

Multi-Factorial Functional Analysis of the Patients with Reconstruction for Oral Carcinoma

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Abstract

This paper is to evaluate postoperative function which has undergone reconstruction with vascularized or pedicled flaps for the treatment of oral carcinomas. The subjects consisted of 22 cases of 17 male and 5 female patients, and their mean age was 55 years. The sites of reconstruction were the tongue in 12 cases, mandible in 10 cases. The reconstruction was performed using deltopectoral (DP) flaps in 6 cases, pectoralis major musculo cutaneous (PMMC) flaps in 3 cases, DP flap + PMMC flap in one case, forearm (FA) flaps in 8 cases and peroneal (P) flaps with fibula in 4 cases. Postoperative masticatory, speech, swallowing functions and facial appearance were evaluated by Multi-factorial analysis. All functional results seem to be related to the type of resection. By multi-factorial analysis, the type of mandibular resection, flap area, and anterior resection were related to the masticatory or speech function in tongue resection. In mandibular resection, masticatory function was subjected to age; speech function was subjected to type of mandibular resection and plate reconstruction. The facial appearance was subjected to flap area. These results suggested that postoperative function was not related to only one factor, but using the classification of each defect site as one of the factor of multi-factorial analysis was useful.

Keywords

Oral Cancer, Postoperative Function, Reconstruction

1. Introduction

In spite of many advances in surgical technique in head and neck cancer, many patients suffer postoperative

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dysfunction.

There are many factors influencing the postoperative functional status, such as primary site, T classification, flap type, irradiation and neck surgery. But, there is little information available concerning postoperative patient's function.

In the influencing factors, the size and extent of resection and type of flap of reconstruction used are considered to be important determinants of postoperative functional status in advanced oral carcinoma [1]-[7].

In this study, we investigated the postoperative function and the factors influencing function in patients who underwent reconstruction with vascularized or pedicled flaps for surgical defects.

2. Patients and Methods

From 23 patients who had undergone reconstructive surgery for oral cancer in our university hospital, one patient who had total necrosis of forearm (FA) flap was excluded. The subjects consisted of 17 male and 5 female patients who underwent reconstruction of defects resulting from treatment of carcinomas. Their mean age was 55 years. The sites of reconstruction were the tongue in 12 cases, mandible in 10 cases. The flaps for reconstruction were deltopectoral (DP) in 6 cases, pectoralis major musculocutaneous (PMMC) in 3 cases, DP and PMMC in one case, forearm (FA) in 8 cases and peroneal (P) with fibula in 4 cases (**Table 1**). The type of flap reconstruction for each patient was selected considering patient's general conditions. In mandible reconstruction, some patients had the plate reconstruction other than vascularized fibula flap for shortning the operation time.

For postoperative function, masticatory, speech, swallowing functions and facial appearance were evaluated. The evaluation was done by a grading system that was reported by our previous study (**Table 2**) [8] [9].

The masticatory function was evaluated by conducting interviews with patients, and classified into 4 grades from grade 1, able to eat a normal diet to grade 4, dependent on tube feeding. For postoperative speech function, the articulatory grade of the patients was classified by speech therapist into 5 grades from grade 1, easy to understand and no problem in daily conversation to grade 5, unable to understand in conversation. Swallowing function was classified by interview into good, slightly disturbed and poor. Facial appearance was evaluated objectively by our team and classified as good, acceptable and poor. All evaluations were done in 6 months after operation.

The classification of extent of tumors is described in **Figures 1-4** and **Table 3**.

To analyze the factor influencing the postoperative function, multivariable analysis was done.

For multivariable analysis, all independent factors which p value was less than 0.1 in the regression analysis were entered to multiple regression analysis. In this study, age, sex, TNM classification, flap size, free flap, irradiation, radical neck dissection, plate reconstruction, type of resection and residual tooth number were analyzed for masticatory, speech, swallowing function and facial appearance. Statistical analyses were performed by SPSS version 10.0 (SPSS, Inc.).

3. Results

3.1. Function in Terms of Sites

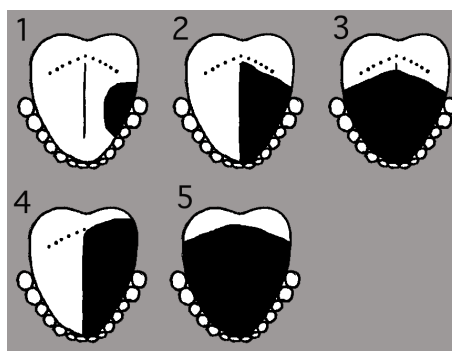
The detailed data of 22 patients entered in the functional analysis is described in **Table 4**. In the group of tongue resection, masticatory function was poor in patients with types 4 and 5, and speech function was poor in patients

Table 1. Reconstruction site and type of flaps.

