Donor site scar preference in head and neck free flap reconstruction: The patient point of view

Andrea Iandelli [a,b], Francesco Mazzola [c,*], Fabrizio Di Mari [d], Gilda Gaglio [b,e], Giulia Bianchi [c], Filippo Marchi [a,b], Giovanni Zoccali [f], Flaminia Campo [c], Giampiero Parrinello [a,b], Gerardo Petruzzi [c], Giorgio Peretti [a,b], Raul Pellini [c]

[a] Unit of Otorhinolaryngology-Head and Neck Surgery, IRCCS Ospedale Policlinico San Martino, Genoa, Italy
[b] Department of Surgical Sciences and Integrated Diagnostics (DISC), University of Genoa, Genoa, Italy
[c] Department of Otolaryngology-Head and Neck Surgery, IRCCS Regina Elena National Cancer Institute, Istituti Fisioterapici Ospitalieri (IFO), Rome, Italy
[d] Department of Statistical Sciences, Università di Roma "La Sapienza", Rome, Italy
[e] Department of Otorhinolaryngology, Ospedale San Paolo, 17100, Savona, Italy
[f] Plastic and Reconstructive Surgery Department-I.R.C.C.S. "Regina Elena" National Cancer Institute, Rome, Italy

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ABSTRACT

Background: Several free flaps are nowadays available for functional reconstruction after hemi-glossectomy in head and neck oncologic surgery. Radial forearm free flap (RFFF) and anterolateral thigh (ALT) have been played a workhorse role until recent years, when other valuable options such as Medial Sural Artery Perforator (MSAP) flap and Profunda Artery Perforator (PAP) flap demonstrated to be suitable contenders and are increasingly taken into account. This study aims to investigate the preference of the donor site in the light of esthetical and functional outcomes.
Methods: The participants attended a one-to-one interview with a surgeon explaining a standardized head and neck oncological procedure requiring a soft tissue reconstruction. The donor site preference in terms of esthetical, functional and overall outcomes among these four flap options was investigated.
Results: Univariable and multivariable analysis were performed comparing the donor site preference between the two most widespread free flap RFFF vs ALT. Subsequently, the analysis was performed comparing RFFF, ALT, MSAP and PAP.
Conclusions: The study illustrated that a diverse group of patients exhibits similarly diverse preferences and expectations. As we observe a shift in the age distribution of patients with OSCC from the fifth-sixth decade towards the two extremes, and an increased incidence in the female population, it becomes essential to enhance reconstructive options provided to patients. This ensures that, while maintaining an equivalent functional outcome, we maximize patient satisfaction to the fullest extent possible.

1. Introduction

In the last decades, the employment of free flaps in reconstructive surgery has exponentially raised among the head and neck surgeons, and today different reconstruction options are available for soft-tissue defects repair [1,2].

The choice of the flap during pre-operative planning relies on many factors evaluated case by case [3]. Of note, tissue bulkiness, vessel disposition, donor site morbidity, functional and esthetical outcomes as well as surgeon experience are taken into consideration.

In this scenario characterized by a great assortment of reconstructive options, the versatility and reliability of free flaps allow to choose the shape and thickness of the flap, fitting the defect without any tension and ensuring a suitable aesthetics result [4].

In the initial stages, the radial forearm free flap (RFFF) emerged as the primary choice for reconstructive head and neck surgery, owing to

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its flexibility, thinness, and limited hair density [5–7]. However, the considerable occurrence of donor site complications and the visibility of scars have prompted physicians to explore alternative options [8]. The antero-lateral thigh (ALT) free flap since its first application demonstrated to represent a reliable substitute [9,10]. Unlike RFFF flap, the ALT is a free flap based on perforators branches whose anatomical distribution are inconstant. This apparent issue is overcome with an appropriate knowledge of its variable vascular anatomy ensuring a proper harvesting of the flap and furthermore the opportunity to get various configurations and reconstructive options [11]. ALT offers the advantage of getting a customized skin paddle design and, with respect to the surgical defect, a large amount of soft tissue providing a primary closure and low morbidity of the donor site [10,12]. Moreover, ALT flap can be harvested as a cutaneous, fasciocutaneous or myocutaneous flap and for complex three-dimensional defects, due to its vascular anatomical feature, a chimeric type flap can be created [13].

