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ORIGINAL PAPER

Flow-through sequentially linked free flaps in head and neck reconstruction

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Abstract Reconstructing extensive composite oromandibular defects is a difficult challenge. Many donor sites have been used including rib, second metatarsal, radius, scapula, iliac crest and fibula. Each of these flaps has advantages and disadvantages with regard to the donor defect, length of bone available, bone stock and reliability of the associated soft tissue. Additionally, a significant limitation in some patients is that the bone cannot be repositioned three-dimensionally with respect to the overlying skin island. The complex three-dimensional nature of composite resections may challenge the ability of any single osteocutaneous flap to adequately reconstruct all aspects of the resultant defect. To overcome this problem, the authors present a retrospective analysis of their experience with the flow-through sequentially linked free flaps concept for reconstruction of complex defects of head and neck in nine selected cases.

Keywords Oromandibular defects · Flow-through concept · Head and neck

Introduction

Following the rapid development of microsurgical technique, free-tissue transplantation has come into wide use in plastic and reconstructive surgery and has become an effective and practical procedure for microsurgical reconstruction and repair of the head and neck. However, in conventional transplantation, only one free-tissue mass can be transplanted with a set of feeding and draining vessels.

Mandibular defects are frequently compound in nature, requiring restoration of bone, skin and oral lining. Facial trauma and radical tumour extirpation with concomitant radiotherapy are the principal sources of these defects [1].

The plastic and reconstructive surgeon has now in his armamentarium a number of free vascularized composite tissue transfers from which to choose for mandible reconstruction. The most frequent selected osteocutaneous free flaps include the dorsalis pedis, rib-serratus muscle, radial forearm, iliac crest, fibula and scapular flaps.

All these sites maintain individual advantages governed by regional anatomic properties. Certain flaps are better qualified for repairs in the head and neck region in terms of colour match, soft-tissue thickness and availability, vessel size and length, vascularized bone length and shape, requirements for patient repositioning during surgery and donor site morbidity.

In spite of these excellent capabilities, the complex three-dimensional nature of composite resections or extensive trauma may challenge the ability of any single osteocutaneous flap to adequately reconstruct all aspects of the resultant defect [2]. For such a complex and extensive reconstruction of through-and-through intra–extra-oral compound defect, there is no ideal osteocutaneous free flap providing both an unlimited length of bone and a sizable skin paddle.

Another paramount point is that most of these patients do not have reliable or enough recipient vascularity in the scarred neck for separate arterial and venous anastomoses of double free flaps [3–5].

These above-mentioned points are real limitations to accomplish such complex reconstructions. In fact, the concept of flow-through sequentially linked free flaps has

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three-dimensionally anatomic capabilities of size and shape of the vascular pedicles and their compound free tissues which allow these types of complex reconstructions in the head and neck (Fig. 1).

A flow-through flap is utilized when vascular reconstruction is required in addition to soft- tissue coverage. This situation is mostly commonly encountered in limb salvage procedures with tissue losses due to trauma (for revascularization or reimplantation), peripheral vascular disease and tumour resection [6, 7]. The head and neck region is the other anatomical region where this concept has another primary application in the pursuing of excellence for the aesthetic and morphofunctional end result [8–11].

Bullocks et al. [12] proposed a classification of the flow-through flaps, based on their inflow, outflow and the nature of their vascular conduit, into three types: Type I, the flow-through conduit is a single artery that traverses some portion of the flap tissue usually in an axial fashion; Type II, the flow-through conduit is two different arteries that communicate via "choke-vessels" within the flap and the inflow and outflow arteries can be reversed; and Type III, a single vein is used as the flow-through conduit (the vein is incorporated into a vascular gap in a reverse orientation with the inclusion of the surrounding soft tissue).

Chun et al. [13] used a rat epigastric flow-through flap model placed in the contralateral femoral artery and demonstrated a superior patency (75% patency after 1 week) when compared to an interpositional artery graft (100% thrombosis causing increased outflow obstruction). They created high outflow resistance by sequentially ligating the outflow vessels of the rat femoral artery and noted increased blood flow to the skin via the epigastric artery of the flow-through flap. These authors hypothesized that a flow-through flap functions as a self-contained modulating arterio-venous fistula which maintains higher flow velocity in situations of outflow resistance. This concept was demonstrated clinically by utilizing the radial artery flow-through flap to simultaneously treat limb-threatening ischemia and non-healing wounds in patients with severe inframalleolar vascular occlusive disease with patency in the majority of the flaps at the 15-month follow-up.

The flow-through conduit delivers arterial blood from a high-pressure proximal patent arterial source to an area that requires revascularization, which is another paramount point in the head and neck reconstruction after tumour ablation and radiation.

Material and methods

Clinical cases

Between 2001 and 2010, nine patients, seven males and two females, ages ranging from 45 to 68 years old (average age 58.1 years) were submitted to complex head and neck reconstructive procedures. The etiology was neoplastic in all cases.

