

## Free Jejunal Transfer for Patients With a History of Esophagectomy and Gastric Pull-Up

Hiroataka Suga, MD, Mutsumi Okazaki, MD, Shunji Sarukawa, MD, Akihiko Takushima, MD, and Hiroataka Asato, MD

**Abstract:** Some patients who undergo pharyngolaryngoesophagectomy with free jejunal transfer reconstruction have a history of esophagectomy and gastric pull-up. We retrospectively reviewed a series of 12 patients to examine the characteristic problems in free jejunal transfer for patients with a history of esophagectomy and gastric pull-up. There was no postoperative thrombosis. No anastomotic leakage or fistula was found. Five of 12 patients presented postoperatively with dysphagia. Two of the 5 patients showed stricture at the distal anastomosis. Three of the 5 patients showed no stricture. However, their reconstructed tracts were tortuous around the distal anastomosis, which could be a cause of dysphagia. Even in patients with a history of esophagectomy and gastric pull-up, free jejunal transfer can be performed safely, although the functional outcome of swallowing is not always satisfactory.

**Key Words:** free jejunal transfer, history of esophagectomy, dysphagia

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It is well known that patients with cancer of the head and neck have a high incidence of multiple primary cancers.<sup>1,2</sup> Some patients who undergo pharyngolaryngoesophagectomy with free jejunal transfer reconstruction have a history of esophagectomy and gastric pull-up. We hypothesized that not only tumor resection but also reconstruction would be difficult in such patients. In this study, we examined the characteristic problems in free jejunal transfer for patients with a history of esophagectomy and gastric pull-up.

### PATIENTS AND METHODS

From 1995 through 2004, 112 patients underwent pharyngolaryngoesophagectomy with free jejunal transfer reconstruction at the University of Tokyo Hospital. Of these patients,

12 had a history of esophagectomy and gastric pull-up (Table 1). All of the 12 patients were males. The average age was 67 years (range, 45 to 82 years). The average interval between esophagectomy and free jejunal transfer was 7.5 years (range, 2 to 16 years). Nine of the 12 patients had received radiation therapy preoperatively. We retrospectively reviewed this series of 12 patients, focusing on the postoperative complications and functional results. The average follow-up was 12 months (range, 2 to 25 months).

### RESULTS

In all 12 patients with a history of esophagectomy and gastric pull-up, a free jejunal graft could be harvested in the usual manner.

For recipient arteries, the superior thyroid artery was used in an end-to-end fashion in 6 patients and the transverse cervical artery in 6 patients. For recipient veins, the internal jugular vein was used in an end-to-side fashion in all 12 patients. There was no postoperative thrombosis, and free jejunal transfer was successful in all 12 patients.

The pharyngojejunal anastomosis (proximal anastomosis) was performed in an end-to-end fashion in all 12 patients. The distal jejunal stump was anastomosed to the esophageal stump in 6 patients because part of the cervical esophagus was left after pharyngolaryngoesophagectomy (Fig. 1). In the other 6 patients, no esophagus was left, and the distal jejunal stump was anastomosed to the gastric tube, which had been pulled up in a previous surgery (Fig. 2). No anastomotic leakage or fistula was found postoperatively, although 2 patients developed minor wound infection.

Five of the 12 patients presented postoperatively with dysphagia. Video fluorography in 2 patients (1 patient had a jejunal graft anastomosed to the esophageal stump, 1 patient to the gastric tube) showed stricture at the distal anastomosis (Fig. 3). Three patients (2 patients had a jejunal graft anastomosed to the esophageal stump, 1 patient to the gastric tube) showed no stricture. However, their reconstructed tracts were tortuous around the distal anastomosis, which could be a cause of dysphagia (Fig. 4).

No perioperative death occurred in this study. During the follow-up period, 7 of the 12 patients died of their tumors.

In the other 100 patients without a history of esophagectomy and gastric pull-up, 3 patients had postoperative thrombosis, 6 patients presented with anastomotic leakage or fistula, and 15 patients suffered from dysphagia postoperatively.

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TABLE 1. Patient Data

Patient	Age/Sex	Interval, Year	Preoperative Radiation	Distal Anastomosis	Postoperative Thrombosis	Leakage or Fistula	Dysphagia	Follow-Up, Months
1	60/M	2	(-)	G	(-)	(-)	(+) a	9
2	80/M	6	(-)	E	(-)	(-)	(-)	9
3	74/M	16	60 Gy	G	(-)	(-)	(-)	2
4	82/M	10	86 Gy	G	(-)	(-)	(+) b	25
5	63/M	6	60 Gy	G	(-)	(-)	(-)	8
6	76/M	5	(-)	G	(-)	(-)	(-)	11
7	72/M	5	70 Gy	E	(-)	(-)	(+) b	6
8	67/M	12	60 Gy	G	(-)	(-)	(-)	14
9	45/M	2	50 Gy	E	(-)	(-)	(-)	8
10	65/M	12	Dose untraced	E	(-)	(-)	(+) a	24
11	55/M	2	72 Gy	E	(-)	(-)	(-)	14
12	61/M	12	Dose untraced	E	(-)	(-)	(+) b	11

a, stricture; b, tortuous tract; E, esophageal stump; G, gastric tube.

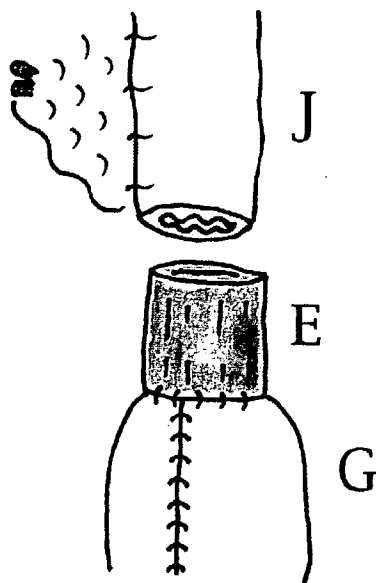


FIGURE 1. The distal jejunal stump is anastomosed to the esophageal stump. J, jejunal graft; E, esophagus; G, gastric tube.

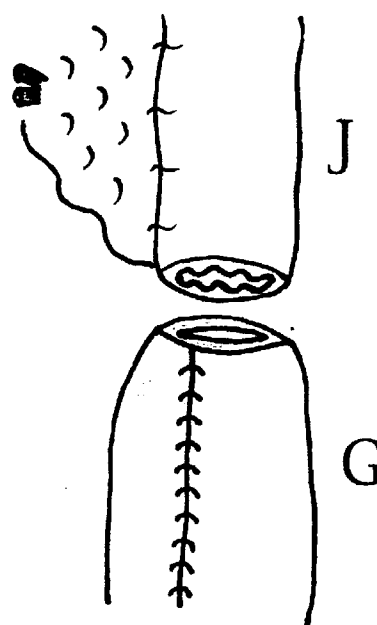


FIGURE 2. The distal jejunal stump is anastomosed directly to the gastric tube. J, jejunal graft; G, gastric tube.

DISCUSSION

Free jejunal transfer has become a standard and reliable procedure for pharyngoesophageal reconstruction. Some previous reports have indicated that this procedure is highly successful, with few postoperative complications.<sup>3-6</sup> At our institution, too, more than 100 free jejunal transfers have been performed during the past 10 years, most of which have been successful.

Patients with cancer of the head and neck have a high incidence of multiple primary cancers. In terms of another primary cancer in the same patient with cancer of the head and neck, esophageal cancer is the most common.<sup>1,2</sup> Gastric pull-up is a well-accepted procedure for esophageal reconstruction, although colon interposition or jejunal pull-up is

used in cases where the stomach is unavailable.<sup>7,8</sup> Against this background, we sometimes perform free jejunal transfer for patients with a history of esophagectomy and gastric pull-up. This tendency is apparently increasing because of the advancing age of patients and improvements in the diagnosis and treatment of malignant tumors.<sup>1,2</sup>

Despite a history of esophagectomy and gastric pull-up, microvascular anastomosis was successful in all patients. Okazaki et al<sup>9</sup> have reported a high rate of arterial thrombosis (3 of 13 patients) in patients who have undergone free jejunal transfer as a salvage surgery after failed esophageal reconstruction. Nakatsuka et al<sup>10</sup> have also described that the flap survival rate in secondary reconstruction is significantly lower than that in immediate reconstruction. In the patients in

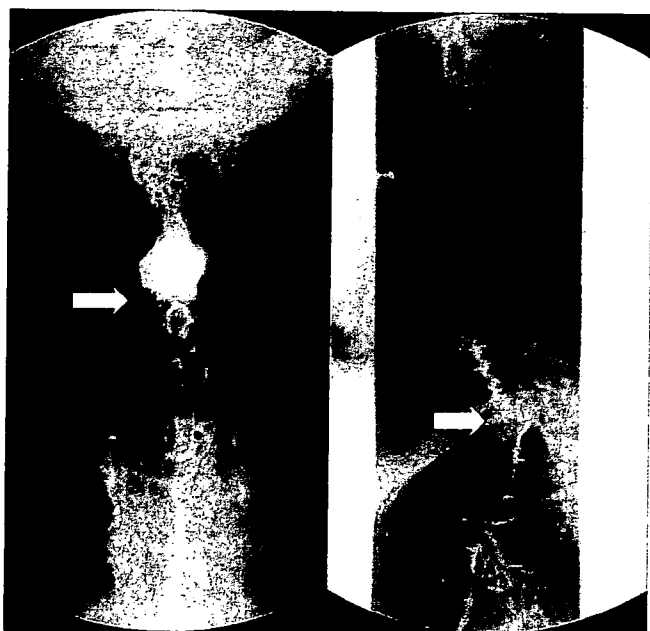


FIGURE 3. Postoperative video fluorography of patient 10. Arrows show stricture at the distal anastomosis.

