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The supraclavicular flap

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In the realm of head and neck reconstruction, many would agree that the pendulum has swung back from free tissue transfer (FTT) to locoregional flaps.[1] The supraclavicular flap has re-emerged in the last several decades as another versatile reconstructive option in the head and neck. The flap is easy to harvest and boasts shorter operative times than FTT.[2] Several authors have demonstrated that supraclavicular flap is equally as effective as FTT in coverage of a variety of defects with better cost-effectiveness. Technique refinements have improved the rate of flap survival and decreased the complication rate of this procedure with minimal donor site morbidity. The flap does have its restrictions, which include size and reach limitations. This article will give some insight into patient selection, different operative techniques, and postoperative care for this flap.

Introduction

Historically, various flaps were described in the shoulder region with the earliest clinical use reported in 1949 by Kazanjian and Converse.[1,2] These flaps were later given the name of "in charretera," which is the name for the strip of cloth that holds military badges on the shoulder.[2] The flap was reported as unreliable with a high rate of flap loss until Lamberty described the axial blood supply from the supraclavicular artery (SCA) in 1979.[1,2] Of the names that appear in a literature search for the supraclavicular flap (SF), Pallua and Demir are perhaps one of the most influential authors. He is credited with repopularizing this flap in the 1990s. He described the use of the SF for head and neck burn contractures.[3]

The nomenclature for the SF is sometimes confusing in the literature. With documented use in over 400 patients in a review article in 2012, the flap was described in different variations including the anterior SCA perforator flap that shifts the skin paddle anteriorly to a different perforating branch from the transverse cervical artery (TCA).[4] In this chapter, we will refer to all variations of this locoregional flap from the supraclavicular area as the SF. All these flaps are based on cutaneous perforating branches from the TCA with similar harvest technique. The SF has evolved with the different approaches beyond use simply for burn contractures to a wide variety of applications in head and neck reconstruction.[4]

Anatomic considerations

The SF is based on the SCA that branches off the TCA that originates from the thyrocervical trunk.[5,6] The reliable SCA diameter measures 1-1.5 mm and is usually found 3-4 cm from the TCA origin at the thyrocervical trunk.[5,7] From a surface anatomy perspective, the SCA is found in a triangle bound by the external jugular vein posterolaterally, the posterior border of sternocleidomastoid (SCM) anteromedially, and the clavicle inferiorly (Figure 1).[7] Venous drainage of the flap is via 2 vena comitantes that accom-

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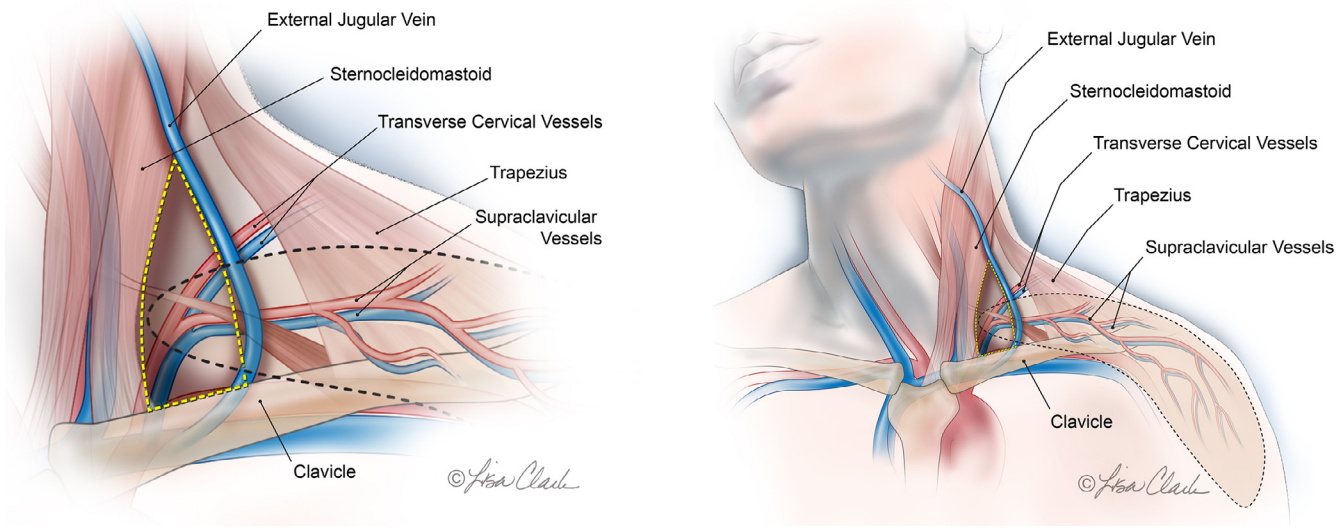

