Management of free flap failure in head and neck surgery

Gestione del fallimento dei lembi liberi in chirurgia testa-collo

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SUMMARY

Free flap surgery is overall considered the gold standard in head and neck reconstruction, with a success rate of 95%. The management of a total flap necrosis and which solution, between a pedicled or a second free flap, is safer for a salvage procedure is still controversial. Object of this study is to describe the authors' management of total free flap loss in head and neck reconstruction and compare the choices and results to those reported in the literature. From January 2012 to January 2016, 149 consecutive free flaps were performed at the Maxillo-Facial Operative Unit of the Hospital Casa Sollievo della Sofferenza in San Giovanni Rotondo (Italy) for reconstruction of head and neck defects. Of these, 6 flaps were lost due to a total necrosis. In 5 cases it was decided to harvest a second free flap, and in the remaining patient a temporalis muscle flap was used. All the free salvage flaps were successful, without complications and with a good aesthetic and functional recovery. Analysing the data obtained, and comparing them with those reported in the literature, it can be concluded that a second subsequent free flap can be considered an ideal and safe procedure in salvage surgery.

KEY WORDS: Free flap failure • Salvage free flap • Head and neck reconstruction • Flap loss management

RIASSUNTO

L'utilizzo dei lembi liberi è oggi considerata l'opzione di prima scelta nella ricostruzione dei difetti testa-collo, con una percentuale di successo di circa il 95%. La gestione del fallimento di un lembo libero e quale soluzione, tra un secondo lembo libero e un lembo peduncolato, sia più sicura è ancora controversa. L'obiettivo del presente lavoro è descrivere le opzioni adottate dagli Autori e confrontare le scelte e i risultati ottenuti con quelli riportati in letteratura. Dal Gennaio 2012 al Gennaio 2016, presso l'UO di Chirurgia Maxillo-Facciale dell'Ospedale Casa Sollievo della Sofferenza, sono stati allestiti 149 lembi liberi per la ricostruzione di difetti interessanti il distretto testa-collo. Di questi, 6 lembi sono stati persi a causa della comparsa di una necrosi totale nel post-operatorio. In 5 casi si è scelto di allestire un secondo lembo libero, nel restante paziente invece è stato utilizzato un lembo di muscolo temporale. Tutti i lembi liberi di salvataggio allestiti hanno avuto successo, senza complicanze e con un buon recupero estetico e funzionale dei pazienti. Analizzando i dati ottenuti e confrontandoli con quanto riportato in letteratura, è possibile concludere come l'allestimento di un secondo lembo libero costituisca una procedura sicura e ideale come salvataggio dopo necrosi totale di un precedente lembo.

PAROLE CHIAVE: *Fallimento di un lembo libero • Lembo libero di salvataggio • Ricostruzione di difetti testa-collo • Gestione dopo fallimento di un lembo libero*

Introduction

Free flap surgery is overall considered the gold standard in head and neck reconstruction, with a success rate of about 95% [1-3]. The most dreaded complication in this procedure is a total loss of the flap. The management of flap necrosis and which solution between pedicled or a second free flap is safer for a salvage procedure is still controversial. In a comprehensive article, Okazaki [4] described the management of 19 flap losses on 502 free flaps. Although performing a new free flap is the best option if achievable, they observed a success rate of 89% in patients who underwent a second subsequent free flap for total necrosis.

Loco-regional flaps may be considered a valid alternative when a second free flap is contraindicated or not ideal, but with some limitations including distal necrosis of the flap, wound healing and increased duration of hospitalization [5]. The object of this pilot study is to evaluate in our experience if a second subsequent free flap can be considered a safe and reliable procedure in salvage surgery.

Materials and methods

From January 2012 to January 2016, 149 consecutive free flaps were performed by the same surgeon at the Operative Unit of Maxillo-Facial Surgery of the Hospital Casa Sollievo della Sofferenza in San Giovanni Rotondo

Table I. Pathology and reconstruction characteristics.

