

# Continuing validity of pectoralis major muscle flap 25 years after its first application

## *Attualità del lembo peduncolato di muscolo grande pettorale a 25 anni dalla sua descrizione*

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### Key words

Pectoralis major • Myofascial flap • Vascular pedicle • Reconstruction

### Parole chiave

Grande pettorale • Lembo mio-fasciale • Peduncolo vascolare • Ricostruzione

### Summary

Surgical treatment of malignant cervico-facial tumours often includes vast demolition of mucosal, cutaneous, muscle and bone tissues, requiring immediate repair of the extensive loss of substance with reconstructive pedicled or revascularised free flaps. Still today, when it is not necessary to reconstruct the mandibular bone or in particular clinical situations as found in patients in whom microsurgery is contraindicated due to general conditions or in those cases of unsuccessful microsurgical flaps, use of the pedicled flaps is still indicated, particularly the myocutaneous flap of the major pectoral muscle described approximately 25 years ago, and quite rightly referred to as "work horse" or "spare wheel" of reconstructive surgery. Study population comprises 33 patients (27 male, 6 female, mean age: 61 years, range: 36-86) observed between 2000-2002. These patients were submitted to demolitive surgery on account of malignant cervico-facial neoplasias. The role of the major pectoral muscle pedicled flap is emphasised stressing that resection of the pedicle, even a few weeks after transplant, together with the subclavicular passage, may avoid the majority of the well-known functional and aesthetic problems related to this reparative technique.

### Riassunto

*Il trattamento chirurgico dei tumori maligni cervico-facciali richiede spesso l'esecuzione di ampie demolizioni a scapito dei tessuti mucosi, cutanei, muscolari e ossei e crea la necessità di riparare immediatamente l'ampia perdita di sostanza con lembi ricostruttivi peduncolati o liberi rivascularizzati. Nei casi in cui la riparazione non richiede il trasferimento di tessuto osseo e quando l'esecuzione della microchirurgia è controindicata (per l'età avanzata, vasculopatie, gravi disordini metabolici, ecc.), i lembi peduncolati, e quello di muscolo grande pettorale in particolare (descritto circa 25 anni fa e giustamente definito "cavallo da lavoro") rappresentano ancora oggi l'opzione di prima scelta. Inoltre il lembo pettorale costituisce anche un'ottima "ruota di scorta" del chirurgo cervico-facciale specie di fronte ad esiti negativi di ricostruzioni microvascolari. La casistica fa riferimento all'esperienza personale dell'ultimo triennio relativa all'esecuzione di 33 lembi peduncolati di muscolo grande pettorale eseguiti in altrettanti pazienti (27 di sesso maschile e 6 di sesso femminile), con età media di circa 61 anni (range 36-86 anni), sottoposti ad interventi chirurgici demolitivi per neoplasie maligne cervico-facciali. Gli Autori enfatizzano il ruolo del lembo peduncolato di muscolo grande pettorale nella varietà mio-fasciale e sottolineano come la sezione del peduncolo, anche a poche settimane dal trapianto possa, unitamente al suo passaggio sottoclavicolare, ovviare a gran parte dei ben noti problemi funzionali ed estetici connessi con l'impiego di tale metodica riparativa.*

## Introduction

In the surgical treatment of malignant cervico-facial tumours, demolitive techniques are often necessary with marked resection of the mucosal, cutaneous, muscle and bone tissues. It is, thus, necessary to immediately repair the great loss of tissue with reconstructive pedicled or revascularised free flaps.

There is no doubt that, as far as concerns functional and aesthetic results, the microvascular flaps are far superior to the pedicled flaps, especially when, as of-

ten occurs in cancer involving the oral cavity and/or oropharynx, reconstruction of the bone is necessary. Replacement of the bone removed cannot, in fact, be reliably effected with osteo-myo-cutaneous or osteo-muscular pedicled flaps, since vascularisation of the bone tissue is insufficient and, therefore, result in a large percentage of failure<sup>1-3</sup>.

Albeit, even today, when reconstruction of the bone is not necessary, and in certain clinical situations observed in patients in whom microsurgery is not feasible, due to poor general conditions, use of pedicled

flaps is advisable, particularly the major pectoral muscle, described some 25 years ago<sup>4,6</sup>, and referred to, quite rightly, as the “work horse”<sup>7,8</sup> of reconstructive surgery. Furthermore, pectoral major muscle flap is still a good “spare wheel” for cervico-facial surgeon in the cases of failure of microsurgical flaps. The present report deals with personal experience, over the last 3 years, concerning the use of major pectoral muscle pedicled flaps focusing on the use of certain techniques aimed at avoiding, at least in part, the well-known functional and aesthetic problems related to this reparative technique.