Therefore, along with RFFF, ALT became the most widespread free flap employed for soft tissue reconstruction in head and neck surgery [10].

Subsequently, anatomic and clinical studies have demonstrated the relevance and the feasibility of harvesting flaps from different anatomical regions obtaining comparable properties.

Specifically in head and neck surgery, the Medial Sural Artery Perforator (MSAP) flap and Profunda Artery Perforator (PAP) flap have demonstrated to be suitable contenders and are increasingly taken into account [14–16].

The MSAP flap encloses both ALT and RFFF flaps qualities as long pedicle, adequate tissue volume, possibility to be used as chimeric flap, minimal donor site morbidity and thinness and pliability respectively [17–19]. In some instances, depending on the patient's thigh adiposity, the ALT flap thickness limits the insetting especially in intraoral reconstruction and although thinning is feasible it could compromise the flap vitality [20,21]. Hence, in respect of the less lower leg fat tissue in patients with high BMI, MSAP flap proved to be a reasonable substitute.

Similarly, PAP flap pointed out analogous benefits regarding flap elevation time, vascular pedicle, low complication rates, further ensuring optimal aesthetic outcomes due to the anatomical location of the donor flap site and the paucity of hairs [22–24].

Other potential flaps are present in literature despite only isolated, single-center and small case series have been published [25–28].

To date, a universal consensus or tendency regarding the ideal fasciocutaneous free flap has not been reached. By consequence, the flap selection between multiple similar options is gaining more and more attention in head and neck field due to new epidemiological data on oral cavity squamous cell carcinoma (OCSCC). As a matter of fact, recently has become evident the rising incidence among youngers and females unexposed to conventional risk factors such as tobacco and alcohol [29]. As suggested from NCCN guidelines, surgery represent the first line approach for oral cavity tumors followed by adjuvant therapy when required. This new trend is hence resulting in younger patients and a shifting from male-to-female population undergoing upfront surgery that requires free-flap reconstruction. Therefore, due to the great assortment of reconstructive options and their substantial comparability in term of surgical outcome, patients should be offered multiple flap options in order to meet their preference for specific donor sites based on their concerns about scarring, such as visibility, size, or potential long-term effects [22,30,31].Therefore, this study aims to investigate the pre-operative preference of the donor site in the light of esthetical and functional outcomes among a heterogeneous population.

In order to compare flaps with similar features and to reduce the bias linked to the ablation procedure, a hemiglosso-pelvectomy, ipsilateral selective neck dissection and temporary tracheostomy for oral cavity squamous cell carcinoma (OCSCC) was chosen as standardized and common procedure usually performed in head and neck departments [32].

2. Material and methods

Healthy participants were enrolled consecutively from September to December 2023. All participants signed an informed consent to the protocol approved by the IRCCS Regina Elena National Cancer Institute, Istituti Fisioterapici Ospitalieri, Institutional Review Board [n.1579/21]. Each participant attended to a one-to-one interview with a surgeon in order to be informed about the condition of a patient affected by tongue cancer which requires a surgical treatment. Epidemiological and clinical data concerning the malignant tongue cancer, the ablation procedure, possible adjuvant radiotherapy with or without concomitant chemotherapy, oncological outcomes in terms of relapse rate, disease specific survival and functional outcomes were exposed. In order to facilitate the comprehension, the exposition was sustained by explicative graphic slides reporting the above-mentioned details in addition to pictures showing donor-site scar outcome for each flap.

At the begin of the interview, data regarding age, gender, relationship status were collected.

The two most represented options among fascio-cutaneous flaps, RFFF and ALT, were then explained to the participants, with specific insight on both functional and esthetical outcomes as well as potential pitfalls complications. A first survey was conducted asking participants to express the preferred flap between these two (Fig. 1), in terms of esthetical, functional and overall outcomes.

Subsequently, MSAP and PAP flaps (Fig. 2) were presented as other two available options, reporting functional, esthetical outcomes and possible complications. Therefore, a second survey was conducted and participants were asked to express a preference among these four flaps (RFFF, ALT, MSAP and PAP) in terms of esthetical, functional and overall outcomes.

