Double free flaps for reconstruction of complex/composite defects in head and neck surgery

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A B S T R A C T

Objective: To demonstrate the feasibility of double free flap surgery in head and neck reconstruction.

Design: Descriptive case series.

Setting: A university-affiliated hospital in Hong Kong.

Patients: Twelve patients with head and neck cancer (encountered over a 2.5-year period) who had reconstructive surgery with planned simultaneous double free flaps.

Results: The mean total operating time was 660 minutes and there were no flap failures. Postoperative stays ranged from 11 to 82 days; nine patients were discharged within 3 weeks and seven were able to maintain their weight with oral feeding. The survival rate up to 1 year was 64%.

Conclusion: The use of double free flaps is an option worth considering for complex head and neck defects in carefully selected patients.

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▸ A video of double free-flap reconstruction is available at <www.hkmj.org>.

New knowledge added by this study

- Double free flaps can be used with good flap success rates, operating times, and patient outcomes.

Implications for clinical practice or policy

- Concerns over the use of double free flaps in head and neck reconstruction should not deter experienced microsurgeons from this procedure whenever they are deemed to offer significant advantages, in terms of reconstructions involving large bulks, multiple surfaces, or multiple tissue types.

Introduction

The use of microvascular free flaps for the reconstruction of defects following the resection of head and neck cancer is a complex but routine procedure. However, single flaps may not be sufficient for some defects that are either too large or warrant composite tissues. In particular, resection of advanced tumours of the oral cavity results in complex oromandibular defects that often involve bone, oral lining, external skin, and soft tissue. The free fibular osteocutaneous (FO) flap is well established as a workhorse flap for mandible reconstruction,[1] which provides 25 to 30 cm of straight bone of good quality that can be contoured, as well as a skin paddle for soft tissue coverage when needed. The pedicle has an acceptable length and its vessels have a good diameter. It is therefore our preferred option for restoring mandibular defects and for lining the oral cavity.

However, the size of the skin paddle is limited[1] and may not be supplied by the same vessel as the bone.[2] Thus, with larger composite defects, a single fibula flap cannot provide sufficient soft tissue coverage and a second skin flap may be necessary. Some surgeons nevertheless elect to avoid a second free flap by choosing either a pedicled flap or alloplastic material. We therefore set out to demonstrate the feasibility of resorting to double free flap surgery in head and neck reconstruction.

Our choice for additional soft tissue is the anterolateral thigh (ALT) flap that provides up to 630 cm^2 of skin.[3] On occasions when the vascularity of the fibula flap skin paddle is deemed borderline, the ALT can be harvested with multiple skin islands so as to cover both the inner lining and the external skin. Harvest of the FO and ALT flaps can proceed at the same time as tumour excision, without the need for patient re-positioning, which is an important logistical advantage. Like most surgeons, whenever possible we prefer using separate anastomoses for double flaps rather than sequential linking or 'flow through',[4-6] as some studies[5,6] suggest that the latter has more complications (possibly due to increased thrombogenicity or a 'steal' phenomena).

頭頸手術中修補複雜缺損的雙游離皮瓣重建術

巫文亮、Alexander Vlantis、王維陽、趙多和

目的：檢視以雙游離皮瓣術進行頭頸重建的可行性。

設計：描述性病例系列。

安排：香港一所大學附屬醫院。

患者：曾進行同步雙游離皮瓣重建手術的12名（發病超過兩年半的）頭頸癌患者。

結果：平均手術總時間為660分鐘，所有手術成功。術後住院時間介乎11至82天；9名患者在3週內出院，7人能以口腔進食以保持體重。1年存活率為64%。

結論：在經謹慎篩選過的患者中進行複雜的頭頸部手術，雙游離皮瓣是一個值得考慮的選擇。

Methods

We conducted a retrospective case review of patients in our institution with head and neck cancer who had reconstruction with planned simultaneous double free flaps over a 2.5-year period (from November 2010 to August 2013). For all cases we deployed two surgical teams; reconstructions were performed (one surgeon) at the same time as tumour excision (other surgeons). Preoperatively, handheld Doppler probes were used to locate the skin perforators for both flaps. The peroneal artery was sacrificed in the harvest of fibula flaps and adequacy of the remaining vessels was screened by palpation of the dorsalis pedis and posterior tibial pulses. An angiogram was used in only one patient with a history of peripheral vascular disease.