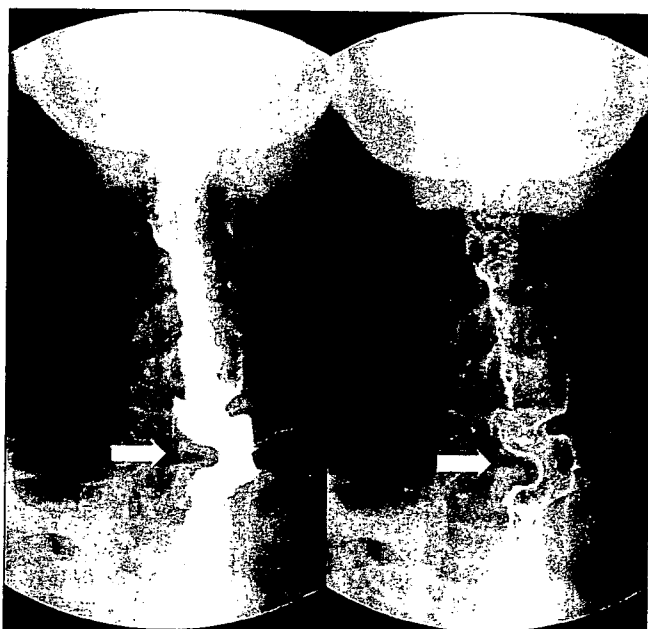


FIGURE 4. Postoperative video fluorography of patient 12. Arrows show a tortuous region around the distal anastomosis.

our study, the interval between esophagectomy and free jejunal transfer was relatively long (7.5 years). There was no active infection or inflammation. We believe that such good conditions reduced the risk of postoperative thrombosis.

Anastomotic leakage or fistula, especially in pharyngojejunal anastomosis, is a common complication in free jejunal transfer, occurring in 4% to 30% of cases.<sup>3-6,11,12</sup> A history of esophagectomy and gastric pull-up can increase the risk of this

complication because of scar formation. A high rate of prior radiation therapy (9 of 12 patients in this study) may have an effect, as some authors have pointed out.<sup>6,13</sup> However, in this study, no anastomotic leakage or fistula was found postoperatively. We believe that a proper suture technique can decrease the rate of anastomotic leakage or fistula, even in patients with a history of esophagectomy and gastric pull-up.

The functional outcome of swallowing was not satisfactory in this study. Two patients presented with stricture at the distal anastomosis, which resulted in dysphagia. However, even in patients without a history of esophagectomy and gastric pull-up, stricture formation is a common complication, occurring in 4% to 30% of cases.<sup>3-6,11,12</sup> Thus, dysphagia caused by stricture does not appear to be characteristic in patients with a history of esophagectomy and gastric pull-up. Okazaki et al<sup>14</sup> have reported a new anastomotic technique, where jejunoesophageal anastomosis is performed after 2 longitudinal incisions are made at the corners of the esophageal stump. This provides a "Z-plasty-like" effect, which reduces the risk of delayed stricture formation. We did not try this technique in this series. However, we believe that this technique can also be applied in patients with a history of esophagectomy and gastric pull-up, where the distal jejunal stump is anastomosed either to the esophageal stump or the gastric tube.

Three patients showing no stricture presented with dysphagia. Their reconstructed tracts were tortuous around the distal anastomosis, which could be a cause of dysphagia. We believe that this type of dysphagia is characteristic in patients with a history of esophagectomy and gastric pull-up. It is likely that scar formation around the distal anastomosis, increased by a previous surgery and a prior radiation therapy, decreases the flexibility of the reconstructed tract and makes it tortuous rigidly. This phenomenon can occur more frequently in patients who have had a jejunal graft anastomosed to the esophageal stump than in those who have had a graft to the gastric tube. A small segment of the cervical esophagus, left after pharyngolaryngoesophagectomy, makes the structure of the reconstructed tract more complicated, and causes a tortuous tract. If possible, such a small segment should be resected, and a jejunal graft should be anastomosed directly to the gastric tube.

In conclusion, free jejunal transfer can be performed safely even in patients with a history of esophagectomy and gastric pull-up. However, the functional outcome of swallowing is not always satisfactory.

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ORIGINAL ARTICLE

## Secondary reconstruction of the eye socket in a free flap transferred after complete excision of the orbit

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### Abstract

Reconstruction of the eye socket in a free flap transferred after complete excision for malignancy is difficult. Between 1980 and 2005 we secondarily reconstructed five eye sockets in free flaps after resection of cancer, cirroid haemangioma, and the consequences of irradiation for retinoblastoma. Free flaps were used during the primary operations to cover the defects. The eye socket was then reconstructed during the secondary operations with a conventional skin graft in two cases, and with a skin graft using the modified Antia's method in three cases. All free flaps survived and all eye sockets accepted ocular prostheses. Three patients in particular, whose eye sockets were reconstructed using the modified Antia's method, had excellent results. Here we describe operations and problems related to secondary reconstruction of eye sockets in previously transferred free flaps after complete excision, and describe some typical cases.

**Key Words:** *Eye socket reconstruction, malignant contracture, free flap*

### Introduction

Surgical reconstruction of a contracted eye socket is a challenging problem for plastic surgeons. To correct a contracted eye socket, we may replace the orbital contents with a skin graft [1,2] or a mucosal graft [3,4], but the results are usually disappointing because of recurrence of the contracture resulting from poor vascularity of the graft bed [1]. Several methods of transferring pedicle flaps have been reported for reconstruction of eye sockets, and some of them may offer satisfactory reconstructive options [5–11]. However, when the tissue defect is extensive after complete excision, or the contracture is severe after heavy irradiation for retinoblastoma, such conventional methods cannot be used, and a free flap transfer would be recommended [12–15].

In 1993, Asato et al. [12] reported a series of 27 cases of reconstruction of the eye socket using a free flap transfer. They proposed four procedures, depending on the extent of the defect. Most of their cases had the eye enucleated, or incomplete excision,

and their eyelids were retained. They could therefore reconstruct an eye socket by folding a free flap at the same time as the transfer. In patients who had complete excision, however, an eye socket cannot be reconstructed primarily with a free flap transfer, and should be reconstructed secondarily within the transferred free flap. We know of no reports that have described secondary reconstruction of an eye socket in a free flap other than that in the report by Asato et al. [12].

Between 1980 and 2005, we had five cases of secondary reconstruction of an eye socket in a previously transferred free flap. Here we report the operative techniques and postoperative problems of reconstructing an eye socket in a free flap.

### Patients and methods

#### Patients

Between 1980 and 2005, we secondarily reconstructed the eye socket in a previously transferred

Table I. Details of patients.

Case No.	Age (years)	Sex	Diagnosis	Flap	No. of revisions
1	51	M	Maxillary sinus carcinoma	LD+SA	3
2	44	M	Cirroid haemangioma	LD	0
3	13	M	Retinoblastoma	DP	1
4	64	M	Squamous cell carcinoma of the palpebral skin	LD	0
5	77	M	Merkel cell carcinoma	RF	0

All sockets were reconstructed with skin grafts, case 2, 4, and 5 by the modified Antia's method.

LD = latissimus dorsi musculocutaneous flap, SA = serratus anterior musculocutaneous flap, DP = deltopectoral flap, RF = radial forearm flap.

free flap in five cases. Details of the patients are shown in Table I. All were men, and ranged in age from 13 to 77 years (mean 50) at the time of the free flap transfer. The diagnoses were recurrent maxillary sinus carcinoma invading the orbit, cirroid haemangioma of the orbit and cheek, retinoblastoma, squamous cell carcinoma of the palpebral skin, and Merkel cell carcinoma of the lower eyelid (1 each).

In all cases, both eyelids and conjunctivae were lost, and a free flap transfer was required to cover the extensive full-thickness defect during the primary resection. There was a bony defect of the zygomaticomaxillary buttress in one case (case 1). Irradiation had been used in one case (case 3) for retinoblastoma in infancy. During the primary operation, a latissimus dorsi musculocutaneous flap was used in two cases, the latissimus dorsi and serratus anterior combined-musculocutaneous flap in one, the deltopectoral flap in one, and the radial forearm flap in one.