The free flaps selected were nine fasciocutaneous radial forearm, eight osteofasciocutaneous fibula and one osteocutaneous iliac crest flaps. In all patients, the radial forearm flap was used as the flow-through flap for revascularization of the free osteocutaneous flaps using the distal stumps of the radial artery and cephalic vein. The proximal stumps of the radial artery and cephalic vein were sutured inside the neck to branches of the external carotid artery and deep jugular vein to revascularise the new composite tissue transfer. Also, in all patients, the fasciocutaneous radial forearm flaps were used to reconstruct intra-oral defects and

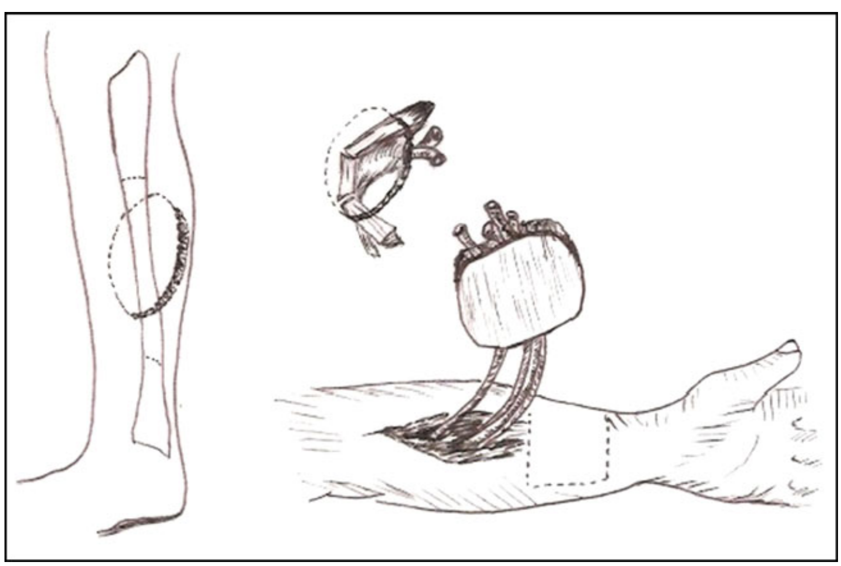


Fig. 1 Diagram showing the anatomical and dynamic concept of the flow-through sequentially linked free flaps in head and neck reconstruction

osteocutaneous free flaps were used to reconstruct the mandible and the external face and neck soft-tissue defects (Table 1).

Operative technique

To minimize operative time, two or, sometimes, three teams worked simultaneously. The osteocutaneous fibular flap is harvested through the lateral approach, as described by Gilbert, or the iliac crest flap is selected for compound mandibular defect [14]. Closing wedge osteotomies are performed to shape the new mandible, controlled by 3D sterolithographic models and surgical guides [15]. At the same time, another team harvested the fasciocutaneous radial forearm flap from the non-dominant arm; the design of the flow-through flap is drawn, moving the skin island slightly proximally and radially, to ensure that adequate lengths of the distal radial artery and cephalic vein are available for microvascular anastomosis; the radial forearm flap is then elevated and allowed to perfuse. Now, the distal stumps of the radial artery and cephalic vein are sutured, under magnification, end-to-end to the vascular pedicle of the contoured free fibula or iliac crest osteocutaneous flaps. Both flaps are allowed to revascularize on the forearm for 20 min. The new composite tissue transfer is then transferred to the head and neck allowing easy and unrestrictable three-dimensional reconstruction with rigid osteosynthesis of the new prefabricated mandible and adequate inset of both cutaneous flaps; during this inset of the fasciocutaneous radial forearm flap into the oral cavity defect and the osteocutaneous free flap for mandible reconstruction and external cutaneous coverage, extreme care is taken to prevent kinking or compression of the vascular pedicles and the microvascular anastomosis between the two flaps. As planned, the proximal stumps of the radial artery and cephalic vein are located in the most favourable side of the neck for flow-through microvascular revascularization without any restraints of vessel length and calibre (Fig. 1).

The average operative time in this complicated head and neck reconstruction series was only 8 h and 14 min (range, 7 h and 20 min to 12 h and 40 min) including patient and anaesthesia preparation and operative procedure.

Postoperative monitoring

The protocol selected in Gaia's Plastic Reconstructive and Craniomaxillofacial Unit includes hourly clinical observation of the skin flaps vascularity and two Doppler probes inside the neck (one around the proximal radial artery testing the arterial anastomosis and another around the side branch of the deep jugular vein where the proximal cephalic vein was end-to-end anastomosed for venous drainage). No Doppler probe is used if the proximal cephalic vein is end-to-side anastomosed to the deep jugular vein.