## Patients and methods

The study population comprises 33 patients (27 male, 6 female, mean age: 61 years, range: 36-86) in whom pedicled major pectoral muscle flaps were used in the surgical treatment, over a 3-year period, for malignant cervico-facial neoplasias. These cases included oral cavity in 14 patients, hypopharynx in 6, larynx in 5, oropharynx in 2, parotid in 2, occult in 2 (in this particular condition, the flap was adopted after extensive demolitive latero-cervical dissection of the skin, to repair the marked removal of soft tissues involved in the collection of biopsy specimens performed elsewhere), in one case nose and thyroid (Table I).

The 33 pedicled major pectoral muscle flaps were prepared as for myo-cutaneous flaps (Lm-c MPM) in 20 cases (when it was mandatory to transfer the skin and, in the early part of the 3 year period, in 2 cases of double island flap) and as myo-fascial (Lm-f MPM) in 13 cases (particularly in the latter period) (Table II).

Flaps were ‘primary’ i.e., used as the sole reconstructive solution at the end of exeresis, in 25 cases; “secondary” i.e., used to repair pharyngostome remnants following unsuccessful direct closure (after 2 total laryngectomies after RT), necrosis of free microvascular flap (2 antibrachial, 1 abdominal rectus and 1 iliac crest) or pedicled for vicinity (2 naso-labial flaps in a single patient), in 7 cases; “combined”, i.e., associated with a revascularised flap (Lm-f MPM and perone) in 1 case.

The 13 Lm-f-MPM have been prepared since, in our experience and from reports in the literature<sup>9-14</sup>, it has been seen that this variation avoids the majority of problems related to “thickness, poor handling and anti-aesthetic appearance” typical of Lm-c MPM and, for this reason, particularly in the latter period, we have very rarely collected the skin island.

Adaptability and plasticity may be further improved by passing the vascular-muscle pedicle below the clavicle in particularly slim subjects, when it is neces-

sary to transfer soft tissue upwards or even much tissue in the site of repair (3 cases, 2 with later resection of the pedicle) and/or severing the pedicle in local anaesthesia, later, (7 cases in our experience, one of Lm-f MPM resected at 4 weeks after preparation).

## Results

The pedicled major pectoral muscle flap has been generally confirmed and, as is well known, is most reliable as far as concerns the vascular aspects and, in practice, we have observed only 4 cases of partial necrosis at the upper tip of the skin graft, all of the Lm-c MPM type, and all of which healed spontaneously, following further treatment, within 2 weeks.

These complications occurred after 2 ‘composite resections’ for tonsil and trigonus carcinoma with demolitive partial madibulectomies following a total pharyngectomy with enbloc resection of the overlying cervical skin carried out due to relapse of the disease following T.L., in a case of reconstruction of the nasal pyramid after exeresis of recurrent carcinoma. The poor general conditions of these patients and, in the latter case, the pre-operative radiotherapy as well as the need to introduce Lm-c MPM in the nasal region, may explain why the tissues appeared damaged.

As far as concerns the donor site, the complications observed (3 sieromas and 2 septic infections) did not significantly alter the clinical course except in one patient who died of septicaemia after 10 days.

Having placed an uninterrupted suture, as routine, over the last 3 years, in the residual resected muscles of the major pectoral, has avoided the formation of haematomas in the donor site.

The myo-fascial (Lm-f MPM) flap was, in our experience, very reliable, guaranteeing good results, both aesthetic and functional, with spontaneous epithelisation, within a few weeks, in the oral cavity and oropharynx (Fig. 1). These, as already pointed out, were used predominantly in the latter period, above all in female patients (4/6) and no complications were observed following resection of the pedicle (5 Lm-f MPP/2 Lm-c MPP) (Fig. 2-4) or passing through the subclavicular tunnel (2 Lm-f MPM/1 Lm-c MPM) (Fig. 5-6). These technical precautions, on the other hand, considerably reduced the traction and “drop” of the flap due to gravity with a positive effect upon the entire reconstructive process.

