Journal of Oral Science, Vol. 46, No. 1, 65-70, 2004

Case report

Three-dimensional reconstruction after oral oncologic surgery using *single* free radial forearm flaps or free rectus abdominis musculocutaneous flaps

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(Received 20 October 2003 and accepted 23 January 2004)

Abstract: This study reviews reconstruction of complex three-dimensional oral and maxillofacial defects using the *single* free radial forearm flap or the *single* free rectus abdominis musculocutaneous flap. Between 1996 and 2003, 124 patients underwent oral and maxillofacial reconstruction in the Department of Oral and Maxillofacial Surgery, Kobe University Graduate School of Medicine. Outcomes for 22 patients who underwent three-dimensional reconstruction of multiple surfaces were evaluated. Reconstruction was performed after resection of malignant tumors in all 22 patients. *Single* FAFs were utilized for 11 patients and single RAMs for the remaining 11. Flap survival rate was 100%. No major donor morbidity was observed, and all surviving patients (20/22) were able to perform normal daily living activities. *Single* FAF and RAM are useful materials for one-stage reconstruction of complex three-dimensional oral and maxillofacial defects requiring replacement of skin, mucosa, and intervening soft tissues. Good to excellent aesthetic results can be attained in most patients. (J. Oral Sci. 46, 65-70, 2004)

Key words: three-dimensional reconstruction; oral oncologic surgery; single flap; free radial forearm flap; free rectus abdominis musculocutaneous flap.

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Introduction

Extensive oral and maxillofacial defects following ablative surgery constitute a challenge for reconstructive surgeons. After extensive resection of malignant tumors in the oral cavity, defects frequently extend to the nasal cavity, maxillary sinus or face. Since each surface is covered with skin or mucosa, three-dimensional reconstruction of multiple surfaces is necessary (1-3).

In this study, we evaluated the usefulness of the *single* free radial forearm flap (FAF) and the single free rectus abdominis musculocutaneous flap (RAM) for three-dimensional oral and maxillofacial reconstruction.

Patients and Methods

Single FAFs or RAMs were used for reconstruction of oral and maxillofacial defects involving two or more anatomical regions or two or more cavities (face/oral cavity, oral cavity/nasal cavity, or face/oral cavity/nasal cavity). For reconstruction of the oral cavity alone, patients who underwent three-dimensional reconstruction involving three or more surfaces (palate/buccal mucosa/alveolus) were included in this study. However, patients who underwent reconstruction of the alveolus/mouth floor/tongue, which involves three surfaces but is not three-dimensional, were excluded.

Between 1996 and 2003, oral and maxillofacial reconstruction was performed at the Department of Oral and Maxillofacial Surgery, Kobe University Graduate School of Medicine, on 124 patients, 22 of whom fulfilled the above criteria for inclusion in the study. The clinical records of all patients were reviewed to obtain demographic data, tumor pathology, defect regions, combined operations

and clinical outcomes.

Results

Reconstruction was performed after resection of malignant tumors in all 22 patients (19 with squamous cell carcinoma and one each with basal cell carcinoma, synovial sarcoma and adenoid cystic carcinoma). *Single* FAFs were used for 11 patients and *single* RAMs for the remaining 11. The follow-up period ranged from 3 months (patient 15) to 6 years (patient 1). Patient 9 died 6 months and patient 12 died 3 months postoperatively. The other 20 patients are still alive. No instances of failure, partial loss, or any other complications, (including oronasal, oroantral or orocutaneous fistula, intraoral bulkiness, or velopharyngeal incompetence) were observed. All patients regained regular oral food intake. In patient 6, one late venous compromise occurred postoperatively, 30 hours after the FAF reconstruction, but was successfully salvaged by exploration during revision of a venous anastomosis. The primary lesion was resected together with the lip and oral commissure in five cases (patients 1, 2, 3, 4, 13 and 14), and one-stage reconstruction with a vermilion advancement flap (VAF) (4) was performed for each of these patients. In three cases (patients 10, 11 and 22) that underwent total maxillectomy, the orbital floor was reconstructed with a titanium mesh, and the contour of the cheek was reproduced with a maxillofacial prosthesis. Mandibular reconstruction was not used in six cases (patients 12, 13, 14, 16, 18, and 19) that underwent hemimandibulectomy, and the contour of the lower face or the cheek was reconstructed for aesthetic purposes with the muscular portion of the RAM (5). No major donor-site area morbidity, such as reflex sympathetic dystrophy (RSD) (6,7) of the forearm, herniation or bulging of the abdominal wall (8,9) was observed, and the patients were able to perform normal daily living activities (Table 1).

