

# Sandwich Fascial Anterolateral Thigh Flap in Head and Neck Reconstruction: Evolution or Revolution?

Mario Cherubino, MD,  
FEBOPRAS\*†  
Jens Berli, MD†  
Mario Turri-Zanoni, MD†§  
Paolo Battaglia, MD†§  
Francesca Maggiulli, MD\*  
Martina Corno, MD\*  
Federico Tamborini, MD\*  
Edoardo Montrasio, MD\*  
Paolo Castelnuovo, MD†§  
Luigi Valdatta, MD, FACS\*†

**Introduction:** The anterolateral thigh perforator flap (ALT) represents the workhorse for most reconstructive efforts in the head and neck regions. The main advantages of this flap are its versatility, the length of the pedicle, and the low morbidity of the donor site. The major drawback is the bulkiness of this flap with the frequent need for secondary revisions. To overcome this, we have developed a novel way to harvest and inset the ALT, called the sandwich fascial ALT flap (SALT).

**Methods:** All patients undergoing head and neck reconstruction using the SALT flap from January 2013 to March 2016 were included in this retrospective analysis. The SALT flap was harvested as a composite flap including the superficial fascia, the subscarpal fat, and the deep fascia. At the recipient site, the flap was inset with the deep fascia facing out. A split thickness skin graft ( $\pm$  dermal substitute) was used to cover the deep fascia and the pedicle.

**Results:** Eleven patients were included: 8 cases of orbital exenteration, 1 case of forehead reconstruction, and 2 cases of palatal reconstruction after radical maxillectomy. Flap survival was 100%. One patient required an early take back for venous thrombosis. The reconstruction was effective in all cases, allowing a prosthetic rehabilitation when required. Donor-site morbidity was minimal.

**Conclusions:** The reconstruction of head and neck defects with a bulky fasciocutaneous ALT flap might not be the best option in every case. The SALT flap could represent a valid alternative for selected cases, with encouraging functional and cosmetic outcomes. (*Plast Reconstr Surg Glob Open* 2017;5:e1197; doi: 10.1097/GOX.0000000000001197; Published online 17 January 2017.)

Nowadays, the anterolateral thigh flap (ALT) represents the workhorse for most complex head and neck reconstructions not involving osseous components.<sup>1-3</sup> It was first described by Song et al<sup>4</sup> in 1984,

and it has since been popularized by Wei,<sup>1,3,5</sup> showing its application for head and neck reconstruction. The ALT flap achieved wide acceptance thanks to its versatility, the possibility of a two-team approach, the length of the pedicle, and the low morbidity of the donor site. It can be harvested as a cutaneous, fasciocutaneous, adipofascial, or chimeric myocutaneous flap with a portion of the vastus lateralis muscle, allowing a variety of complex reconstructions. However, the main concern in head and neck reconstruction is the thickness of the flap that often results in poor aesthetic outcomes with the need for secondary surgery. Especially in the periorbital area, the placement of alloplastic prosthesis may not be possible after reconstruction with a traditional ALT. When a thinner flap is needed, a suprafascial ALT flap may be raised and debulked at the time of the harvest. This is technically challenging and in obese patients still leads to a bulky flap. To overcome such problems, the authors have come up with a double fascia

From the \*Division of Plastic and Reconstructive Surgery (M.C., F.M., M.C., F.T., E.M., L.V.) and †Head and Neck Surgery & Forensic Dissection Research Center (M.C., M.T.-Z., P.B., P.C., L.V.), Department of Biotechnology and Life Sciences, University of Insubria, Varese, Italy; ‡Division of Plastic & Reconstructive Surgery, Transgender Health Program, Oregon Health & Science University, Portland, Oregon (J.B.); and §Division of Otorhinolaryngology - Head & Neck Surgery, Department of Biotechnology and Life Sciences, University of Insubria, Varese, Italy (M.T.-Z., P.B., P.C.). Received for publication September 20, 2016; accepted November 9, 2016.

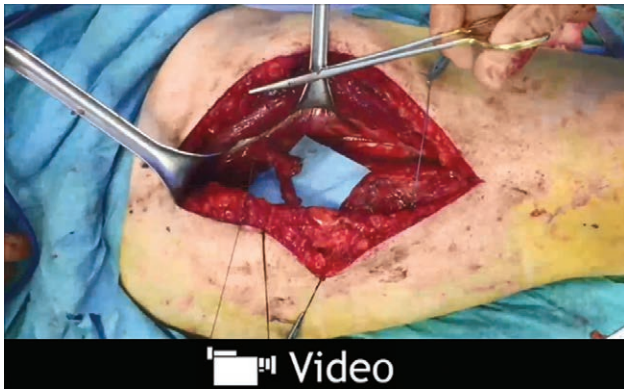
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**Video Graphic 1.** See video, Supplemental Digital Content 1, which demonstrates the SALT flap technique. This video is available in the “related videos” section of the full-text article on PRSGlobalOpen.com or available at <http://links.lww.com/PRSGO/A350>.