	Tongue	Mandible	Total
DP	2	4	6
PMMC	2	1	3
DP + PMMC		1	1
FA	7	1	8
Peroneal	1	3	4
Total	12	10	22

Table 2. Gradings of masticatory, speech, and swallowing functions and facial appearance.

A: Masticatory function	
Grade	1. able to eat normal diet
	2. able to eat soft diet
	3. able to eat liquid diet
	4. depend on tube-feeding
B: Speech function	
Grade	1. easily understandable
	2. sometimes not understandable
	3. understandable if contents are previously informed
	4. sometimes understandable
	5. not understandable
C: Swallowing function	
Grade	1. good
	2. slightly disturbed
	3. poor
D: Facial appearance	
Grade	1. good
	2. acceptable
	3. poor

**Figure 1.** Classification of tongue resection.

with anterior tongue resection (types 3 and 5) (Table 5). Swallowing function and facial appearance were normal in all cases.

In the group of mandibular resection, masticatory function, speech function and facial appearance are seemed to be worse in advanced resection type (Table 6).

3.2. Multiple Regression Analysis Study in Tongue and Mandible Resection

In tongue resection, the p value of type of mandibular resection was 0.018 in masticatory function. And p value of flap area and anterior resection was 0.042 in speech function. When the larger flap was used, the speech function became better. And speech function was poor in patients with anterior tongue resection (Table 7).

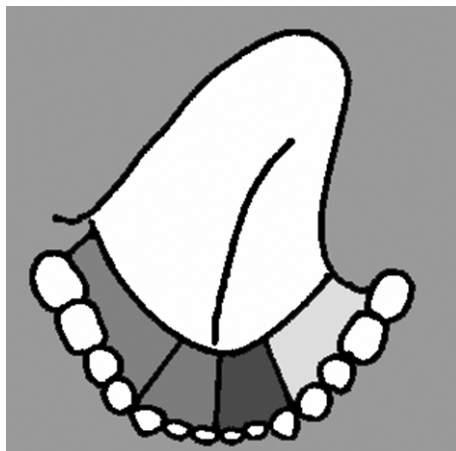


Figure 2. Classification of FOM resection.

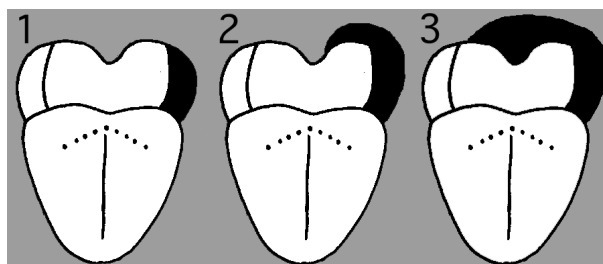


Figure 3. Classification of oropharynx resection.

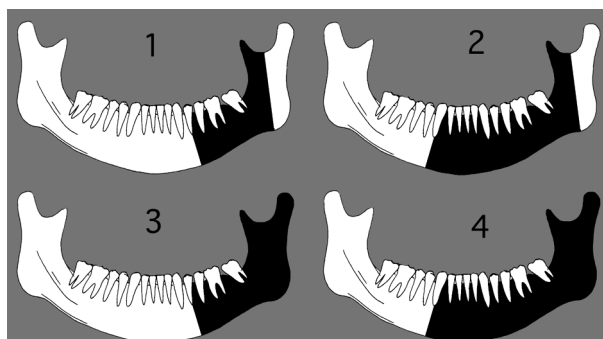


Figure 4. Classification of mandible resection.

In mandibular resection, age was an influencing factor ($p = 0.038$) in multiple regression analysis in masticatory function. p value of plate reconstruction and type of mandibular resection were 0.008, 0.012 respectively in speech function. Facial appearance was influenced by flap area. When the larger flap was used, the function became better ($p = 0.005$).

4. Discussion

Reconstruction of the head and neck defects with flap is a routine procedure to minimize functional disturbance and facial deformity resulting from abrasive surgery.