Figure 1 Anatomical location of the SCA and its distribution. (Reprinted with permission © 2013 Lisa Clark) Kokot et al.

pany the SCA and the nerves supplying the flap that are derived from the cervical plexus branches of C3 and C4.[6–8]

Indications, patient selection, and preoperative considerations

Since its initial repopularization for head and neck contractures, the SF is notably a versatile flap.[3] Chiu et al have published several case series showing the utility of the SF flap for reconstruction of various oncologic head and neck defects. The flap can successfully reconstruct tracheostomal, pharyngeal, as well as cutaneous defects of the lower face and neck.[9] The SF is also described extensively for parotidectomy defect as well as oral defect reconstruction.[10,11] Example of a harvested SF flap for pharyngeal closure is shown in Figure 2.

The flap's safety and success is possible even in the setting of ipsilateral neck dissection including level V, as well as in patients with a history of preoperative radiation therapy. However, in those cases, the decision to use this flap is made after confirmation of an intact TCA.[12] The SF also is reportedly effective for reconstruction after extirpation of late-stage disease rendering large defects.[13]

The SF in general does not need any preoperative vascular studies. The SCA is consistently present as a branch of the TCA. This was found in 100% of subjects in a cadaver study.[6] Most authors use a handheld Doppler probe to identify the SCA during surgery.[4,9,14] An interesting article did look at 6 different methods of identifying and mapping the SCA preoperatively. In that study, computed tomography angiography was found as the most reliable method for mapping the course of the SCA.[15] However, the cost of this is likely prohibitive in most healthcare systems. The majority consensus in the literature is that no preoperative imaging is needed for this flap making surgical planning more expedient.

The general indication for the SF in the author's experience is the need for a thinner pliable skin paddle flap for the lower face or neck. The SF is an excellent option for pharyngeal reconstruction and utilized as an alternative for the pectoralis major flap previously considered a workhorse for this specific defect. The definite advantage to this flap is the ease of harvest and the short operative time for harvest of the flap. As with all surgical procedures, there is a learning curve. In an excellent article that discusses technique refinements, Herr et al demonstrated a decrease in harvest time from 75 to 40 minutes with experience.[16] In general, the harvest time of the flap in experienced hands is approximately 40 minutes or less.[17] This shorter harvest time makes the SF ideal for patients with co-morbidities where a shorter anesthetic time than that needed for free tissue transfer (FTT) is preferable. A relatively large skin paddle of over 100 cm^2 is possible to harvest.[9,16,17] In virtually all cases the donor site is primarily closed. Another advantage of the SF over FTT is the lack of need for flap monitoring postoperatively.

The disadvantages of the flap are related to its limitations. Despite historical description of an osteocutaneous SF, the SF is for all practical purposes a soft tissue flap only.[4] The obvious contraindication to the use of this flap is transection of the TCA. This artery is anatomically located deep in level V and is usually preserved in most neck dissections. As alluded to previously, the flap is safe in the case of Level IV and V neck dissection in select cases.[12] Other disadvantages reported with this flap are due to the geometry and anatomic reach. The flap is suitable only for the lower third of the face and neck including intraoral applications. Harvesting a flap that will reach superior to the root of the helix is usually not achievable. In certain defects the lack of bulk of the SF is a disadvantage. For example, consideration in the case of a radical neck dissection with exposure of the carotid artery in a previously radiated field. In those situations, a bulkier flap like the