### Method

#### Technique

Eye sockets were reconstructed secondarily with a conventional skin graft in two cases and with a skin graft based on the modified Antia's method [1] in three. Antia's method is an inlay skin grafting technique for reconstructing severely contracted eye sockets, which was originally described in 1984 [1]. We modified the procedure, and used it for reconstruction of eye sockets in a previously transferred free flap. The operation is done in 2 stages. During the primary operation a silicone or resin implant is draped with a split thickness skin graft and buried in a cavity made in the transferred flap through a transverse midline incision. The skin graft is folded, with its epithelial surface toward the implant. The implant should be considerably larger than the ultimate prosthesis. After six months or more, the implant is removed and the survival of the skin graft is confirmed. Suture of the lid margin is

sufficient to reconstruct an eye socket, while an additional skin graft is added if necessary (Figure 1).

### Results

All flaps survived. All patients could use an ocular prosthesis. After reconstructions, revision operations were required in two cases. Good shape and contour of the reconstructed eye sockets was obtained in all patients except case 1, in whom there was a large bony defect of the zygomaticomaxillary buttress without reconstruction. In particular, three cases whose eye sockets were reconstructed using a modified Antia's method had aesthetically excellent results, but the match of the colour and texture of the transferred flap with the surrounding skin was not satisfactory in all cases.

#### Case reports

##### Case 4

A 64-year-old man with a squamous cell carcinoma of his left upper palpebral skin had a radical resection of the tumour including complete excision of his left orbit (Figure 2a). The defect was immediately reconstructed with a free latissimus dorsi musculocutaneous flap transfer by anastomosis to the left superficial temporal vessels (Figure 2b).

At 20 months, a silicone implant draped with a split thickness skin graft taken from the groin was buried in the flap to reconstruct the eye socket. However, after the second operation, he did not return to our hospital.

At 5 years, he visited our hospital. The implant was removed and an additional split thickness skin graft was supplemented to reconstruct the eye socket. His left eyebrow was reconstructed simultaneously with a free hair-bearing scalp graft.

The reconstructed eye socket was wide enough, and the shape and contour of his left orbit were excellent, but the colour match of the flap was not satisfactory (Figure 2c, d).

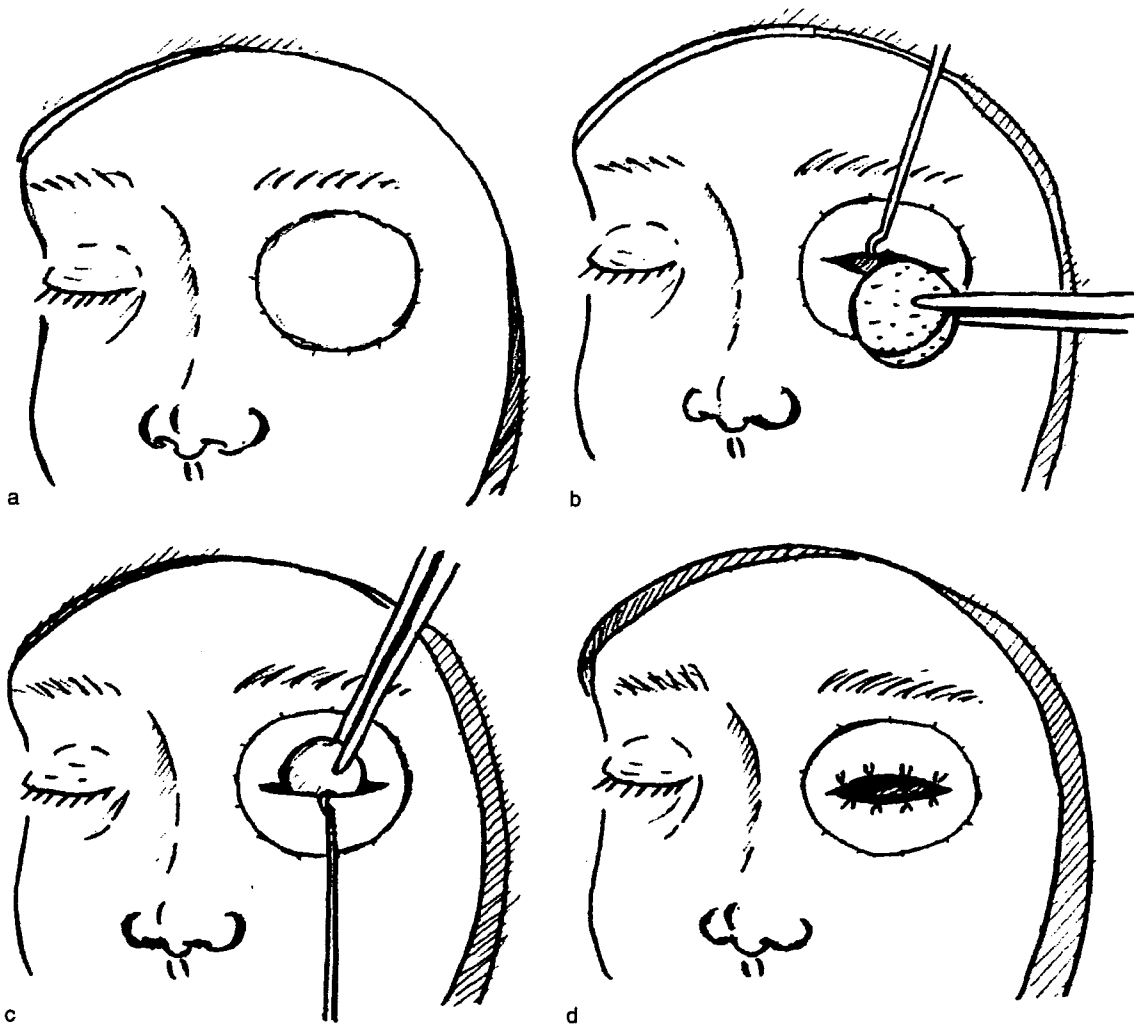


Figure 1. Diagram of the reconstruction of the eye socket based on the modified Antia's method. (a) Preoperative state. (b) During the first operation the implant, draped in a skin graft, is buried into the flap. (c) Six months or more later the implant is removed, and the survival of the skin graft is confirmed. (d) After removal of the implant.

#### Case 5

A 77-year-old man with a Merkel cell carcinoma of the right lower eyelid had a radical resection of the tumour including complete excision of his right orbit (Figure 3a). Immediately after resection of the tumour, a resin implant draped with a split thickness skin graft taken from lateral thigh region was buried in the orbit (Figure 3b), and a free radial forearm flap was subsequently transferred to cover the implant (Figure 3c). The right facial vessels were used as recipient vessels.

At 9 months, the resin implant was removed by incising the transferred flap, and the skin graft survived completely (Figure 3d). An eye socket was reconstructed with no need for an additional skin graft.

The shape and contour of his reconstructed eye socket were excellent, and the colour match of the flap was satisfactory (Figure 3e).

#### Discussion

A severely contracted eye socket, the so-called "malignant" contracted eye socket, [1] cannot be corrected by conventional methods alone, such as a full thickness skin graft or a mucosal graft, because of the poor vascularity of the recipient bed and deficiency of tissue. The use of a prefabricated temporoparietal fascial flap [5-7], a temporal muscle flap combined with a skin graft [8], a posterior auricular flap [9,10], a lateral orbital flap, or an expanded median forehead flap [11], might be a good option in some cases, but when the defect is extensive the volume of the flap is not sufficient.

For such cases, we have used a free flap transfer for reconstruction of the eye socket since 1980. In 1993, Asato et al. [12] reported a series of 27 cases of reconstructions with free flap transfers. In most of their patients in whom eyelids were retained, they reconstructed the eye socket primarily with a free

