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Risk factors for flap failure and complications in microvascular free flaps*

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미세혈관유리피판 이식의 실패 위험인자 및 합병증 연구

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ABSTRACT

Background: Many surgeons consider free flap reconstruction as a standard protocol for orofacial defects requiring tissue grafts. This study aimed to figure out risk factors of free flap failure and complications in the orofacial region through retrospective analysis

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of 1143 cases performed at a single institute.

Methods: Medical records of patients who underwent microvascular free flap reconstruction surgeries between 2006 and 2018 were reviewed. Total of 1143 free flaps were included. Each risk factor was examined by univariate analysis using chi-squared and Fisher's exact tests. Factors influencing local and systemic complications were also examined.

Results: Overall success rate of free flap transfer surgeries performed over 13-year period was 96.5%. Microvascular anastomosis using saphenous vein graft resulted in statistically significant increase in flap failure rate. Higher tendency for developing local complications was shown in male, latissimus dorsi free flap, and double free flap groups. Risk of wound dehiscence was higher in the male and double free flap groups, while risk of bleeding was higher in the preoperative chemotherapy group. Also, old patients were at higher risk of developing systemic complications, the most common causes of which were vein crises.

Conclusions: With proper planning and surgical technique, free flap reconstruction is a safe and reliable treatment option for various defects of the head and neck region. Attention to known risk factors may aid in achieving successful free flap reconstruction.

Keywords: maxillofacial reconstruction, microvascular free flap, risk factor, flap failure, complication

초 록

연구 목적: 구강악안면부 결손의 기능적, 형태적 회복을 위해서 다양한 재건술이 시도되고 있으며, 그중에서도 미세혈관 문합술을 통한 유리 피판 재건이 우선적으로 사용되고 있다. 하지만 여러 가지 장점에도 불구하고 유리피판술은 고난이도의 수술이라는 점과 실패 시 공여부와 수여부의 합병증 및 장애의 위험요소가 있어 성공률이 매우 중요하다. 본 연구의 목적은 단일기관에서의 환자들을 대상으로 구강악안면부 미세혈관유리피판 이식을 사용한 재건 시 실패 위험인자와 합병증에 대한 후향적 연구를 통해, 유리피판술의 성공율을 높이고 발생 가능한 합병증을 감소시키기 위함이다.

연구 방법: 서울대학교치과병원 구강악안면외과에서 2006년부터 2018년까지 시행된 미세혈관유리피판 이식술을 시행받은 1143 증례를 후향적으로 조사하여 분석하였다. 환자의 인구통계학적 정보, 이식술 시행 전 병리학적 진단명, 결손부위, 피판의 종류, 피판성공 유무, 피판 실패원인, 국소/전신 합병증, 술 전 항암치료 및 방사선치료의 유무, 정맥이식술, 피판 구제술의 방법, 흡연와 음주 습관 등을 조사 분석하였다. 유리피판술의 실패 위험인자와 술 후 합병증에 대하여 chi-square test 및 Fisher's exact test를 통한 단변량분석을 시행하였다.

연구 결과: 13년간 1143개의 유리피판 이식술 성공률은 96.5% 였으며, 다양한 요인 중 유리피판 이식술의 성공률에 유의한 영향을 주는 요인은 정맥이식이었다. 총 40개의 이식술 실패 증례에서 가장 많은 비율을 차지한 18개의 증례는 정맥혈관의 혈전이었으며, 기록상 이유를 알 수 없는 15개의 증례 또한 대부분 정맥혈관에서의 문제로 유추할 수 있었다. 술 후 출혈, 동맥혈관의 혈전과 불완전함이 뒤를 이었다. 기타 나이, 성별 및 부위, 피판의 종류 등에서는 성공률에 유의한 영향을 주지 않았다. 합병증 관련 부분에서는 술 전 방사선 치료를 시행한 환자와 광배근 피판 시행한 환자에서 국소합병증의 비율이 상대적으로 높았으며, 술 전 항암치료를 시행한 환자에서 술 후 출혈 경향이 높았다. 전신합병증에서는 나이 요인으로 60세 이상의 환자에서 60세 미만 환자보다 증가되는 경향을 관찰하였다.