There are many reports about various types of flap reconstruction for oral defects [1]-[20].

Talensnik *et al.* [16] said the free flap is better than PMMC and Vaughan *et al.* [17] compared free flaps with their previous study of pedicled flap and concluded that free flap had better outcome. Though, our data didn't show that the functional deference among flap types, the free flap is thought better than pedicled flap, because the free flap is pliable and can de-epithelialize to pack into dead space [8].

Table 3. The classification of tumor resection.**A. Tongue**

1. partial resection of tongue
2. hemiglossectomy of mobile tongue
3. bilateral resection of anterior tongue
4. hemiglossectomy
5. total glossectomy

B. FOM

1. 1 part of FOM resection
2. 2 parts of FOM resection
3. 3 parts of FOM resection
4. 4 parts of FOM resection

C. Oropharynx

1. unilateral oropharyngeal resection
2. 1 + unilateral soft palate resection
3. 1 + bilateral soft palate resection

D. Mandible

1. segmental mandibulectomy
2. segmental mandibulectomy involving symphysis
3. hemimandibulectomy
4. hemimandibulectomy involving symphysis

Although posterior resection was mentioned to be a predictive factor for speech in tongue resection by Imai *et al.* [3], Pauloski *et al.* [12], and Schliephake *et al.* [15], our data showed that speech function was poor in patients with anterior tongue resection (type 3 and 5). This finding is almost same as Colangelo *et al.* [2] and Matsui *et al.* [20].

McConnel *et al.* [7] showed a relationship of swallowing function to extent of oral tongue and extent of tongue base resection, Colangelo *et al.* [2] and Zelefsky *et al.* [19] noted that T stage was a good predicting factor for speech and swallowing function. Our study had shown tumor site and flap area to be the predicting factor but no correlation with T stage. It is difficult to evaluate the accurate size of defects, because of complicated structures in the posterior tongue area, thus we have to consider the tumor site and flap size as well as the tumor size to evaluate postoperative function. Colangelo *et al.* [2] also investigated the effect of irradiation to functional outcome, and he found no effects.

Our data didn't show the irradiation influenced the postoperative function neither.

In terms of masticatory function in tongue resection, only the type of mandibular resection was related to the function. Combination of the type of resection, for example type 2 tongue resection + type 3 mandibular resection, was thought to be a predictive factor.

In mandible region, T and stage classification weren't used. Because all cases in this study had T4 and stage 4, we were unable to compare the T and stage classification. The difference in volume of flap area was noted in facial appearance. This result means that the larger flap had good facial appearance. In speech function, type of mandibular resection and plate reconstruction were affected function.

In masticatory function, the age is related to function. This result means that old patients with many systemic disease had more minimal surgery as plate reconstruction rather than bony reconstruction. This should be a reason for the age was related to the function.

Table 4. Clinical findings of patients (n = 22).

Case	Age	Sex	Site	Diag.	T	N	Stage	Area	Rx	Reconst.	Plate	Timing	RND	Type of resection				Function				Face	Tooth
														tongue	ant.	mand.	FOM	Oro.	Max.	Mast.	Sp.		
1	43	M	mand.	SCC	4	2b	4	49	50.0	DP		0	1	2	2	1	2	1	1	3	22		
2	53	M	mand.	SCC	4	1	4	48	50.0	DP	1	0	1	2	3	1	2	2	1	3	13		
3	56	M	mand.	SCC	4	1	4	80	74.4	DP	1	0	1	3	2	2	+	2	3	1	2	19	
4	49	M	mand.	SCC	4	1	4	100	50.0	DP + PMMC		0	1	2	2	0	2	1	1	2	21		
5	36	M	mand.	SCC	4	2b	4	36	50.0	FA		0	1	4	-	4	2	2	2	2	1	3	19
6	36	M	mand.	SCC	4	2b	4	80	50.0	peroneal		1	1	4	-	4	2	2	1	2	1	2	19
7	57	F	mand.	SCC	4	0	4	64	0.0	peroneal		0	0	2	1	0	2	1	1	2	13		
8	59	M	mand.	SCC	4	1	4	48	42.0	PMMC		0	1	4	2	0	2	2	1	3	3		
9	56	M	mand.	SCC	4	2b	4	64	60.0	DP		0	1	3	2	1	2	2	1	3	17		
10	37	M	mand.	SCC	4	0	4	72	63.8	peroneal		0	1	2	2	0	1	1	1	2	18		
11	50	F	Tongue	SCC	2	0	2	56	18.0	DP		0	1	2	-	2	1	1	1	1	28		
12	68	M	Tongue	SCC	4	2c	4	48	0.0	DP		0	1	5	+	2	1	2	3	1	1	22	
13	68	F	Tongue	SCC	2	1	3	24	0.0	FA		0	0	4	-	2	1	2	1	1	28		
14	59	M	Tongue	SCC	2	0	2	28	0.0	FA		0	0	4	-	2	1	1	3	1	1	26	
15	67	M	Tongue	SCC	2	0	2	25	50.0	FA		0	1	4	-	2	1	2	2	1	1	2	
16	58	F	Tongue	SCC	3	2b	4	48	50.0	FA		0	1	5	+	2	1	1	2	1	1	5	
17	55	M	Tongue	SCC	2	1	3	30	0.0	FA		0	1	3	+	3	1	3	1	1	21		
18	61	F	Tongue	SCC	3	0	3	25	0.0	FA		0	0	5	+	2	1	1	2	1	1	28	
19	68	M	Tongue	SCC	4	1	4	36	0.0	FA		0	1	5	+	2	1	2	3	1	1	27	
20	48	M	Tongue	SCC	3	2c	4	84	50.0	peroneal		0	1	4	-	1	2	1	3	1	1	26	
21	60	M	Tongue	SCC	3	1	3	64	70.0	PMMC		0	1	4	-	2	1	1	1	1	13		
22	58	M	Tongue	SCC	3	1	3	40	99.0	PMMC		0	1	3	+	2	1	3	1	1	20		