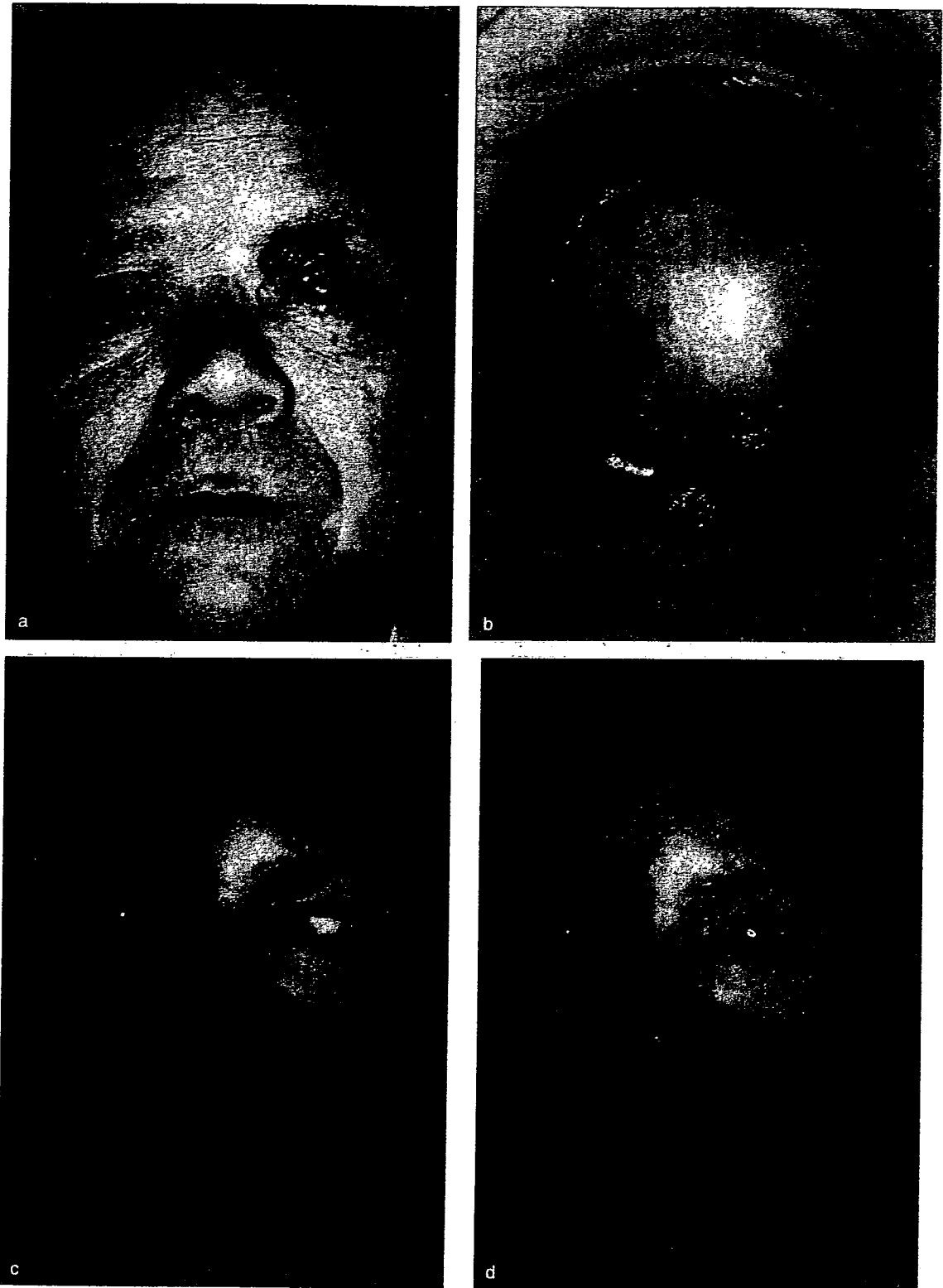


Figure 2. Case 4. (a) Preoperative view. (b) After radical excision of the tumour including excision of his left eye, a free latissimus dorsi musculocutaneous flap was transferred to the left superficial temporal vessels. (c) Final result without an ocular prosthesis. and (d) with an ocular prosthesis. (Published with the patient's consent).



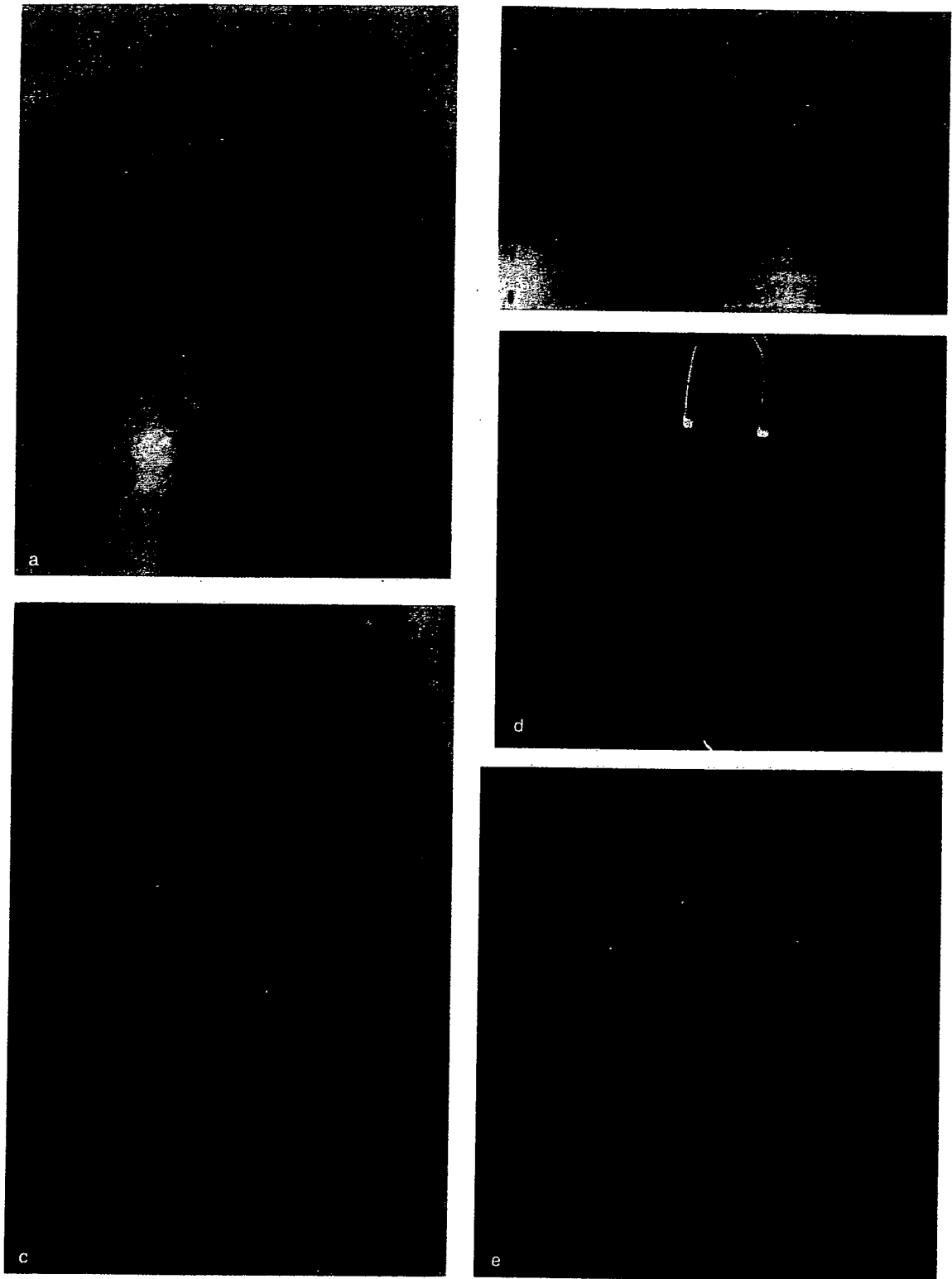


Figure 3. Case 5. (a) After resection of the tumour. (b) A resin ball draped with a skin graft. (c) After the resin ball had been implanted into the orbit, a free radial forearm flap was transferred. (d) At the time of removal of the resin ball, the skin graft had survived well. (e) Final result of the patient with an ocular prosthesis. (Published with the patient's consent).

flap transfer. In a patient whose conjunctival remnant was sufficient, the flap was buried in the orbit for augmentation alone. In a patient whose conjunctival remnant was not sufficient, they used the free flap for partial or total lining of the eye socket. However, in a patient who had had a complete resection, the defect could be covered only with a free flap transfer at the primary operation. In such cases, an eye socket should be reconstructed secondarily in the previously transferred free flap.

In our cases, the eye socket was reconstructed secondarily in a free flap with a skin graft. Though a skin graft on scar tissue is prone to a recurrent contracture, a skin graft on a free flap is resistant to contracture as a result of its abundant vascularity. The eye socket is therefore reconstructed in a free flap, where it retains sufficient volume to hold an ocular prosthesis. This is the main advantage of using a free flap at the primary operation, and assists in revision operations if required later. For patients who had postoperative radiotherapy for the treatment of retinoblastoma in infancy, the depression deformity is corrected by augmenting the soft tissue in the orbitozygomatic region [12].

We modified Antia's method [1] and used it for reconstruction in three cases. It is simple and gives a natural appearance to the eyelid and canthal region, as shown in cases 4 and 5. In recent cases, we bury the implant into the orbit at the same time as free flap transfer, as in case 5, for the patient who will need reconstruction of the eye socket later.

Because the anterior lobes of the eyelids were reconstructed with a free flap after excision of the orbit, the texture and colour match of the flap becomes a problem. Some local flaps (such as the lateral orbital flap or the median forehead flap) are superior to the free flaps as regards texture and colour match. Most patients tend to wear an eye patch even after reconstruction, and this prevents the flap from tanning, which is one of the causes of the mismatch of texture and colour. Some authors recommend the use of an external prosthesis when the defect is extensive. In some cases, this might be a good choice, but it cannot be worn on unstable skin.

Other serious problems are drooping of the flap, which results in ptosis of the lower eyelid. Drooping of the flap is inevitable, particularly when the bone of infraorbital rim is excised and the zygomaticomaxillary buttress is absent, and reconstruction of the socket becomes difficult. To correct ptosis of the lower eyelid a cartilaginous graft, suspension of fascia, or pedicled flap transfer may be attempted, but the results are usually disappointing. It is

difficult to reconstruct the natural shape of the lower eyelid and canthal region by manipulating soft tissue in such cases.

### Conclusion

Reconstruction of the eye socket in a free flap transferred after complete excision for malignancy is difficult. We applied a modified Antia's method for three patients, and obtained good aesthetic results. It is thought that this method offers a good option for eye socket reconstruction in a previously transferred free flap. However, mismatch of colour and texture and drooping of the flap are two major problems in such patients.

