

ONCOLOGY

Anterolateral thigh cutaneous flap vs. radial forearm free-flap in oral and oropharyngeal reconstruction: an analysis of 48 flaps

Leombo anterolaterale di coscia vs. lembo libero radiale nella ricostruzione orale ed orofaringea: un'analisi di 48 lembi

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SUMMARY

Microvascular free-flaps have been in clinical use for nearly 3 decades becoming the gold standard in oral and oropharyngeal reconstruction. In this study, a comparison has been made between the radial forearm fasciocutaneous flap with the thinned anterolateral thigh cutaneous flap (tALT), showing the advantage of the anterolateral thigh cutaneous flap in oral and oropharyngeal reconstruction. Between January 2003 and January 2007, 48 reconstructions were performed in patients submitted to surgery for oral and oropharyngeal carcinoma using, in 17 cases, a radial forearm fasciocutaneous flap and, in 31, an anterolateral thigh cutaneous flap. In patients treated with the radial forearm fasciocutaneous flap, results showed 94.1% flap survival; in cases treated with the anterolateral thigh cutaneous flap, 93.5% flap survival ($p < 0.9$). Functional results, at receiving site, were comparable in both groups. Functional results, at donor site, were less successful in the radial forearm fasciocutaneous flap group, with permanent forearm movement impairment in 35.3% of cases; in the anterolateral thigh cutaneous flap group, only transitory gait impairment occurred in 12.9% of patients. In conclusion, in our experience, the thinned anterolateral thigh cutaneous flap is comparable to radial forearm fasciocutaneous flap in terms of functional results at receiving site, but, having no limitation in availability of donor tissue, it allows a more extended resection of the tumour. Moreover, the donor site can be closed primarily with only an inconspicuous curvilinear scar left over the thigh and with significantly reduced functional impairment.

KEY WORDS: Oral-oropharyngeal carcinoma • Surgical treatment • tALT • RFFF • Complications • Functional results • Quality of life

RIASSUNTO

I lembi liberi microvascolari sono nell'uso clinico da circa tre decenni e sono progressivamente diventati il gold standard per la ricostruzione della regione orale ed orofaringea. Nel presente studio, abbiamo confrontato il lembo libero radiale (RFFF) con il lembo anterolaterale di coscia assottigliato (tALT), mostrando i vantaggi del tALT nella ricostruzione orale ed orofaringea. Tra gennaio 2003 e gennaio 2007, abbiamo eseguito 48 ricostruzioni microvascolari in pazienti operati per carcinoma orale ed orofaringeo, usando un RFFF in 17 casi ed un tALT in 31. Nei pazienti trattati con RFFF o tALT abbiamo ottenuto rispettivamente un 94,1% ed un 93,5% di sopravvivenza ($p < 0,9$). I risultati funzionali a livello del sito ricevente sono stati sovrapponibili nei 2 gruppi. I risultati funzionali a livello del sito donatore sono stati, invece, decisamente peggiori nel gruppo trattato con RFFF, con un'alterazione permanente della motilità del braccio in 35,3% dei casi; nel gruppo trattato con tALT abbiamo notato una transitoria alterazione della marcia nel 12,9% dei pazienti. In conclusione, nella nostra esperienza, il tALT è paragonabile al RFFF in termini di risultati funzionali a livello del sito ricevente, ma, non avendo limitazioni di tessuto donatore, consente una resezione più ampia della neoplasia. Inoltre, il sito donatore può essere facilmente chiuso di prima intenzione, con soltanto una residuale cicatrice curvilinea sulla coscia e con alterazioni funzionali significativamente ridotte.

PAROLE CHIAVE: Carcinoma cavo orale/orofaringeo • Terapia chirurgica • tALT • RFFF • Complicanze • Risultati funzionali • Qualità di vita

Introduction

Oncological surgery of the oral and oropharyngeal region should allow complete resection of the tumour with minimal morbidity, preserving the function and adequately reconstructing the region.

Free-flaps have been in clinical use for several decades; in the last few years, survival rates have improved, as refinements have been made to the surgical technique and instrumentation, allowing free-flaps to become the gold standard in oral reconstruction.

Currently, the primary concern of surgeons is the function and appearance of the receiving and donor sites, because the survival rates of free-flaps have risen to more than 90% and become similar at most centres¹⁻⁴.

The radial forearm fasciocutaneous flap (RFFF) is one of the most popular free-flaps in oral reconstruction. It is a fasciocutaneous flap elevated from the volar region of the forearm and based on the radial artery and comitant venous pedicle. In spite of its usefulness and feasibility, at the receiving site, harvesting the RFFF implies sacrifice of an important vessel, namely, the radial artery and a high rate of donor site morbidity.