Results

Eighteen flaps were used to reconstruct nine defects, seven of these reconstructions healed uneventfully. There were two total failures of both flaps (Cases 2 and 8) since attempts to redo the arterial and venous anastomoses proved unsuccessful after consecutive thrombosis; Case 2—the patient either did not have or want further reconstruction, considering his general medical condition; Case 8—after debridement of both radial forearm and fibula flaps, the exposed mandible reconstruction plate was covered by a large myocutaneous pectoralis major flap.

All the patients were evaluated after reconstruction for the improvement of biofunctional (such as swallowing, chewing, speaking and retaining saliva) and aesthetic outcomes.

Patients 2 and 8 did not achieve any improvement in biofunctional capabilities and aesthetic end results due to the total necrosis of both flaps. All the remaining seven patients had improvement in swallowing, chewing and speech capabilities, and the aesthetic end results were deemed good and very good. Differences between them are mostly related on external scar appearances which are directly dependent on the preoperative patient status. Another paramount point was the need for gastrostomy feeding which was present preoperatively in six patients and postoperatively in two patients (the two failed cases), denoting the great biofunctional improvement offered by this reconstructive concept.

Selected clinical cases

Case 1

A female patient, 68 years old, presented herself to Gaia's Plastic, Reconstructive and Craniomaxillofacial Surgery Unit, with an extensive compound oromandibular defect. She had been operated 5 years ago in another institution for an invasive squamous cell carcinoma (T4N1M0) involving the floor of the mouth, left lateral tongue, cervical skin and left body and chin of the mandible. Radical resection had been performed along with left radical and right functional neck dissections. Immediate reconstruction had not been performed and the patient was submitted to postoperative radiotherapy. She presented us with serious impairment in speech articulation and masticatory functions. Reconstruction was accomplished with a left fasciocutaneous radial forearm flap for intra-oral lining which flow-through

Table 1 Description of all patients and their respective procedures

Case	Age	Sex	Etiology	Defect	Feeding gastrostomy		Radiotherapy	Flow-through fasciocutaneous flap	Osteocutaneous flap	Time reconstruction	Complications
					Pre-op	Post-op					
1	68	F	SSC; T4 N2 M0	Left tongue floor of mouth and cheek-neck skin. Ascending ramus, angle and body of mandible—16 cm	No	No	Yes	RFF; 10×6 cm; intra-oral	Iliac crest skin 8×8 cm; bone 16 cm; extra-oral	Secondary 20/11/2001	No
2	63	M	SSC; T4 N2 M0	Floor of mouth and ventral tongue mentum and submental skin. mandible—angle to angle 17 cm	Yes	Yes	Yes	RFF; 14×8 cm; intra-oral	Fibula skin 16×8 cm; bone 17 cm; extra-oral	Secondary 11/12/2001	Total necrosis; no further reconstruction
3	59	M	BCC	Anterior floor of mouth, lower lip and chin skin. mandible—angle to angle 18 cm	No	No	No	RFF; 8×12 cm; intra-oral	Fibula skin 14×8 cm; bone 18 cm; extra-oral	Immediate 19/03/2003	No
4	46	M	SSC; T4 N2 M0	Floor of mouth neck skin mandible—angle to angle 22 cm	Yes	No	Yes	RFF; 14×8 cm; intra-oral	Fibula skin 15×7 cm; bone 22 cm; extra-oral	Secondary 21/11/2006	No
5	43	M	SSC; T4 N2 M0	Floor of mouth, anterior tongue and submental skin mandible—angle to angle 16 cm	Yes	No	Yes	RFF; 10×8 cm; intra-oral	Fibula skin 9×12 cm; bone 16 cm; extra-oral	Secondary 06/02/2007	No
6	65	F	Adenocystic carcinoma	Floor of mouth, lower lip and cervical skin mandible—ascending ramus to ascending ramus 18 cm	No	No	No	RFF; 10×7 cm; intra-oral	Fibula skin 8×14 cm; bone 18 cm; extra-oral	Immediate 27/11/2007	No
7	63	M	SSC; T4 N2 M0	Floor of mouth, anterior tongue, chin and neck skin mandible—angle to angle 12 cm	Yes	No	Yes	RFF; 9×12 cm; intra-oral	Fibula skin 7×12 cm; bone 12 cm; extra-oral	Secondary 12/02/2008	No
8	54	M	SSC; T4 N2 M0	Floor of mouth, chin and neck skin mandible—angle to angle 14 cm	Yes	Yes	Yes	RFF; skin 10×7 cm; intra-oral	Fibula extra-oral skin 10×12 cm; bone 14 cm	Secondary 03/11/2009	Total necrosis; myocutaneous pectoralis major
9	45	M	SSC; T4 N2 M0	Ventral tongue, Floor of the mouth, submandibular skin mandible—angle to body—14 cm	Yes	No	Yes	RFF; skin 9×14 cm; intra-oral	Fibula skin 12×8 cm; bone 14 cm; extra-oral	Secondary 28/09/2010	No

