Combined anterior thigh flaps and vascularised fibular graft for reconstruction of massive composite oromandibular defects

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SUMMARY. Six massive, composite oromandibular defects were reconstructed using combined anterior (anterolateral and anteromedial) thigh flaps and vascularised fibular graft in bridge or chimeric fashion. Except for minor dehiscence in one case and infection in another, all flaps survived without complication. Anterior thigh flaps provide large-calibre, long vascular pedicles while derivative branches from the lateral circumflex femoral system facilitate simultaneous transplantation of multiple components. Because the pedicle of the vascularised fibular graft is of insufficient length, the lateral circumflex femoral vessels provide a remote vascular source as a flow-through vascular conduit. A combined flap using the lateral circumflex femoral system is considered to be most suitable for reconstruction of through-and-through defects of the head and neck. The authors describe the advantages of this method and the detailed anatomy of the cutaneous perforators of the anterior thigh flaps.

Several methods have been reported for reconstructing massive composite oromandibular defects by means of free flap transfer. Since recipient vessels are often absent in the vicinity of the defect due to previous radiotherapy or metastasis, long vascular pedicles are required. When only one paired artery and vein are available as recipient vessels, a vascular conduit for which a free radial forearm flap has commonly been used, is required to combine skin flap and vascularised bone. Because the descending branch of the lateral circumflex femoral artery (LCFA) runs a long course giving off many derivative branches, we prefer to use anterior (anterolateral and anteromedial) thigh flaps for this purpose. Also, minimum donor site morbidity is anticipated using this method.

In 1991, Hallock2 introduced the concept of the chimeric flap. Koshima3 reported free chimeric flaps using the LCFA system for the reconstruction of head and neck defects. Several forms of free combined flap are shown in Figure 1. Two different vascularised components can be connected in tandem to form a bridge or chain-link flap with establishment of vascular flow-through between both components (Fig. 1, I). A chimeric flap consists of two or more independent components that are supplied by a single vascular source (Fig. 1, II).

Patients and methods

Between June 1995 and February 1997, 6 patients (4 male and 2 female) aged from 43 to 63 years, underwent reconstruction of the tongue, the floor of the mouth and the mandible using combined anterior thigh flaps and vascularised fibular graft. Five had reconstruction for defects immediately following tumour ablation while the other underwent secondary reconstruction for chronic fistula and persistent bone exposure. Operations were performed simultaneously by two surgical teams with the patient in the supine position. Flaps were transferred to the defects in bridge fashion in three cases and chimeric fashion in the others. Vascular anastomoses were established on the affected side of the neck in five patients and on the contralateral side in the other without vein graft. Donor defects were closed primarily in four cases while two required skin grafting. Double-barrel vascularised fibula5,6 was used in one patient (Case 5). Three patients had radiotherapy after reconstruction while the other three had undergone this prior to transfer. Details of the six cases are shown in Table 1.

Vascular anatomy

The LCFA gives off two large branches, the ascending and descending. The descending branch is the largest and longest, and it runs through the intermuscular space between the vastus intermedius and rectus femoris muscles. The branching point of the cutaneous perforator varies. It can arise from the lateral descending, medial descending, ascending and innominate branches, the deep femoral vessels, and the muscle branches (Fig. 2), emerging at the level of the midpoint of the thigh. In our experience, the dominant cutaneous perforator runs through the muscles as a musculocutaneous perforator in 71% of flaps (83% of anterolateral and 10% of anteromedial thigh flaps). The medial descending branch is occasionally observed in the same intermuscular space as the lateral descending branch. This branch gives off either a cutaneous perforator or an innominate branch with a cutaneous perforator. Lateral and medial perforators are rarely available simultaneously, but
Combined flaps for oromandibular reconstruction

Figure 1—Schematic diagram illustrating possible flap combinations.

I Bridge flap: double components are combined in tandem.
II variants of chimeric flap combinations.
A: Ordinary; B: Parallel: possessing double descending branches with a single (or double) skin paddle; C: Hybrid: hybrid of bridge and chimeric form; D: Flow-Through: preserving recipient vessels using derivative branches.