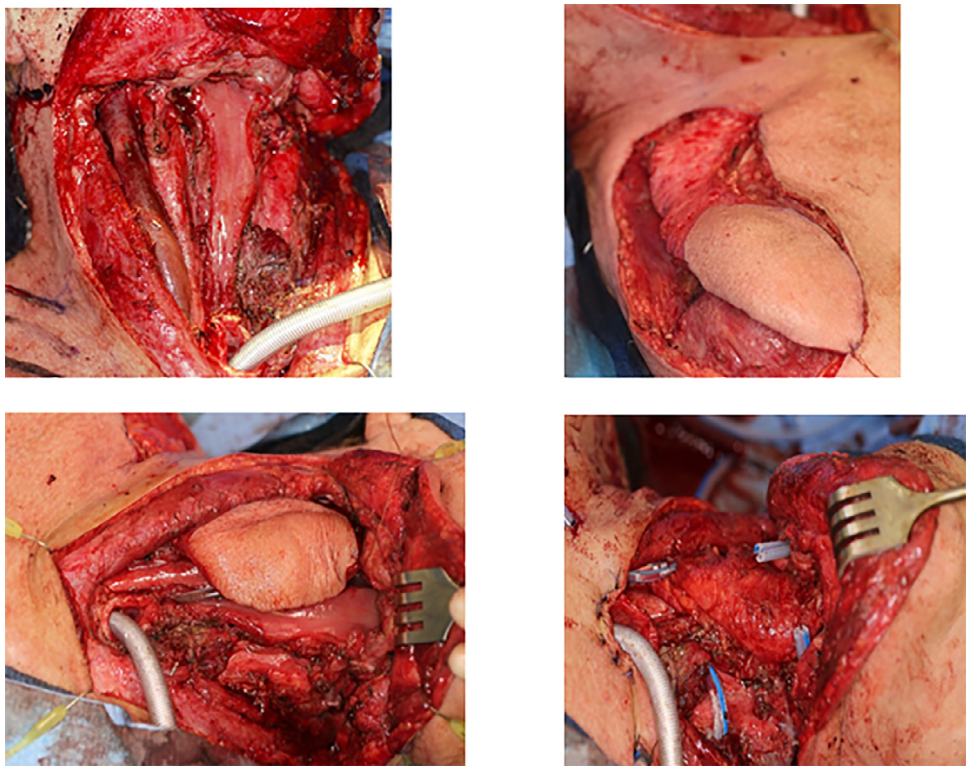

Figure 2 SF depicted in reconstruction of pharyngeal defect.

pectoralis major or anterolateral thigh free flap may provide a better alternative for reconstruction.

With FTT readily available and its widespread use for head and neck reconstruction, the performance of the SF compared to FTT comes into question. As in the rest of the surgical literature, no trials exist comparing the SF to FTT, however, several retrospective studies have shown equal performance of the SF. Kozin et al discovered lower overall operative time for similar defect sizes associated with lower hospital costs.[18] Another study showed similar outcomes with shorter operative times and shorter intensive care unit stay.[10] Yet another study from Germany showed decreased operative time, harvest time, and ICU stay as well as decreased rate of tracheostomy placement.[19] All studies showed similar complication rate without significant difference in morbidity.

Techniques in harvest and inset

The SF is an axial patterned flap inset as a tunneled flap or used with the pedicle incorporated into the neck.[9,20]

The procedure begins with preparation of the neck and upper arm in the surgical field. The handheld Doppler is used to identify the SCA in the triangle between the external jugular vein, SCM, and the clavicle. The artery is traced over the clavicle as far as possible. The designated skin paddle is marked extending 5 cm from the most distal point where the Doppler is heard with reliable results, but should not extend beyond the insertion of the deltoid muscle.[21] A fusiform shaped skin paddle is usually fashioned to facilitate closure. A fairly large skin paddle with lengths up to 20-25 cm from the rotation point at the origin of the SCA from the TCA generally achievable.[22] The width is usually kept less than 8 cm to permit primary closure in non-expanded flaps, as anything beyond this is difficult to close primarily.[9] Pre-expansion of the flap is described in the literature as a means to increase skin paddle size up to 15 × 35 cm.[23]

The design for the pedicle portion of the flap depends on the plan for inset. If the plan is to de-epithelialize the pedicle and pass it through a tunnel, 1 of 2 approaches is recommended. The first approach was described by Herr et al where subdermal flaps are raised bilaterally outward proximal to the skin paddle creating a tunnel through which the skin paddle is passed without tension.[16] Another method involves harvesting skin around the pedicle and de-epithelializing the buried tunneled portion of the skin paddle. De-epithelialization requires some portion of the dermis left in continuity with the skin paddle in order to preserve the subdermal plexus. One advantage the author has found to this latter approach is the use of the de-epithelialized portion as a skin graft, demonstrated in the case in Figure 3.