During the interview the site, size and appearance of the donor site scar were explained along with post-operative complications, which are summarized in Table I. However, donor site non-specific post-operative complications such as hematoma, seroma, hemorrhage, site infection, suture dehiscence, hypertrophic or keloid scar formation and scar pain, were accounted to each flap.

Statistical analysis was performed using R programming language through the integrated development environment RStudio. A descriptive analysis was obtained on the epidemiological data collected. Groups were compared using chi-square test for both univariate and multivariate analysis. Monte-Carlo simulation was used in case of lack of records to simulate the p-value. The significance level for p value was set to 0.05.

3. Results

The epidemiological data of the population is reported in Table II.

Among the 242 participants, 118 were females (48,8 %) and 124 were males (51,2 %). Mean age was 44,6 yo, median age was 47 yo. The participants with less than 47yo were 119 (49,2 %) while participants that were 47 or older were 123 (50,8 %). Partnered participant were 144 (59,5 %) while non-partnered were 98 (40,5 %). The population was divided by median age in two groups and compared.

In the first survey the univariate analysis (Table III) showed a significative preference in terms of esthetical outcomes for ALT option for both females (66,9 %) and males (84,7 %), comparing to RFFF option for females (33,1 %) and males (15,3 %), (p 0.0028). The multivariate analysis (Table IV) showed significative results among females and males younger than 47yo which preferred ALT, respectively 58,6 % and 85,2 %, instead of RFFF flap, 41,4 % and 14,8 % (p 0.00238). A non-significative tendency was confirmed in the overall outcome for the same group (p 0.1435).

In the second survey the univariate analysis (Table V) showed significative results for gender distribution in the flap choice, preferring PAP versus other flaps for esthetical (p 0.0067) and overall outcomes (p 0.0127). A non-significative tendency was observed over the same population for the functional outcomes. Similarly, the partnered status
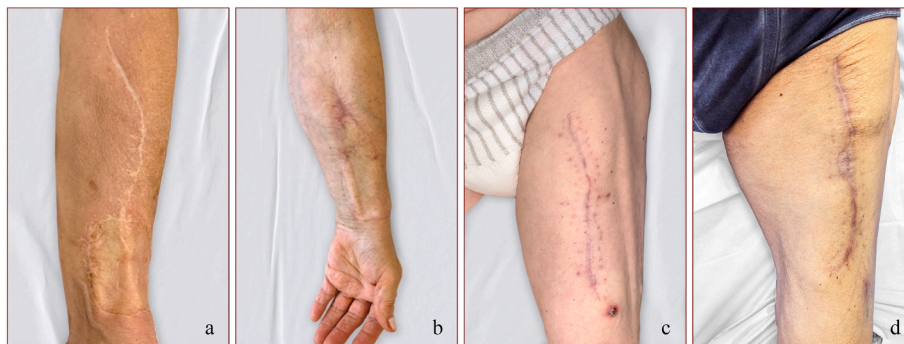
Fig. 1. a–b) RFFF donor-site scar aesthetic outcomes; c-d) ALT donor-site scar aesthetic outcomes.

Fig. 2. a-b) MSAP donor-site scar aesthetic outcomes; c-d) PAP donor-site scar aesthetic outcomes.

Table 1

Aesthetical and functional outcomes specific for each flap donor site. (RFFF: radial forearm free flap; ALT: antero-lateral thigh; PAP: profunda artery perforator; MSAP: medial sural artery perforator).

Type of flap	Aesthetical and functional complications
RFFF	Skin graft necrosis
	Tendon exposure
	Cold intolerance
	Hand swelling
	Descending suppurative tenosynovitis
	Altered sensation over the snuffbox, thumb and first finger (anesthesia, hypoesthesia, paresthesia, hyperesthesia)
	Transitory function impairment
	Reduced pinch and/or hand grip strength
	Wrist stiffness or reduced extension
	Compartment syndrome
	Thumb or hand acute ischemia
ALT	Rectus femoris muscle necrosis
	Leg weakness
	Muscle herniation
	Thigh contour deformity
MSAP	Skin graft death (if needed)
	Transitory function impairment
	Lower extremity cellulitis
PAP	Transient lower leg adduction limitation
	Contour deformity
	Liponecrosis

Table 2

Epidemiological data of the 242 participants.

	n.	%
Gender		
F	118	48,8
M	124	51,2
Total	242	
Age		
Mean	44,6	
Median	47	
Partnered status		
Partnered	144	59,5
Non-partnered	98	40,5

outcome (p 0.01449) and with a non-significative tendency for functional (p 0.1244) and overall outcomes (p 0.1254).