Table 1 Case of three-demensional reconstruction with a *single* skin flap or a musculocutaneous flap

Case	Age	Sex	Diagnosis	Reconstruction region	Flap	Remarks
1	75	M	SCC of left buccal mucosa	Buccal skin + oral commissure + buccal mucosa	FAF	Lips reconstruction with VAF
2	53	M	SCC of left buccal mucosa	Buccal skin + oral commissure + buccal mucosa	FAF	Upper lip reconstruction with VAF Secondary reconstruction with malar flap and skin grafting
3	65	M	SCC of right buccal mucosa	Buccal skin + oral commissure + buccal mucosa	FAF	Lips reconstruction with VAF
4	72	F	SCC of right buccal mucosa	Buccal skin + oral commissure + buccal mucosa	FAF	Lips reconstruction with VAF
5	62	F	BCC of left buccal skin	Buccal skin · nasal ala + nasal cavity + gingiva	FAF	Secondary reconstruction of malar flap for cheek and mesian forehead flap for nasal ala
6	75	F	SCC of intramaxilla	Hard palate + nasal floor + upper labial mucosa	FAF	Revision of venous anastomosis
7	74	M	SCC of left soft palate, buccal mucosa, tongue	Soft palate + buccal mucosa+ tongue	FAF	
8	65	M	SCC of left tongue	Soft ·hard palate + buccal mucosa + oral floor · tongue	FAF	
9	59	M	SCC of left tongue	Soft ·hard palate + buccal mucosa + alveolus (lower gingiva)	FAF	
10	63	M	SCC of left maxillary sinus	Maxillary sinus (upper + mesial + posteror + anterior wall·buccal mucosa + nasal cavity)	FAF	Orbital floor reconstruction using titanium mesh, total maxillectomy, maxillary prosthesis
11	60	F	SCC of left maxillary sinus	Maxillary sinus (upper + mesial + posterior + anterior wall·buccal mucosa + nasal cavity)	FAF	Orbital floor reconstruction using titanium mesh, total maxillectomy, maxillary prosthesis
12	65	M	SCC of left buccal mucosa	Buccal skin + oral commissure + buccal mucosa	RAM	Hemimandibulectomy, partial maxillectomy , maxillary denture
13	82	F	SCC of left buccal mucosa	Buccal skin + oral commissure + buccal mucosa	RAM	Hemimandibulectomy, lip reconstruction with VAF
14	65	M	SCC of left buccal mucosa	Buccal skin + oral commissure + buccal mucosa + soft palate	RAM	Hemimandibulectomy, lip reconstruction with VAF
15	66	F	SCC of left buccal mucosa	Buccal skin + oral commissure + buccal mucosa	RAM	
16	69	M	SCC of right lower gingiva	Soft · hard palate + buccal mucosa + gingiva·oral floor·tongue	RAM	Hemimandibulectomy
17	77	F	SCC of right buccal mucosa	Soft · hard palate + buccal mucosa + gingiva·oral floor·tongue	RAM	
18	78	F	SCC of left buccal mucosa	Soft · hard palate + buccal mucosa + gingiva·oral floor·tongue	RAM	Hemimandibulectomy, partial maxillectomy, maxillary denture
19	75	M	SS of right mandible	Soft · hard palate + buccal mucosa + gingiva·oral floor·tongue	RAM	Hemimandibulectomy, partial maxillectomy, maxillary denture
20	55	M	SCC of right tongue	Anterior + lateral oropharyngeal wall + soft palate + buccal mucosa + gingiva·oral floor·tongue	RAM	
21	55	M	SCC of left lower gingiva	Lower gingiva + buccal skin + buccal mucosa	RAM	Mandibular marginal resection
22	37	F	ACC of left maxilla	Maxillary sinus (upper + mesial + posterior + anterior wall·buccal mucosa + nasal cavity)	RAM	Orbital floor reconstruction using titanium mesh, total maxillectomy, maxillary prosthesis

SCC: squamous cell carcinoma
BCC: basal cell carcinoma
SS: synovial sarcoma
ACC: adenoid cystic carcinoma
FAF: free radial forearm flap
RAM: free rectus abdominis musculocutaneous flap
VAF: vermilion advancement flap