결론: 본 연구는 국내 환자에서 시행한 대규모 단위의 구강악안면외과 분야 유리피판술에 대해 피판술의 실패 및 합병증 요인을 종합적 분석하였다. 본 연구의 실패율에 대한 분석과 합병증에 영향을 주는 요인에 대한 분석을 바탕으로 수술을 보다 더 안전하고 예측력 있도록 할 수 있는 기초적 자료가 될 수 있으며, 해외의 다른 나라 혹은 국내의 다른 기관과의 비교 연구를 통하여 경향성 및 차이점에 대해서도 분석할 수 있는 기초자료가 될 것이다,

주제어: 악안면재건, 미세혈관유리피판, 위험인자, 피판 실패, 합병증

CONTENTS

Ⅰ. Introduction

Since the introduction of free jejunum flap by Seidenberg et al.(1959), vascularized free flap has become a major surgical tool for the reconstruction of orofacial defects(Kim et al. 2008). There have been many studies on the outcome of free flap surgeries and their associated risk factors and the studies have reported free flap transfer success rates of 90% to 97%(Eckardt et al. 2007; Pohlenz et al. 2012; Gerressen et al. 2013; Zhang et al. 2015; Sanati-Mehrizy et al. 2016). Over the years, numerous clinicians and researchers have developed surgical techniques and modified the previous ones. The accumulation of knowledge and experience have resulted in shorted operation time and hospitalization period, fewer complication and lower flap failure rate(Kakarala et al. 2012). Flap failures, however, still occur for several reasons such as thrombosis, calcified artery and mechanical obstruction(Yu et al. 2009). Flap failure in the orofacial region can be a burden to both the surgeon and the patient since it entails tissue defect and, often times, functional debilitation.

Many parameters can affect the rate of flap failure and complication, and risk factors of flap failure and complication have been reported in many previous studies(Eckardt et al. 2003; Zhang et al. 2015). Some study reported that patient age, operating time and tobacco use seemed to be risk factors for complications(Eckardt et al. 2003). Nuara et al.(2009) suggested that chemotherapy or radiation therapy involving the site of defect might be positive predictors for postoperative complications of microvascular reconstruction surgeries. Arce et al.(2012) on the other hand, reported that neither radiation alone nor concomitant chemo-radiotherapy had a statistically significant effect on the overall flap success or complication rates.

In Seoul National University Dental Hospital, free flaps with microvascular anastomoses have been a standard protocol of orofacial reconstruction since 1996. This study includes accumulated data of 13-year period from 2006 to 2018. Earlier cases were excluded from this study for poor preservation quality of patient information and lack of digitized records. The aim of this study was to present and analyze demographic information and clinical records of the 1143 free flap reconstruction cases retrospectively, and make an assessment on risk factors related to flap failures and postoperative complications.

Ⅱ. Patients and Methods

1. Patients

Demographic information and clinical records were collected from all patients who underwent orofacial microsurgical free flap reconstruction at Department of Oral and Maxillofacial Surgery, Seoul National University Dental Hospital from January 2006 to December 2018. With approval granted by the institutional review board (IRB number: S-D20150032), radiographic records, outpatient records, and inpatient progress notes including operation records of 1015 patients who received total of 1143 free flap reconstruction surgeries were reviewed. Collected information includes primary pathology, sites of defect, type of free flaps used, success or failure of the free flap, local and general complications, and salvage methods. Patients who underwent pre-operative chemotherapy or radiotherapy were further investigated for possible influence of adjunctive cancer therapies on flap failure and complication rates. Sequential flap surgeries, double free flap cases and concomitant saphenous vein graft cases were also further analyzed separately.