Pathology	No. flaps	Donor sites	No. patients	Area reconstructed	No. flaps
Squamous cell carcinoma	122	ALT	50	Mandible	41
Recurrent squamous cell carcinoma	5	Radial forearm	49	Tongue	34
Ameloblastoma	4	Fibula	30	Maxilla	15
Adenoid cystic carcinoma	2	Scapular+latissimus dorsi	8	Cheek	13
Keratocystic tumour	2	Iliac crest	8	Oropharynx	11
Osteoradionecrosis	3	Latissimus dorsi	2	Floor of the mouth	12
Sarcoma	1	Gracilis	2	Scalp	8
Recurrent pleomorphic adenoma	1			Orbito-nasal	3
Facial paralysis	2			Facial reanimation	2
Osteomyelitis	1				
Secondary reconstruction	1				
Free flap necrosis	5				

(Italy). Our cohort consisted in 139 patients, 102 males and 38 females, with a mean age of 65.4 (36-88). Almost all the reconstructions were secondary to oncological resections. The pathological and reconstructive details are shown in Table I. The most common reconstructive options were the antero-lateral thigh (n = 50) and the radial forearm (n = 49) free flaps. Four patients underwent two free flap reconstructions because of the reoccurrence of the disease. One case had a simultaneous double free-flap transfer (fibula + ALT). In all cases flap vitality was controlled through clinical monitoring.

Functional and aesthetic outcomes were evaluated after 6 months, following the scores listed in Table II, using a questionnaire filled out by patients and as judged by a commission of three colleagues.

Results

In a group of 149 consecutive free flaps, there were 6 flap losses in 6 different patients with an overall success rate of 96%. Of these there were 4 males and 2 females, with a mean age of 52 years (range 25 and 69 years). Table III lists the type, aetiology, clinical details of the flaps lost and subsequent treatment. We observed total necrosis of three fibula flaps, used for the reconstruction of mandibular (n = 2) and maxillary (n = 1) defects, one ALT flap, performed after a total glossectomy and two latissimus dorsi/scapular flaps performed to reconstruct maxillary defects.

We did not observe any early necrosis: the first signs of necrosis were detected between the 7th and 13th day after surgery (mean time: 10.6 days). In one case (Patient 4), there was a massive haemorrhage due to the rupture of the common carotid artery: the vascular procedure performed in urgency resulted in a thrombosis of the flap's pedicle. This was the only patient who had undergone previous radiotherapy. In one case, we observed a late infection (Patient 6) that resulted in a total flap loss. The other four cases had unknown causes of necrosis.

Table II. Diet, speech ability and aesthetic scores.

Diet	
1	Poor swallow ability
2	Liquid diet
3	Soft diet
4	Free diet
Speech ability	
1	Not intelligible speech
2	Difficult to understand
3	Acceptable speech
4	Normal speech
Aesthetic results	
1	Poor
2	Acceptable
3	Good
4	Excellent

In five of the six patients a second subsequent free flap was performed, with a success rate of 100%. In one case, we decided to reconstruct the palate defect using a temporalis muscle flap. The donor sites of the salvage free flaps were the antero-lateral thigh (n = 3: subsequent to 1 ALT flap, 1 fibula flap and 1 combined scapula + latissimus dorsi flap), the fibula (n = 1: secondary to a fibula flap loss) and the latissimus dorsi (n = 1: after a combined latissimus-scapula free flap necrosis). The microvascular anastomoses were made on the same side in four cases (Table IV). In one patient, there was the necessity to use the contralateral neck vessels. No vessel grafts were required.

The salvage procedure was made during the same hospitalisation in four patients, within 26 days after the first surgery (mean time: 20 days). Two patients were discharged and after a mean of 44 days they were readmitted and underwent the salvage procedure with a new free flap. The mean hospitalisation time after the second surgery was 15.3 days (range: 1-20 days).

Table III. Characteristics of failed free flaps.

	Sex	Age	Pathology	Pre-RT	Failed flap	Timing of loss (days)	Causes	Salvage procedure	Timing after first surgery (days)	Hospitalisation after salvage procedure (days)
1	M	48	Maxillary squamous cell carcinoma	No	Scapolar +latissimus dorsi free flap	10	Unknown	ALT	26	16
2	M	25	Mandibular ameloblastoma	No	Fibular free flap	10	Unknown	Fibular flap	48	11
3	M	67	Tongue squamous cell carcinoma	No	ALT	12	Unknown	ALT	40	18
4	F	45	Mandibular squamous cell carcinoma	Yes	Fibular free flap	13	Common carotid artery haemorrhage	ALT	26	20
5	M	69	Maxillary squamous cell carcinoma	No	Fibular free flap	7	Unknown	Temporal flap	13	15
6	F	58	Maxillary adenoidcystic carcinoma	No	Scapolar +latissimus dorsi flap	12	Infection	Latissimus dorsi flap	15	12

Table IV. Failed free flaps: vascular pedicle details.