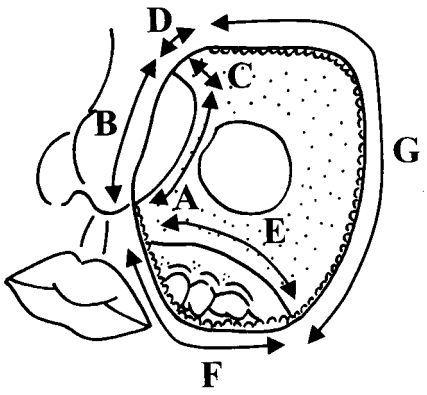
Case Reports

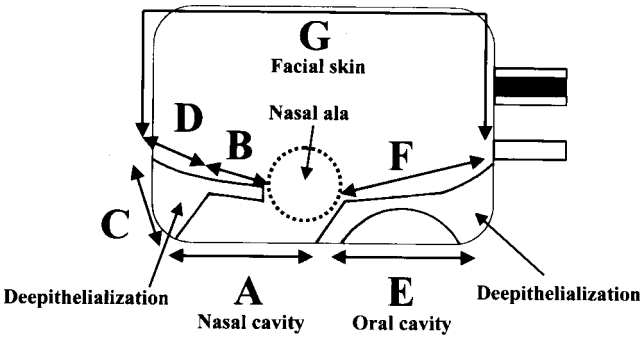
Patient 5

A 62-year-old female with basal cell carcinoma of the left buccal skin underwent resection of the facial skin including the nasal ala, resulting in exposure of the nasal septum, maxillary bone and upper gingiva. Reconstruction of the oral and nasal cavities and the facial skin were requisite. A *single* FAF was divided into three parts (face, nasal cavity and oral cavity) and used for a three-dimensional reconstruction of these regions. Revision and secondary reconstruction were accomplished with a malar flap for the cheek and a forehead flap for the nasal ala to achieve maximal aesthetic restoration. No recurrence was observed, and aesthetic appearance remained good six years postoperatively (Fig. 1).

(A)

(C)





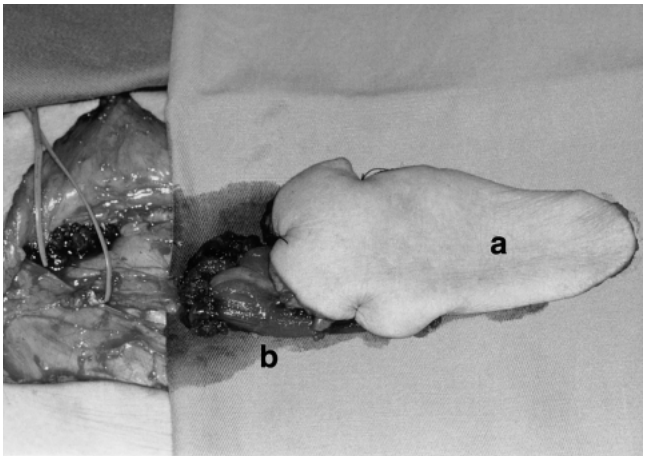
(B)

Fig. 1 Patient 5; (A) The left buccal skin was resected including the nasal ala. The nasal septum, maxillary bone and upper gingiva were exposed. (B) A single FAF was divided into three parts (face/nasal cavity/oral cavity) and three-dimensional reconstruction was performed. (C) Complete reconstruction in the primary operation.

Patient 14

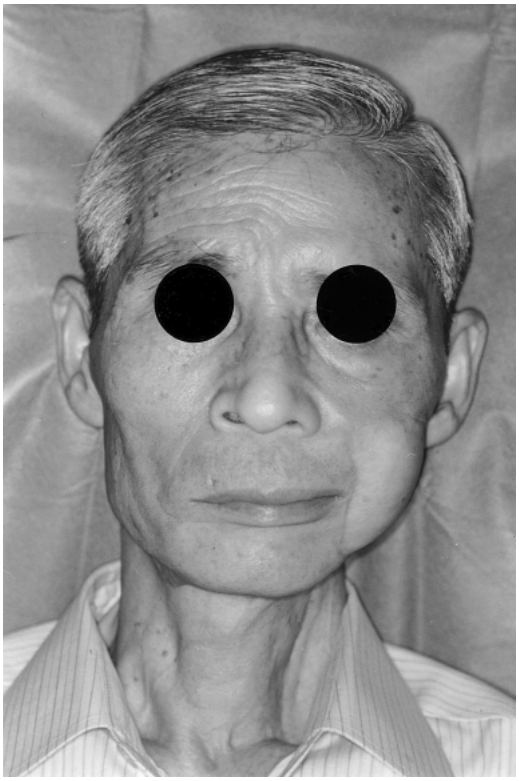
A 65-year-old male with advanced squamous cell carcinoma of the left buccal mucosa underwent a hemimandibulectomy, which involved resection of the soft palate, buccal mucosa, oral commissure, lower lip and buccal skin. A RAM was raised with the proximal portion comprising the skin and muscle, and a distal portion of only the skin. The soft palate, buccal mucosa and the contour of the cheek were reconstructed with the proximal portion, and the buccal skin with the folded distal portion. A VAF was produced in the lower lip, and the oral commissure and lip were reconstructed. Since the maxillary sinus remained open, masticatory function was restored with a prosthesis. No tumor recurrence has been observed 2 years postoperatively (Fig. 2).