The FO flap was harvested first using a lateral approach; a sterile tourniquet was placed on the upper thigh but not inflated. A skin island was harvested in nine out of 10 fibula flaps. In one patient, the skin island was not perfused by the peroneal artery and thus not harvested. In another, the vascularity of the skin island was deemed suboptimal and therefore not used. The fibula flap was kept in situ after isolation of its vascular pedicle while the ALT was harvested. Intramuscular perforators to the thigh skin island were skeletonised in all cases so as to completely visualise the vessels. Once the surgical margins were deemed clear by frozen sections, the final dimensions of the ALT flaps were determined when the final defect was defined.

Whenever possible, intermaxillary fixation was used to hold the mandible and maxilla in an optimal position, and 'by eye' the fibula was osteotomised to fit (average 1-2 osteotomies). Two sets of mini-plates were used per osteotomy site so as to maximise rotational stability. The use of 2.5 x or 3.5 x loupes by the reconstructive surgeon allowed micro-anastomoses of the vessels, whilst insetting of the flap was completed.

Illustrative case

A 58-year-old man was referred to our centre with a second recurrence of a squamous cell carcinoma of his tongue. Three years earlier, he had had a partial right glossectomy with a selective neck dissection for a pT2N0 lesion. One year later he underwent a complete neck dissection for a right nodal recurrence, and another year later he had had a reconstruction with a pectoralis major myocutaneous flap (PMMF) after total glossectomy for local tumour recurrence. After the tumour was resected, he had a bony defect from one angle of the mandible to the other, and a soft tissue defect that involved the entire inferior oral cavity down to the chin and anterior neck skin, which left a 3-cm rim of lower lip (Fig 1).

We used a fibula flap with its overlying skin island along with a large ALT flap (Fig 2). After anastomosis of the two sets of vessels, bleeding from the edge of the fibula flap skin island appeared rather sluggish. So the ALT was used for both intraoral lining and external skin cover. A strip of the ALT flap was de-epithelialised for suturing to the lower lip remnant (Fig 3). There were no major complications and the patient was discharged on the 14th postoperative day. There was a good contour at follow-up (Fig 4); the patient used a percutaneous endoscopic gastrostomy (PEG) for feeding preoperatively but regrettably could not resume oral feeding after this surgery and therefore remained reliant on the PEG.

Results

All tumours were stage T4a, with nodal status ranging from N0-N3 (Table). During the study period, there were six male and six female patients

FIG 1. The large post-extirpative defect; the lower lip remnant has been retracted with a gauze sling

FIG 2. The bone of the fibula has been fashioned into a 'U'-shaped arch with two sets of osteotomies

