

# Postoperative Complications of Jejunal and Skin Valve Reconstruction in Free Reconstructive Surgery for Hypopharyngeal Carcinoma

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**Abstract.** *Background/Aim:* This study evaluated the incidence of perioperative complications in jejunal flap compared with the free tissue flap approach. *Patients and Methods:* This study included 75 patients who underwent free flap reconstruction for hypopharyngeal carcinoma. The primary outcome was the incidence of pharyngocutaneous fistula, and the secondary outcomes were perioperative complications. *Results:* Pharyngocutaneous fistula developed in 7% of patients who underwent jejunal flap procedures and 6% of patients who underwent free tissue flap procedure. Flap sampling site complications occurred in 23% of patients who underwent jejunal flap procedures and in none of the patients who underwent free tissue flap procedure. *Conclusion:* No significant difference was observed in the incidence of pharyngocutaneous fistula between the two groups ( $p=0.99$ ), but complications at the flap sampling site were significantly more common in jejunal flap procedures than in free tissue flap procedures ( $p=0.03$ ). Free tissue flap procedures are potential reconstruction methods superior to jejunal flap methods.

The prevalence of hypopharyngeal carcinoma in Japan is 2%. Reconstruction aimed at recovery of feeding function is important in surgery for advanced hypopharyngeal carcinoma, and a free jejunal flap is a recommended method of pharyngeal reconstruction in hypopharyngeal cancer surgery (1). However, harvesting the jejunal flap requires laparotomy, cutting off the intestinal tract, and suturing the remaining

small intestine. The complications associated with harvesting the jejunal flap are often problematic and include adhesive or paralytic bowel obstruction (2). We have frequently encountered cases in which the hospitalization period was prolonged because the patient was unable to start oral intake due to intestinal obstruction and cases in which frequent inpatient treatment was required after discharge. In addition, patients with hypopharyngeal cancer who are elderly or have a history of laparotomy may not tolerate the invasiveness of laparotomy. Recently, free tissue flaps have been used as reconstructive materials (3) due to the absence of abdominal complications; further, studies have found no differences in cervical complications between free jejunum and free tissue flaps (4, 5). At our institution, we have been performing hypopharyngeal reconstruction using free tissue flaps in patients who have difficulty with laparotomy or who do not require resection up to the posterior wall of the pharynx.

Since a comparative study of free tissue flap and jejunum flap has not been performed previously in Japan, in this study, we investigated postoperative complications in patients who underwent hypopharyngeal and laryngeal resection and either a jejunal flap or a free tissue flap procedure after a diagnosis of hypopharyngeal carcinoma. We hypothesized that there would be no significant difference in the incidence of head and neck complications between jejunal and free tissue flaps. Thus, this study aimed to evaluate the usefulness of free tissue flaps in terms of postoperative complications in reconstructive surgery for hypopharyngeal cancer.

## Patients and Methods

*Patients.* This study enrolled 75 patients who underwent free reconstructive surgery for hypopharyngeal cancer at Tokyo Medical University Hospital from January 1, 2010 to April 30, 2020.

*Ethics.* This study was approved by the ethics committee of the Tokyo Medical University (approval no. T2020-0094). Patients who refused to participate in the study were excluded. All surgeries were

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performed following written informed consent. All protocols were conducted in accordance with the Declaration of Helsinki, and written consent for participation in the study was obtained from each patient.

**Methods.** Sex, age, previous medical history, subsite of the hypopharynx, and tumor/node/metastasis classification were recorded. Preoperative treatment history was categorized into induction chemotherapy, radiotherapy, and chemoradiotherapy.

Perioperative complications were classified into flap sampling site, systemic, and neck complications. Flap sampling site complications were classified into abdominal complications, such as intestinal obstruction or nerve paralysis, and common complications, such as hemorrhage and infection. Systemic complications were classified into respiratory disorders, cardiovascular disorders, and others. Neck complications were classified as fistula, flap necrosis, lymphatic fistula, hemorrhage, and infection.