4. Discussion

Although we are observing a decline in the consumption of alcohol and tobacco, especially in Western countries, there hasn't been yet a significant reduction in the incidence of head and neck cancers, specifically those arising in the upper aero-digestive tract such as tongue cancer [29].

Concerning this specific subsite, on the contrary, an increase of the incidence has been observed, especially among youngers and patients unexposed to conventional risk factors [33]. Various hypotheses have been formulated to partially explain these trends. Several studies highlight the rising prevalence of exposure to smokeless tobacco and e-cigarettes among young adults. However, e-cigarettes weren't available until the 2000s, after the increase in oral cavity squamous cell carcinoma (OCSCC) had already begun, and smokeless tobacco never gained

showed a non-significative tendency in preferring PAP flap for functional and overall outcomes. The multivariate analysis (Table VI) showed a non-significative tendency among females and males younger than 47yo for esthetical outcomes (p 0.1289), which became significative for overall outcomes (p 0.02899). In the group of females and males older than 47yo, the flap choice resulted significative for esthetical

Table 3
Univariate analysis comparing RFFF and ALT flap choice.

			RFFF n.	RFFF %	ALT n.	ALT %	p
Aesthetical	Gender	F	39	33,1	79	66,9	0,0028
		M	19	15,3	105	84,7	
	Age	<47	33	27,7	86	72,3	NS
		>47	25	20,3	98	79,7	
	Partnered status	Partnered	37	25,7	107	74,3	NS
		Non-partnered	21	21,4	77	78,6	
Functional	Gender	F	19	16,1	99	83,9	NS
		M	24	19,4	100	80,6	
	Age	<47	23	19,3	96	80,7	NS
		>47	20	16,3	103	83,7	
	Partnered status	Partnered	27	18,8	117	81,3	NS
		Non-partnered	16	16,3	82	83,7	
Overall	Gender	F	25	21,2	93	78,8	NS
		M	21	16,9	103	83,1	
	Age	<47	27	22,7	92	77,3	NS
		>47	19	15,4	104	84,6	
	Partnered status	Partnered	28	19,4	116	80,6	NS
		Non-partnered	18	18,4	80	81,6	
Total			58	24,0	184	76,0	

Table 4
Multivariate analysis comparing RFFF and ALT flap choice.

			RFFF n.	RFFF %	ALT n.	ALT %	p
Aesthetical	<47	F	24	41,4	34	58,6	0,00238
		M	9	14,8	52	85,2	.
	≥47	F	15	25,0	45	75,0	NS
		M	10	15,9	53	84,1	.
Functional	<47	F	10	17,2	48	82,8	NS
		M	13	21,3	48	78,7	.
	≥47	F	9	15,0	51	85,0	NS
		M	11	17,5	52	82,5	.
Overall	<47	F	17	29,3	41	70,7	0,1435
		M	10	16,4	51	83,6	.
	≥47	F	8	13,3	52	86,7	NS
		M	11	17,5	52	82,5	.

Table 5
Univariate analysis comparing RFFF, ALT, PAP and MSAP flap choice.