Recently, the anterolateral thigh flap (ALT), based on the septocutaneous vessels or musculocutaneous perforators from the descending branch of the lateral circumflex femoral artery⁵, has gained popularity in soft-tissue reconstruction⁶⁻¹⁰. It has some advantages in free-flap surgery with respect to the RFFF, such as low donor site morbidity, availability of different tissues with large amounts of skin, adaptability as a sensate or flow-through flap (with the possibility of harvesting a long pedicle with a suitable vessel diameter)¹¹⁻¹³. Moreover, the thickness of the flap is adjustable until the subdermal fat level, allowing it to be used as a thin or ultrathin flap.

Aim of the present investigation was to compare the radial forearm fasciocutaneous free flap (RFFF) versus the thinned anterolateral thigh cutaneous free flap (tALT flap) in reconstruction after surgery for oral and oropharyngeal squamous cell carcinoma.

Material and methods

Between January 2003 and January 2007, 48 patients affected by oral or oropharyngeal squamous cell carcinoma (36 males, 12 females; age range: 34-82 years, mean: 61.4) were treated with a demolitive procedure and subsequent microsurgery reconstruction. Specifically, radial forearm fasciocutaneous free flaps (RFFF) were used in the reconstruction, in 17 patients, and the thinned anterolateral thigh flap (tALT) in 31 cases. In the pre-operative setting, color Doppler ultrasonography (US) with Allen test was employed to study the forearm and hand vascular supply in patients undergoing RFFF; patients scheduled for tALT surgery were examined using color Doppler US, to map points where perforators seemed to penetrate the *fascia lata* in the region between the proximal and medial third of the anterolateral region of the thigh. Written informed consent had been signed by all patients prior to surgery.

Dissection of all flaps was performed simultaneously with tumour resection by two surgical teams.

During ALT flap dissection, the lateral femoral cutaneous nerve and the motor branches to the *vastus lateralis* and *rec-*

tus femoralis muscle of the femoral nerve were respected in all cases.

The superficial branch of the radial nerve was always preserved in RFFF dissection.

All the ALT flaps were trimmed to subdermal fat level for use as a thin flap (thickness ranged from 9 to 12 mm).

In all the patients treated with RFFF, the donor site was closed with a skin graft: in the tALT flap group, the donor site was always closed primarily, except in one case repaired with skin graft.

Flap Anatomy and Dissection

Radial forearm fasciocutaneous flap (Fig. 1): The standard technique was performed for surgical elevation of RFFF, as well described in the literature¹⁴⁻¹⁶.

Anterolateral thigh flap (Fig. 2): A line drawn from the ASIS (Anterior Superior Iliac Spine) to the lateral edge of the patella and centered over the perforators locates the central axis of the flap.

Dissection proceeds from a medial to a lateral direction in a subfascial plane until reaching the perforators that may be septocutaneous or musculocutaneous. The septocutaneous perforator always lies superficially on the *vastus lateralis* muscle and crosses into the intermuscular septum of the *rectus femoris* and *vastus lateralis* muscles proximally. The musculocutaneous perforators always emerge from the *vastus lateralis* muscle either two or three at a time. Usually, the most proximal one is dissected on account of the relatively larger diameter of the perforator.

The vascular pedicle must then be carefully dissected from the motor branches of the femoral nerve innervated to the *vastus lateralis* muscle that should be well preserved until it emerges from the lateral circumflex femoral vessels.

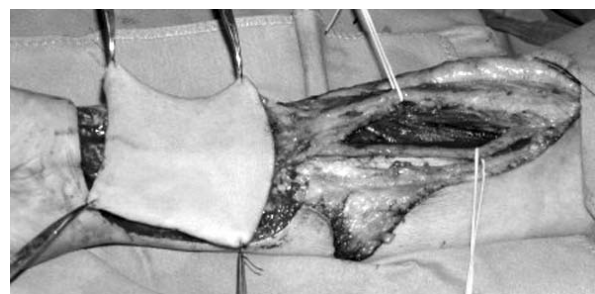


Fig. 1. Elevated radial forearm fasciocutaneous free flap (RFFF).



Fig. 2. Elevated thinned anterolateral thigh cutaneous free flap (tALT flap).

The lateral femoral cutaneous nerve is also preserved where possible.

The tALT is, then, outlined and harvested to fill the resected area. Thinning of the anterolateral thigh flap is performed either before or after ligation of the vascular pedicle. To achieve more reliable haemostasis, thinning, before pedicle ligation or after revascularization, is recommended. The flap, in the present series, was thinned using scissors down to the level of the subdermal plexus. Routinely, a cuff (5 mm in diameter) of subdermal fat was left around the perforator vessels preserving also 2-3 mm of superficial fat below the subdermal plexus to avoid injury to the plexus.

