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Supraclavicular flap as a salvage procedure in reconstruction of head and neck complex defects

Helio R.N. Alves*, **Jose Carlos Marques de Faria, Rafael Varella dos Santos, Claudio Cernea, Fabio Busnardo, Rolf Gemperli**

Instituto do Câncer do Estado de São Paulo, Division of Plastic Surgery, Sao Paulo University Medical School, Av Dr. Eneas de Carvalho Aguiar, 255, 8th floor, Sao Paulo, Brazil

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Summary The supraclavicular island flap (SCIF) is an interesting therapeutic option in head and neck reconstruction. Since popularized by Pallua in the late 90s, several clinical series have been published showing its versatility and usefulness. However, only a few studies have focused on factors associated with complications from SCIF use. In this study, we analyzed the factors contributing to SCIF unreliability. We performed a retrospective review of the data of 87 patients undergoing SCIF reconstruction between 2008 and 2015. No significant differences in mean complication rates were observed when the SCIF was used for primary or salvage reconstruction (28% *versus* 25%, respectively, $p = 0.816$) or for cutaneous or intraoral reconstruction (27% *versus* 28%, respectively, $p = 0.932$). Flap folding, preoperative radiotherapy, and microsurgery were associated with significantly increased complication rates ($p = 0.002$, $p = 0.043$, and $p = 0.001$, respectively), whereas smoking ($p = 0.431$) had no impact with regard to this. In conclusion, the SCIF is a versatile flap and an important therapeutic tool for use in salvage surgeries, particularly in those performed in patients with poor clinical conditions and limited flap options.

Introduction

Large oncological head and neck resections require complex reconstructions with more than one flap.[1,2,3] The complexity of these procedures and the adverse clinical conditions of the patients result in considerable complication rates. Complications, in turn, often require new procedures that

* Corresponding author. Present address: Al. Jau, 361 AP.32. Jardim Paulista, 01420-000 Sao Paulo, Brazil.
E-mail address: heliomed85@yahoo.com (H.R.N. Alves).

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Table 1 Epidemiological data related to the age and gender of the participants in each group.

Reconstruction	Immediate		Salvage		Total
Groups	Skin	Intraoral	Skin	Intraoral	
Gender	69% (26/38) M 31% (12/38) F	41% (9/22) M 59% (13/22) F	71% (12/17) M 29% (5/17) F	80% (8/10) M 20% (2/10) F	87
Age (years)	66.86 (29 to 88)	63.5 (42 to 83)	59.76 (46 to 81)	60.2 (50 to 78)	62.55

Abbreviations: M, male; F, female

are even more challenging than the initial ones.[4] In most cases, a second microsurgery may not be the best option, due to either the clinical condition of the patient or lack of adequate local conditions.[5] Locoregional flaps are reliable and easily dissected and are usually an interesting option in these cases.

Only a few locoregional flap options are available in the head and neck area. Among potential options, the pectoralis myocutaneous flap is one of the most versatile flaps in head and neck salvage surgery.[6] However, disadvantages associated with this type of flap should be considered, including excessive volume, rate of partial loss, and donor site characteristics (especially in women).[7]

Pallua used the supraclavicular island flap (SCIF) in head and neck reconstruction for the first time in 2000[8]. Since then, several authors have reported the use of this type of flap with good results in reconstructions of the pharynx, oropharynx, and posterolateral defects of the base of the skull, among others.[9-13]

The objective of this study was to assess the complications resulting from SCIF use in head and neck reconstructions on the basis of the location of the oncological defect in patients undergoing immediate reconstructions and salvage surgeries.

Patients and methods

From July 2008 to March 2015, a total of 87 patients underwent head and neck reconstruction with an SCIF at *Instituto do Câncer do Estado de São Paulo*, and the data related to the procedures were reviewed. Table 1 presents the demographic characteristics of the patients included in the study, which comprised individuals undergoing immediate and secondary reconstruction of intraoral and cutaneous defects. Most patients were operated on by the first author along with medical residents.