The skin incision for pharyngolaryngectomy was U-shaped. The hyoid bone was identified, and after cutting the suprahyoid muscle group and entering the pharyngeal cavity, a 3% Lugol's iodine stain was applied to identify the non-staining zone of the mucosa. The resection line was determined by securing a safety zone of at least 10 mm from it. In cases where the lesion was circumferential or the posterior wall was the main locus, total resection of the hypopharynx was performed, while partial resection was performed in cases where a portion of the posterior wall could be preserved after securing a safe zone. If necessary, the jejunal flap was sutured using the Gambee method (6) on both the cranial and caudal sides after making a longitudinal incision in the esophageal mucosa to eliminate the difference in diameter, which could lead to stenosis. For the free tissue flap, the free flap was made in the form of a roll (Figure 1) in patients who underwent total pharyngolaryngectomy; the remaining pharyngeal mucosa and the free flap were sutured in one full layer if the hypopharyngeal mucosa remained; after reconstruction, the head and tail of the anastomosis were clamped, and saline was injected through a feeding tube to confirm that there was no leak. The skin incision and reconstruction were performed by a head and neck surgeon, the jejunal flap procedure by a gastrointestinal surgeon, and the free tissue flap procedure by a plastic surgeon. The surgeons were not the same for all patients, but their experience was similar with regards to number of years, so that surgeon experience was not an obvious factor for the occurrence of complications.

**Outcomes.** The primary outcome was the incidence of pharyngocutaneous fistulae in the two groups undergoing jejunal flap and free tissue flap procedures. The secondary outcome was the incidence of perioperative complications.

**Statistical analysis.** Statistical analysis was performed using Fisher's exact test, and statistical significance was set at  $p < 0.05$ . All statistical analyses were performed using EZR, a software package that extends the functionality of R and R Commander and is available free of charge from the Jichi Medical University Saitama Medical Center website (7).

## Results

**Background characteristics of patients.** Table I presents a comparison of the background characteristics of the patients



Figure 1. The free flap was made in the form of a roll and sutured by the Gambee method on both the cranial and caudal sides.

who underwent jejunal flap procedures and those who underwent free tissue flap procedures. Of the 75 patients with hypopharyngeal carcinoma, 57 (mean age, 69 years; range=50-81 years; 56 males) underwent jejunal flap procedures and 18 (mean age, 71 years; range=52-80 years; 17 males) underwent free tissue flap procedures (10 lateral thigh flaps and eight forearm flaps). In terms of subsite, 41 patients underwent jejunal flap procedure and 12 underwent free tissue flap procedure in the pyriform sinus (PS); eight patients underwent jejunal flap procedure and four underwent free tissue flap procedure in the postcricoid (PC); finally, eight patients underwent jejunal flap procedure and two underwent free tissue flap procedure in the posterior wall (PW). As for preoperative treatment history, nine patients in the jejunal flap group and three in the free tissue flap group had chemotherapy, while five patients in the jejunal flap group and three in the free tissue flap group underwent salvage surgery after radiotherapy and chemoradiotherapy. Age, sex, history, subsite, T classification, and preoperative treatments were compared between patients in the jejunal flap and free tissue flap groups, and no significant differences in any of the factors or any bias in the patient background were observed.

Table I. Background characteristics of patients.

	Jejunal flap group n=57		Free tissue flap group n=18		p-Value
	N	%	N	%	
Age, years: mean (range)	69.0 (50-81)		71.0 (52-80)		0.70
Gender					
Male	56	98	17	94	0.43
Female	1	12	1	6	
Medical history					
Diabetes	11	19	3	33	0.99
Coronary artery disease	6	10	2	17	0.99
Cerebrovascular disease	5	9	1	1	0.99
Tumor subsite					
PS	41	72	12	67	0.70
PC	8	14	4	22	
PW	8	14	2	11	
T (TNM classification)					
½	11	19	2	11	0.72
¾	46	81	16	89	
Preoperative therapy					
Neo-adjuvant Chemotherapy	9	16	3	17	0.99
Chemoradiotherapy	2	4	2	11	0.24
Radiotherapy	3	5	1	6	0.99

PS: Pyriform sinus; PC: postcricoid; PW: posterior wall; TNM: tumor/node/metastasis.

Table II. Prevalence of pharyngocutaneous fistula in each group.