Systemic diseases such as hypertension and diabetes and social histories such as smoking and alcohol consumption were reviewed for their influence on flap failure and complication rates. Postoperative complications were divided into two groups: local and general. Local complications included wound dehiscence, infection, postoperative bleeding, flap necrosis, and malocclusion that required additional treatments both surgical and nonsurgical. Three most common local complications—dehiscence, infection and bleeding—were investigated independently from each other. Systemic complications included postoperative cardiovascular, pulmonary and/or neurologic problems.

2. Statistical analysis

Each of the risk factors including both patient and surgical factors was examined by univariate analysis using chi-squared and Fisher's exact tests. Statistical analysis was done using the statistical package (SPSS for Windows releases 21.0.0.0, SPSS Inc., Chicago, IL, USA). A p-value of 0.05 or less was regarded as statistically significant.

Ⅲ. Results

Total of 1143 free flap transfer surgeries were performed on 1015 patients. Of the 1143 cases, 939 were primary reconstructions immediately following ablation surgery, and the other 204 cases were secondary reconstruction of pre-existing defects. The number of flap surgeries performed every year for the 13-year period is shown in Table 1. On average, 88 cases were conducted per year.

Median age of patients was 59 years with range of 4 to 90 years. The overall male to female ratio was 56:44 (643 male and 500

female). Primary pathologies responsible for the ablation surgeries are listed in Table 2. Most common causative primary pathology was squamous cell carcinoma (67.4%), while the most common reasons for secondary reconstruction were deformity (53.9%) followed by failed flap (15.6%) and recurred tumor (15.6%) (Table 3).

Table 4 lists risk parameters of flap failure. Overall flap success rate was 96.5% (1103 of 1143 cases). Age, gender, systemic disease, habitude and defect sites were not found to have statistically significant effect on flap failure. With regard to types of free flap, radial forearm free flap (RFFF) accounted for the most portion with 472 cases (41.3%) followed by fibula free flap (FFF) with 292 cases (25.5%) and latissimus dorsi free flap (LD) with 194 cases (17.0%). Among the flap failures, 17 cases were RFFF, 9 were FFF, and 9 were LD.

Four of 22 cases (18.2%, $p < 0.05$) performed with saphenous vein graft for vascular anastomosis resulted in flap failures (Figure 1). Preoperative chemotherapy, preoperative radiotherapy, and double free flap surgery did not have statistically significant effect on the flap failure rate.

Total of 40 free flaps failed due to thrombosis, post-operative bleeding or unknown reasons (Figure 2). Medical records of 15 failure cases indicated no apparent or probable cause for the flap failure (Table 5). Among the 40 failures, 16 cases were reconstructions of the mandible, 12 cases of the maxilla, and 8 cases of the tongue and mouth floor (Table 4).

Following flap failures, the most common salvage treatment was a secondary reconstruction using another free flap transfer. Other salvage methods included debridement without reconstruction and pedicled flaps. (Table 6).

In Tables 7 and 8, the univariate analyses of risk factors associated with local and general complications are listed. The three most common local complications－dehiscence, infection and bleeding

-were examined separately for each parameter. Male patients were at higher risk of developing local complications compared to female patients (OR: 1.878, CI: 1.400-1.520, $p < 0.001$). According to analysis by flap types, LD (OR: 1.844, CI: 1.252-2.715, $p < 0.05$) and other minor flap types (OR: 2.719, CI: 1.311-5.635, $p < 0.05$) showed increased risk of developing local complications. As for categories of local complication, male gender (OR: 1.579, CI: 1.117-2.234, $p < 0.05$), and the use of double free flaps (OR: 2.478, CI: 1.083-5.667, $p < 0.05$) increased the risk of dehiscence significantly. On the other hand, pre-operative chemotherapy (OR: 2.390, CI: 1.004-5.686, $p < 0.05$) increased the risk of postoperative bleeding while pre-operative radiotherapy ($p < 0.05$) increased the risk of local complication. Old patient (age over 60) showed statistically significant correlation with increase in systemic complications(OR: 2.113, CI: 1.271-3.511, $p < 0.05$).