As far as concerns the functional results (complete return to “self-sufficiency” of the patient), in 16 cases the patient was discharged from hospital within 20 days of the surgical treatment, in 7 within 30 days, in 2 >30 days. In this series, 8 patients have not been in-

Table 1. Study population.

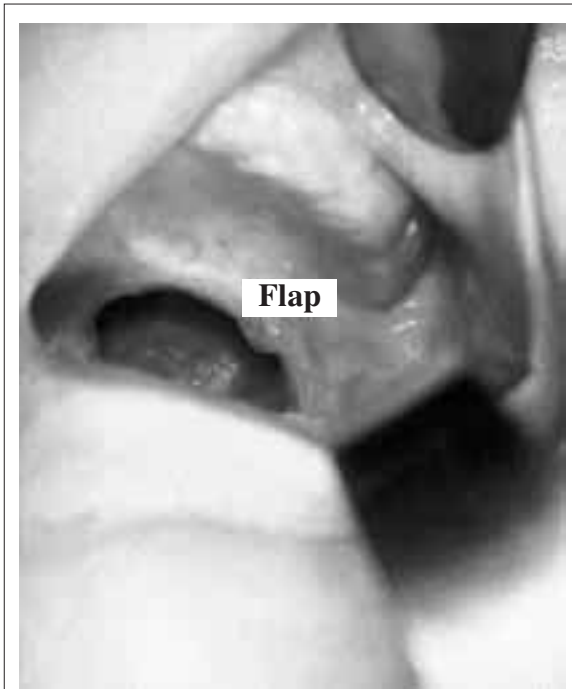
Patient No.	Age (yrs)	Sex	Tumour site	Histology	TNM	Surgery	Other treatment	Follow-up
1. P.E.	70	M	Larynx	EC	T4N2cM0	Sq. laryngectomy + bilateral FLCD	RT post	NED at 3 yrs
2. P.C.	53	M	Oropharynx	EC	T3N1M0	Composite resection + monolateral FLCD	RT post	NED at 3 yrs
3. D'A.A.	51	M	Oral cavity	EC	T3N2aM0	Composite resection + monolateral FLCD	RT post + CT	DFD at 3 yrs
4. M.G.	59	M	Thyroid	Tall cell	rT4N0M0	Sq. laryngectomy	S pre / RT post + CT	DFD at 1 yr
5. D'O.I.	36	M	Hypopharynx	EC	T4N2cM0	THPL + bilateral FLCD	CT + RT pre	D due to septicæmia after 10 days
6. F.A.	55	F	Oral cavity	EC	T3N0M0	Pelvis-hemiglossectomy + monolateral FLCD	RT post + CT	DFD after 5 months
7. A.A.	45	M	Oral cavity	EC	T4N0M0	Composite resection + monolateral FLCD	RT post + CT	DFD after 2 years
8. I.G.	68	M	Oral cavity	EC	T4N2bM0	Composite resection + monolateral FLCD		D due to uraemia after 20 days (pt. dialysed)
9. D.P.N.	68	M	Oral cavity	Cylindroma	rT3N0M1	Total glossectomy	RT pre / CT post	AWD after 3 years
10. D.S.G.	70	M	Oral cavity	EC	T2N1M0	Part. ant. pelvis-mandibulectomy + monolateral FLCD		NED after 3 years
11. C.D.	75	F	Nasal pyramid	Baso. c. → EC	rT4N0M0	Pyramid exeresis	RT pre / CT post	AWD after 3 years
12. F.A.	46	M	Hypopharynx	EC	T4N3M0	THPL + bilateral FLCD	RT post	DFD after 1 year
13. F.G.	52	M	Occult	EC	TxN3M0	Tonsillectomy + FLCD+ DLCD	CT + RT pre	NED after 3 years
14. D.P.M.	73	F	Oral cavity	EC	T3N0M0	Cheek exeresis + monolateral FLCD		NED after 2 years
15. F.G.	46	M	Larynx	EC	rT4N0M0	Tot. laryngectomy + bilateral FLCD	CT + RT pre	DFD after 1 year
16. M.E.	54	F	Oral cavity	EC	rT2N0M0	Composite resection + bilateral FLCD	RT pre	NED after 3 years
17. O.D.	57	M	Larynx	EC	T4N2cM0	Tot. laryngectomy + tongue base + bilateral FLCD	RT post	NED after 2 years
18. C.A.	69	M	Occult	EC	TxN3M0	Tonsillectomy + DLCD		D due to acute resp. insuff. after 10 days
19. C.M.C.	54	F	Oral cavity	EC	T4N2AM0	Part. ant. pelvis-mandibulectomy + bilateral FLCD	RT post	NED after 1 year
20. A.G.	78	M	Parotid	EC	T4N0M0	Tot. parotidectomy with resection of VII cn involving surrounding skin, masotid and EUC bone + auricular pavillon + muscleplasty	S pre / RT pre	NED after 2 years with a secondary lung tumour
21. V.D.C.P.	70	M	Oral cavity	EC	rT3N0M0	Composite resection + bilateral FLCD	RT pre	NED after 2 years
22. M.C.	50	M	Oropharynx	EC	T4N2aM0	Composite resection + monolateral FLCD	RT + CT post	AWD after 8 months
23. D.A.A.	85	M	Hypopharynx	EC	T4N1M0	THPL + bilateral FLCD		DWD after 10 months
24. C.L.	64	F	Oral cavity	EC	T3N2aM0	Composite resection + monolateral FLCD		NED after 1.5 years
25. N.E.	63	M	Hypopharynx	EC	rT4N0M0	Sq. hypopharyngectomy	S pre (TL)	DWD after 8 months
26. G.E.	61	M	Hypopharynx	EC	T4N3M0	Sq. hypopharyngectomy + bilateral FLCD		D due to haemorrhage after 7 days
27. S.L.	47	M	Larynx	EC	T2N0M0	CHP → sepsis → tot. laryngectomy + skin		NED after 8 months
28. T.S.	64	M	Oral cavity	EC	rT4N3M0	Composite resection + FLCD + DLCD	CT + RT pre	D due to AMI after 30 days
29. N.N.	56	M	Oral cavity	EC	rT3N0M0	Part. ant. pelvis-mandibulectomy + bilateral FLCD	CT + RT pre	NED after 1 year
30. G.M.	59	M	Larynx	EC	T4N1M0	Tot. laryngectomy + bilateral FLCD	RT pre	NED after 3 years
31. V.G.	86	M	Parotid	EC	T4N0M0	Tot. parotidectomy with resection of VII cn involving surrounding skin + auricular pavillon + muscleplasty	S pre	NED after 2 years
32. D.A.T.	75	M	Oral cavity	EC VER.	T4N1M0	Composite resection + monolateral FLCD		IF
33. P.C.	47	M	Hypopharynx	EC	T4N2aM0	THPL + bilateral FLCD		IF