In nearly all reports on the use of this flap, the harvest of the flap is undertaken distal to proximal. Bovie cautery is used by many but other methods can be utilized as well. As pointed out by Chiu et al, it is prudent to switch to bipolar or sharp dissection as the harvest approaches the pedicle takeoff over the clavicle.[9] After the skin is incised and the incision deepened to the fascia, the harvest proceeds from lateral to medial in the subfascial plane over

Figure 3 Left auriculectomy defect where SF used after de-epithelialization of tunneled portion. De-epithelialized skin was subsequently used to resurface the defect of the cheek resulting from WLE of cutaneous malignancy. There was partial flap loss at the distal tip with eventual granulation several months postoperatively.

the deltoid. Once the dissection reaches the clavicle, the dissection switches to a subperiosteal plane over the clavicle into the supraclavicular fossa.[16] It is not necessary to identify the pedicle in the supraclavicular fossa and generally a good amount of soft tissue and fascia is preserved in this area to protect the pedicle and prevent kinking of the pedicle.[16,24] An exception to this is planned denervation of the flap with division of the supraclavicular nerve, or if the flap is taken as a free flap. The denervation procedure requires meticulous dissection in the pedicle area and is considered risky and unnecessary by the author. Use of the SF as a free flap is also risky given the small vessel caliber.

After the flap is completely elevated to the base of the pedicle with tension-free rotation and mobilization into the defect, the tunnel is created. The tunnel is usually placed anterior to the SCM. The tunnel is created bluntly by piercing the platysma to the subcutaneous plane in the supraclavicular fossa. It is very important to ensure the pedicle is tension free and no vascular kinking occurs at the base prior to inset of the flap.

The remainder of the procedure involves inset of the flap. Bleeding is assured at the most distal point of the flap. Sometimes indocyanine green angiography intraoperatively is helpful to confirm blood flow into the flap after inset if there is any question about adequate perfusion of the flap. In radiated patients with fibrosis, the author has a low threshold for incorporating the skin over the pedicle into the neck. This is shown in Figure 4. In cases where the surgeon is concerned about the viability, the flap is delayed or raised as an interpolated flap with plan on division and inset of the pedicle later.

Wounds are closed and drain placement in the harvest and recipient site is undertaken at surgeon discretion.[24]

Postop care and complications

Refinement in technique and experience has made the SF a reliable reconstructive option with some series reporting 100% survival.[25] No surgery is without complications and the SF is no exception. The pooled reported rate of partial flap loss in the larger series in the literature ranges from 6% to 18%. The rate of complete flap loss is low and less than 4% comparable to FTT.[1] In one study the flap was shown to have lower complication rates for cutaneous rather than mucosal defects.[33] The flap does not require any postoperative monitoring other than routine inspection.

Figure 4 SF used with pedicle incorporated into the neck exterior.

A review looking at the infection rate for the SF reported an 11% rate without any identified risk factors on multivariant analysis.[26] The recommendation stands for preoperative antibiotics for these clean contaminated surgeries.

Retained sensation in the SF may prove beneficial or problematic. The possibility of a nerve anastomosis to preserve sensation of the SF when taken as a free flap may aid in rehabilitation for oral reconstruction. This remains theoretical as most of the time this flap is harvested as a locoregional pedicled flap. Patients undergoing the SF may complain of dysesthesia due to nerve preservation in the flap with sensation referred to shoulder.[8] This can prove bothersome to the patient. Delayed sectioning of the pedicle with severing of the nerves is possible to treat.

Two studies that examined shoulder function after the SF showed minimal morbidity to the shoulder at the harvest site.[27,28] One study showed slight impact with the limitation of range of motion, but this may represent confounding with concomitant disability from neck dissection.[28] Overall, the SF results in minimal shoulder morbidity.

Conclusion

The SF has established itself as a versatile reconstructive option in the head and neck. In most cases, it is a thin hairless flap making it an ideal flap for pharyngeal, intraoral, and cutaneous reconstructions. From its re-emergence as a flap for burn contractures of the neck and torso, the SF has found its home in the flap options for head and neck oncologic reconstruction.[29,30] The flap is a viable alternative to FTT with shorter operative time and comparable complication rate.[10,18,19,31] It is reliably used in vessel depleted necks and with prior radiation.[32] Its increased use has proven utility in the armamentarium of modern head and neck reconstruction.

Disclosure

The authors reported no proprietary or commercial interest in any product mentioned or concept discussed in this article.

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