During follow-up, patients were periodically assessed for the extent, visibility and eventual hypertrophy of scar tissue at the donor site, for pigmentation of a scar or of the skin-grafted region. Light touch sensation evaluation was performed using a cotton-tipped applicator: patients were asked to note any sensory stimulus and to judge it as normal or altered, compared to the other side.

Functional impairment of the donor limbs (transitory and permanent) was also evaluated. Moreover, patients were asked about itching at the donor site and about numbness and paresthesia of the skin-grafted area. They were also asked to describe the impact of the donor site on their social life (recorded as presence/absence of a negative social stigma). Last of all, patients were asked to express overall judgment on the donor site results (good/acceptable/poor). The statistical analysis was performed using the Chi-square test.

Results

Patients included in the two groups (group A treated with RFFF and group B with tALT) were comparable in terms of

age, tumour stage, histology and follow-up time (Table I). There was no statistically significant difference between groups A and B ($p = 0.9$) in terms of type of demolitive surgical procedures performed (Table II). Survival data will not be discussed in this report.

As far as concerns outcome of the flaps, similar results were obtained in the two groups; namely, flap survival rates were 94.1% in the RFFF group and 93.5% in the tALT group ($p = 0.9$).

Functional results, at the receiving site, were comparable in both groups (Figs. 3, 4).

Donor site morbidity evaluation showed, in the RFFF group, major complications in 7 patients (41.2%) with necrosis of skin grafts and exposure of tendons, which required surgical revision in 3 (Fig. 5). In the ALT group, only a partial



Fig. 3a. Tongue carcinoma: pre-operative appearance



Fig. 3b. Tongue carcinoma: reconstruction with RFFF.

Table I. Population data.

	Group A (RFFF)	Group B (tALT flap)
Mean age (yrs)	59.3	62.2
Sex (M/F)	3.2/1	2.8/1
Histology	Squamous cell carcinoma (17/17)	Squamous cell carcinoma (31/31)
Stage	T2N0M0-T4N2M0	T2N0M0-T4N2M0
Mean flap size	52.6 cm ²	67.5 cm ²
Mean follow-up (months)	20.6	16.2

Table II. Demolitive surgical procedure.

	Group A (RFFF) n. pts/total of pts (%)	Group B (tALT flap) n. pts/total of pts (%)
Composite resection with mandibulotomy	9/17 (52.9)	15/31 (48.4)
Composite resection with marginal mandibulectomy	7/17 (41.3)	14/31 (45.1)
Composite resection with segmental mandibulectomy	1/17 (5.8)	2/31 (6.5)

Chi-square test, $p = 0.9$



Fig. 4a. Tongue carcinoma: pre-operative aspect.

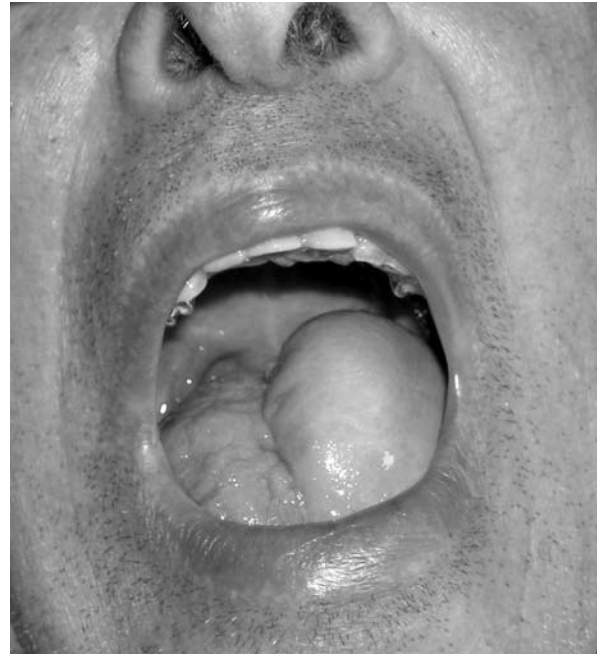


Fig. 4b. Tongue carcinoma: reconstruction with tALT.

diastasis of the suture (managed with conservative treatment) occurred in 2 cases (6.4%) (Table III).

Also assessment of minor complications, at the donor site, showed less successful results in the patients treated with RFFF (hypertrophic scar in 35.3% of patients of the RFFF group and 0% in the tALT flap group; itching was reported by 76.4% of the RFFF group and only 29% of those treated with the tALT flap) (Table III).