Figure 1. Intraoperative photographs showing vein grafting for anastomosing contralateral neck donor vessel at osteoradionecrosis mandible reconstruction.

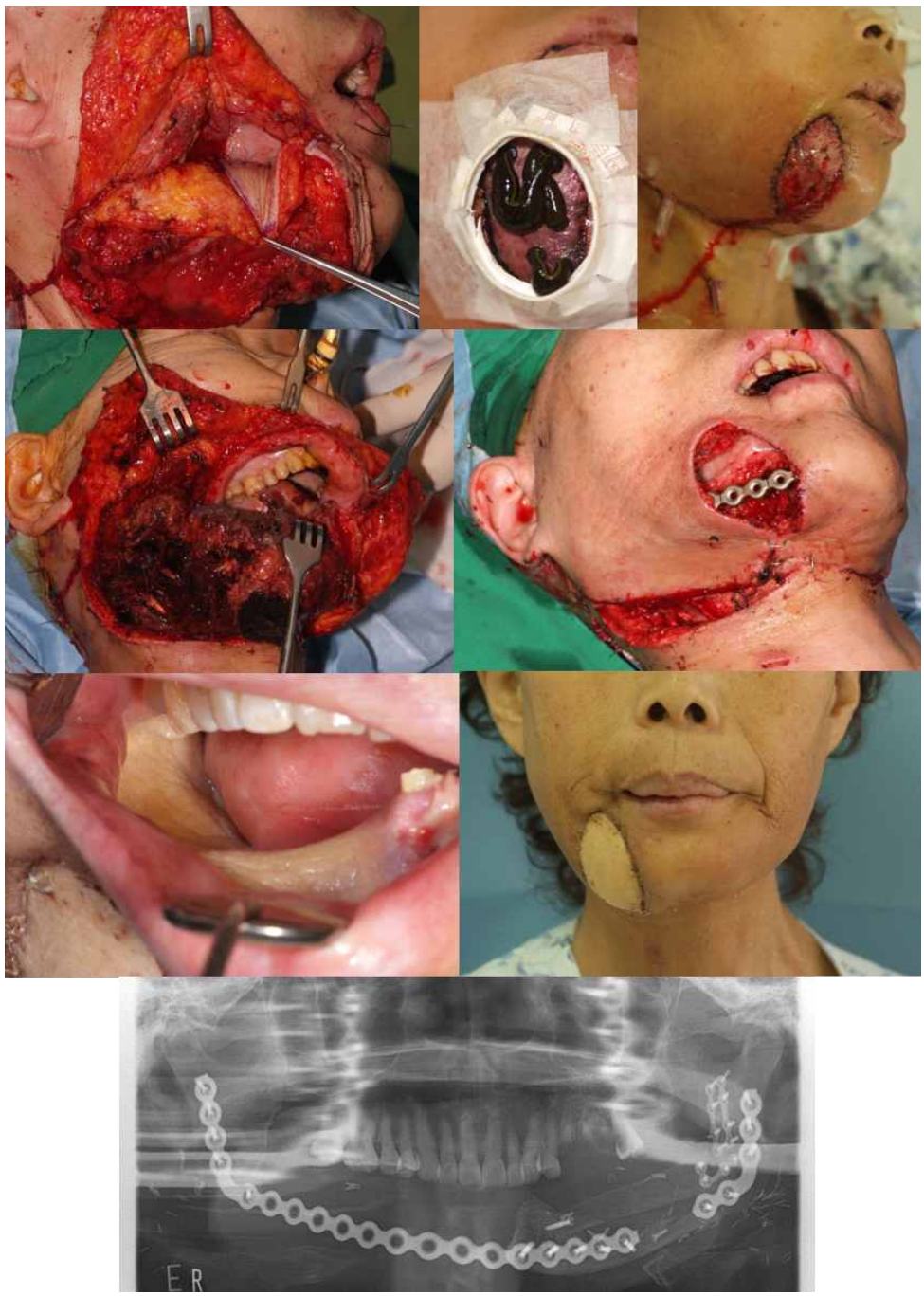

Figure 2. Venous crisis was firstly managed with medical leech. Ultimately, venous patency was not restored and fibular flap was changed with LD flap + reconstruction plate.