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# Reconstruction with Rectus Abdominis Myocutaneous Flap for Total Glossectomy with Laryngectomy

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## ABSTRACT

From October 1999 to July 2005, defects after total glossectomy with laryngectomy (TGL) for cancer of the tongue or middle pharynx were reconstructed with rectus abdominis myocutaneous (RAMC) flaps in nine patients. The skin flaps were designed larger in width than the original defect to create a funnel-shaped oropharynx and prevent stricture. Six patients had uneventful postoperative courses and began to eat perorally 8 to 15 days postoperatively. One patient suffered flap necrosis due to arterial thrombosis and two patients had leakage. Eventually, eight patients could eat soft foods or gruel, except one patient who had ingested food through a gastrostomy preoperatively. When TGL was performed without mandibulectomy, the blood supply for the remnant mucosa of the backside of the mandible is generally not good, for which the reconstruction with the overlapping deepithelialized flap and muscle is useful for prevention of the fistula formation. We considered that the RAMC flap is a good option for reconstruction after TGL.

**KEYWORDS:** Total glossectomy with laryngectomy, reconstruction, rectus abdominis myocutaneous flap

Total glossectomy with laryngectomy (TGL) is a surgical procedure that is performed for tongue-base cancers or advanced tongue cancers. Survival rates for advanced tongue carcinoma remain poor despite advances in multimodality therapy.<sup>1-4</sup> Five-year cure rates for stage IV tongue cancers treated with surgery with postoperative radiation therapy or radiation alone range from 17 to 33%.<sup>2-4</sup> Ruhl and colleagues<sup>1</sup> reported that corrected actuarial survival was 48 and 38% at 3 and 5 years, respectively, in 15 patients who had undergone TGL. Different from total glossectomy *without* laryngectomy

(TGNL), the defect after TGL is extensive and involves the entire floor of the mouth and the anterolateral walls of the pharyngoesophageal tract. Although several reports on the prognosis after TGL have been published,<sup>1-4</sup> there are only a few reports<sup>5,6</sup> that focus on the procedure for reconstruction following extensive ablation, including TGL. Reconstruction after TGL does not require consideration for the restoration of postoperative articulation and deglutition without miss-swallowing. However, large and voluminous flaps are often needed because the defects are extensive and

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sometimes involve the neck skin in cases with advanced tongue cancer. Using free jejunal transfer, Jones and associates<sup>5</sup> reported an inverted J-shaped funnel and Imanishi and coworkers<sup>6</sup> reported the use of an extended sigmoid-shaped patch after TGL. In the reconstruction of the pharyngeal space, the use of the gut has advantages over skin or musculocutaneous flaps<sup>7</sup> because the mucosa undergoes rapid wound healing and is not prone to postoperative contraction. However, in cases with complex oropharyngeal defects following TGL, reconstruction using jejunum has some drawbacks, such as excessive mucous secretion, flabbiness of the jejunal mucosa in the oral floor, and lack of sufficient volume. In our institute, the reconstruction of the extensive defects after TGL has been performed using a rectus abdominis myocutaneous (RAMC) flap. We here analyze these cases and discuss the merits, drawbacks, and problems, compared with other procedures.

### PATIENTS AND METHODS

Between October 1999 and July 2005, nine patients underwent TGL for cancer of the tongue or middle pharynx and had immediate reconstruction with RAMC flap at the University of Tokyo Hospital. The profiles of the nine patients are shown in Table 1.

These patients included one woman and eight men ranging in age from 30 to 77 years, with an average age of 64 years. There was one patient with stage III tumor and eight patients with stage IV tumors. All patients were diagnosed with squamous cell carcinoma. Seven of nine patients had a history of preoperative irradiation (30 to 72 Gy). Five patients had diabetes mellitus, one of whom also had gout and liver dysfunction. Four patients had recurrent cancer after a previous operation, of which three patients had previously undergone reconstruction with free scapular osteocutaneous

flap (one patient) or pedicled pectoralis major myocutaneous (PMMC) flap (two patients). In these four patients with recurrent cancer, ablation of the neck skin was needed because of cancer invasion. In five of nine patients, segmental mandibulectomy was needed. In all patients, immediate reconstruction was performed with the RAMC flap. Three patients were irradiated postoperatively (40 to 70 Gy). The hospital charts were reviewed, and the validity of the operative procedure was assessed based on the time required to the initiation of oral intake, quality of diet, and complication. The average follow-up was 10 months (range, 3 to 18 months). Six of nine patients died during the follow-up period (3 to 18 months).

### Operative Procedure

The RAMC flap was used because a large and voluminous flap is suitable for the extensive defects after TGL. The skin flap was designed to match the shape of the defect, but it was ~20% larger in width to create a funnel-shaped oropharynx with a downward slope to the cervical esophagus and to prevent stricture. When cervical skin or lateral mesopharyngeal wall was extensively ablated, a bilobe-shaped or long skin flap was employed. When mandibulectomy was involved, the flap was sutured directly to the buccal or vestibular mucosa. After the suture of the flap, the flap was revascularized with microvascular anastomosis. The rectus abdominis muscle body was set to cover the great vessels and fill the dead space on the underside of the mandible.

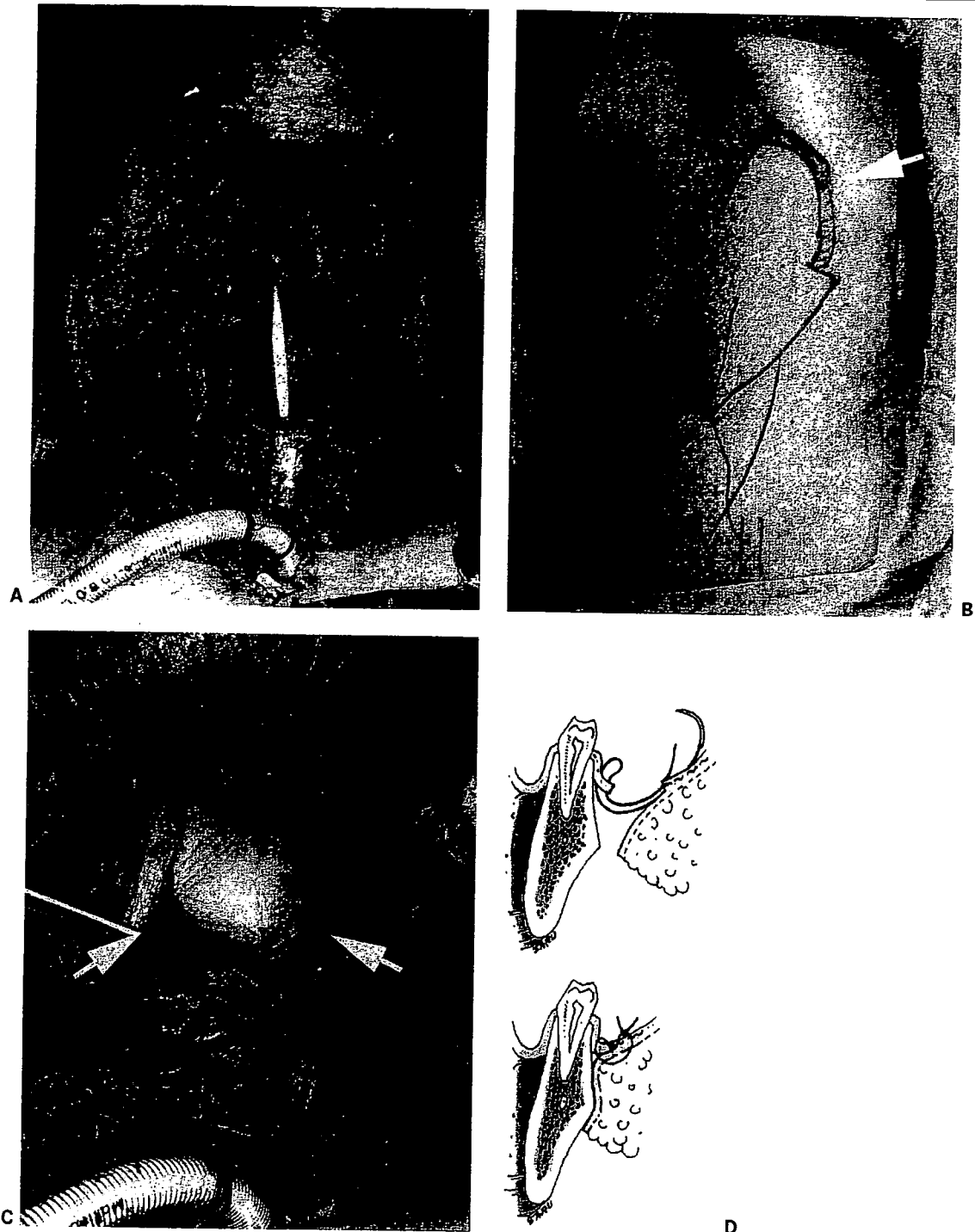
### Case Report (Patient 7)

A 70-year-old man presented with cancer of the tongue base and underwent extensive ablation including TGL and bilateral modified radical neck dissection (Fig. 1A). A free RAMC flap measuring 15 × 10 cm was elevated

**Table 1 Profile of Nine Patients**

Case No.	Age (y) and Sex	Disease (Skin Invasion)	Stage	Complication	Previous Operation	Preoperative Radiation (Gy)
1	57 F	Base of tongue (-)	IV	(-)	(-)	60
2	60 M	Lateral mesopharynx (-)	IV	DM, gout, liver dysfunction	(-)	30
3	64 M	Tongue (+)	IV	DM	Subtotal glossectomy mandibulectomy (right 1-9) scapular OsC flap	70
4	49 M	Tongue (+)	IV	DM, arteriosclerosis	Left neck dissection	68
5	77 M	Base of tongue (+)	IV	(-)	Total glossectomy with laryngectomy PMMC flap	40
6	69 M	Base of tongue (-)	IV	(-)	(-)	(-)
7	70 M	Base of tongue (-)	III	(-)	(-)	(-)
8	74 M	Base of tongue (+)	IV	DM, arteriosclerosis	Basal glossectomy with laryngectomy PMMC flap	72
9	59 M	Base of tongue	IV	DM	(-)	72

DM, diabetes mellitus; PMMC, pectoralis major myocutaneous; OsC, osteocutaneous.