			RFFF n.	RFFF %	ALT n.	ALT %	PAP n.	PAP %	MSAP n.	MSAP %	p
Aesthetical	Gender	F	14	11,9	11	9,3	89	75,4	4	3,4	0,0067
		M	8	6,5	27	21,8	78	62,9	11	8,9	
	Age	<47	14	11,8	14	11,8	82	68,9	9	7,6	NS
		>47	8	6,5	24	19,5	85	69,1	6	4,9	
	Partnered status	Partnered	13	9,0	17	11,8	104	72,2	10	6,9	NS
		Non-partnered	9	9,2	21	21,4	63	64,3	5	5,1	
Functional	Gender	F	14	11,9	16	13,6	82	69,5	6	5,1	0,0819
		M	14	11,3	30	24,2	69	55,6	11	8,9	
	Age	<47	13	10,9	23	19,3	77	64,7	6	5,0	NS
		>47	15	12,2	23	18,7	74	60,2	11	8,9	
	Partnered status	Partnered	19	13,2	20	13,9	94	65,3	11	7,6	0,0946
		Non-partnered	9	9,2	26	26,5	57	58,2	6	6,1	
Overall	Gender	F	17	14,4	13	11,0	83	70,3	5	4,2	0,0127
		M	14	11,3	33	26,6	69	55,6	8	6,5	
	Age	<47	17	14,3	25	21,0	72	60,5	5	4,2	NS
		>47	14	11,4	21	17,1	80	65,0	8	6,5	
	Partnered status	Partnered	21	14,6	20	13,9	94	65,3	9	6,3	0,0846
		Non-partnered	10	10,2	26	26,5	58	59,2	4	4,1	
Total			22	9,1	38	15,7	167	69,0	15	6,2	

the same popularity as its inhaled counterpart [34]. Additionally, young OCSCC patients typically lack extensive carcinogenic exposure data.

Within the group of young patients, several studies have indicated a higher occurrence among females. Foy et al. proposed a hypothesis linking this increase in non-smoking, non-drinking women to changing sexual behavior in Western countries [35]. They attribute this shift to a greater incidence of herpes virus infections in the oral cavity, akin to what has been described for the papillomavirus. Since viral genome integration hasn't been detected in non-smoking, non-drinking patients with OSCC, a viral "hit-and-run" mechanism involving epigenetic deregulation might play a crucial role during the early stages of carcinogenesis in this patient population. A lack of evidence in this field will require further investigations to correlate tongue cancer to date unknown risk factors.

Concurrently, the percentage of elderly people with head and neck cancers (HNC) is rising due to increasing average lifespan [36,37].

In this scenario, the population spectrum is changing drastically compared to the former average head and neck patients, and so is the necessity to cope with functional and aesthetic post-operative outcomes, sometimes for life.

It is therefore essential to develop a holistic management that, besides choosing the best oncological treatment according to latest evidence, bring into play the patient as protagonist to guarantee the best accessible quality of life. The patient's viewpoint on donor site scars plays a pivotal role in the decision-making process, as it reflects their personal aesthetic preferences and influences their overall experience with the reconstructive surgery. This underscores the importance of a collaborative approach between patients and healthcare professionals in tailoring the reconstructive plan to align with individual preferences and priorities. In head and neck reconstructive field, this virtuous attempt requires to offer various flap alternatives that can best adapt to patient's expectations.

Very few studies have assessed patient opinion regarding aesthetical and functional outcomes whilst having missed the goal of describing a preference among possible flaps. Indeed, these studies make a valid contribution in providing details to the patient during informed consent in case of surgical treatment.

Overall, in the author's opinion, the investigation of a consensus or trend in scar preference for reconstructive surgery is merely utopistic. The claim for a systematic description of such a complex, multifactorial and single-patient related phenomenon would bring to a lackadaisical and shallow representation, far from actual usefulness. Thus, the side aim of this study is to encourage surgical reconstructive teams in training on non-mainstream flaps in order to offer the best option that

Table 6
Multivariate analysis comparing RFFF, ALT, PAP and MSAP flap choice.