(A)

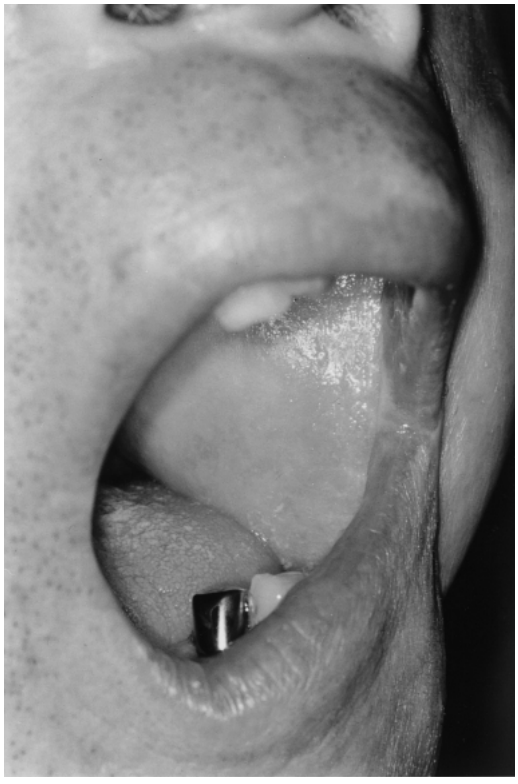


(B)-a

(B)-b



(C)-a



(C)-b

Fig. 2 Patient 14; (A) The defects were the soft palate, buccal mucosa, oral commissure, lower lip, buccal skin and half of the mandible. (B)-a A RAM was raised with its distal portion comprising the skin alone (a), and the proximal portion comprising the skin and the muscle (b). (B)-b The soft palate, buccal mucosa and the contour of the cheek were reconstructed with the proximal portion containing the muscle, and buccal skin was reconstructed by folding the distal portion comprising the skin alone. A vermilion advancement flap was produced in the lower lip, and the oral commissure and lip were reconstructed. (C) No tumor recurrence has been observed two years postoperatively.

Discussion

Defects resulting from extirpation in the oral and maxillofacial region (oral cavity, nasal cavity, maxillary sinus and facial skin) constitute major functional and aesthetic reconstructive challenges due to their complex three-dimensional nature. Various pedicled regional flaps, such as the deltopectoral flap, pectoralis major musculocutaneous flap, and forehead flap, have therefore been advocated (10). Basically, however, regional pedicled flaps are inappropriate for these defects because of limitations of the arc of rotation, flap size and bulkiness, unreliability in transferring for three-dimensional reconstruction, and the necessity to extend the reach with delay procedures. Unidimensional closure of midface defects results in scar contracture, poor aesthetic appearance, and inadequate function. On the other hand, microvascular free tissue transfer provides well-vascularized composite tissue with which reconstruction of multiple planes can be freely performed, thus filling potential dead space (11). With free tissue transfer, one-stage replacement of the important surfaces of the defect becomes possible.

Flaps with the circulation preserved for three-dimensional reconstruction should be transferable with adequate volume to the recipient site, soft and flexible for one-stage application to complicated three-dimensional defects, and should leave minimal postoperative scar contracture. FAFs represent the best option for microvascular free flaps as they meet all of these conditions (3). When the amount of reconstruction is large, however, the FAF is too thin, dead spaces become difficult to fill, and the midface contour cannot be reproduced. The use of free musculocutaneous flaps is in such cases, and RAMs are optimal because of the flexibility of the cutaneous portion for three-dimensional reconstruction (12). For both types of vascularized free flaps, it is particularly important that three-dimensional reconstruction should be easily performed with a *single* flap.

Unexpected situations often occur during reconstructive surgery, and the preoperatively planned procedures may not be implementable. An advantage of free flaps is that appropriate changes during surgery are possible according to the situation. Tentative reconstruction plans can thus be made based on the "Cut as you go" principle. Reconstruction is implemented using resection and de-epithelialization to preclude raw surfaces and adapt to situations.

One disadvantage of FAFs and RAMs is their poor color and texture matching with facial skin, leading to suboptimal aesthetic results, as was seen for patients 2 and 5. Such color mismatches can be compensated with full-thickness grafts or local flaps such as the malar or forehead flap in second-stage procedures.

Conclusion

Free skin flaps and musculocutaneous flaps are useful for three-dimensional reconstruction in the oral and maxillofacial region because: 1) a three-dimensional structure can be produced from a *single* skin or musculocutaneous flap, and 2) a "Cut as you go" approach is feasible. Of the numerous types of flaps reported, the FAF and RAM seem to be the most suitable for such reconstructions.

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