	Sex	Age	Pathology	Failed flap	Artery pedicle 1st surgery	Vein pedicle 1st surgery	Salvage procedure	Artery pedicle 2nd surgery	Vein pedicle 2nd surgery
1	M	48	Maxillary squamous cell carcinoma	Scapolar +latissimus dorsi free flap	Superior thyroyd artery	Internal giugular vein	ALT	External carotid artery	Internal giugular vein
2	M	25	Mandibular ameloblastoma	Fibular free flap	Facial artery	Anterior giugular vein	Fibular flap	External carotid artery	Thyreo-lingual-facial trunk
3	M	67	Tongue squamous cell carcinoma	ALT	Facial artery	Thyreo-lingual-facial trunk	ALT	Lingual artery	Thyreo-lingual-facial trunk
4	F	45	Mandibular squamous cell carcinoma	Fibular free flap	External carotid artery	Inferior thyroid vein	ALT	Contralateral transverse cervical artery	Contralateral thyreo-lingual-facial trunk
5	M	69	Maxillary squamous cell carcinoma	Fibular free flap	Facial Artery	External giugular vein	Temporal flap		
6	F	58	Maxillary adenoidcystic carcinoma	Scapolar +latissimus dorsi flap	Facial Artery	Facial vein	Latissimus dorsi flap	Lingual artery	Thyreo-lingual-facial trunk

No local or systemic major complications were observed. Functional and aesthetic outcomes are shown in Table V. Speech ability was normal in three patients and acceptable in two cases. In only one patient was speech described as difficult to understand. Considering diet and swallowing ability, four patients expressed the capacity of eating a soft diet, one patient can only feed himself with a liquid diet and one patient achieved the possibility of a normal diet after implants. The commission of colleagues who assigned an aesthetic score observed excellent aesthetic results in two patients, good results in one patient and acceptable results in three cases.

Discussion

Free flap surgery is considered a reliable and safe procedure for head and neck reconstruction. The success rate of a free flap described in the literature is about 95% [1-3]. In our cohort, we observed a rate of 96% in 149 consecutive procedures. Despite the high success rates, free flap losses still occur at a rate of about 1% to 6% [6].

The risk factors for a total flap loss are still unclear. Preoperative or previous radiotherapy is reported to be associated with a higher risk of free flap failure and complications [7]. Radiotherapy produces, in fact, macro and microscopic alterations on vascular structures [8-10]. In our

Table V. Aesthetic and functional results.

Sex	Age	Pathology	Failed flap	Salvage procedure	Aesthethic results	Speech	Diet
M	48	Maxillary squamous cell carcinoma	Scapolar +latissimus dorsi free flap	ALT	3	3	3
M	25	Mandibular ameloblastoma	Fibular free flap	Fibular free flap	4	4	4
M	67	Tongue squamous cell carcinoma	ALT	ALT	4	3	3
F	45	Mandibular squamous cell carcinoma	Fibular free flap	ALT	2	2	2
M	69	Maxillary squamous cell carcinoma	Fibular free flap	Temporal flap	2	4	3
F	58	Maxillary adenoidcystic carcinoma	Scapolar +latissimus dorsi free flap	Latissimus dorsi flap	2	4	3

series, only one patient had previously undergone RT and had a common carotid artery rupture.

Anatomic limitations such as vessel depletion can make the search for reliable recipient vessels challenging and increase operation time. However, some authors [11] observed no correlation between the rates of flap necrosis and the choice of recipient vessels, the method of arterial or venous anastomosis, the use of an interposition vein graft, or the timing of reconstruction. According to the literature, in our cohort of 6 patients that experienced a total flap loss we did not observe any primary vessel depletion during the first procedure.

Several authors [12,13] have reported that age alone should not be considered as a contraindication or an independent risk factor when considering free-tissue transfer. Ferrari [12] observed a successful free-flap rate of 98.2% in 54 flaps harvested in patients over 75 years of age and a successful rate of 96.2% in 306 of the 318 flaps performed in those under 75 years. Tarsitano [13] described a similar success rate in patients aged ≥ 75 years compared to the general population. Considering our limited series of total flap loss, we observed a mean age of 52 years (range from 25 to 69) with no patient over 75 years.

Hypercoagulable states, the development of severe infection, external compression and errors in flap harvesting and management of the pedicle can be further causes of flap loss.

In 5 of our 6 cases, the aetiology of the flap loss could not be determined. According to Corbitt [14], who reported similar findings, both the artery and vein were thrombosed and the detection of flap compromise occurred late (mean: 10.6 days; range: 7th-13th day after surgery).