Table 1. Distribution of microvascular flap performed and number of failed cases

Year	Cases	Fail cases
2006	81	2
2007	83	3
2008	94	7
2009	72	4
2010	81	3
2011	77	2
2012	98	4
2013	80	5
2014	103	3
2015	101	1
2016	110	3
2017	79	1
2018	84	2
Total	1143	40

Table 2. Primary pathology of 1143 free flap reconstruction cases

Primary pathology	Total cases(%)	Fail cases(%)
Squamous cell carcinoma	770 (67.4)	25 (62.5)
Mucoepidermoid carcinoma	43 (3.8)	4 (10)
Ameloblastoma	38 (3.3)	3 (7.5)
Melanoma	34 (3.0)	0
Osteoradionecrosis	31 (2.7)	1 (2.5
Adenoid cell carcinoma	30 (2.6)	2 (5.0)
Osteosarcoma	29 (2.5)	1 (2.5)
Deformity	23 (2.0)	0
Adenocarcinoma	22 (1.9)	0
Chondrosarcoma	13 (1.1)	0
Osteomyelitis	12 (1.0)	0
Others	98 (8.6)	4 (10)
Total	1143	40

Table 3. Secondary pathology of 204 secondary reconstruction cases.

Secondary pathology	Total cases (Proportion %)	Failed flap cases
Deformity	110 (53.9)	4
Flap failure	32 (15.6)	2
Recurrence	32 (15.6)	0
Mouth opening limitation	16 (7.8)	1
Fracture of R-plate	9 (4.4)	1
Infection of R-plate	5 (2.5)	0
Total	204 (100)	8

Table 4. Parameters associated of patients, flaps, defects related with flap failure.

Parameters	Success Cases (proportion %)	Failed flap cases (proportion %)	p value
Total (1143 cases)	1103 (96.5)	40 (3.5)	
Age			.317
60	573 (50.1)	24 (2.1)	
〉60	530 (46.3)	16 (1.4)	
Gender			.144
Male	616 (53.9)	27 (2.4)	
Female	487 (42.6)	13 (1.1)	
Systemic disease			
Diabetes mellitus	146 (12.8)	8 (0.7)	.163
Hypertension	338 (29.6)	13 (1.1)	.679
Habitude			
Smoking	191 (16.7)	8 (0.7)	.750
Drinking	223 (19.5)	9 (0.8)	.846
Defect site			.908
Mandible	556 (48.6)	16 (1.4)	
Maxilla	300 (26.2)	12 (1.1)	
Tongue & Mouth floor	167 (14.6)	8 (0.7)	
Buccal cheek	88 (7.7)	3 (0.3)	
Others**	32 (2.8)	1 (0.1)	
Primary/Secondary			.637
Primary	907 (79.3)	32 (2.8)	
Secondary	196 (17.1)	8 (0.7)	
Flap type			.724
RFFF	472 (41.3)	17 (1.5)	
FFF	292 (25.5)	9 (0.8)	

Parameters	Success Cases (proportion %)	Failed flap cases (proportion %)	p value
LD	194 (17.0)	9 (0.8)	
RA	39 (3.4)	1 (0.1)	
DPA	32 (2.8)	1 (0.1)	
LA	37 (3.2)	0 (0.0)	
SA	20 (1.7)	0 (0.0)	
DCIA	20 (1.7)	0 (0.0)	
Others***	33 (2.9)	3 (0.3)	
Pre-operative therapy			
Chemotherapy	104 (9.1)	4 (0.4)	0.840*
Radiotherapy	123 (10.8)	5 (0.4)	0.718
Others			
Use of vein graft	22 (1.9)	4 (0.4)	0.000 *
Double free flap	30 (2.6)	2 (0.2)	0.339