Statistical analysis

Fisher's exact test was applied to compare the rates of partial flap necrosis between groups undergoing primary and secondary reconstructive surgeries and between groups undergoing intraoral and cutaneous procedures. We evaluated the presence of flap folding, preoperative radiotherapy, association with microsurgery, and smoking, as these factors may increase the risk of complications associated with the procedures. Statistical analyses were performed using IBM SPSS (Statistical Package for Social Sciences, Chicago, IL, USA), version 23.0.

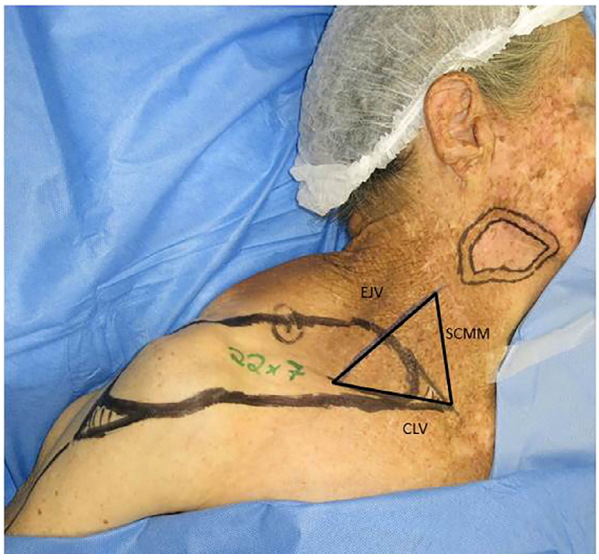

Figure 1 SCIF planning: A triangle limited by the dorsal edge of the sternocleidomastoid muscle (ECMM), the external jugular vein (EJV), and the medial part of the clavicle (CLV) origin of the supraclavicular vessels is marked to include the axis of the supraclavicular pedicle. A fusiform skin paddle measuring 7 × 22 cm was outlined between a posterior line at the trapezius border and an anterior line parallel to the clavicle.

Surgical technique

The patients were placed in a supine position for the procedure. A triangle limited by the dorsal edge of the sternocleidomastoid muscle, the external jugular vein, and the medial part of the clavicle was marked. The supraclavicular pedicle was inside of this triangle (Figure 1). A handheld Doppler probe could be used to confirm the presence of the perforators. A fusiform skin paddle for the SCIF was outlined between a posterior line at the trapezius border and an anterior line parallel to the clavicle, with the proximal portion at the base of the ipsilateral neck, inside the previously marked triangle, and the distal portion extending to the deltoid region. The flap was harvested from the lateral to the medial direction in the subfascial plane. Caution was taken during dissection of the supraclavicular fossa to avoid severance of the pedicle, which usually does not require skeletonization. The flap could be rotated up to 180° and tunneled safely, if required. The donor site was usually closed primarily and drainage was usually not required.