Pre-op preoperative, *Post-op* postoperative, *RFF* radial forearm flap revascularized a left osteocutaneous iliac crest flap for mandible reconstruction and external cervical skin coverage. Inside the right neck, the proximal stumps of the radial artery and cephalic vein were T-T anastomosed to the facial artery and to a branch of internal jugular vein, respectively. The postoperative period occurred uneventfully with primary healing. At the 2-year follow-up, the patient had a good morphofunctional result, enabling her to maintain a regular diet and an intelligible speech. Osteointegrated implants for dental rehabilitation were performed at 10 months postoperative (Fig. 2)

Case 3

A male patient, 59 years old, was referred to our Unit with an extensive recurrent multioperated basal cell carcinoma of the chin and lower lip with extensive involvement of the mandible arch, floor of the mouth and ventral tongue. A radical through-and-through excision was performed including lower lip (preservation of lower vermilion), chin and adjacent cervical skin, floor of the mouth, ventral tongue and mandibular arch. Immediate reconstruction was accomplished with the flow-through sequentially linked flap technique: a right fasciocutaneous radial forearm flap was used for external skin coverage which revascularized a left osteofasciocutaneous fibula flap for intra-oral lining and mandible reconstruction. In the left neck, the proximal stumps of the radial artery and cephalic vein were T-T anastomosed to the superior thyroid artery and to the external jugular vein, respectively. The postoperative period occurred without complications and with primary healing. At the 3-year follow-up, the patient presented with a good morphofunctional result with an interesting aesthetic achievement and free of disease (Fig. 3).

Case 4

A male patient, 46 years old, presented himself to our Unit with an extensive compound oromandibular defect. He had been operated 4 years ago in another institution for a large squamous cell carcinoma (T4N1M0) involving the floor of the mouth, ventral tongue, cervical skin and mandible arch. Radical excision had been performed along with right radical and left functional neck dissections. Reconstruction had not been performed and the patient was submitted to postoperative radiotherapy. He presented us with serious impairment in speech articulation and masticatory functions. Reconstruction

Fig. 2 **a**–**c** Preoperative frontal and lateral views of the patient. **d** 3D-computed axial tomography (CAT) scan showing the mandible defect. **e** Drawing of the left fasciocutaneous radial forearm flap. **f** Drawing of the ipsilateral left osteocutaneous iliac crest flap. **g** The distal stumps of the radial artery and cephalic vein were T-T anastomosed to the stumps of the deep circumflex iliac artery and vein, respectively. The composite flap was allowed to perfuse on the forearm for 20 min prior to transfer to the head and neck. **h** The sequentially linked free flaps have been inset. **i/j** Postoperative lateral and frontal views at 6 months and 2 years respectively. A good morphofunctional result was accomplished. Note the dental rehabilitation with osteointegrated implants

Fig. 2 (continued)

was accomplished with a left fasciocutaneous radial forearm flap for intra-oral lining which flow-through revascularized a right osteofasciocutaneous fibula flap for mandible reconstruction and external skin coverage. Inside the left neck, the proximal stumps of the radial artery and one venae comitantes were T-T anastomosed to the superior thyroid artery and external jugular vein, respectively. The proximal stump of the cephalic vein was T-L anastomosed to the internal jugular vein. The postoperative period occurred uneventfully with primary healing. At the 2-year follow-up, the patient had a good aesthetic result and from the functional point, he was able to maintain a regular diet and an intelligible speech (Fig. 4).

Discussion

After introduction of the concept of axial-pattern flaps, by McGregor and Morgan in 1973, many axial flaps have been described and all have a vascular pedicle in common which provides the blood supply for the flap tissue [16]. Muscles have been classified on their patterns of vascular anatomy and this morphological study made an enormous contribution, particularly for the selection of muscles which could be used for flaps [17]. Fasciocutaneous flaps have also been classified according to their patterns of vascularisation [18].

Recently, other free flap concepts have also emerged, such as the chimera principals and the simultaneous double free flap procedures for the management of extensive