RFFF: Radial forearm free flap; FFF: Fibula free flap; LD: Latissimus dorsi free flap; DPA: Dorsalis pedis artery free flap; DCIA: Deep circumferential iliac artery free flap; RA: Rectus abdominis free flap SA: Serratus anterior free flap.
* Fisher's exact test
** Including the following: lower lip, parotid gland, pharynx, nose and temporal area
*** Including the following: lateral arm, anterolateral thigh perforator, scapula, gracilis and double free flap

Table 5. Cause of flap failure

Cause of flap failure	Cases	Proportion
Vein crisis	18	45%
Artery crisis	3	7.5%
Post-operation bleeding	4	10%
Unknown reason	15	37.5%
Patient death	0	0%
Total	40	100%

Table 6. Salvage methods of 40 failed free flap

Salvage methods	Cases	Proportion
Re-free flap	21	52.5%
Debridement	17	42.5%
Re-pedicle flap	2	5.0%
Total	40	

Table 7. Univariate analysis of potential risk factors for local complications.

Parameters	Total local complication # (%)	p value	Dehiscence # (%)	p value	Infection # (%)	p value	Bleeding # (%)	p value
Total (n=1143)	307 (26.6))		171 (15.0)		55 (4.8)		36 (3.2)	
Age		0.212		0.162		0.776		0.821
60 (n=597)	151 (25.3)		97 (16.2)		34 (5.7)		20 (3.4)	
〉60 (n=546)	156 (28.6)		106 (19.4)		29 (5.3)		17 (3.1)	
Gender		0.000		0.005		0.234		0.037
Male (n=643)	207 (32.2)		132 (20.5)		40 (6.2)		27 (4.2)	
Female (n=500)	100 (20.0)		71 (14.2)		23 (4.6)		10 (2.0)	
Systemic disease								
DM (n=146)	39 (26.7)	0966	23 (15.8)	0.497	8 (5.5)	0.985	8 (5.5)	0.101
HT (n=228)	95 (28.1)	0.538	68 (20.1)	0.176	18 (5.3)	0.858	15 (4.4)	0.137
Habitude								
Smoking (n=191)	58 (30.3)	0.432	38 (18.8)	0792	10 (5.2)	0.820	6 (3.1)	0.845
Drinking (n=223)	64 (28.6)	0.881	43 (21.2)	0.475	13 (5.8)	0.630	6 (2.7)	0.485
Defect site		0.937		0.797		0.154		0.942
Mandible (n=556)	151 (27.2)		99 (17.8)		39 (7.0)		14 (2.5)	
Maxilla (n=300)	84 (28.0)		55 (18.3)		14 (4.7)		12 (4.0)	
Tongue & Mouth floor (n=167)	49 (29.3)		31 (24.5)		8 (4.8)		9 (5.4)	
Buccal cheek (n=88)	17 (19.3)		15 (17.0)		0 (0.0)		2 (2.3)	
Pri/Sec		0.872		0.540		0.961		0.542
Primary (n=939)	255 (27.1)		171 (18.2)		52 (5.5)		32 (3.4)	
Secondary (n=204)	52 (25.4)		32 (15.7)		11 (5.4)		5 (2.5)	
Flap type		0.002		0.145		0.076		0.363
RFFF (n=472)	114 (24.2)		81 (17.2)		18 (3.8)		21 (4.4)	
FFF (n=292)	78 (25.4)		50 (17.1)		19 (6.5)		5 (1.7)	
LD (n=194)	70 (36.1)		40 (20.6)		18 (9.3)		9 (4.6)	
RA (n=39)	9 (23.1)		6 (15.4)		1 (2.6)		2 (5.1)	
DPA (n=32)	7 (21.9)		6 (18.8)		0 (0.0)		0 (0.0)	
LA (n=37)	6 (16.2)		6 (16.2)		0 (0.0)		0 (0.0)	
SA (n=20)	2 (10.0)		1 (5.0)		1 (5.0)		0 (0.0)	
DCIA (n=20)	3 (15.0)		1 (5.0)		2 (10.0)		0 (0.0)	