FIG 4. The postoperative appearance at 2 weeks after discharge

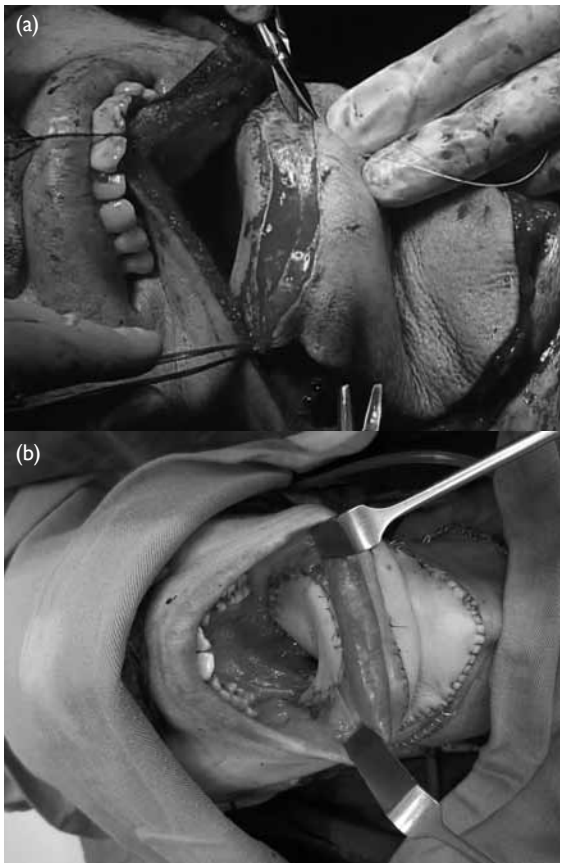

FIG 3. (a) The anterolateral thigh (ALT) flap is being used for both intraoral lining and skin cover, thus the segment that will be covered by the lower lip remnant is de-epithelialised. (b) The lip is sutured to the ALT flap

who had double free flap surgery. Their ages ranged from 31 to 88 (mean, 55) years. In 10 of them, a free fibula flap was combined with an ALT flap harvested from the same limb; in eight of them a skin island was harvested with the bone. One patient had bilateral ALT flaps for reconstruction of an extensive tumour of the tongue and floor of the mouth without bone involvement. Another patient had a free fibula flap combined with an anteromedial thigh flap, due to absence of suitable perforators upon dissecting the ALT flap.

The mean total operating time was 660 minutes, which included the time for frozen section results. Postoperative hospital stays ranged from 11 to 82 days; nine patients were discharged home within 3 weeks. Patient 10 stayed 80 days. She declined further surgery for an intraoral dehiscence, which was therefore treated conservatively. Patient 7 stayed 82 days, as his recovery was complicated by a carotid blowout on the 11th postoperative day for which he had a surgery; subsequently a pseudomonas wound infection was treated with antibiotics. After surgery, seven patients were able to resume oral feeding sufficient to maintain their body weight; the remainder relied on tube feeding. Five patients received adjuvant treatment (4 had chemoradiation and 1 only had radiotherapy).

Minor postoperative complications (fluid collections, fistulae) occurred in 67% of these patients and usually resolved with conservative management. More serious complications occurred in 33% of the patients (carotid blowout, wound dehiscence/infection, and fluid collections treated surgically). In one patient, a haematoma was treated by debridement of the soft tissue portion of the free fibula flap that had been de-epithelialised and 'buried'. There were no instances of total flap loss; two patients were taken back to theatre for exploration and their flaps were salvaged. One of them (patient 10) had venous congestion of the fibula skin flap (used for intraoral

TABLE. Details of patients undergoing reconstruction with double free flaps

Patient No.	Sex	Age (years)	Tumour	Stage	Duration (mins)	Complication	Diet	Hospital stay (days)	Survival time (days)
1	F	59	Lower alveolus	T4aN2bMx	630	Recurrence	Soft diet	15	60
2	M	31	Maxillary sinus	T4aN1Mx	645	Facial nerve palsy (expected)	Soft diet	11	211
3	M	48	Retromolar	T4aN2bMx	600	Skin fistula (healed) Recurrence	Soft diet	17	303
4	F	50	Recurrent maxillary sinus	T4aN0Mx	695	Fluid collection Palatal fistula	Fluid diet	18	Alive
5	F	52	Lower alveolus	T4aN0Mx	570	Sialocele (drained)	NG feeding	20	Alive
6	F	65	Lower alveolus	T4aN2bMx	600	Drooling Malocclusion	Soft diet	16	Alive
7	M	48	Tongue and floor of mouth	T4aN3Mx	735	Carotid blowout *Pseudomonas* infection	NG feeding	82	126
8	F	88	Lower alveolus	T4aN2cMx	755	Debridement of fibula flap Neck wound dehiscence	NG feeding	70	Alive
9	M	57	Recurrent tongue	T4aN2aMx	610	Free fibula flap partial loss	PEG (pre-op)	17	Alive
10	F	54	Recurrent tongue	T4aN0Mx	570	Venous congestion (day 2) Intraoral wound dehiscence – pectoralis major flap (day 9)	NG feeding	80	Alive
11	M	42	Hard palate	T4aN0Mx	825	Nil	Fluid diet	22	Alive
12	M	62	Retromolar	T4aN0Mx	680	Neck seroma (evacuation on day 7)	NG feeding	14	Alive