			RFFF		ALT		PAP		MSAP		p
			n.	%	n.	%	n.	%	n.	%	
Aesthetical	<47	F	9	15,5	3	5,2	42	72,4	4	6,9	0,1289
		M	5	8,2	11	18,0	40	65,6	5	8,2	.
	≥47	F	5	8,3	8	13,3	47	78,3	0	0,0	0,01449
		M	3	4,8	16	25,4	38	60,3	6	9,5	.
Functional	<47	F	7	12,1	8	13,8	40	69,0	3	5,2	NS
		M	6	9,8	15	24,6	37	60,7	3	4,9	.
	≥47	F	7	11,7	8	13,3	42	70,0	3	5,0	0,1244
		M	8	12,7	15	23,8	32	50,8	8	12,7	.
Overall	<47	F	11	19,0	6	10,3	38	65,5	3	5,2	0,02899
		M	6	9,8	19	31,1	34	55,7	2	3,3	.
	≥47	F	6	10,0	7	11,7	45	75,0	2	3,3	0,1254
		M	8	12,7	14	22,2	35	55,6	6	9,5	.

takes into account the preference of the patient. After having considered all the variables, in the event of level playing field among flaps, is unjustified to not offer multiple option to the patient. This transition requires to avoid the only surgeon-based point of view and yet to recruit the patients when deciding. Thus, shared decision-making is considered the benchmark in healthcare, as previous studies have shown a decrease in decisional conflict and an enhancement in decision quality and patient satisfaction through the implementation of decision aids [38]. Breast reconstructive surgery pioneered this approach; the advancements in decision support tools have shown promising progress, aiding in guiding patient decisions, enhancing patient satisfaction, and minimizing decisional regret [39].

The authors acknowledge several limitations to this study.

The present study reports the results of consecutive healthy participants which underwent a pre-operative talk regarding a theoretical medical condition. This artificial scenario, on one hand does not involve retrospectively affected patients, however it recreates the pre-operative situation in which the patient expresses the preference among flaps without one of the main biases, the clinical history and the emotions around the recently communicated diagnosis of cancer. In fact, the retrospective studies involving affected patients provide valuable information on patient acceptance of the scar but, still, neglect the pre-operative preference of the patients. For sure, prospective studies that report pre-operative patient's preference on scar and besides follow-up the patients over time for aesthetical and functional outcomes, will provide even more interesting information.

The investigated population, despite being consistent and showing a reasonable heterogeneity, manifested a preference which is certainly affected by social, regional, cultural and historical bias and which, consequently, lacks of application in other population settings.

Authors selected four flaps among the many described in literature in order to simplify the decision of the patient. As a matter of fact, each flap required a detailed explanation in terms of aesthetical, functional outcomes and pitfalls and such a technical and multifactorial description would probably confuse the patient, adding a further bias in the preference. Indeed, other valid reconstructive options could have been taken into consideration but authors selected the most common and depicted in literature. This trend in head and neck reconstructive surgery is likely to change over the years, bringing the use of different and better flaps in terms of aesthetical and functional outcomes.

The application of the results of this study cannot curtail a multiple steps evaluation. Firstly, the evaluation of the clinical condition along with clinical history of a specific patients. Secondly, several surgery-related variables are taken into account such as surgeon expertise, length of surgery, previous procedures, post-operative rehabilitation and risks. Often, as a result of these assessments, the flap options can reduce to smaller amount to that predicted by theory. In fact, only in a selected part of the population all these four flaps are actually interchangeable. Last but not least, the final decision lies with the patient that

will express a preference among the proposed flaps.

5. Conclusion

The study illustrated that a diverse group of patients exhibits similarly diverse preferences and expectations. As we observe a shift in the age distribution of patients with OSCC from the fifth-sixth decade towards the two extremes, and an increased incidence in the female population, it becomes essential to enhance reconstructive options provided to patients. This ensures that, while maintaining an equivalent functional outcome, we maximize patient satisfaction to the fullest extent possible.

CRediT authorship contribution statement

Andrea Iandelli: Conceptualization, Methodology, Writing – original draft, Writing – review & editing. **Francesco Mazzola:** Conceptualization, Methodology, Writing – original draft. **Fabrizio Di Mari:** Data curation, Formal analysis. **Gilda Gaglio:** Data curation, Investigation. **Giulia Bianchi:** Data curation, Investigation. **Filippo Marchi:** Conceptualization, Resources, Supervision, Writing – original draft. **Giovanni Zoccali:** Investigation, Resources, Visualization. **Flaminia Campo:** Data curation. **Giampiero Parrinello:** Supervision. **Gerardo Petruzzi:** Software. **Giorgio Peretti:** Supervision. **Raul Pellini:** Supervision.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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