mand.: mandible; SSC: squamous cell carcinoma; Area: flap area; 0: primary; 1: secondary; ant: anterior resection of tongue; Max.: maxilla; Mast.: mastication; Sp.: Speech; Sw.: swallowing.

Table 5. Function in patients with tongue resection (n = 12).

Type of resection (1-5)				
	2	3	4	5
Masticatory function (1-4)				
1	1	2	3	2
2			1	2
3			1	
Speech function (1-5)				
1	1		2	
2			2	1
3		2	1	3

Table 6. Function in patients with mandibular resection (n = 10).

	Type of resection		
	2	3	4
Masticatory function (1-4)			
1	1		1
2	4	2	4
Speech function (1-5)			
1	4		
2	1	1	3
3		1	
Face appearance (1-3)			
2	3	1	1
3	2	1	2

Table 7. Multiple regression analysis of function after resection.

	A. Tongue			
	R ²	P value	SC	VIF
Mastication	0.753			
Sex		0.266	0.239	1.111
T		0.142	0.341	1.209
Flap area		0.380	-0.265	2.262
Type of mand		0.018	0.846	2.128
Speech	0.624			
Flap area		0.042	-0.499	1.068
Anterior		0.042	0.499	1.068
	B: Mandible			
	R ²	P value	SC	VIF
Mastication	0.433			
Age		0.038	0.658	1.00
Speech	0.934			
Rx		0.934	0.129	1.445
Plate		0.008	0.654	1.816
Type of mand		0.012	0.635	2.051
Type of Oro		0.621	0.085	1.959
Face	0.785			
N		0.096	0.348	1.070
Flap area		0.005	-0.731	1.070

SC: Standardized Coefficients; VIF: Variance inflation factor; mand.: mandible; oro.: oropharynx.

About the classification of type of resection for oral cancer, Jacobson *et al.* [5] used 5 categories and Yamashita *et al.* [18] used 8 categories for oral and oropharyngeal defects. And Imai *et al.* [3] made a classification by combination of 6 type of tongue resection and 3 types of FOM resection. We have been using original criteria as seen in **Table 4** and **Figures 1-4**, for many years. This time, we proposed the combined expression of each defect score, and the usage of multivariate analysis. In our classification, type of mandibular resection correlated with masticatory function in tongue resection and speech function in mandibular resection. And anterior resection of tongue had worse speech function.

Although this study was performed in only small samples, post-operative functions were suggested to have relation with type of defects and type of reconstructions. Using the classification of each defect site as one of the factor of multi-factorial analysis is suggested to be useful.

5. Conclusion

All functional results seem to be related to the type of resection. These results suggested that postoperative function was not related to only one factor, but using the classification of each defect site as one of the factor of multi-factorial analysis was useful.

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None.

Competing Interests

None declared.

Ethical Approval

Not required.

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