a patient has undergone prior level IV or V neck dissection and the patency of the transverse cervical artery is not documented, we consider these events to contraindicate use of the SAI flap. Alternatively, computed tomographic angiography can be used preoperatively to demonstrate the patency of the supraventricular artery, and some authors21,25 advocate routine use of computed tomographic angiography in all cases.

Study Limitations
The major limitation of this study is its retrospective nature, which carries biases inherent in retrospective studies. We report a series of the first 45 consecutive patients undergoing the SAI flap reconstruction, which will help eliminate selection bias that favors good results. However, there may be a preoperative selection bias in favor of patients who will have an anticipated smaller defect that can be reconstructed with an SAI flap rather than with free-tissue transfer. Another limitation of our study is that we did not assess the patient perception of the reconstructive surgery, especially with regard to aesthetic results for cutaneous defects or with regard to the donor-site scar. For cases of oral or pharyngeal reconstruction, we also did not assess functional outcomes of swallowing. Both areas require future research. Finally, despite the associations of a flap length greater than 22 cm and a history of smoking with increased flap complications, in some cases we were unable to identify the cause of flap failure. We have postulated that in some defects of the oral cavity or the oropharynx, the complex folding needed to resurface the defect may lead to distal tip necrosis. However, we did not find that defect location was statistically associated with flap complications. This lack of correlation may result from the small numbers in our series; with additional experience, we may find that certain defect locations are associated with flap failures. Lack of a causative factor for failure makes prediction of success more difficult. In
the future, we may use preoperative computed tomographic angiography to better predict flap viability.

Applications and Limitations of the SAI Flap

We have found the SAI flap to be safe, versatile, easy to harvest, and reliable in select cases of head and neck reconstruction. In our experience, the SAI flap is advantageous for the following reasons. First, harvesting the flap is simple and can be accomplished in less than 1 hour in most cases. Second, the skin is thin and pliable and provides an excellent color match for cervical and facial defects. The length of the flap is sufficient to reach many defects in these locations. Third, the length of the flap is sufficient to reach defects of the tonsil and lateral pharyngeal wall. Fourth, the SAI flap works very well to augment the pharyngeal closure after total laryngectomy. Finally, donor-site morbidity is minimal.

Despite our enthusiasm, we have encountered limitations of the SAI flap. First, a flap length greater than 22 cm is associated with distal flap necrosis. Second, complex defects of the oropharynx and oral cavity may be better reconstructed with free-tissue transfer owing to the greater ability of the latter procedure to contour the flap. The SAI flap is limited by its arc of rotation and the vascular pedicle that makes reconstruction of some of these defects difficult. Third, the vascularity of the SAI flap may be inadequate in smokers and patients with multiple medical comorbidities.

In conclusion, the SAI flap is useful in reconstruction of head and neck oncologic defects and may have certain advantages compared with free-tissue transfer and regional flaps in select cases. Our study shows that the SAI flap has limitations in length that can help guide the reconstructive surgeon when choosing the optimal soft-tissue flap.

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Study concept and design: Kokot, Mazhar.

Acquisition of data: All authors.

Analysis and interpretation of data: All authors.

Drafting of the manuscript: Kokot, Mazhar, Reder, Peng.

Critical revision of the manuscript for important intellectual content: Kokot, Sinha.

Statistical analysis: Mazhar, Reder.

Administrative, technical, and material support: Kokot, Peng, Sinha.

Study supervision: Kokot, Sinha.

Conflict of Interest Disclosures: None reported.

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REFERENCES