ALT (from superficial fascia to muscular fascia), called “sandwich fascial ALT flap” (SALT). The aims of this article were to propose this innovative surgical technique and to present our preliminary outcomes.

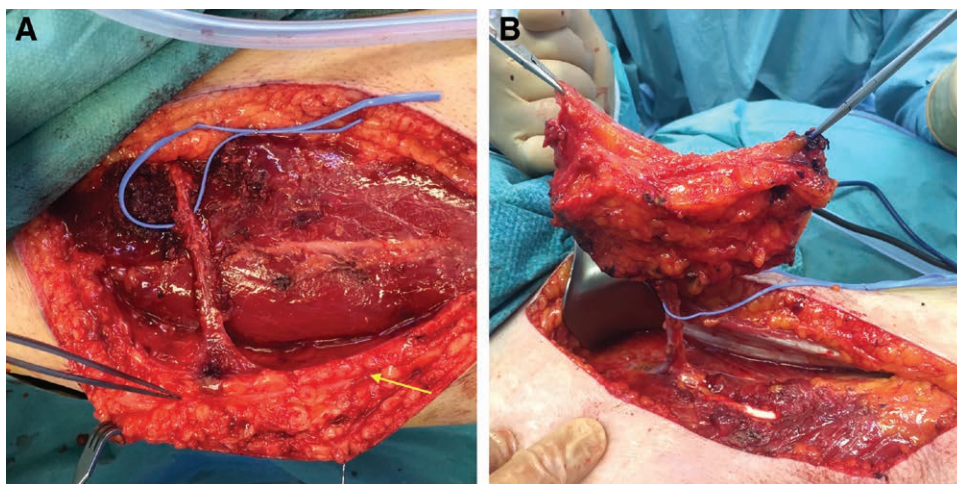
### PATIENTS AND METHODS

All patients treated by the way of a SALT flap for the reconstruction of surgical defects after head and neck cancer ablation between January 2013 and March 2016 were retrospectively reviewed. The study has been conducted in line with policies approved by the local ethical committee. We design the study according to the population, intervention, control, outcome, setting, and time horizon recommendation<sup>6</sup> (See video, Supplemental Digital Content 1, which demonstrates the SALT flap technique. This video is available in the “related videos” section of the full-text article on PRSGlobalOpen.com or available at <http://links.lww.com/PRSGO/A350>). The skin incision is marked 2 to 3cm anterior to the skin projection of the intermuscular septum between the rectus femoris and the vastus lateralis. The incision is carried down to the deep fascia while sparing the medial branch of

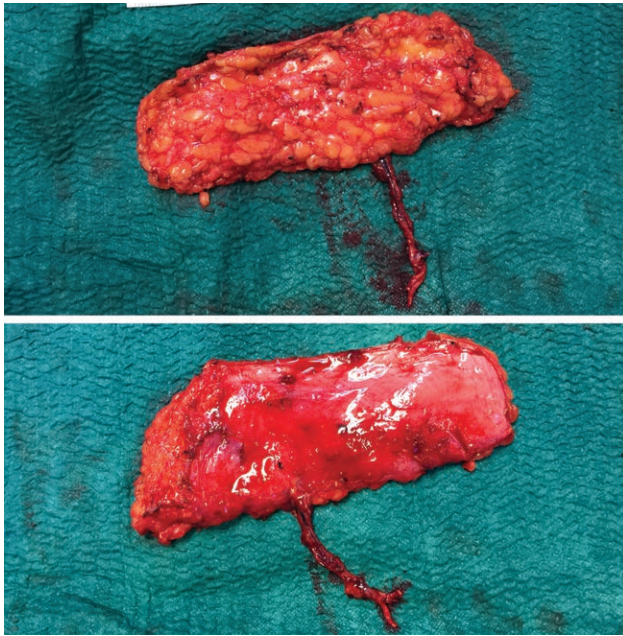
the lateral cutaneous femoral nerve. The deep fascia past the lateral border of the rectus femoris is opened, and the perforators in the subfascial plane are identified and isolated. If no perforator through the septum or the vastus lateralis is identified, we use a tensor fasciae latae or rectus femoris perforator. We follow the perforators to dissect out the pedicle until an adequate length is achieved. Once the pedicle is properly isolated, the dissection of the flap continues on the top of the superficial fascia (Scarpa’s fascia), thereby separating the cutaneous and subcutaneous plane from our flap (Fig. 1). Once an adequate area has been exposed, the flap design is marked on the superficial fascia. The superficial fascia, subscarpal fat, and deep fascia are then incised, and the harvest was completed by elevating the flap (Fig. 1). The pedicle is cut, and the flap is transferred to the recipient site (Fig. 2). At the inset, the flap is turned upside down, so that the undersurface of the deep fascia faces outward. The deep fascia is then secured to the dermis of the recipient site (Fig. 2). Once microsurgical anastomoses have been performed, the reconstruction is completed by grafting the deep fascia with either dermal substitute (Integra LifeSciences, Plainsboro, N.J.) or a split thickness skin graft (Fig. 3). With this technique, the donor site can always be closed primary. A laser Doppler probe was used as a postoperative flap monitoring system.