EC: Epidermoidal carcinoma; TL: Total laryngectomy; THPL: Total hemi-pharyngo-laryngectomy; CHP: Cricohyoid-plexy; FLCD: Functional latero-cervical dissection; DLCD: Demolitive latero-cervical dissection; S/RT/CT: Surgery/Radiotherapy/Chemotherapy; D: Died; NED: No evident disease; DFD: Died from the disease; AWD: Alive with the disease; IF: Insufficient follow-up (<3 months); Cn: Cranial nerve.

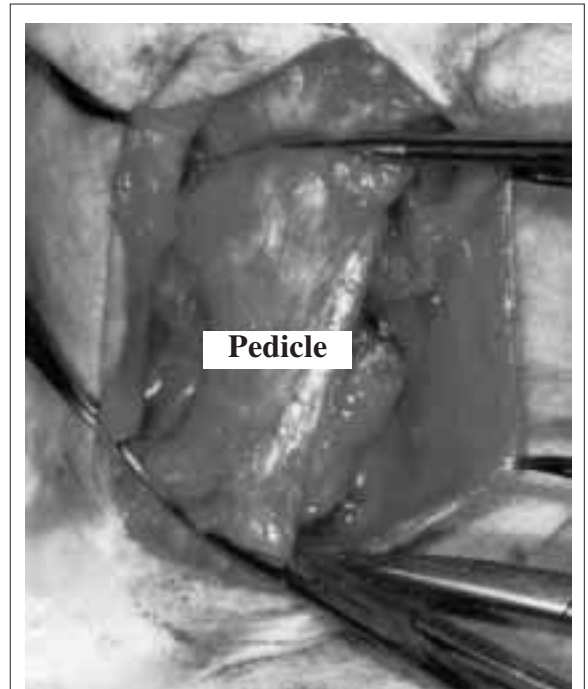
**Table II.** Type of pedicled flaps of major pectoral muscle and type of use, details.