Thrombosis on postoperative day 5 or later after microvascular reconstruction (late thrombosis) is reported to account for 10% to 28% of all thromboses [15]. Even if free flaps are believed to undergo revascularisation via the surrounding tissue and are able to survive without pedicle flow for several days after surgery, compromised recipient beds (such as irradiated tissue), chronically infected wounds and ischaemic vascular disease can interfere with free flap revascularisation, making the flap dependent on the pedicle for a longer period of time [15,16].

Probably in our group of patients the reduced or absent revascularization via the surrounding tissues added to late impairment of the pedicle (kinking, compression, misdiagnosed infections, etc.), which was the cause of the delayed loss of the flap.

Few studies have been published about the best way to manage the loss of a free flap, and the use of a subsequent salvage free flap is still a controversial issue. The hesitation is due to concerns regarding lack of recipient vessels, as well as increased risk of a second flap loss and postoperative complications. Different authors, in fact, have described higher rates of failure of a second free flap reconstruction, with success rates varying from 28% to 89% [9,10,12]. Bozikov [17] observed that free flap failure was 4.6 times more likely to occur after a salvage free flap transfer with a success rate of 53%. Ross [18] in a series of 30 patients described a success rate of 73%, a percentage significantly lower in comparison with second free flaps performed for recurrences. On the contrary, our results, even if on a small group of patients, show a higher rate of success (100%) that mirrors the experiences of Wei of 94.1% [19], Alam and Khariwala of 100% [20] and Corbitt of 96.4% [14]. Such success rates suggest that free flaps can be still a safe option even after an initial failure.

Wei [19] reported the necessity to reach the contralateral neck for recipient vessels in 35% of cases, and the use of interpositional vein grafts in the 30% of cases. In our experience, in only one patient there was the necessity to reach the contralateral vessels, and venous or arterial grafts were not used in any case. Accordingly to Corbitt [14], in some cases we re-used vessels that had previously been used for the initial free flap, without complications. Moreover, the rich vascularity of the head and neck often allows finding adequate recipient vessels, even after prior resection, neck dissection and free flap reconstruction.

The choice of the donor site should be made based on prognosis, general conditions and functional needs. Ideally, a free flap lost should be replaced by the same option if the first selection of the donor site has been correctly done. When prognosis is poor, the patient has comorbidities and bony reconstruction is not mandatory to obtain adequate functional rehabilitation, a soft tissue free flap can be chosen instead of an osseous flap. It is, in fact, characterised by lower donor site morbidity and faster re-

habilitation time. Even if the overall complication rate in patients who undergo a subsequent free flap attempt is reported to be slightly higher than those who were primarily reconstructed, in our cases we did not observe any local or systemic complications. The relatively short times of hospitalisation after the second free flap (mean: 15.4 days; range: 11-20 days) show the possibility to obtain quick rehabilitation of patients even after a salvage procedure. Moreover, satisfactory results, both in terms of function and aesthetics, were observed. We acknowledge that the relatively small number of cases in this series, particularly of patients who underwent secondary pedicled flap reconstruction, does not permit meaningful comparison between free and regional flaps. However, more extensive studies have shown that free flap reconstruction usually results in superior functional outcomes [14 21 22]. Moreover, higher rates of local complications (fistulas, wound dehiscences, pedicle retraction, etc.) are reported in literature for pedicled flaps with respect to free flaps, both after primary and salvage harvesting.

These data confirm our opinion that a second subsequent free flap should be considered as the first option after the total loss of a free flap in most cases. It represents, in fact, the technique that allows the best functional and aesthetic results, together with low complication rates and acceptable hospitalisation times. However, we agree with Corbitt [14] in that good surgical and medical judgment, together with a careful primary selection of the patient and serious analysis of causes of loss, are crucial for the success of salvage free flaps.

Conclusions

The reconstruction of a head and neck defect after a free flap failure can be challenging for the surgeon. Even if pedicled flaps are classically considered the mandatory choice in salvage surgery after a free flap loss, accordingly with the most recent reports we consider the use of a subsequent second free flap the first option in salvage surgery. Despite major technical complexity and longer operative times, free flaps are reliable and safe procedures that bring the best aesthetic and functional results. The high success rates of the subsequent salvage free flaps and, on the contrary, the poor results and higher local complication rates of pedicled flaps, suggest that most patients would benefit from a reattempt at microvascular reconstruction.

References

[1] Gusenoff JA, Vega SJ, Jiang S, et al. *Free tissue transfer: comparison of outcomes between university hospitals and community hospitals*. Plast Reconstr Surg 2006;118:671-5.