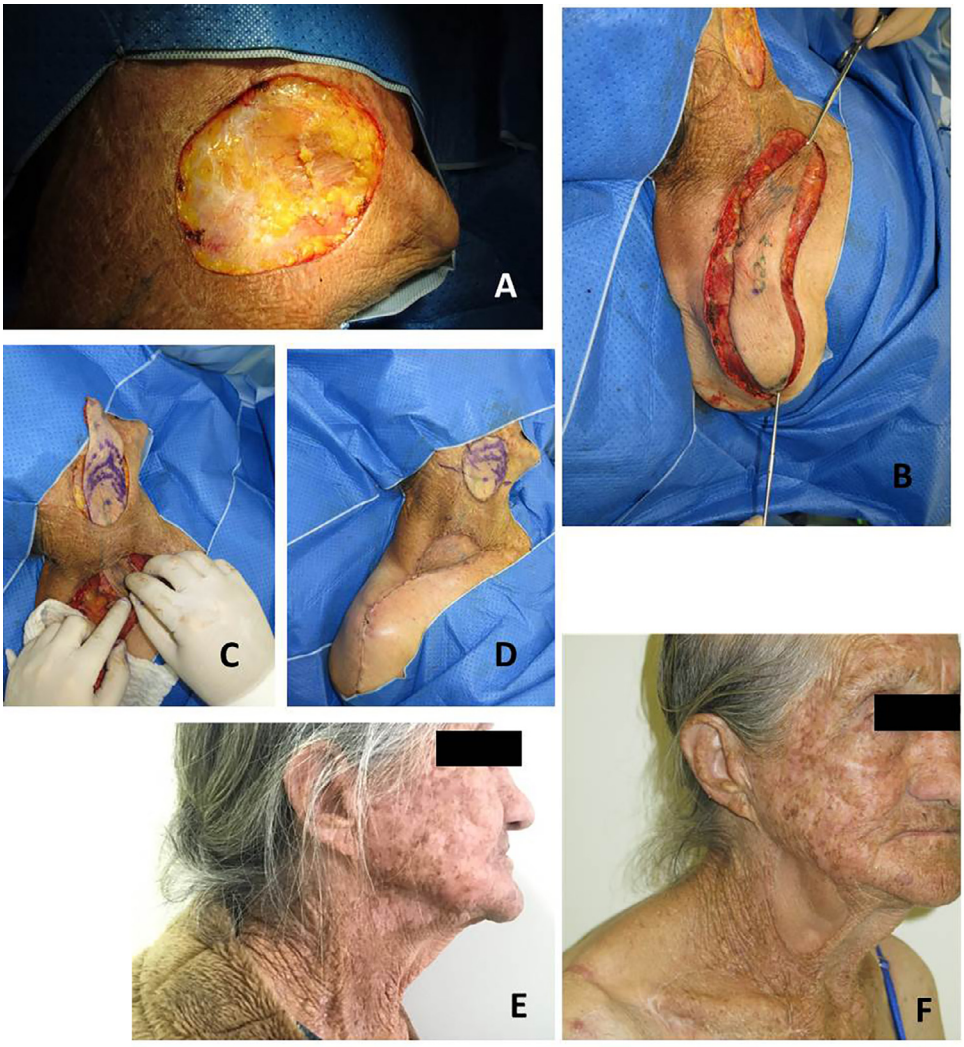

Figure 2 Clinical case. (A) A mandibular soft tissue defect of 7 cm diameter after the resection of a recurrent squamous cell carcinoma. (B) SCIF dissected. (C) Deepithelialization of the tunneled area. (D) Immediate postoperative lateral view. (E) Preoperative lateral view, and (F) 7-month postoperative lateral view.

Clinical case

A 79-year-old man presented with a 7-cm diameter defect in the cervical area after undergoing resection of a recurrent squamous cell carcinoma. A 7×22 cm SCIF was performed to reconstruct the defect, and the donor site was closed primarily. No complications were detected in the postoperative period (Figure 2).

Results

Of the 87 patients undergoing SCIF, 19 (21.8%) experienced distal partial necrosis; of them, 21 (24%) required additional surgical procedures. No total losses were observed.

Table 2a and 2b shows the complications observed in association with the procedures, distributed according to the location of the defect. Cases in which complications emerged from partial flap loss were managed with additional procedures such as resutures, skin flaps, locoregional flaps, and microsurgical flaps. There were 11 cases of donor site dehiscence, which were treated conservatively. The mean dimensions of the flaps were 25.9 mm (length) and 8.0 mm (width), and the mean hospitalization duration was 17 ± 18 days.