Patients	Defect		Mode of preparation				Complications		Functional results	Pedicle	
	Mucous	Cutaneous	Primary	Secondary	Combined	Minor	Major	Resection		Passage below clavicle	
1. P.E.		m-c flap	X						+++		
2. P.C.	m-c flap		X			Marginal n.			+++		
3. D'A.A.	m-c flap		X				d.s. sepsis		++		
4. M.G.	m-c flap		X						+		
5. D'O.I.	m-c flap		X						D		
6. F.A.	m-c flap			X (after radial) X (after recto abd.)					+++		
7. A.A.	m-c flap		X						++	YES	
8. I.O.	m-c flap		X						D		
9. D.P.N.	m-c flap		X						+++	YES at 2 yrs +++	
10. D.S.G.	m-c d-i flap		X		X (after 2 naso-labials)				+++		
11. C.D.	m-c flap		X			Marginal n.			+++		
12. F.A.	m-f flap		X						++		
13. F.G.	m-c flap		X						+++		
14. D.P.M.	m-f flap		X						+++		
15. F.G.	m-c flap		X		X (after pharyngostomy)		d.s. sieroma d.s. sieroma		+++	YES at 6 months	
16. M.E.	m-f flap		X						++		
17. O.D.	m-f flap		X						D	YES at 7 months	
18. C.A.	m-c flap		X						+++		
19. C.M.C.	m-f flap		X						+++	YES at 3 months YES at 2 months	
20. A.G.	m-c flap		X		X (with perone)				+++		
21. V.D.C.P.	m-f flap			X (after iliac crest)					+++		
22. M.C.	m-f flap		X						+++		
23. D.A.A.	m-f flap		X						++		
24. C.L.	m-f flap		X						+++		
25. N.E.	m-c flap		X			Marginal n.			-		
26. G.E.	m-c flap		X						D		
27. S.L.	m-f flap		X						+		
28. T.S.	m-f flap		X						D	YES at 4 weeks	
29. N.N.	m-f flap		X						+++	YES	
30. G.M.	m-c flap		X		X (after pharyngostomy)		d.s. sieroma		+++		
31. V.G.	m-c flap		X						+++	YES at 2 months	
32. D.A.T.	m-c d-i flap				X (after radial)			Marginal n.	+++	IF	
33. P.C.	m-f flap		X						IF		

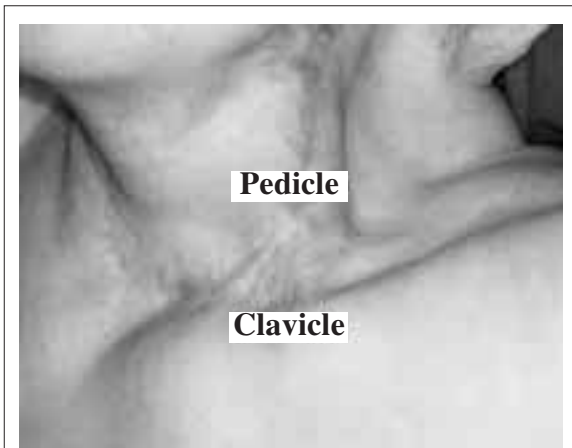
m-c flap: myo-cutaneous flap; m-f flap: myo-fascial flap; m-c<sup>dt</sup> flap: double island myo-cutaneous flap; d.s. sepsis: donor site sepsis; ++: discrete functional results; discharge within 30 days; +: sufficient functional results; discharge after 30 days; -: poor functional results; no discharge; D: died in immediate post-operative period; IF: insufficient follow-up (<3 months).



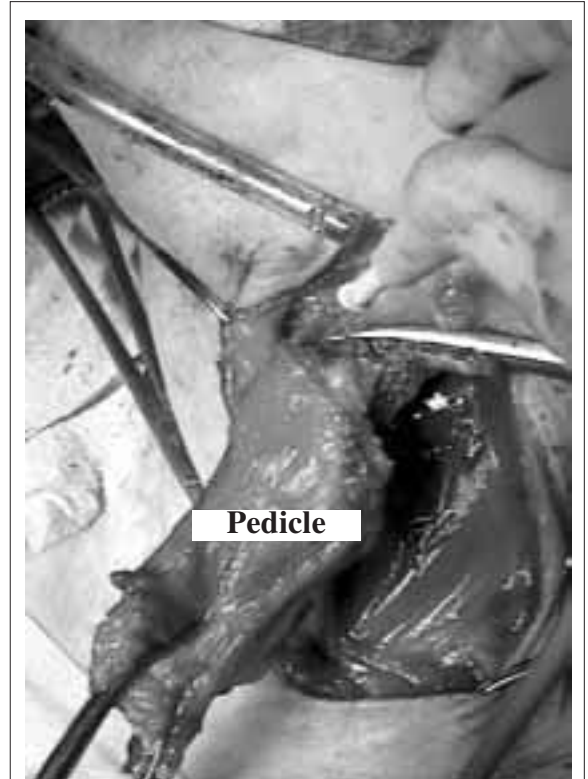
**Fig. 1.** Endoral appearance of myo-fascial flap a few weeks after surgery. NB: spontaneous epithelialization of fascia.