[2] Almadori G, Rigante M, Bussu F, et al. *Impact of microvascular free flap reconstruction in oral cavity cancer: our experience in 130 cases*. Acta Otorhinolaryngol Ital 2015;35:386-93.

[3] Tarsitano A, Ciocca L, Cipriani R, et al. *Mandibular reconstruction using fibula free flap harvested using a customised cutting guide: how we do it*. Acta Otorhinolaryngol Ital 2015;35:198-201.

[4] Okazaki M, Asato H, Takushima A, et al. *Analysis of salvage treatments following the failure of free flap transfer caused by vascular thrombosis in reconstruction for head and neck cancer*. Plast Reconstr Surg 2007;119:1223-32.

[5] Colletti G, Autelitano L, Tewfik K, et al. *Autonomized flaps in secondary head and neck reconstructions*. Acta Otorhinolaryngol Ital 2012;32:329-35.

[6] Bianchi B, Copelli C, Ferrari S, et al. *Free flaps: outcomes and complications in head and neck reconstructions*. J Craniomaxillofac Surg 2009;37:438-42.

[7] Herle P, Shukla L, Morrison WA, et al. *Preoperative radiation and free flap outcomes for head and neck reconstruction: a systematic review and meta-analysis*. ANZ J Surg 2015;85:121-7.

[8] Cheng SW, Wu LL, Ting AC, et al. *Irradiation-induced extracranial carotid stenosis in patients with head and neck malignancies*. Am J Surg 1999;178:323-8.

[9] Benatar MJ, Dassonville O, Chamorey E. *Impact of preoperative radiotherapy on head and neck free flap reconstruction: a report on 429 cases*. J. Plast. Reconstr Aesthet Surg 2013;66:478-82.

[10] Yoshimoto S, Kawabata K, Mitani H. *Factors involved in free flap thrombosis after reconstructive surgery for head and neck cancer*. Auris Nasus Larynx 2010;37:212-6.

[11] Nahabedian MY, Singh N, Deune EG, et al. *Recipient vessel analysis for microvascular reconstruction of the head and neck*. Ann Plast Surg 2004;52:148-55.

[12] Ferrari S, Copelli C, Bianchi B, et al. *Free flaps in elderly patients: outcomes and complications in head and neck reconstruction after oncological resection*. J Craniomaxillofac Surg 2013;41:167-71.

[13] Tarsitano A, Pizzigallo A, Sgarzani R, et al. *Head and neck cancer in elderly patients: is microsurgical free-tissue transfer a safe procedure?* Acta Otorhinolaryngol 2012;32:371-5.

[14] Corbitt C, Skoracki RJ, Yu P, et al. *Free flap failure in head and neck reconstruction*. Head Neck 2014;36:1440-5.

[15] Kadota H, Sakuraba M, Kimata Y, et al. *Analysis of thrombosis on postoperative day 5 or later after microvascular reconstruction for head and neck cancers*. Head Neck 2009;31:635-41.

[16] Wax MK, Rosenthal E. *Etiology of late free flap failures occurring after hospital discharge*. Laryngoscope 2007;117:1961-3.

[17] Bozikov K, Arnez ZM. *Factors predicting free flap complications in head and neck reconstruction*. J Plast Reconstr Aesthet Surg 2006;59:737-42.

[18] Ross G, Yla-Kotola TM, Goldstein D, et al. *Second free flaps in head and neck reconstruction*. J Plast Reconstr Aesthet Surg 2012;65:1165-8.

[19] Wei F-C, Demirkan F, Chen HC. *The outcome of failed free flaps in head and neck and extremity reconstruction: what is next in the reconstructive ladder?* Plast Reconstr Surg 2001;108:1154-60.

[20] Alam DS, Khariwala SS. *Technical considerations in patients requiring a second microvascular free flap in the head and neck*. Arch Otolaryngol Head Neck Surg 2009;135:268-73.

[21] Chepeha DB, Annich G, Pynnonen MA. *Pectoralis major myocutaneous flap vs revascularized free tissue transfer:*

complications, gastrostomy tube dependence, and hospitalization. Arch Otolaryngol Head Neck Surg 2004;130:181-6.

[22] Tsue TT, Desyatnikova SS, Deleyiannis FW. *Comparison of cost and function in reconstruction of the posterior oral cavity and oropharynx. Free vs pedicled soft tissue transfer*. Arch Otolaryngol Head Neck Surg 1997;123:731-7.

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