Overall, we observed no significant difference in mean complication rates of SCIF used for primary or salvage reconstruction (28% *versus* 25%, respectively, $p = 0.816$). We also observed no significant difference when we examined the mean complication rate in the groups undergoing cutaneous and intraoral reconstruction (27% *versus* 28%, $p = 0.932$). When we stratified the groups undergoing cutaneous and intraoral reconstruction on the basis of the timing of the surgery (primary or salvage procedures), both groups presented no significant difference in complication rates (cutaneous 26% *versus* 29%, respectively, $p = 0.812$, and intraoral 31% *versus* 20%, respectively, $p = 0.491$).

Flap folding, preoperative radiotherapy, and association with microsurgery were associated with significantly increased complication rates ($p = 0.002$, $p = 0.043$, and

Table 2a Type and management of complications according to the location of the reconstructed sites of the skin defects.

Group	Quantity	Types of complications	Management of complications
Cutaneous	55	27% (15/55)	93% (14/15)
Temporal region (Upper third of the face)	7	5 Partial necroses 1 dehiscence	3 Scalp flaps 2 Grafts
Mandibular region	18	5 Partial necroses 2 dehiscence	2 Pectoralis flaps 1 Contralateral SCIF 1 Graft 3 Resuture
Maxillary and orbital region	4	2 Partial necroses	2 Frontal flaps
Neck region	4	0	0
Parotid and mastoid region	22	0	0

Table 2b Type and management of complications according to the location of the reconstructed sites of the intraoral defects.

Group	Quantity	Types of complications	Management of complications
Intraoral	32	28% (9/32)	77% (7/9)
Retromolar trigone and cheek mucosa	15	2 Partial necroses	1 Imap flap 1 Resuture
Mouth floor (7PVM)	11	3 Partial necroses	1 Micro alt flap 1 Trapezius flap 1 Pectoral flap
		1 Dehiscence	1 Resuture
Tongue	2	0	0
Palate	4	1 Desquamation	Conservative management
		2 Partial necroses	1 Forearm flap

Abbreviations: PVM, pelvi-mandibulectomy.

$p = 0.001$, respectively), whereas smoking ($p = 0.431$) had no impact with regard to this.

Discussion

One or more flaps are frequently required in patients undergoing head and neck reconstruction after resection of advanced tumors.[1,2,3] These patients often experience partial or total flap loss, which requires an even more challenging surgery to correct than the initial procedure.[5]

Many of these patients undergoing head and neck reconstruction have a fragile clinical condition due to the presence of comorbidities, and the use of microsurgical flaps may be associated with even increasing morbidity in these cases. In addition to that, the availability of vessels to receive a new free flap is scarce.

The trapezius muscle flap has a good rotation arc and a suitable range, especially when the donor site is the most posterior portion of the muscle. However, due to a high complication rate (between 0% and 57%), this type of flap is not considered very reliable by some authors.[14-16]

The pectoralis muscle flap is considered the first choice in salvage surgeries, but its volume and donor site appearance, especially in women, sometimes impose limitations.[17]

The internal mammary artery perforator flap, derived from the deltopectoral flap, has a short pedicle and often requires resection of the costal cartilage to reach a longer distance, potentially causing pneumothorax, thoracic deformity, and intercostal neuralgia.[18-20]

The SCIF offers a desirable amount of available and reliable tissue. This type of flap can be used in the reconstruction of cutaneous defects up to the superior third of the face and intraoral cavity. The appearance of the skin in the SCIF is similar to that of the skin in the face.[8,9] The flap is easily raised, the morbidity at the donor site is minimal, and there is no functional sequelae.[9-13]

Nakatsuka et al. reported that the survival rate of the flap in secondary reconstruction was significantly lower than that in the immediate reconstruction.[21] On the other hand, Baek et al. found no difference in rates of flap failure between the primary and salvage surgery groups (5.4% and 4.1%, respectively), although the authors reported a significantly higher rate of wound dehiscence in the salvage than the primary surgery group (13.0% and 3.6%, respectively).[22] In the present study, when we compared the complication rates between the SCIF use for primary or salvage purposes, we found no significant difference between both. Additionally, when we stratified by reconstruction location, neither the cutaneous nor the intraoral group undergoing primary and salvage SCIF presented significant differences. No problems occurred while the flap was raised or positioned during salvage procedures.