**Fig. 3.** Intra-operative view prior to resection of pedicle.



**Fig. 2.** Preoperative view of pedicle to be resected of myo-fascial flap of left major pectoral muscle.



**Fig. 4.** Intra-operative view at end of resection of pedicle.

cluded in the evaluation since 5 died in the immediate post-operative period due to various reasons, one at 8 months due to progression of the disease, while 2 have been operated upon recently and had too short a follow-up.

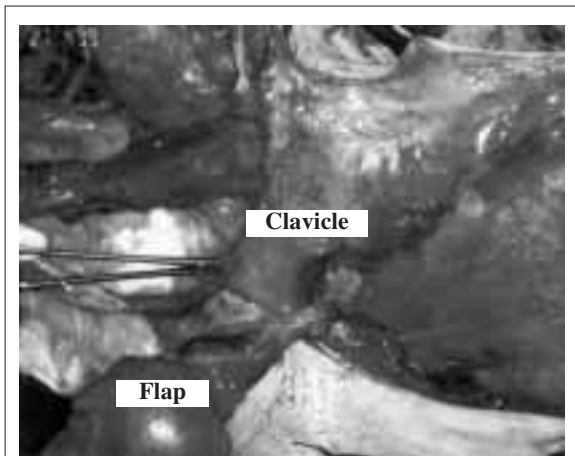


Fig. 5. Preparation of subclavicular tunnel for passage of myo-fascial flap.

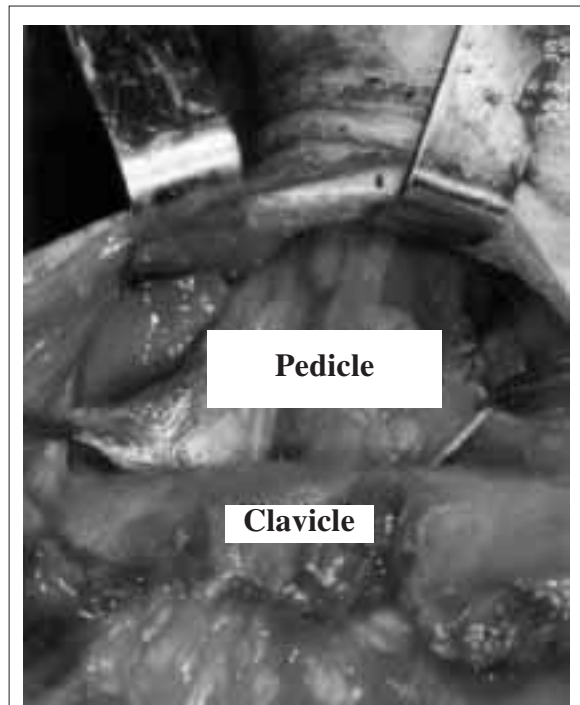


Fig. 6. "Arterialised" vascular pedicle for subclavicular passage.

## Discussion and conclusions

Since revascularised free flaps with microsurgical techniques have been accepted, and quite rightly so, as the methods of choice in reconstructive cervico-facial surgery, it might appear anachronistic and inappropriate to still refer to pedicled flaps, particularly of major pectoral muscle.

There can be doubt, however, that if today we can still refer to pedicled flaps, then attention should be focused on major pectoral muscle on account not only of the simple and easy preparation (constant vascular anatomy, excellent reliability even compared to other pedicled flaps, but also the rapidity with which these can be prepared and the possibility of harvesting without moving the patient)<sup>15-21</sup>.