The analysis of functional results, at the donor site, in the RFFF group showed persistent forearm movement impairment in 35.3% of cases (compared to 0% in the tALT group) and sensitivity changes in the skin graft area in 76.4% of patients; in the tALT flap group, transitory gait impairment was observed in only 4 patients (12.9%) (Table III).

Subjective outcome assessments of donor site in patients treated with tALT were as follows: “good” in 18 patients (58%) and “acceptable” in 13 patients (42%); none of this group expressed a “poor” judgement.

On the contrary, in the RFFF, subjective outcome assessments were “acceptable” according to 7 patients (41.3%) and “poor” according to 10 (58.7%) ($p < 0.001$) (Fig. 6).



Fig. 5a. Scar retraction and pigmentation.



Fig. 5b. Exposure of tendons.



Fig. 5c. Partial necrosis of flap.



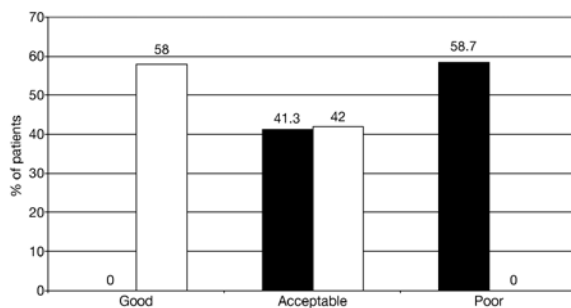
Fig. 5d. Diffuse necrosis of flap.

Fig. 5. RFFF complications at donor site:

Table III. Donor site morbidity.

	Group A (RFFF) n. pts/total of pts (%)	Group B (tALT flap) n. pts/total of pts (%)
Hypertrophic scarring	6/17 (35.3)	0/31 (0)
Itching*	13/17 (76.4)	9/31 (29)
Pigmentation	17/17 (100)	0/31 (0)
Numbness of skin-grafted area	15/17 (88.2)	1/1 (100)
Paraesthesia of skin-grafted area	13/17 (76.4)	1/1 (100)
Necrosis/diastasis of donor site*	7/17 (41.2)	2/31 (6.4)
Social stigma	5/17 (29.4)	0/31 (0)
Transitory/temporary function impairment**	12/17 (70.6)	4/31 (12.9)
Permanent function impairment	6/17 (35.3)	0/31 (0)

* Chi-square test, $p < 0.01$; ** Chi-square test, $p < 0.001$

**Fig. 6.** Subjective outcome assessment of donor site.

Discussion

Free-flaps are a common option for soft tissue reconstruction and the improvements of the surgical technique have progressively concerned the function and appearance of the recipient and donor sites.

The ALT flap is becoming a useful option in reconstructive surgery for its reliability, allowing a large amount of skin and various other tissues to be transferred; moreover, it offers a long vascular pedicle with suitable vessel diameter, giving multiple recipient vessel options in the neck region. These characteristics, together with very low donor site morbidity, allowed this flap to be used in many clinical conditions for the reconstruction of the head and neck region including: pharyngo-oesophageal and oral cavity reconstruction, skin surface replacement and scalp reconstruction. The option of trimming the ALT to the subdermal plane means it can be used as a thin or ultrathin flap, extending its application to oral reconstruction with comparable functional results, at the receiving site, with the RFFF.

One of the main advantages of the tALT flap, with respect to the RFFF, is the low morbidity rate of the donor site^{6,7,17} that rarely requires more than primary closure (Fig. 7). It allows sacrifice of important muscle or major vascular axis to be avoided as well as the risk of exposure of important structures like tendons or nerves, unlike the RFFF flap. The advantages of the tALT flap with respect to the RFFF flap are evident in the patients' assessments of the aesthetic and functional outcomes of the donor site that showed a high level of satisfaction only in the tALT flap group.

**Fig. 7a and 7b.** tALT: donor site healing in two cases.

Conclusions

Tissue transfers with microsurgical techniques have been in clinical use since the 1980s. In the last few decades, a significant reduction in failure rates has been obtained due to advances in surgical techniques and instruments. For this reason, interest has shifted from flap anatomy and survival towards functional and aesthetic outcome of donor and receiving sites.

With increasing knowledge of perforator flap entity and refinements of surgical techniques, the thinned anterolateral thigh perforator cutaneous flap becomes as reliable as other types of fasciocutaneous free-flaps.

In our experience, the tALT flap is comparable to the RFFF in terms of functional results at the receiving site with evident less morbidity at the donor site and a better level of patient satisfaction, therefore it could successfully replace the RFFF in oral reconstruction.

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