### RESULTS

Eleven patients (9 males and 2 females), aged from 27 to 76 years (mean age, 57.2 years), were included in this case series. Clinical and pathological findings of the patients enrolled are summarized in Table 1. The defects were classified according to the classification by Brown and Shaw.<sup>7</sup> The perforators were classified according to the classification by Yu and Shieh.<sup>8,9</sup> The recipient vessels were the temporal artery and vein in 10 patients. In 1 case, where a simultaneous neck dissection was performed, the facial artery and the vein of the thyrolingual trunk were used. All the flaps survived, and there was no partial flap loss observed. A vein thrombosis occurred in 1 case (patient 6), and a surgical revision of the anastomosis



**Fig. 1.** SALT flap harvested with the superficial fascia (Scarpa’s) and deep fascia. A, The forceps and the arrow indicate the superficial fascia. B, The flap elevated before pedicle division.



**Fig. 2.** SALT flap. The superficial and deep fascia aspects.

was performed within 24 hours after the primary surgery. The mean time for complete healing was 34.3 days from the time of surgery. The reconstruction was effective in all cases, allowing a prosthetic rehabilitation without any surgical revision (Fig. 4). However, of 8 patients with orbital exenteration, only 2 demanded external prosthesis once the wounds were healed. Donor-site morbidity was minimal (Fig. 4).

The mean follow-up time was 12.4 months (range, 9–48 months). One patient (case 6) died 6 months after surgery because of the persistence of a high-grade glioma (grade IV). Another patient (case 5) died after 1 year of local recurrence and systemic dissemination of a mucosal melanoma. The remaining patients (9/11) are alive and satisfied by the reconstructions. Follow-up data are detailed in Table 1.

### DISCUSSION

The ALT flap is a well-described and frequently used flap for complex reconstruction. Its application has been described for soft-tissue reconstruction in almost every area of the body<sup>3,8,10–12</sup> and for a variety of indications. The characteristics of an ideal soft-tissue free flap for head and neck reconstruction might be described as having a large skin

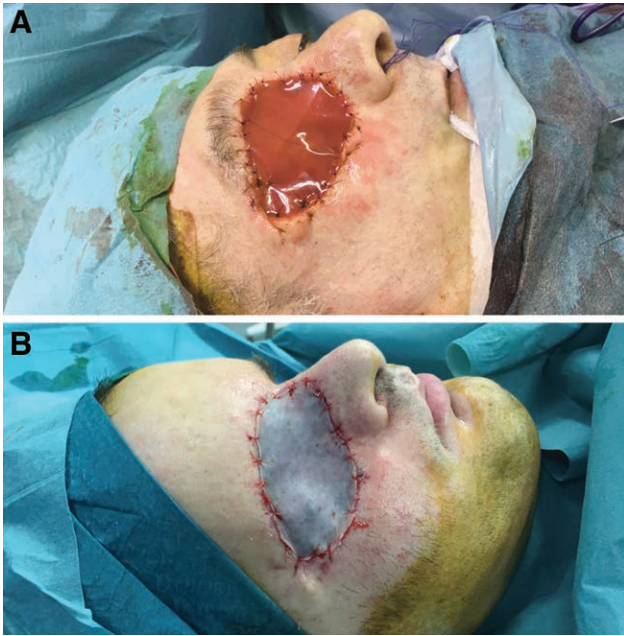


**Fig. 3.** Flap inset. The deep fascia is sutured to the recipient dermis. The pedicle is tunneled to the temporal recipient vessels (patient 9).