Parameters	Total local complication # (%)	p value	Dehiscence # (%)	p value	Infection # (%)	p value	Bleeding # (%)	p value
Others** (n=33)	16 (48.5)		10 (30.3)		4 (12.1)		0 (0.0)	
Pre-operative therapy								
Chemotherapy (n=104)	29 (27.9)	0.805	16 (15.4)	0.506	9 (5.7)	0.141	7 (6.7)	0.035
Radiotherapy (n=123)	44 (35.8)	0.018	26 (21.1)	0.299	12 (9.8)	0.029	3 (2.4)	0.597
Others								
Use of vein graft (n=22)	7 (31.8)	0.596	4 (18.2)	0.958	0 (0.0)	0.253	1 (4.5)	0.726
Double free flap (n=30)	13 (43.3)	0.039	10 (33.3)	0.024	2 (6.7)	0.779	0 (0.0)	0.310

Table 8. Univariate analysis of potential risk factors for general complications.

Parameters	General complication # (%)	p value
Total (n=1143)	70 (6.1)	
Age		0.004
60 (n=597)	25 (4.2)	
〉60 (n=546)	45 (8.2)	
Gender		0.368
Male (n=643)	43 (6.7)	
Female (n=500)	27 (5.4)	
Systemic disease		
DM (n=146)	5 (3.4)	0.145
HT (n=228)	16 (11.4)	0.204
Habitude		
Smoking (n=191)	12 (6.3)	0.502
Drinking (n=223)	15 (6.7)	0.883
Pre-operative therapy		
Chemotherapy (n=104)	5 (4.8)	0.557
Radiotherapy (n=123)	12 (9.8)	0.075

DM: Diabetes mellitus; HT: Hypertension.

Ⅳ. Discussion

Reconstruction of medium to large orofacial defect using free flap transfer with microvascular anastomosis has become a standard protocol at our institute. The overall flap success rate was 96.5%, which is in approximate agreement with flap success rates reported in other studies (90% to 97%)(Eckardt et al. 2007; Pohlenz et al. 2012; Gerressen et al. 2013; Zhang et al. 2015; Sanati-Mehrizy et al. 2016). According to the statistical analysis, several risk factors have shown to correlate with increased chance of flap failure (Table 3). Among them, incorporation of saphenous vein graft was the strongest indicator of increased chance of flap failure ($p < 0.05$). Although the influence of vein graft on flap survival is still under debate, vein grafts are sometimes necessary especially when pedicle length is insufficient(Nemoto et al. 2015). Khouri and colleagues (1998) reported that intraoperative thrombosis with the use of vein grafts was not necessarily associated with higher flap failure rate. However, as previously reported by Bozikov and Arnez(2006), the results of this study also have shown that vein grafts increase the risk of flap failure. Therefore, when utilizing vein grafts, careful attention must be paid to prevent venous thrombosis that can lead to flap failure or other consequences of vascular occlusion.

A number of studies on the effects of diabetes mellitus (DM) on flap survival identified DM as a risk factor of flap failure(Liu et al. 2015; Rosado et al. 2015). Results of this study, however, indicated that flap failure rate of patients with DM were not significantly higher than that of patients without DM. Occurrence of local complications in male patients was significantly higher than that of female patients ($p<0.001$). Higher rates of cigarette smoking and alcohol consumption were noted in male patients (28.7% and 30.9%, respectively) compared to female patients (1.2% and 4.8%,

respectively). While smoking and drinking habits did not seem to have statistically significant correlation with flap failure, they may be related to the higher local complication rates in male patients.