Table 1 Details of the patients

<table>
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<tr>
<th>No.</th>
<th>Age</th>
<th>Sex</th>
<th>Underlying disease</th>
<th>Flap</th>
<th>Complication</th>
<th>Survival</th>
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<td>1</td>
<td>60</td>
<td>F</td>
<td>Tongue cancer</td>
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<td></td>
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<td>2</td>
<td>63</td>
<td>M</td>
<td>Rt. submandibular tumour</td>
<td>VFG, 7 cm</td>
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<td>Complete</td>
</tr>
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<td></td>
<td></td>
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<td>3</td>
<td>45</td>
<td>M</td>
<td>SCC, floor of mouth</td>
<td>VFG, 9 cm</td>
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<td>ALT, 14 × 7 cm, chimeric</td>
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<td></td>
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<td>4</td>
<td>63</td>
<td>M</td>
<td>Lt. submandibular tumour</td>
<td>VFG, 5 cm</td>
<td>None</td>
<td>Complete</td>
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<td>ALT, 21 × 5 cm, bridge</td>
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<tr>
<td>5</td>
<td>43</td>
<td>M</td>
<td>SCC, floor of mouth</td>
<td>VFG, 13 cm</td>
<td>Minor dehiscence</td>
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<td>Infection</td>
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<td>ALT, 21 × 9 cm, chimeric</td>
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ALT: anterolateral thigh flap; AMT: anteromedial thigh flap; VFG: vascularised fibular graft; SCC: squamous cell carcinoma.

double skin flaps can be elevated separately or with a single vascular source (Fig. 2, above right). In the rare event that absence of the lateral descending branch occurs, it is replaced by the medial descending branch which runs distally and laterally after giving off a medial perforator (Fig. 2, below left). The lateral descending branch sometimes terminates at the proximal portion of the vastus lateralis muscle as a muscle branch, then runs distally through the muscle giving off a few musculocutaneous perforators (Fig. 2, below right). Absence of the intermuscular space between the vastus lateralis and rectus femoris muscle rarely occurs.
Elevation of anterior thigh flaps

Doppler flowmetry to identify cutaneous perforators is always performed preoperatively. Angiography is also helpful if previous surgery or injury has affected the thigh. With the patient in the supine position, operative procedures are performed simultaneously by two surgical teams. A 10 cm longitudinal incision is made down to underlying muscle above the rectus femoris muscle at the centre of the anterior aspect of the thigh. One or two septocutaneous or musculocutaneous perforators are usually seen passing through the vastus lateralis muscle and/or the intermuscular septum along the lateral or medial side of the rectus femoris. After the dominant cutaneous perforator is selected, the vascular pedicle is skeletonised simultaneously with the procedure performed by the head and neck surgical team. The rectus femoris muscle is retracted medially and the intermuscular space separated by finger dissection. Should the cutaneous perforator pass through the vastus lateralis muscle, careful dissection is made to avoid damage to the vascular pedicle and muscle. Multiple small branches from the descending branch of the LCFA are ligated and motor nerve branches derived from the femoral nerve separated from the vessels. If a chimeric combined flap is planned, the large derivative branch should be preserved and included in the vascular pedicle. The flap is then outlined according to the size of the defect, and a circumferential incision made. This flap is then elevated proximally as a fasciocutaneous flap. If a thin flap is required, only a small amount of the fascia lata around the cutaneous perforator is attached to the flap.

Results

All flaps survived completely although cases 5 and 6 were complicated by minor wound dehiscence and infection by methicillin resistant staphylococcus aureus respectively. Both healed by secondary intention. The length of the vascular pedicle of the anterior thigh flaps ranged from 10 to 17 cm. The harvested fibular bone ranged from 5 to 13 cm (mean: 8.8 cm) in length (Table 1). In two patients (Cases 2 and 3) tumour recurred. One patient who had undergone postoperative deep radiotherapy developed a cervical fistula 2 months after reconstruction (case 4), but this healed upon removal of the titanium mini-plate implant.

Case reports

Case 1
A 60-year-old woman presented with an incurable large fistula on the chin and persistent exposure of the titanium plate. Two years earlier at another hospital, the patient underwent ablative surgery including segmental mandibulectomy for cancer of the tongue followed by extremely high doses of radiotherapy. Preoperative angiography revealed complete obstruction of all branches of the external carotid artery secondary to previous surgery and radiotherapy, but the thyrocervical trunk remained intact. The through and through composite mandibular defect was reconstructed using a vascularised fibular graft and an anteromedial thigh flap in 'bridge' fashion. A flow-through vascular pedicle 17 cm in length was interposed between recipient vessels and peroneal vessels as a vascular conduit. The postoperative course was uneventful and so far there has been no fistula recurrence (Fig. 3).