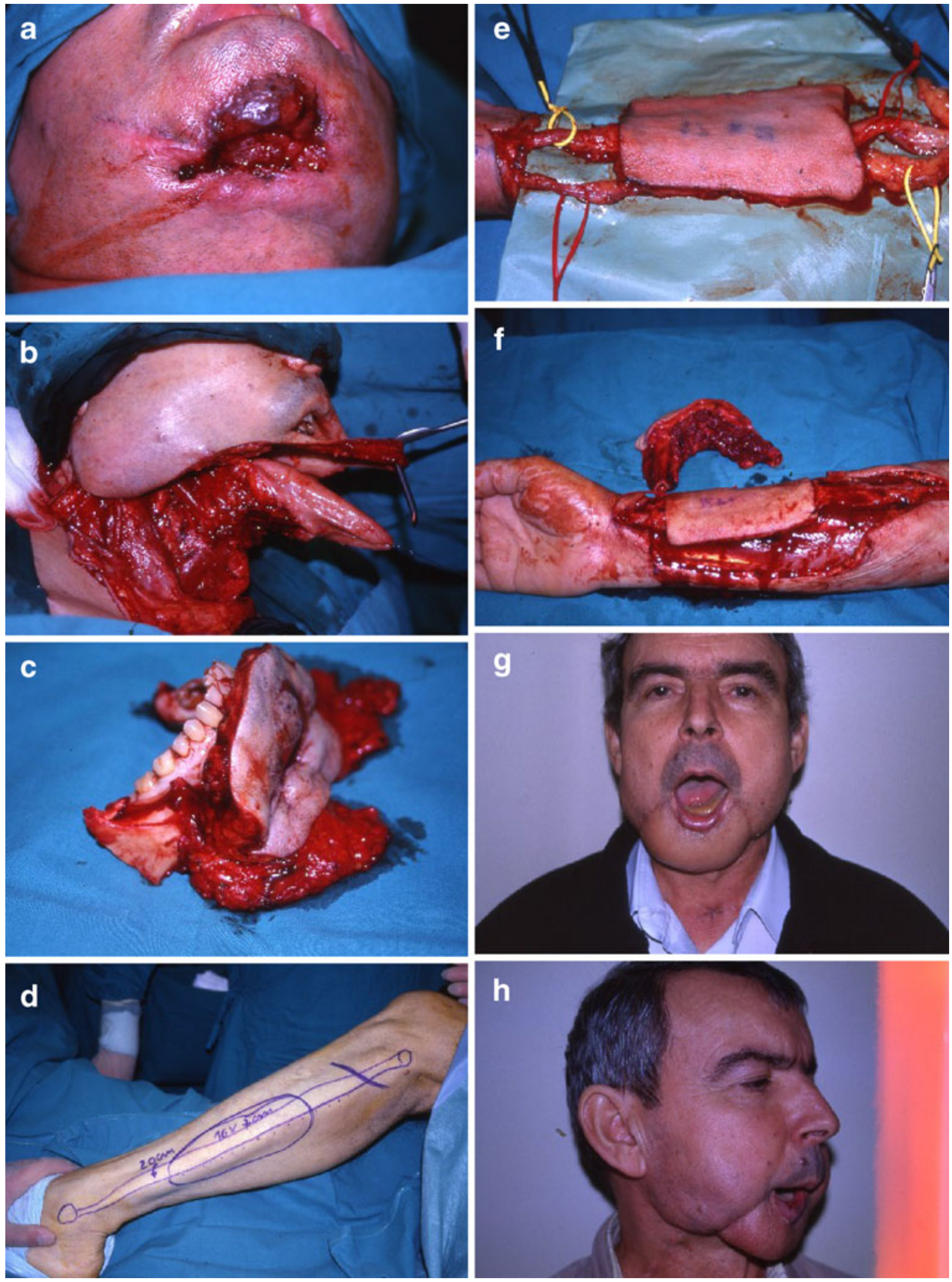


Fig. 3 **a** Extensive BCC of the lower face and neck. **b** Radical en bloc resection—the vermilion of the lower lip was preserved. **c** Peroperative view of the surgical specimen. **d** Drawing of the L osteofasciocutaneous fibula flap. **e** The flow-through fasciocutaneous radial forearm flap has been harvested. **f** The proximal stumps of the peroneal artery and vein have been T-T anastomosed to the distal stumps of the radial artery and cephalic vein, respectively. The composite flap is now ready for transfer to the head and neck. Note the closing wedge osteotomies of the fibula for mandible match. **g/h** Postoperative frontal and lateral views at 3 years. A good morphofunctional result was achieved

composite head and neck defects. The chimeric flap concept has few available flap donor areas to respond adequately to the diversity of the head and neck major defects [19]. The double free flap concept has a major drawback which is the need for two separate pairs of recipient vessels (arteries and veins) ipsilateral or bilateral inside the neck for flap revascularization [3–5]; this point can be a major problem in the scarred neck, the multi-operated patient, bilateral neck dissections, extensive tridimensional compound defects and/or the flap insetting which may require vein grafts. Finally, the operative time is much longer compared with the flow-through sequentially linked free flaps; Wei et al. reported a series where the average operative time was 14 h and 25 min (range, 9 h and 10 mi to 23 h and 50 min), including patient and anaesthesia preparation and operative procedure [5].

On analysing all the described axial flaps, one finds few have the capacity to allow a flow-through circulation. This idea was suggested by Soutar et al. for head and neck reconstruction, establishing an uninterrupted arterial flow through a flap between the external carotid and distal facial artery and also by Cormack and Lamberty with the Siamese or sister flaps in which a flap could be attached onto the end of another flap [18, 20].