**Figure 1** (A) After total glossectomy with laryngectomy and bilateral neck dissection, the posterior wall of the middle and hypopharynx were preserved. Bilateral facial and lingual arteries were ligated, but bilateral external carotid arteries, internal jugular veins, and superior thyroid arteries with thyroid gland were preserved. (B) A RAMC flap measuring  $15 \times 10$  cm was designed. The lined area (arrow) was deepithelialized. (C) The proximal part of the flap had already been sutured to reconstruct the pharyngoesophageal space. The deepithelialized section is indicated with an arrow. (D) Schematic of the "deepithelialized flap overlapping method." The distal part of the flap was deepithelialized and set to overlap the mucosal stump (top). The deepithelialized part is attached to the mandibular bone (bottom).

(Fig. 1B). Although the remnant mucosa of the oral floor with dark color was removed, it was suspected that a part of the mucosal stump might develop necrosis due to insufficient blood supply. Therefore, a part of the RAMC flap corresponding to the gingiva was deep-

ithelialized to overlap the mucosal stump (Fig. 1C, D). The deepithelialized part of the RAMC flap was firmly attached to the mandibular bone (Fig. 1D). The flap artery and vein (deep interior epigastric artery, deep interior epigastric vein) were anastomosed to the right



**Figure 1** (Continued) (E) Photos taken during video-fluorographic study showed a smooth passage without leakage. (F) Ten-month postoperative finding. The funnel-shaped oropharynx was reconstructed.

transverse cervical artery and internal jugular vein, respectively.

Although the RAMC flap survived perfectly, the mucosal stump of the oral floor partially degraded into necrosis, which resulted in slight leakage. However, the underlying deepithelialized flap epithelialized shortly and the leakage healed with conservative treatment within 3 weeks. A video-fluorographic study of the reconstructed oropharynx performed on postoperative day 25 showed a smooth passage without leakage (Fig. 1E). The patient began to eat perorally on postoperative day 27 and had a soft diet after discharge. The 10-month postoperative finding is shown (Fig. 1F). A smooth downward slope of the oral floor to the cervical esophagus enables the patient to eat and swallow the soft diet easily.

## RESULTS

A summary of the nine patients is shown in Table 2. Three bilobe-shaped and six unilobe-shaped RAMC flaps were used for the reconstruction. The transferred RAMC flap survived perfectly in eight of nine cases, but one flap degraded into total necrosis due to arterial thrombosis. Among five patients with segmental mandibulectomy, hard tissue reconstruction was achieved using a reconstruction plate in one patient, and this was not done in four patients. Among four patients with skin invasion of the cancer, the skin defects were simultaneously reconstructed with the bilobed (patient 3, 4) or long (patient 5) RAMC flap in three patients and with an additional deltopectoral flap in one patient.

Six patients had uneventful postoperative courses without leakage or serious complications, and they began to eat perorally 8 to 15 days postoperatively. In one patient (patient 8), arterial thrombosis developed 3 hours postoperatively, and the flap became unsalvageable despite prompt reexploration. As thick scarring spread over the neck region and involved recipient vessels, we abandoned retransferring the free flap and chose reconstruc-

tion with a pedicled latissimus dorsi myocutaneous (LDMC) flap. Leakage occurred postoperatively and the wound took ~5 weeks to close with conservative treatment. The patient began to eat gruel perorally at postoperative day 45. In one patient (patient 9), the remnant mucosa of the oral floor (near gingiva) partially degraded into necrosis and major leakage occurred postoperatively although the transferred RAMC flap survived completely. Sudden rupture of the external carotid artery occurred due to infection 11 days after the operation. The coverage of great vessels was performed using a PMMC flap. After the regional infection was controlled, a second salvage surgery was performed using an LDMC flap. The patient was able to initiate oral intake on postoperative day 154. In another case (patient 7), the remnant mucosa of the oral floor partially degraded into necrosis, but the leakage was slight because a distal part of the RAMC was deepithelialized intentionally to overlap the mucosal stump (see Case Report 1). The leakage healed conservatively within 3 weeks. The patient began to eat perorally on postoperative day 27 and had a soft diet.

Finally, eight of nine patients could eat a soft diet or gruel, and the one patient who could not had had to ingest most food through a gastrostomy preoperatively. Six patients died of the disease within 3 to 18 months after the operation. Three patients are alive with recurrent cancer (two patients) or without cancer (one patient).

## DISCUSSION

In our series, eight of nine RAMC flaps survived completely, and one degraded into total necrosis due to arterial thrombosis. In this patient, salvage reconstruction was performed using pedicled LDMC flap. Although the size of the initial RAMC flap was 18 × 10 cm, the width of the LDMC flap was 8 cm, which was the widest to be closed primarily in this

Table 2 Patient Summary

Case No.	Size of RAMC	Mandibulectomy (Hard Tissue Reconstruction)	Recipient Artery, Vein	Skin Resection	Additional Flap	Postoperative Radiation (Gy)	Initiation of Oral Intake	Diet	Course	Follow-up (mo)
1	17 × 8	lt. 1-rt. ramus (plate)	LA, IJV	(-)	(-)	(-)	14 POD	Gruel	Leakage (-)	3 (D)
2	Bilobe 18 × 8 (6 × 5)	lt. 4-rt. ramus (-)	TCA, IJV	(-)	(-)	40	15 POD	Soft diet	Leakage (-)	18 (D)
3	Bilobe 19 × 8 (10 × 6)	rt. 1-rt. angle (-)	TCA, IJV	(+)	(-)	(-)	14 POD	Soft diet	Leakage (-)	9 (D)
4	Bilobe 16 × 12 (12 × 6)	lt. 2-rt. ramus (-)	STA, IJV	(+)	(-)	50	10 POD	Soft diet	Leakage (-)	4 (D)
5	38 × 12	lt. angle-rt. angle (-)	ECA, IJV	(+)	(-)	(-)	12 POD	Liquid gastrostomy	Leakage (-)	8 (L) cancer +
6	15 × 13	(-)	TCA, IJV, EJV	(-)	(-)	70	8 POD	Soft diet	Leakage (-)	9 (L) cancer +
7	15 × 10	(-)	TCA, IJV	(-)	(-)	(-)	27 POD	Soft diet	Minor leakage	12 (L) cancer -
8	18 × 10	(-)	TCA, IJV	(+)	DP	(-)	45 POD	Gruel	Atrial thrombosis LDMC flap (3 POD)	11 (D)
9	15 × 12	(-)	TCA, IJV	(-)	(-)	(-)	154 POD	Soft diet	minor leakage Major leakage PMMC flap (11 POD) LDMC flap (70 POD)	17 (D)

D, dead; L, living; LA, lingual artery; TCA, transverse cervical artery; STA, superior thyroid artery; DP, deltopectoral; ECA, external carotid artery; IJV, internal jugular vein; EJV, external jugular vein; POD, postoperative days; LDMC, latissimus dorsi myocutaneous; PMMC, pectoralis major myocutaneous; lt., left; rt., right.

patient. Leakage occurred in the rétromandibular region, the cause of which might have been a tension on the suture. In free flap transfer in the head and neck, partial necrosis of the flap is rare,<sup>8,9</sup> whereas the pedicle flap tends to sustain partial necrosis of the distal parts, especially in cases where a large flap is required. After TGL, the defect consisted of the entire floor of the mouth and the anterolateral walls of the pharyngoesophageal tract. Therefore, the large flap is required for reconstruction. We now design the RAMC flap with a width of more than 10 cm so that the tension on the suture is reduced and a funnel-shaped oropharynx is created. Patient 1 (whose flap was 17 × 8 cm) was our first case in this series.