**Table 1. Patient Data**

Patient	Age	Sex	Histology	Site of Onset	Surgery	Classification by Brown and Shaw <sup>7</sup>	Type of Perforator (Classification by Yu and Shieh <sup>8</sup> )	Hospitalization Time, d	Status
1	54	M	Squamoecellular carcinoma	Left alveolus	Tracheotomy, left hemimaxillectomy, SALT	Ib	A, type II	21	NED
2	72	M	Adenoid cystic carcinoma	Right maxillary sinus	Right hemimaxillectomy, exenteratio orbitae, SALT flap, local flap	IVb	B, type III	16	NED
3	76	F	Squamoecellular carcinoma	Left alveolus	Tracheotomy, left hemimaxillectomy, SALT flap	Ib	B, type III	23	NED
4	40	M	Squamoecellular carcinoma with focal neuroendocrine differentiation	Right nasal cavity	Tracheotomy, right hemimaxillectomy, exenteratio orbitae, ASB reconstruction, SALT flap, STSG	IVb	B, type I	22	AWD
5	64	M	Malignant melanoma	Right nasal cavity	Tracheotomy, right hemimaxillectomy, frontal-ethmoidal- exenteratio orbitae, ASB reconstruction SALT flap → dermal substitute → STSG	IVb	B, type III	29	DOD (7/6/2015)
6	73	F	Glioma IV grade, with sarcomatoid aspects (relapsed)	Left frontal lobe	SALT flap, STSG	NA	B, type I	14	NED
7	50	M	Uveal malignant melanoma	Right ocular globe	Exenteratio orbitae, SALT flap, STSG	V	C + B, type I	11	NED
8	27	M	Pleomorphic rhabdomyosarcoma	Right maxillary sinus, nasal cavity	Right hemimaxillectomy, exenteratio orbitae, ethmoidal-sphenoidal resection, craniectomy, ASB reconstruction, SALT flap → dermal substitute → STSG	V	B, type I	31	AWD
9	63	M	Basal cell carcinoma	Right lower lid skin	Exenteratio orbitae, SALT flap, dermal substitute, STSG	V	A + B, type II	6	NED
10	73	M	Squamoecellular carcinoma with focal neuroendocrine differentiation	Right nasal cavity	Right hemimaxillectomy, frontal-ethmoidal- exenteratio orbitae, ASB reconstruction, SALT flap, STSG	V	C + B, type I	31	NED
11	73	M	Intestinal like adenocarcinoma	Right maxillary sinus, ocular cavity	Exenteratio orbitae, SALT flap, STSG	V	B, type I	15	NED

ASB, anterior skull base; AWD, alive with disease; DOD, died of disease; NA, not applicable; NED, no evidence of disease; STSG, split thickness skin graft.



**Fig. 4.** Immediate postoperative appearance after reconstruction of the orbital cavity. A, A dermal substitute was used to cover the flap (patient 9). B, A split thickness skin graft was sutured directly on the deep fascia of the flap (patient 8).

territory, good color and texture match with the recipient site, a long and large caliber vascular pedicle, reliability for different flap designs, constant pedicle anatomy, acceptable donor-site morbidity, suitability for sensate reconstruction, feasibility for a two-team approach, no need of major artery or muscle sacrifice, applicability as a flow-through flap, and suitability for usage as a thin flap. The ALT flap presents most of these characteristics, and this is why it has become the workhorse for most head and neck soft-tissue reconstructions. However, the ALT also has some disadvantages. Multiple factors can result in donor-site morbidity of the ALT flap including damage to the vastus lateralis muscle or motor nerve, closure with skin grafts, loss of function, or injury to the lateral cutaneous femoral nerve.<sup>13,14</sup> Recently, Chen et al,<sup>2</sup> to overcome the morbidity of the donor site, suggested the harvesting of the ALT flap in a suprafascial plane for head and neck reconstruction. In our experience, this technique is valid in the case of thin person and especially for male patients. Conversely, when dealing with obese patients and in women, the dissection around the pedicle in the suprafascial plane may represent a difficult procedure, and the risk of damaging the perforator limits the ability to thin only the periphery of the flap, thereby resulting in a pyramid shape flap. Furthermore, the standard cutaneous



**Fig. 5.** Preoperative appearance and early follow-up after 3 weeks (patient 11).

ALT flap has some disadvantages at the recipient site as well. The aesthetic outcome is rarely optimal as there is usually a marked color mismatch. Also, the flap is often too bulky and over time leads to a ptotic appearance with it “melting” down the face, thereby worsening the aesthetic appearance and precluding the possibility of prosthetic rehabilitation.