The necrosis rate observed in this study is consistent with that reported by other studies in the literature (Table 3). In a series of 47 cases, Alves et al. published a partial loss rate of 14.9%[13]. In four cases of distal loss, the flap was folded for three-dimensional reconstruction, calling attention for the first time to the fragility of the tip. The distal tip of the flap is often the most important part of the reconstruction,

Table 3 Literature review of the outcomes of supraclavicular flap reconstructions.

Author	No.	Total complications (%)	Partial necrosis (%)	Total necrosis (%)	Reoperation (%)
Chiu et al.[9]	18	44	5	5	0
Alves et al.[13]	47	25	14.9	0	8.5
Sandu et al.[22]	50	-	8*	4	4
Razdan et al.[24]	22	27.5	4.5	4.5	13
Su et al.[25]	9	38	22	0	38
Granzow et al.[26]	18	39	5	0	17.64

* The authors described these outcomes as distal flap desquamations resolved with conservative measures alone.

and a loss at that location often demands a new surgical procedure. In this study, the tip of the SCIF was folded at an angle greater than 90° in 14 patients. Tip loss occurred in 10 of these patients, requiring a new surgical procedure. Care must be taken during placement of the flap to prevent folding of the tip, particularly in complex reconstructions.

Distal necrosis of the flap was observed in five patients undergoing cutaneous reconstruction of the upper third of the face and orbit. Sandu et al. recommend autonomization of the distal portion of the flap 7 to 10 days before transferring the flap to the upper third portion of the defect to reduce the risk of distal necrosis.[23] No anatomical parameter is available to evaluate the maximum range of this flap without the risk of distal loss. In our series, as shown in Table 2a, 6/7 (90%) temporal defects, 7/18 (40%), mandibular defects, and 2/4 (50%) maxillary and orbital defects had flap loss or dehiscence. The patients with defects in the neck, parotid, and intraoral region had no complications. A limit must be imposed beyond the distal mandible, where excessive tension may compromise the flap. Ideally, both distal perfusion and the degree of flaccidity of each patient should be assessed to ensure that the flap reaches the defect without tension.

Some authors have pointed out the possibility of reconstructing head and neck defects with the supraclavicular flap in patients with level V neck dissection, provided the thyrocervical trunk is preserved.[13,24,25] In primary reconstructions associated with level V lymph node dissection, the supraclavicular flap may be employed, as long as the oncologist surgeon is cautious when dissecting around the vascular pedicle. In salvage reconstructions, it is important to gather information regarding the extent of prior dissections. Before flap planning, the use of Doppler and exploration of the pedicle is recommended.

Su et al. reported a 38% complication rate associated with the use of the SCIF in irradiated and dissected necks.[26] Razdan et al., in a series of 22 cases, found complications in five patients (23%) using the SCIF in dissected and irradiated necks.[25] The authors concluded that prior radiotherapy or neck dissection is not a contraindication for the flap. In our series, we observed five cases of partial loss when the SCIF was used in patients with prior radiotherapy. However, the tip of the flap was folded in three of these cases. A history of radiotherapy does not preclude the use of the SCIF, but when combined with other risk factors, the risk of complications could be higher.

SCIF is an important resource in head and neck reconstruction, but some limitations must be considered before recommending this type of flap. SCIF can be used in primary reconstructions either alone or in combination with other flaps, as well as in salvage surgeries. In the latter, a history of radiotherapy or neck dissection is not a contraindication. SCIF is an important therapeutic tool, more so in patients with poor clinical conditions and limited flap options.

Conflict of interest

None

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