In our experience, Lm-f MPM is the first choice solution in the endoral mucosal and oro-hypopharyngeal reconstruction, with contraindications only when it is necessary to use an island skin flap to repair "external" defects. In fact, this flap, comprising only muscle and the superficial and deep fascia, has been shown to be an excellent reconstructive alternative following extensive exeresis or a reparative procedure following complications in other types of first choice flaps, such as the microvascular flaps.

Harvesting of Lm-f MPM is carried out in the same way as for the myo-cutaneous variety, on the same side as the loss of substance if this is "lateral" taking into consideration the predominance of the upper limb (left in right-handed patients and right in the left-handed) if "central".

Harvesting of the flap without the skin island means that:

1. a considerably thinner graft can be obtained;
2. the most reliable and better fed, both muscular and fascial, part of the flap can be transferred;

3. it avoids hair growing in oral and oro-hypopharyngeal site;
4. avoids use of the peripheral skin areas "at risk" of marginal muscular necrosis, which are found at the level of the sutures;
5. allows harvesting of the flap even in females by moving the skin and mammary gland and, later, returning this to the original site covering most of the surgical scar;
6. aesthetic results are improved at the harvesting site also in males in whom the thoracic skin can be re-sutured without any tension;
7. it lightens the flap and decreases the force of gravity which tends to pull the transposed tissues downwards;
8. reducing the nutritive requirements guarantees great vitality to the myo-fascial component which can be transferred also in toto (harvesting from the lateral border) and suturing the fascia to the mucosal surfaces taking care to make the incision as a "new suture border", about 2 cm inside the tips of the flap (always in excess, in order to cover the sutures).

As occurs for the temporal muscle, in the intra-oral reconstruction<sup>22</sup>, also the Lm-f MPM fascia is rapidly and spontaneously epithelialised in the oral cavity and in oro-hypopharynx and thus transfer of the sub-cutaneous-cutaneous portion is superfluous (with

time, since it is not possible even with Lm-c MPM to obtain a true ‘mucosisation’, results are identical). The traction exerted downwards, both by the myofascial and the myo-cutaneous type of flap, may be further reduced by performing, at a later date, resection, several cm in length, of the vascular pedicle in the neck. This resection, and not a simple incision, is indicated also in those cases in which the pedicle is “arterialised”, provided this is pulled downwards limiting the rotation of the head on the opposite side. As already pointed out, we carried out resection of the vascular pedicle, already 4 weeks after preparation, with the patient under local anaesthesia, thus improving cervical mobility, and obtaining, once again, a good appearance of the neck and decreasing the traction downwards of the flap also thanks to a consequent, limited, atrophy due to reduced flow in the distal muscular portion.

Thus, in our opinion, resection of the pedicle, under local anaesthesia, can always be carried out within a short time in those cases in which the flap became attached too soon, perhaps before 4 weeks, also in elderly patients and in poor general conditions. Resection is carried out as soon as “vascular integration” of the flap is confirmed with the tissues in the receiving district and this greatly reduces problems and poor aesthetic results related to the use of this reconstructive technique.

In certain anatomical situations (slim patients), when the flap is to be used to cover large tissue defects, particularly if it has been prepared as myo-fascial, it is possible to pass it, preferably “arterialised”, below the clavicle.

The Lm-f MPM which is thinner obviously makes passage below the clavicle easier and limits further traction being exerted, later, downwards. In 3 cases, this technique was carried out, whilst in 2 patients, the vascular pedicle was resected (at 4 weeks and 3 months).

Resection was slightly more difficult inasmuch as the supraclavicular “reper” did not exist and the pedicle only “arterialised” is less visible in the scarred tissue. The technical procedures described, as far as concerns the pedicled major pectoral muscle flap, whether myo-cutaneous and myo-fascial, have never led, in our experience, to marked atrophy and/or retraction, negatively affecting the final functional result or subsequent complementary radiotherapy.

We do not have much experience with Lm-f MPM using free skin graft, as proposed by others in the past<sup>23 24</sup>, since, in our opinion, this cannot be considered a valid alternative to the classic Lm-c MPM also because, as already pointed out, once in contact with the mucosa, the fascia is well epithelialised and, if skin is necessary, the flap should be prepared in the classic fashion.

In conclusion, the pedicled major pectoral muscle flap, some 25 years since the first description, is still today a more than valid “parachute” to which we should cling in particular clinical conditions and it appears feasible to state that particularly in the myofascial variety, once the technical details described have been effected, it is possible to avoid several of the defects generally attributed to reconstructive pedicled flaps.

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