	Jejunal flap group n=57		Free tissue flap group n=18		p-Value
	n	%	N	%	
Pharyngocutaneous fistula					
No	53	93	17	94	0.99
Yes	4	7	1	6	
Pharyngocutaneous fistula with operation	1	2	1	6	0.42

**Complications.** Table II presents the incidence of pharyngocutaneous fistula, which was the primary outcome. Pharyngocutaneous fistulae were observed in 5 (7%) of 75 patients, and specifically in 4 (7%) of the 57 patients undergoing jejunal flap procedures, including 1 (2%) requiring reoperation; 1 (6%) of the 18 patients who underwent free tissue flap procedures required reoperation. No significant difference was observed between the two groups ( $p=0.99$ ).

Table III presents the perioperative complications, which were the secondary outcomes. Flap sampling site complications included intestinal obstruction in 10 (18%) patients and infection in 3 (5%) patients, while no cases of hemorrhage or nerve palsy were observed. There were no flap sampling site complications in patients with free tissue flaps. No significant

difference was observed between the two groups for any specific flap sampling site complications, but the overall incidence of such complications was significantly higher in the jejunal flap group ( $p=0.03$ ). Systemic complications included respiratory failure in 2 (4%) patients and cardiovascular disorders in 2 (4%) patients undergoing jejunal flap procedure. Furthermore, gastrointestinal perforation occurred in 2 (4%) patients and kidney failure in 1 (2%) patient. Respiratory failure occurred in 1 (6%) patient of the free tissue flap group. No significant differences were observed between the two groups. Neck complications in the jejunal flap group included fistula in 9 (16%) patients, flap necrosis in 4 (9%), lymphatic fistula in 4 (7%), and infections in 8 (14%). As such, a total of 19 (33%) jejunal flap patients had neck complications. Among

Table III. Prevalence and type of post-operative complications on each group.

	Jejunal flap group n=57		Free tissue flap group n=18		p-Value
	n	%	N	%	
<b>Flap site complications</b>					
Ileus	10	18	0		0.10
Infection	3	5	0		0.99
Hemorrhage	0	0	0		(-)
Neuroparalysis	0	0	0		(-)
Total	13	23	0		0.03
<b>Systemic complications</b>					
Respiratory disease	2	4	1	6	0.57
Cardiovascular disease	2	4	0	0	0.99
Others	3	5	0	0	0.99
Total	7	12	1	6	0.67
<b>Cervical complications</b>					
Fistula	9	16	4	22	0.50
Flap necrosis	4	7	1	6	0.99
Lymph fistula	4	7	1	6	0.99
Hemorrhage	0	0	0	0	(-)
Infection	8	14	2	11	0.99
Total	19	33	5	28	0.78

Table IV. Reported prevalence of post-operation pharyngocutaneous fistula.

Author	Year of publication	Pharyngocutaneous fistula			
		Jejunal flap group		Free tissue flap group	
		n	%	n	%
Yu <i>et al.</i> (12)	2010			91	9
Huang <i>et al.</i> (13)	2015			45	11
Kurita <i>et al.</i> (14)	2018	243	3.7		
Ishida <i>et al.</i> (15)	2016	54	4	10	0

those who underwent free tissue flap procedures, 4 (22%) patients had fistula, 1 (6%) had flap necrosis, 1 (6%) had lymphatic fistula, and 2 (6%) had infections. No significant differences were observed between the two groups.

**Discussion**

This study investigated the prevalence of postoperative complications associated with reconstructive surgery for hypopharyngeal cancer using jejunal or free tissue flaps. We observed that the occurrence of pharyngocutaneous fistula was similar with both techniques, although flap-site complications were more frequent with the jejunal flap. This study suggests that the free tissue flap procedure may be

superior to jejunal flaps for reconstructive surgery in hypopharyngeal carcinoma.

In Japan, the jejunal flap procedure is the first-choice for reconstructive surgery after pharyngolaryngectomy from the viewpoint of postoperative function and postoperative complications (1, 8, 9). This is because reports have indicated that the jejunal flap procedure causes less anastomotic stenosis than the radial forearm flap procedure (1) and less early fistula and anastomotic stenosis than the anterolateral thigh flap procedure (8), making it more useful than other reconstruction methods. However, because jejunal flap procedures require laparotomy, abdominal complications may occur, the most problematic being intestinal obstruction. In this study, 18% of patients developed intestinal bowel obstruction. Suzuki *et al.* (2)