Abbreviations: NG = nasogastric; PEG = percutaneous endoscopic gastrostomy

lining), which was salvaged but remained swollen and indurated. In view of a concomitant intraoral wound dehiscence, the swollen skin island was debrided and a pedicled ipsilateral pectoralis major flap was harvested to close the intraoral wound. Regrettably, although the pedicled flap survived, the intraoral wound dehisced again, and the patient declined to have further surgery so her wound was managed with daily dressings (see above).

Two (17%) out of the 12 patients had tumour recurrence during the follow-up period, and a further two (17%) had distant metastases. Survival from the time of surgery ranged from 60 to 303 days. The patient survival rate at 6 months was 91%, and at 1 year was 64%. At the time of writing this paper, only seven of the 12 patients had been followed up for at least 2 years, three (43%) of whom were still alive.

Discussion

Following resection of advanced oral cancers, it is our standard practice to use double free flaps when needed for reconstruction of complex oromandibular defects, particularly those involving large defects of both bone and soft tissue. In most cases, the indication for double free flaps was the requirement for bone and soft tissue/skin not provided by the skin island of a FO flap. This practice is by no means universal; some surgeons are reluctant to contemplate a second free flap due to the perceived increase in technical complexity, operating time, and risk of complications. Alternative strategies include substitution of the fibular flap with a metal reconstruction plate, combined with a soft tissue flap for resurfacing[7]; combining a fibular free flap with pedicled regional flaps, such as the deltopectoral flap, PMMF,[8] or latissimus dorsi myocutaneous flap. Some centres regard such cases as 'inoperable' and offer palliative treatment only.

However, these simpler alternatives have their drawbacks. The problems associated with an alloplastic plate with a soft tissue flap for composite mandible reconstruction are well documented,[9-11] there being high rates of delayed plate exposure and recourse to salvage procedures.[12] In the long term, use of vascularised bone (particularly in the FO flap) is more successful for mandible reconstruction,[2] and was our first choice in all cases, with the possible exception of patients with a short life expectancy (<6 months). Recourse to a regional pedicled soft tissue flap instead of a free flap is based on its perceived advantage in being technically easier to harvest and involving shorter operating times.[9,13] There is also a perceived lower risk of complications through avoiding a second set of microanastomoses. The PMMF is the most commonly used regional flap,[14] but the vascularity of its skin paddle (like that of other regional flaps used in head and neck reconstruction) tends to be suboptimal; if the muscle is too short, more of the skin paddle results in a 'random-pattern'. Crucially, the skin islands tend to

be positioned at the most distal portions and thus have the poorest vascularity in the most critical parts.[15] Chen et al[16] recommends avoiding PMMFs to line the oral cavity due to a high rate of bone exposure from dehiscence.

On the contrary, surgeons such as Bianchi et al[17] have actually demonstrated better outcomes with double free flaps compared to a combination of one free flap with one pedicled flap. The bulk of the muscle pedicle in regional flaps can interfere with the inset and vascularity of a concomitant free flap,[13] and the tendency for muscle atrophy and gravitational effects can adversely affect the final results of reconstruction. Chen et al[16] demonstrated a lower failure rate with two free flaps (2.8%) compared with the combination of one free and one pedicled flap (9%). They speculated that the bulky PMMF pedicle may actually compress the free flap pedicle, citing the 14% to 33% frequency of internal jugular vein thrombosis after radical neck dissection covered with pedicled flaps.[18,19] The skin island of a regional flap also tends to be thicker, less pliable, and thus may interfere with intraoral function. Regional flaps may be limited in other ways (eg lack of necessary tissue components or specific tissue volume), which compromise the final aesthetic and functional outcomes.[20]