In our series, eight of nine patients (except patient 7: stage III) had stage IV tongue cancer. Six patients died of the disease within 18 months, and two patients were alive but had cancer recurrence. We had one patient with disease-free survival of 12 months. Survival rates for advanced tongue carcinoma remain poor despite advances in multimodality therapy.<sup>1-4</sup> Five-year cure rates for stage IV tongue cancers treated with surgery with postoperative radiation therapy or radiation alone range from 17 to 33%.<sup>2-4</sup> Ruhl and colleagues<sup>1</sup> reported that corrected actuarial survival was 48 and 38% at 3 and 5 years, respectively, in 15 patients who had undergone TGL, and in addition to these 15 patients, two patients died in the immediate postoperative period, and three died of unknown cause in less than 2 years.<sup>1</sup> Because the prognoses are generally poor and postoperative irradiation is often planned in patients with TGL for the tongue cancer, early wound healing and initiation of peroral diet bring much benefit to such patients. In our series, segmental mandibulectomy was added in five cases, among which bony reconstruction was achieved in one case (patient 1: reconstruction using titan plate); Mandibular reconstruction using reconstruction plates occasionally results in major complications, including refractory infection or exposure.<sup>10,11</sup> In patients with TGL, mastication and deglutition are not greatly affected whether hard tissue reconstruction is performed or not. We consider that the reconstruction with hard tissue is not always necessary in patients with TGL with segmental mandibulectomy.

In cases of reconstruction after TGNL, the RAMC flap has been preferably used because the reconstruction of a convex tongue facilitating both glossal-palatal and glossal-pharyngeal contact is mandatory to achieve better restoration of postoperative articulation and deglutition.<sup>12-15</sup> On the other hand, in cases with TGL, neither prevention of aspiration nor restoration of articulation without miss-swallowing has to be considered. As the passage of food from the oropharynx to the esophagus depends almost entirely on gravity, achieving a funnel-shaped oropharynx with a downward

slope from gingiva to the cervical esophagus is important for the smooth passage of the food.

In the reconstruction of pharyngoesophageal space, the use of the gut has advantages over skin or musculocutaneous flaps.<sup>7</sup> The mucosa has rapid wound healing and is not prone to postoperative contraction. Jones and associates<sup>5</sup> reported an inverted J-shaped jejunal funnel and applied it to an extensive defect that consisted of the entire oral floor and circumferential pharyngoesophageal tract after standard total pharyngolaryngoesophagectomy with extended total glossectomy. Imanishi and coworkers<sup>6</sup> reported the extended sigmoid-shaped free jejunal patch after TGL. However, in cases with complex oropharyngeal defects following TGL, excess mucous secretion and flabbiness of the jejunal mucosa in the oral floor are considered drawbacks. Further, one disadvantage of their method is a longer suture line. Moreover, in cases after TGL, large and voluminous flaps are often needed to fill the dead space at the underside of the mandible, to cover the great vessels, and to reconstruct the neck skin that sometimes has been invaded by advanced tongue cancer. Actually, the neck skin defects were simultaneously reconstructed with the bilobed (patients 3, 4) or long (patient 5) RAMC flap. In patient 5, a long gourd-shaped RAMC flap was transferred using a new method: a shortcut vascular augmented technique, additionally anatomizing the eighth intercostal perforator with the lateral branch of the deep inferior epigastric vessels of the flap itself.<sup>16</sup> Reconstruction with RAMC flap has several advantages over the jejunal patch:

1. The celiotomy is not needed.
2. As a large flap, it can be harvested as it stands; a longer suture line is not needed, which contributes to shorter operating time and decreased risk of anastomotic leakage.
3. Complex defects of the oropharyngeal space and neck skin can be reconstructed simultaneously with a flap based on a single pair of pedicles.
4. The extensive defects and dead spaces can be reconstructed with voluminous adiposal tissue and muscle, covering the great vessels.
5. In cases where segmental mandibulectomy was also done, the shape of the mandible was preserved to some extent even without hard tissue reconstruction, because the musculocutaneous flap has a thicker and tighter structure compared with the jejunal patch.

In regards to 2, 3, and 4, the RAMC flap has an advantage over other (myo-)cutaneous flaps, such as PMMC, forearm, anterolateral thigh, and latissimus dorsi flap, which have been commonly used for the reconstruction of head and neck cancer.



The disadvantage of reconstruction with the RAMC flap is the late contracture of the flap and inclination to dry due to lack of mucous secretion. In our series, no dysphagia due to stricture formation of the digestive tracts was experienced, probably because the pharyngoesophageal defects are not circumferential, and we designed the RAMC flap ~20% wider than the original defect. The oral floor is wet enough for the oral intake because the parotid gland and duct were preserved bilaterally after TGL. Although the patients occasionally needed the aid of liquids to swallow foods smoothly, they did not have much difficulty eating a soft diet.

In our series, five patients with segmental mandibulectomy had an uneventful postoperative course without leakage. On the other hand, three of four patients without segmental mandibulectomy had leakage due to partial necrosis of the mucosal stump. When the TGL was performed without segmental mandibulectomy, it is probable that the blood supply for the remnant mucosa of the oral floor was not good because the bilateral facial and lingual arteries were ligated during the neck dissection. If a patient has irradiation preoperatively or has serious complication such as diabetes mellitus, blood supply to the mucosal stump becomes worse. Therefore, careful removal of the remnant mucosa with poor blood circulation is necessary before flap suture. And it is recommended that the distal part of the RAMC flap corresponding to the gingiva is deepithelialized and attached to the mandibular bone, overlapping the mucosal stump (deepithelialized flap overlapping method) (Fig. 1D).

In patients who have cancer of the tongue base and undergo extensive ablation including TGL, we occasionally have difficulty selecting a suitable recipient artery in the upper neck region because branches of the external carotid artery are damaged due to preoperative radiation and/or previous operation. In such cases, the transverse cervical artery is often available.<sup>17</sup> When the transverse cervical arteries are not available for the recipient (e.g., in patient 5 who had a "frozen neck"), we prefer to apply end-to-side anastomosis directly to the external carotid artery.<sup>18</sup> Regarding the recipient vein, at least one of the internal or external jugular veins is usable in most cases.

## CONCLUSION

In conclusion, the RAMC flap is a good option for reconstruction following TGL. Creation of a funnel-shaped oropharynx using a wider flap is important for postoperative deglutition. In cases without mandibulectomy, the reconstruction with the deepithelialized flap overlapping method is useful for the prevention of leakage in the flap-gingival suture.

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# 血管柄付き遊離腓骨移植による下顎再建

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Key words : 下顎 再建 血管柄付き遊離骨移植 マイクロサージャリー 腓骨

## はじめに

血管柄付き遊離骨あるいは骨付き皮弁移植(以下、骨・骨皮弁と略す)では、いわゆる living bone graft として骨移植を行うことができる<sup>1)</sup>。このため、感染の危険性が高く、再建硬組織の強度が必要な下顎再建においても、有用な再建材としてすでに多くの報告がある<sup>2)</sup>。血管柄付き遊離骨・骨皮弁としては、これまでに肋骨<sup>3)</sup>、腸骨<sup>4)</sup>、肩甲骨<sup>5)</sup>などが報告されてきたが、比較的新しく開発された腓骨・骨皮弁は、その多くの利点から、下顎再建における第1選択として広く用いられるようになって来ている<sup>6)7)</sup>。しかし、腓骨に付けた皮弁は薄く、血行が不安定なことより<sup>8)</sup>、口腔粘膜再建に用いた場合には瘻孔を生じやすいなどの問題点も多い。したがって、軟部組織欠損範囲が大きな下顎欠損症例においては、ほかの皮弁と組み合わせるなど<sup>9)</sup>、手術適応をよく考慮する必要がある。

本稿では、腓骨・骨皮弁を用いた腫瘍切除後の下顎再建の基本的な手術手技、手術適応、さらにわれわれが注意している手技上のポイントについて述べる。

## I 私の手術手技の基本

### 1. 術前の準備

#### 1) 下顎部

腫瘍切除に伴う一期の下顎再建の際には、残存下顎をできるだけ元の位置に保持したまま、下顎骨の連続性を回復する必要がある。このことは下顎切除後の残存歯が多い場合に特に重要であり、われわれは予想される残存歯に術前にブラケットを装着し、術中にこれを利用して顎間固定を行い、それに合わせて骨移植を行ってきた<sup>10)</sup>。矯正歯科の協力が得られれば、術後の咬合のわずかなずれもブラケットをそのまま利用して矯正できるため、正確な咬合を獲得することが可能である。しかし、この方法では残存する2つの下顎片の両者に残存歯がなければ顎関節の位置を正しく保持することができない。また、矯正歯科がない施設では施行することは困難である。このようなことから、最近われわれは、術中に reconstruction plate を用いて咬合の保持を行う簡便な方法を使うことの方が多いが<sup>11)</sup>、これに関しては後述する。

#### 2) 腓骨部

腓骨・骨皮弁を選択した場合、術前に必ずドップラー血流計を用いて腓骨動静脈からの

皮膚穿通枝の部位を確認し、マーキングしておく。穿通枝が確認されない場合は、皮弁への良好な血行が得られないことがあるため、前腕皮弁などとの併用、あるいは肩甲骨皮弁などへの変更を考えた方がよい。われわれは、侵襲の大きさを考慮して術前の血管造影を行っていないが、ドップラーによる穿通枝の確認ができれば、ほとんどの症例で安全に腓骨・骨皮弁を挙上できると考えている。