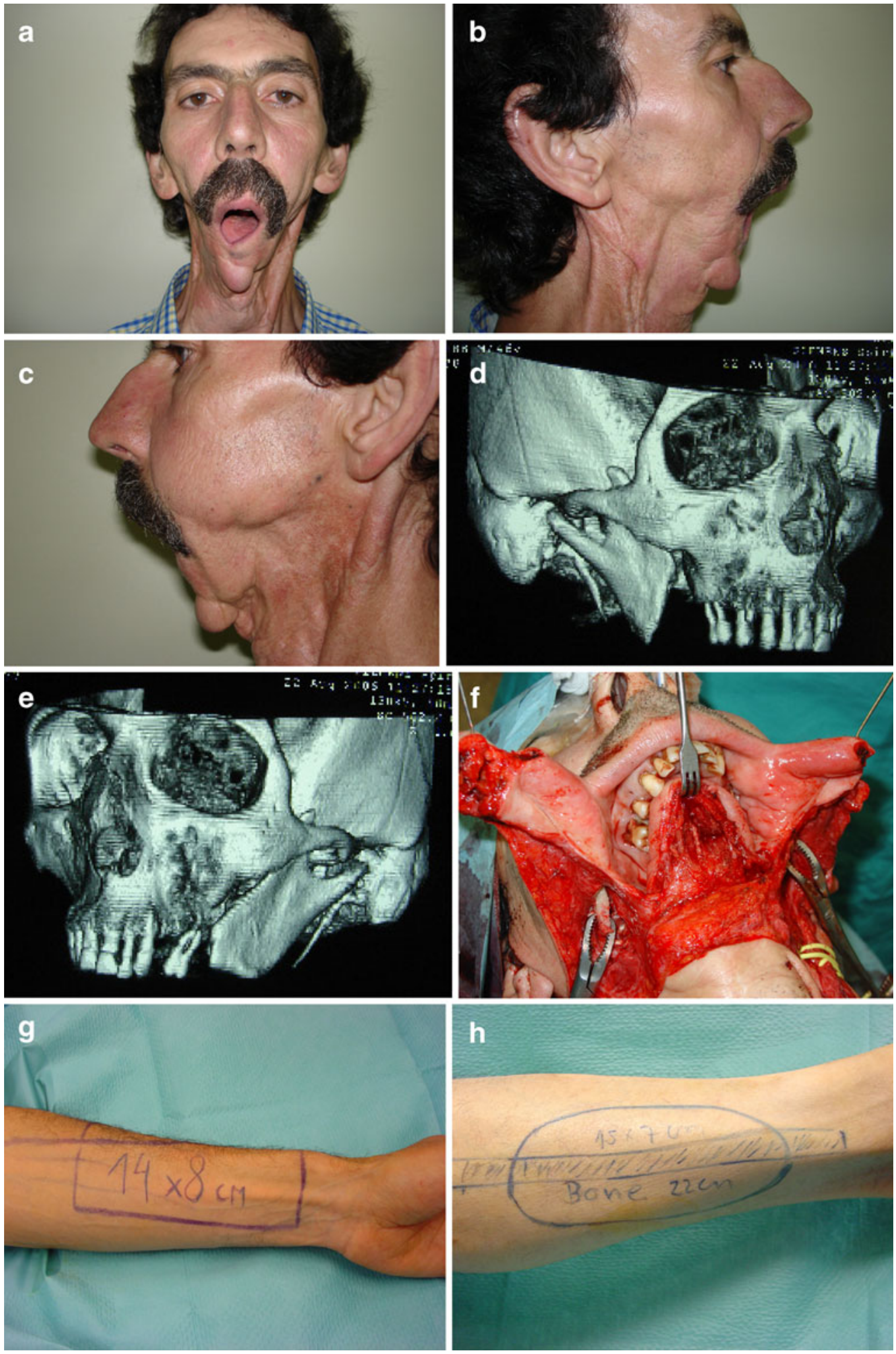
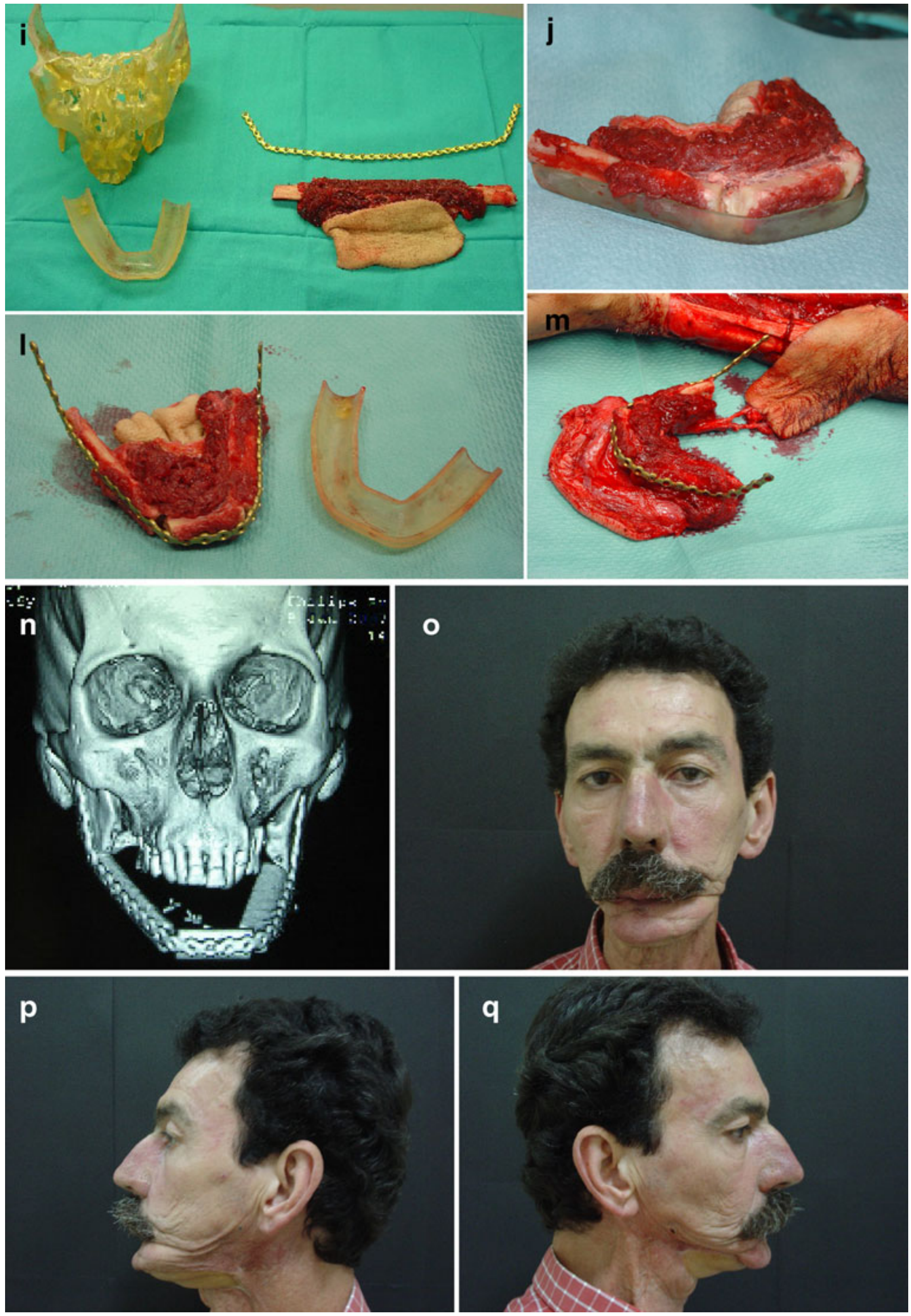