Although on average, a single free flap can take 1.5 hours longer than a PMMF to harvest, Tsue et al[21] found that the operating time for double flaps can be 3 hours shorter than for a one free and one pedicled combination. They explained this by citing possible bias by surgeons choosing to use a second pedicled flap, when the resection time was longer, and surgeons working faster whenever two free flaps were anticipated. Guillemaud et al[22] found no significant difference in the duration of surgery and complication rate when comparing double free and one free and one pedicled surgeries. In the end, the duration of surgery should not be a factor in determining the type of reconstruction.[23]

Proposed indications for the use of double free flaps are listed in the Box.[20] The reconstruction of defects resulting from tumour resection in the head and neck region is a challenge, particularly when a composite of tissues is required or the defect is too large to cover by a single flap. Recourse to two free flaps allows more versatility and flexibility when reconstructing such complex defects. The best osseous and soft tissue elements may be independently selected, yielding appropriate tissue characteristics for ideal defect reconstruction. Using two separate thin pliable free flaps rather than bulky pedicled flaps may allow easier insetting and better restoration of the 3-dimensional anatomical boundaries,[24] and thus both the functional and aesthetic outcomes can be addressed. With free flaps, there is also the potential for including other components such as nerves for sensate flaps.[24]

BOX. Indications for the use of double free flap reconstruction

1. Extensive composite defects involving bone, oral mucosa, external skin and soft tissue, which cannot be adequately reconstructed with one composite flap
2. Huge coverage and intraoral lining defects that cannot be adequately resurfaced with one large cutaneous or myocutaneous flap
3. Difficult insetting of a single free flap because of the extent and tridimensional nature of the defect

Good-quality soft tissue coverage is needed to reduce the risk of plate exposure[12]; even when the skin component of the FO flap can provide adequate surface cover, there is usually an overall shortage of soft tissue. Soft tissue reconstruction is as important as bone reconstruction[25] in determining a satisfactory outcome, as deficiency of the latter tissues is poorly tolerated in the head and neck,[26] and may lead to inadequate obliteration of dead spaces (eg from resection of masticators, buccal fat pad, and parotid). This causes accumulation of fluid which may become secondarily infected,[16] and threaten micro-anastomoses and lead to contractures, and poor cosmetic outcomes or functionality that can lead to trismus, as well as contraction of the floor of the mouth with tethering of the tongue with difficulties in swallowing and speech.[27] Therefore, even in the absence of bone loss, a double free flap reconstruction can be advantageous especially if soft tissue loss is substantial or beyond the reach of pedicled alternatives.

The use of two simultaneous free flaps undoubtedly poses technical difficulties, by increasing potential patient morbidity and is time-consuming. Although it is not our intention to promote double free flap reconstruction as a 'routine' reconstruction procedure, we wish to highlight it as an option, at least for tumours that are often deemed 'inoperable'. Balasubramanian et al[28] demonstrated that advanced 'inoperable' tumours such as T4b (in 7 of 21 cases) can be safely operated on; having double free flap reconstruction in the armamentarium allows surgeons to be more aggressive with extirpation. With careful patient selection, the duration of surgery, hospital stays, and complications need not be prohibitive compared to single free flap operations.[25] Wei et al[20] suggest that double free flaps should be restricted to patients with primary cancers, avoiding their use in those with recurrent cancers or second primaries. Nevertheless, in our series three patients presented with recurrent cancer. Individual patients should be assessed on a case-by-case basis—a PMMF could be considered to cover the skin of the neck, whilst reconstruction plates may be used to reconstruct short posterior or lateral mandible defects, particularly in those with a

short life expectancy.

Our study shows that double free flap reconstruction can be worthwhile in patients with T4 tumours with a flap survival rate of 100% and a patient survival rate of 64% at the time of going to press. Just over half of our patients were able to resume oral feeding, which is somewhat lower than that in some other studies,[28,29] and may be related to the locally advanced extent of their tumours, particularly with regard to tongue involvement.

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