Case 5
A 43-year-old man presented with a squamous cell carcinoma of the floor of the mouth. The patient underwent tumour ablation with partial mandibulectomy and radical neck dissection following preoperative chemotherapy and radiotherapy. The massive composite defect was reconstructed using a vascularised fibular graft and an anteromedial thigh flap in 'bridge' fashion. A flow-through vascular pedicle 17 cm in length was interposed between recipient vessels and peroneal vessels as a vascular conduit. The postoperative course was uneventful and so far there has been no fistula recurrence (Fig. 3).
Figure 3  (A) Preoperative view showing a huge oromandibular fistula accompanying persistent exposure of the mandible and titanium plate. (B) Intraoperative marking of an anteromedial thigh flap measuring 12 × 21 cm. The distal portion of the flap was de-epithelialised to fill the submandibular dead space. (C) Postoperative X-ray at 2 months. (D) Postoperative view at 1 month.

Discussion

The goal of mandibular reconstruction is to achieve an aesthetically acceptable contour as well as masticatory, speech and swallowing function. Vascularised
Figure 4—(A) Resected specimen and 'Double-barrel' fibular graft preserving the continuity of the vasculature of the peroneal vascular pedicle and the periosteum. (B) Flap marking. (C) Harvested flaps. (D) Postoperative view at 1 month. (E) Schematic diagram illustrating flap positioning and anastomoses.

ALT: anterolateral thigh flap
AMT: anteromedial thigh flap
D: descending branch of the LCFA
P1: cutaneous perforator for anteromedial thigh flap
P2: cutaneous perforator for anterolateral thigh flap
M1: muscle branch
M2: muscle branch
PV: peroneal vessels
V: innominate vein
F: facial artery and vein
J: external jugular vein
iliac crest and scapula have commonly been used in the past. Recently however, vascularised fibula has become a popular choice for mandibular reconstruction. In oriental adults, the fibula is approximately 1.5 cm thick, and a straight bone segment more than 20 cm long can be harvested. Vascularised fibular graft, providing consistent thickness and cortical density, is therefore more appropriate for osseo-integrated implants than other alternatives. 7-9

Unreliability of the blood supply for the skin portion of the fibular osteocutaneous flap has been reported, but more detailed knowledge of vascular anatomy has led to improved survival. 10-14 Because it is thin and pliable, the skin paddle of the fibular osteocutaneous flap is suitable for intraoral lining and tongue reconstruction. Also, when two dominant perforators are found, a double skin paddle can be connected to the fibula for reconstruction of the through and through oromandibular defect. However, in massive through and through defects, the skin paddle is inadequate for extraoral skin coverage due to insufficient bulk. Submandibular dead space should be filled with appropriate bulk to avoid salivary fistula formation or disfigurement.

Anterior thigh flaps provide a long vascular pedicle and a large flap based on one or two perforators without sacrificing muscles and main vessels. It can readily be formed into a de-epithelialised flap or thin flap appropriate to the defect. Soft tissue defects of the oral floor and submandibular dead space following tumour ablation and neck dissection can be filled with a de-epithelialised portion so that salivary fistulae will not occur. Anterior thigh flaps have more adequate bulk than the skin portion of the fibular osteocutaneous flap for this purpose. The descending branch of the LCFA is the longest branch running distally that maintains an adequate calibre for anastomosis while the LCFA is the longest branch running distally that maintains an adequate calibre for anastomosis while giving off many derivative branches. When multiple tissue transplantation is required, additional anastomosis of the vascular pedicles of other flaps to these branches or to the distal end of the descending branch enables a combined flap in bridge or chimeric fashion (Fig. 1). 21 Wei et al10 used the distal run-off of the peroneal vessels as the recipient vessel for the second flap but, in our experience, positioning of the flaps is not easy due to the close attachment of the peroneal vessels to the fibula. Also, since harvesting of the peroneal vascular pedicle is limited to a maximum length of 5 cm, a vein graft is needed if there is no recipient vessel available in the vicinity of the defect. In these circumstances, using anterior thigh flaps, a long vascular segment of the LCFA can be interposed between the peroneal vessels and the vascular source distant from the defect as a flow-through vascular conduit. 21 14 We conclude therefore that combined anterior thigh flaps with vascularised fibular graft is the most suitable method for reconstruction of massive composite oromandibular defects.

References


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