Fig. 4 **a**–**c** Preoperative frontal and lateral views of the patient. **d**–**e** 3D-CAT scan demonstrating the amount of mandible defect. **f** The excisional surgical defect was recreated. **g** Drawing of the left fasciocutaneous radial forearm flap. **h** Drawing of the right osteofasciocutaneous fibula flap **i**–**l** 3D biomodeling technology with stereolithographic model and surgical guide to shape the fibula and plate to mandible. **m** The proximal stumps of the peroneal artery and vein have been T-T anastomosed to the distal stumps of the radial artery and cephalic vein, respectively. The composite flap was allowed to perfuse on the forearm for 20 min prior to transfer. Note the closing wedge osteotomies of the fibula to mandible shape. **n** 3D-CAT scan demonstrating the mandible reconstruction. **o**–**q** Postoperative frontal and lateral views at the 2-year follow-up. A good morphofunctional result was accomplished

Lamberty and Cormack [21] reported one clinical case of head and neck reconstruction in which they used an antecubital fasciocutaneous free flap, to reconstruct an excisional defect after removal of a squamous cell carcinoma, involving the left pinna and external auditory meatus. The proximal end to the divided facial artery was anastomosed to the proximal end of the radial artery and the distal end of the radial artery was looped back to be anastomosed to the distal end of the facial artery. Costa et al. [6] described a different concept in which an uninterrupted arterial and venous flow through the radial mid-forearm fasciocutaneous flap was established, allowing cover and revascularization of ischaemic upper and lower extremities after major trauma (this work is incorrectly

Fig. 4 (continued)



quoted in the paper of Bullocks et al. [12]) . Costa et al. [7] also applied the flow-through free flap concept in hand replantation surgery, reporting two successful selected cases.

The concept of using one flap to serve as a flow-through conduit to vascularize a second flap is not new. In 1987, Yu Zhong-jia described the combined transplantation of free tissues as a new microsurgical technique by which, with only a set of vessels supplying blood, two or more free tissues can be transplanted simultaneously. Very large soft-tissue defects that are not amenable to conventional transplantation, or defects of two or more tissues, either similar or different in nature, could be repaired in a one-stage operation. In this paper, 17 cases of combined transplantation of free tissue were performed for reconstruction of severely injured upper and lower extremities. On the basis of the nature of the tissues transplanted, this series of patients was classified into seven clinical types: combined transplantation of bilateral latissimus dorsi myocutaneous flaps in four patients, bilateral vascularized free fibulas in three, latissimus dorsi myocutaneous flaps and vascularized free fibulas in three, free scapular flaps and big toe skin-nail flaps in two, latissimus dorsi myocutaneous flap and big toe skin-nail flap in one, latissimus dorsi myocutaneous flaps and toes in two and a toe taken from one foot and toes from the other in two. All the transplanted parts survived with encouraging final results [22].