reported that 3.3% of patients who underwent jejunal flap procedures developed postoperative intestinal obstruction, a much lower prevalence compared with the present study. Concerning the variation in the incidence rate of abdominal complications between centers, Shantanu *et al.* (10) reported that jejunal flap is a safe method of flap sampling, but its success depends on the skill level of the surgeon. Therefore, the number of years of experience of the surgeon, method of flap sampling, and method of intestinal anastomosis should be considered in each institution. Concerning systemic complications, Pateru *et al.* (5) pointed out that patients with head and neck cancer often have cardiovascular disorders and reduced pulmonary function due to the high prevalence of smoking and heavy alcohol consumption and that cardiopulmonary failure may develop with laparotomy. This is thought to occur because dehydration is aggravated by a combination of insensible perspiration due to laparotomy and insensible perspiration due to cervical manipulation (11). Although no significant difference was observed between the jejunal flap and free tissue flap groups in this study, two cases of cardiovascular failure and two cases of gastrointestinal perforation were observed in the jejunal flap group, which may be related to dehydration and decreased circulating blood volume due to laparotomy. Table IV illustrates reports on the incidence of fistula as a head and neck complication. Peirong *et al.* (12) reported that fistula occurs in 9% of the anterolateral thigh flap procedures, and Huang *et al.* (13) reported that fistula occurs in 11% of anterolateral thigh flap procedures that required localized flap treatment. Kurita *et al.* (14) also reported that fistulas occur in 3.7% of jejunal flap procedures. The incidence rate of fistulas in the present study was similar to that in these studies. Ishida *et al.* (15) compared the incidence of fistula between the jejunal flap procedure and the anterolateral thigh flap procedure in Japanese patients and observed no significant difference, similar to our study. In a study of free tissue flap procedures, the incidence of fistula was compared between anterolateral thigh flap and radial forearm flap procedures, and studies reported that the incidence was higher in the radial forearm flap procedure (12, 16-19). The reason is that the anterolateral thigh flap procedure allows the femoral fascia to cover the anastomotic site. In this study, the number of cases of free tissue flap procedures was small, so we were not able to examine each flap individually. In the future, it will be necessary to increase the number of cases in a multicenter joint study.

This study examined the perioperative complications of reconstructive materials; however, several limitations should be mentioned. First, surgeons have different techniques and skill levels. Not having considered the skill of the surgeons, could have been a bias. Ideally, the same surgeons should have performed all surgeries. However, since head and neck surgeons, plastic surgeons, and gastrointestinal surgeons are involved in reconstructive surgery for hypopharyngeal cancer, it is difficult to have a single surgical team. In our hospital,

surgeons at the specialist level or above in each department perform reconstructive surgery, and we believe that we have maintained a minimum level of skill and technique among surgeons. Second, we were not able to examine functional outcomes. Peirong *et al.* (11) compared the functional outcomes of the jejunal flap procedure and the anterolateral thigh flap procedure and observed that the anterolateral thigh flap produced superior speech and swallowing outcomes. Studies have also reported that the jejunal flap procedure has a lower rate of esophageal speech acquisition (20, 21). It would be desirable to investigate the usefulness of free tissue flap procedures for reconstructive surgery for hypopharyngeal carcinoma in terms of swallowing function and speech acquisition. Finally, the number of cases of free tissue flap procedures was small, so we were not able to examine each flap individually. In the future, it will be necessary to increase the number of cases in a multicenter joint study.

We investigated the usefulness of free tissue flaps in reconstructive surgery for hypopharyngeal carcinoma in terms of perioperative complications. We observed no significant difference in the incidence of cervical complications between the free tissue flap and the jejunal flap procedures ( $p=0.99$ ) and significantly fewer flap sampling site complications ( $p=0.03$ ) with the free tissue flap procedure. Our findings suggest that the free tissue flap procedure may be superior to the jejunal flap procedure in reconstructive surgery for hypopharyngeal cancer.

### Conflicts of Interest

The Authors have no conflicts of interest to declare in relation to this study.

### Authors' Contributions

Kunihiko Tokashiki and Isaku Okamoto designed the study. Kunihiko Tokashiki wrote the main manuscript text and prepared the Figure. Kunihiko Tokashiki, Isaku Okamoto, Takuro Okada, Hiroki Sato and Kiyooki Tsukahara were involved with data collection. Kunihiko Tokashiki and Isaku Okamoto performed the analysis. All Authors discussed the results of the study, made comments on the manuscript, and gave final approval of the version to be published.

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