Age of over 60 years correlated with increased incidence of systemic complications ($p < 0.05$). Pohlenz and colleagues reported that the incidence of postoperative medical complications was associated with age, operation time and ASA (American Society of Anesthesiologists) classification of the patient(Pohlenz et al. 2007). Therefore, geriatric patients should be given more attention to postoperative care.

Pre-operative chemotherapy or radiation therapy can make microvascular surgery more difficult and lead to higher complication rate(Zhang et al. 2015). In this study, 104 cases with pre-operative chemotherapy (9.1%) and 123 cases with pre-operative radiation therapy (10.7%) were included. According to statistical analysis, preoperative chemotherapy significantly increased the rate of postoperative bleeding ($p < 0.05$). Antiangiogenic properties of chemotherapeutic agents can lead to vascular damage(Pastorino et al. 2003) and this may be the underlying cause of increased rate of postoperative bleeding in patients with history of preoperative chemotherapy.

Arce and colleagues(2012) reported that neither radiation alone nor concomitant chemoradiation had a statistically significant effect on the overall flap success or complication rate. Klug et al.(2006) however, noted that preoperative radiotherapy seems to significantly increase the rate of flap failure or postoperative mortality without increasing the rate of postoperative complications or length of hospitalization. Nuara et al.(2009) also report that a combination of surgery and preoperative radiotherapy increases the rate of surgical wound complications. Preoperative radiation therapy induces soft tissue fibrosis and changes quality of vessels and nerves, making dissection and anastomosis more difficult(Lee and

Thiele 2010; Arce et al. 2012). However, results of this study showed that preoperative radiotherapy did not significantly increase the flap failure or complication rates. It is also notable that 31 free flap transfers (2.7%) were done on osteoradionecrosis (ORN) patients. ORN is one of severe complications of cancer radiotherapy especially in the head and neck region(Curi et al. 2007). Compromised cellularity and vascular support apparently did not significantly influence the survival of transferred free flaps. There had been reports of successful reconstruction cases of mandibles with ORN(Kim et al. 2015; Kim et al. 2016). Therefore, free flap reconstruction seems to be a reliable treatment option for ORN defects.

Thirty double free flap reconstruction surgeries were performed at our institute over the 13-year period and two of them failed. Extensive orofacial defects involving multiple tissue types such as bone, oral mucosa and skin may require multiple free flaps for an adequate reconstruction(Wong and Wei 2010). The survival rate of double free-flaps was similar to that of single free flaps. A Similar study by Andrades et al.(2009) concluded that double free flap is a reliable and predictable reconstruction technique for large defects of head and neck region involving multiple tissue-types. Dehiscence was one of most common complications, and it seems to occur in higher frequency with large volume flaps and poor postoperative condition of recipient site(Bianchi et al. 2009; Myers and Ahn 2014). The risk of dehiscence was significantly higher ($p < 0.05$) in double free-flap reconstructions. Therefore, it may by prudent to pay close attention to postoperative care in double free-flap reconstruction cases.

Ⅴ. Conclusions

Overall success rate of free flap transfer surgeries performed during the 13-year period was 96.5%. Microvascular anastomosis with saphenous vein graft resulted in statistically significant increase in flap failure rate(18.2%, $p < 0.05$). Significantly higher tendency for developing local complications was shown in male (32.2%, $p < 0.05$) and LD free flap groups(36.1%, $p < 0.05$). As for types of local complications, wound dehiscence was noted with higher frequency in the male(20.5% $p < 0.05$), and double free-flap groups (33.3% $p < 0.05$), while bleeding was more common in the preoperative chemotherapy group(6.7%, $p < 0.05$). In addition, old patients were at higher risk of developing systemic complications (8.2%, $p < 0.05$).

With proper planning and surgical technique, free flap reconstruction is a safe and reliable treatment option for various defects of head and neck region. Attention to known risk factors may help minimize complications and lead to successful free-flap reconstruction.

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