At the head and neck region, Chen et al. [23] reported the use of serially linked flaps to reconstruct a defect caused by corrosive injury to the oesophagus. Sanger et al. [8] described six patients who were treated with fibular osseous flaps sequentially linked to either a radial forearm flap or lateral arm flap; only one venous occlusion occurred which was salvaged by reoperation; these authors used the fibular and peroneal vessels rather than the fasciocutaneous flaps as the flow-through component of the transfer. Soutar [24] applied the concept of sequentially linked free flap in one clinical case with an extensive intra–extraoral defect following excision of tumour; the intra-oral reconstruction was achieved by a radial forearm flap where a deep circumflex iliac composite osteocutaneous flap was "piggy-backed" for mandible and overlying skin reconstruction. Boyd [25] also applied this concept in one clinical case of osteoradionecrosis of the mandible extending from angle to angle; the intra-oral defect was reconstructed by a radial forearm flap in which as osteofasciocutaneous fibula flap was flow-through revascularized for mandible and external skin reconstruction.

Wells et al. [10] reported ten cases of extensive oromandibular reconstructions using this concept. Twenty flaps were used to reconstruct such defects with the sequentially linked free flap technique. In all patients, a radial forearm flap served as the flow-through flap for the second free-tissue transfer. Bone support was provided in eight patients by fibular transfer (three osteocutaneous and five myo-osseous flaps) and one patient by an osteofasciocutaneous radial forearm flap. For one patient in the series, the defect required soft tissue only and was reconstructed with sequentially linked radial forearm flaps to provide both lining and cover. Six of these reconstructions healed uneventfully, one patient suffered partial osteocutaneous flap loss and three patients total loss of both flaps.

Ceulemans et al. [26] described a case where an osteocutaneous fibula flap was not sufficient for a composite lateral mandible reconstruction and so an anterolateral thigh flow-through flap was sequentially used as an interposition conduit and contour filler.

The reconstruction of through-and-through extensive intra–extra-oral defects of the head and neck has to tackle three major problems for its adequate functional and anatomical achievement.

First, there is no ideal osteocutaneous free flap providing both an unlimited length of bone and skin paddle area. Second, in these large three-dimensionally compound defects, it is impossible to orient the cutaneous component of one osteocutaneous free flap independent of the vascularized bone. And third, some of these patients who need such a large reconstruction have a limited vasculature in the neck caused by previous operation, radiation or, most often, both. The concept of sequentially linked free flaps is able to overcome these three major anatomical and functional problems, allowing useful reconstructions of the head and neck.

This concept, consisting of one fasciocutaneous free flap (radial forearm) linked to a second osteocutaneous free flap (fibula or iliac crest) has the following three advantages:

1 Availability of two large well-vascularized skin surface areas, one (radial forearm skin paddle) which can be oriented and repositioned three-dimensionally independently of the vascularized bone component of the reconstruction (osteocutaneous fibula or iliac crest flaps).
2 By combining the strengths of each flap into a new composite tissue transfer, the problems of the size of skin surface area, length and shape of vascularized bone and their three-dimensional repositioning in the head and neck are solved.
3 Revascularization of the new composite tissue transfer can be accomplished in one side of the neck vasculature since the osteocutaneous free flap is already vascularized by the distal vascular stumps of the flow-through radial forearm flap. The long proximal stumps of the radial artery and cephalic vein are anastomosed inside the neck, allowing reconstruction in the multioperated patients with scarred necks, overcoming their limited vasculature without the resource of the interpositional vein grafting.

As disadvantages of the technique, one may point:

1 Proximal thrombosis of the flow-through flap results in the loss of both free flaps if the occlusion is not detected or solved. This point needs good postoperative monitoring which is based on the Unit's protocol as previously mentioned.
2 Increased operative time: this point is turned irrelevant if a two- or three-team approach, with microsurgical

expertise, are organized. The overall operative time is slightly longer (our average time 8 h and 14 min).

Conclusion

The technique seems ideally suited for the patient with extensive and complex soft-tissue and bony defects, particularly the one who has already undergone multiple head and neck operations and post irradiation, resulting in limited recipient vascularity in the neck. Combining a reliable fasciocutaneous flap with an osteocutaneous flap which can be shaped with multiple osteotomies gives the surgeon the flexibility to reconstruct complex three-dimensional head and neck defects with one procedure. The biofunctional end results have been excellent with significant improvements in retaining saliva, swallowing, chewing and speech capabilities as well as the aesthetic outcomes.

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