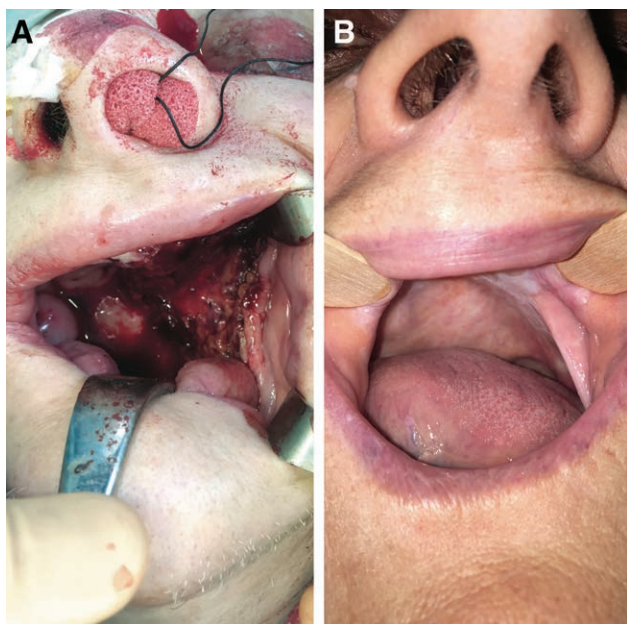
This is particularly evident in the case of orbital exenteration where the patients cannot wear an eye prosthesis until a debulking procedure is performed.<sup>15-17</sup> However, the need to submit the patient to additional surgical procedures may represent a limitation considering that this patient population often has a poor life expectancy.<sup>18</sup> Ideally, the first surgical procedure should achieve the goals of a good functional and aesthetic outcome, avoiding subsequent surgical procedures.

To overcome these issues, we developed the SALT flap. Harvesting the flap in the superficial plane does not need any particular skills when compared with the standard ALT flap technique. The perforators can be identified in a standard fashion in the subfascial plane and dissected in a retrograde fashion till enough length of the pedicle is achieved. As such, the harvest is no different than in the standard ALT dissection. The only technical difference is that the harvest is performed through a single incision.

By turning the flap upside down, the robust fascia can be sutured to the recipient dermis, preventing secondary drop of the loose subcutaneous tissue. Skin grafting on the fascia is considered a valid treatment for third-grade burns. For all these reasons, we advocate turning the flap upside down and to skin graft the deep fascia. During the harvesting of the flap, we generally leave a little cuff of soft tissue around the pedicle to prevent the skin graft from being directly on the pedicle. The use of the dermal substitute (i.e., Integra, Inc., Plainsboro, N.J.) can assist in protecting the pedicle at the same time providing a more pliable skin and a higher vascularity of the reconstructed soft tissues.<sup>19-21</sup> In the present case series, we used the dermal substitute in 3 cases with encouraging results (Table 1; Figs. 5, 6). To improve the color match, the skin graft could be harvested from the supraclavicular region.<sup>22</sup> In case that, there are no significant differences between the color of the thigh and the recipient site, or a wide flap is needed; a split thickness skin graft can be harvested directly from the donor site and closed primary exactly as for the standard ALT flap (Fig. 6). In selected cases, the SALT flap does not need any skin cover. For the reconstruction of palatal defects resulting from a radical maxillectomy, the intraoral por-



**Fig. 6.** Twelve-month follow-up: the patient can wear an external prosthesis without any surgical revision. The donor site is closed primarily (patient 7).



**Fig. 7.** The SALT flap is left to mucosalize spontaneously in the mouth after radical hemimaxillectomy. A, An immediate postoperative image: the deep fascia is sutured facing the oral cavity. B, Nine-month follow-up: the deep fascia has mucosalized with no scar retraction on the soft palate (patient 3).

tion of the flap is left to mucosalize spontaneously, as occurs for muscular flaps (Fig. 7).<sup>23–26</sup>

## CONCLUSIONS

The preliminary outcomes obtained from the present case series support the use of the SALT flap as a valid and safe option for several head and neck reconstruction. In our opinion, the SALT flap represents an evolution of the standard ALT flap, which may revolutionize head and neck cancer reconstruction.

**Mario Cherubino, MD, FEBOPRAS**

Division of Plastic and Reconstructive Surgery  
Department of Biotechnology and Life Sciences (DBSV)  
University of Insubria  
ASST Sette Laghi, Viale Borri 57  
Varese, 21100 (VA), Italy  
E-mail: mario.cherubino@gmail.com

## PATIENT CONSENT

Patients provided written consent for the use of their images.

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