## 2. 手術手技

### 1) 腓骨・骨皮弁採取部の準備

腓骨・骨皮弁の利点の一つに、皮弁の挙上を仰臥位で、下顎の手術と同時進行に行えるという点が挙げられる。このため、下顎の術野の準備と同時に下腿の準備も行う。腓骨動静脈の皮膚穿通枝は、腓骨の内後方から腓骨後方を回って皮膚に向かって筋間中隔を穿通してくるので、腓骨の後面を見やすい体位を確保する。具体的には、まず、腰部に枕を置き、少し体幹を傾かせ、ターニケットを装着したうえで、下肢全体の消毒を行う。次に、股関節を内転させ、膝関節に滅菌布を挟み、屈曲させる。

皮弁の挙上は、皮膚、軟部組織、骨の欠損量が大体把握できれば、腫瘍切除の終了を待たずに開始する。そして、腫瘍切除が終了した段階で移植床側の準備を行う。

### 2) 移植床の準備

まず、移植床血管の準備を行うが、腓骨・骨皮弁の血管柄は短いため、上甲状腺動脈、舌動脈など頸部上方の動脈を用いることがほとんどである。腓骨動脈はこれらの血管と比較して太いことが多いので、それに見合う血管を選択する。放射線照射後の二次再建などで、瘢痕組織により候補となる移植床血管が細くなっているような場合は、外頸動脈へ直接、端側吻合することも考慮する。静脈に関しては、われわれは内頸静脈に端側吻合する

方法を好んで行っている<sup>12)</sup>。次に、皮弁を縫着する予定の粘膜部分の縫い代を確保する。切除の際に粘膜が大きく裂けている場合は、裂けた部分を先に縫合しておくが、裂けている部分が小さい場合はトリミングを行い、皮弁を差し込んで、できるだけ3点縫合を避けるようにした方がよい。また、残存する歯肉粘膜と皮弁との縫合部（特に前歯部）は、一番瘻孔を形成しやすい部位であるので、皮弁を縫着できるしっかりとした歯肉粘膜を確保しておく。

### 3) 腓骨・骨皮弁の挙上

皮弁挙上に際しては、腓骨周囲の神経、血管、筋肉組織などを含めた断面図をイメージすることがまず重要である（図1）。腓骨体の断面は、前縁、後縁、内側稜を頂点とする三角形をなしているの、それぞれの頂点の間に存在する組織を分けて覚えておけばイメージしやすい。また、どの皮膚穿通枝を取り込んで皮弁を作成するかも重要である。近位の腓骨頭から、腓骨長の1/2より遠位で2/3より近位に比較的太い穿通枝があることが多く、腓骨との位置関係もよいため、われわれはこの穿通枝を利用するようにしている。皮弁の挙上は、まず、ドップラーによる穿通枝のマーキングポイントを中心に、欠損範囲に合わせて皮弁部分のデザインを行うことから始める。下顎の高さと腓骨の径はかなり違うため、皮弁が口腔内で少し沈み込んで腓骨に接着する方が死腔の形成が少ない。このため皮弁の大きさは、欠損部より少し大きめにデザインすることが大切である。この際、ドップラーによる穿通枝のマーキングポイントがずれていることも考慮に入れて、腓骨を採取するためのデザインを、皮弁部分のカーブをそのまま緩やかな波形に頭側、尾側に延長して行う（図2）。

皮弁の皮切の始まりは、前方からでも後方からでもよいが、皮切が筋膜に達したら、筋

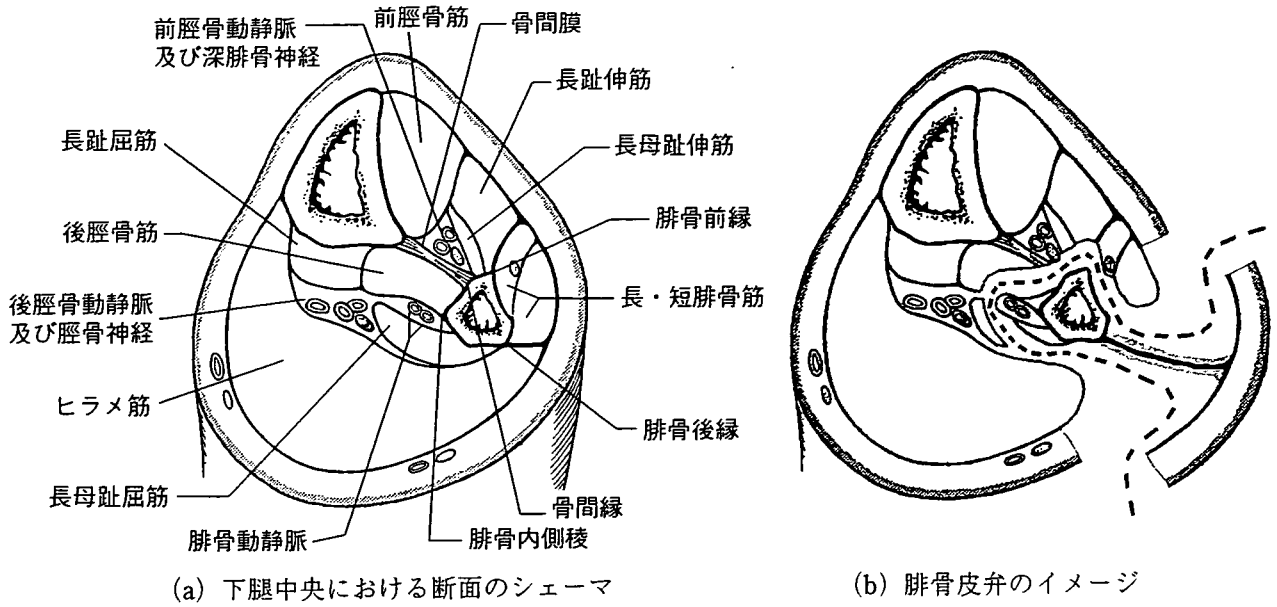
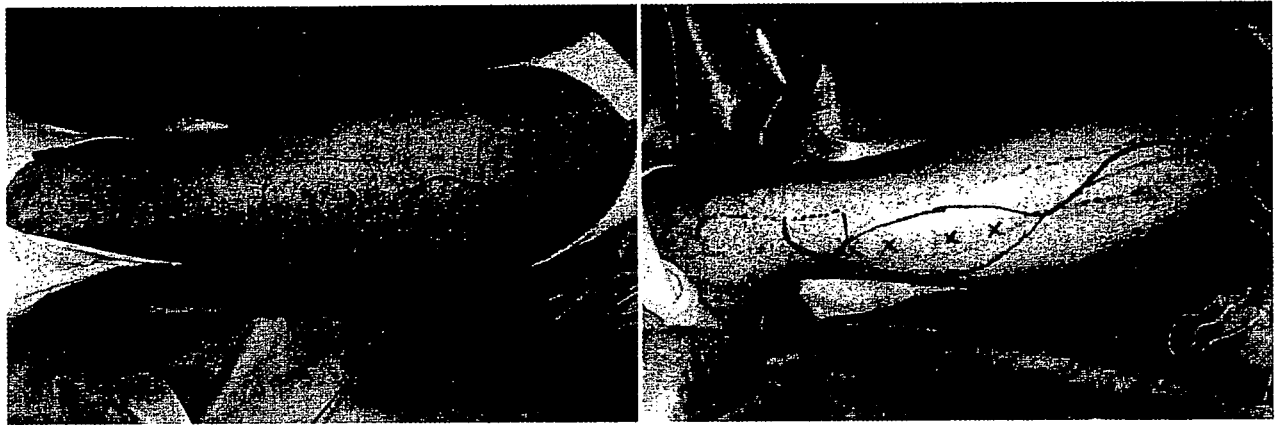


図1 下腿中央部での断面



(a) このデザインのまま、皮弁部分の切開を行うと 穿通枝の位置がずれていた場合に対応できない。  
(b) このようにデザインすれば穿通枝の位置がずれていても対応できる。

図2 腓骨皮弁のデザイン

膜下に下腿後筋間中隔に向かって剥離を進める。筋間中隔に達するまでは筋膜上を剥離するとの報告も多いが<sup>13)</sup>、筋膜下で剥離した方が筋膜上の血管網を確保できるため皮弁の血行はより安定すると思われる。筋間中隔付近で穿通枝が確認できたらそれに合わせて皮島のデザインをもう一度見直す。皮弁の全周を切開，剥離し，腓骨に向かってヒラメ筋と長腓骨筋の間で穿通枝を含めた筋間中隔をできるだけ皮弁に取り込むようにして剥離を進める (図3)。また，穿通枝がヒラメ筋などの筋

体内を通っている時は，少量の筋体をつけたまま剥離の方が安全である。穿通枝が腓骨後縁の後方から立ち上がってくるところまで剥離できたら腓骨の処理に移る。  
腓骨の上下端に向けてゆるやかなS字状に皮切を伸ばすが，腓骨頭近くでは総腓骨神経を損傷しないように注意する。腓骨はまず後縁から前縁にかけて長・短腓骨筋の剥離を行う。重要組織はないため電気メスを用いてもよい。次に，前縁を乗り越えて骨間縁にかけて腓骨骨膜上を剥離するが，ここは視野が狭