

# Salvage Treatment of Failed Free Jejunal Flap Transfer: Our Experiences and Literature Review

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**Background:** Although there have been many reports on the success of free jejunal flap transfer for pharyngoesophageal reconstruction, reports on salvage procedures for failed transfers remain sparse. In this report, we retrospectively reviewed our salvage procedures for failed jejunal transfers and previous articles describing salvage treatment in failed jejunal flap cases.

**Methods:** This report includes 6 cases of failed jejunal flap transfer, leading to necessary salvage surgery. We reviewed all cases to examine salvage procedures and early postoperative complications such as fistula formation. We also assessed postoperative late complications and swallowing function during long-term follow-up. A review of the literature was performed via PubMed.

**Results:** Rejejunal transfer was performed successfully in 3 of 6 cases. Gastric pull-up reconstruction was adopted in 2 cases. In 1 case, an external stoma was created because of the patient's poor medical condition. All 3 cases of rejejunal transfer and 1 gastric pull-up case recovered to resuming a normal diet. However, 1 gastric pull-up case required supplemental feeding with a jejunostomy tube. We reviewed 6 articles describing salvage treatment in failed jejunal flap cases.

**Conclusion:** When free jejunal transfer fails, rejejunal transfer is optimal. However, in cases that lack suitable recipient vessels or have infection, a second jejunal transfer should not be considered. In such cases, gastric pull-up or colon interposition may be an alternative because they do not require vascular anastomosis. Pedicled pectoralis major flap is also an alternative, although the risk of salivary fistulas is very high. (*Plast Reconstr Surg Glob Open* 2018;6:e1889; doi: 10.1097/GOX.0000000000001889; Published online 6 August 2018.)

## INTRODUCTION

The primary goal of pharyngoesophageal reconstruction after removal of hypopharyngeal and esophageal cancers is to restore continuity of the aerodigestive tract with improvement in the quality of life by maximizing speech and swallowing functions.<sup>1-3</sup> Free jejunal flap transfer is a commonly performed, reliable procedure for pharyngoesophageal reconstruction with low complication and donor-site morbidity rates and high overall success rates of 92–98%.<sup>1,2,4-9</sup> However, total flap loss due to vascular occlusion cannot always be avoided, even when the procedures

are performed by skilled microsurgeons. Therefore, management of salvage treatment following failed jejunal flap transfer is very important. Although there have been many reports on the success of free jejunal transfers, reports on salvage procedures are sparse.<sup>10-15</sup> In this report, we retrospectively reviewed our salvage procedure for 6 cases of failed jejunal transfer and previous articles describing salvage treatment in failed jejunal flap cases.

## PATIENTS AND METHODS

We performed 96 cases (81 men and 15 women; mean age, 68.0±10.2 years; age range, 18–85 years) of free jejunal flap transfer for circumferential pharyngoesophageal reconstruction due to cancer ablation from April 2007 to April 2018, and this report included 6 cases of necrosis of a free jejunal flap, leading to necessary salvage surgery. The 6 cases were male patients aged 49–72 years. A summary of the 6 cases is provided in Table 1. Five cases involved primary reconstruction after cancer removal. One case involved salvage jejunal transfer for partial gastric tube necrosis following subtotal esophagectomy and

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gastric pull-up due to treatment of thoracic esophageal cancer. In cases of failed jejunal transfer, we adopted re-jejunal transfer as a first choice of salvage treatment as long as patients' medical condition is not poor (patients 1–3). If there was a lack of suitable recipient vessels, then we selected gastric pull-up (patients 4–5). In case of a poor medical condition, an external stoma was created (patient 6). We reviewed all cases to examine early post-operative complications such as fistula formation (any salivary leakage) and perioperative mortality (any death occurring within 30 days after surgery). We also assessed late complications and postoperative swallowing function during the long-term follow-up (at least 8 months after surgery) for the 5 cases of salvage alimentary tract reconstruction.

A review of the literature was performed via PubMed using the terms “salvage” or “failure” tagged in the title and the term “jejunum” tagged in all the fields. Search results were filtered for the literature between 1973 and 2018. The articles used had to meet the following inclusion criteria: human studies and studies published in the English language. They must include clinical cases in which jejunal transfer failed, and then immediate salvage reconstruction was performed. All the titles and abstracts of the reports were screened for relevancy according to the abovementioned criteria. If the abstracts did not provide sufficient information, the full-text article was downloaded and reviewed. Articles that might have met the inclusion criteria, but could not be downloaded as the full-text version, were excluded in this review.

This retrospective study was approved by the Ethics Committee of Osaka University Hospital (approval number 17124-2).

## RESULTS

Onset of flap failure ranged from 1 to 8 days postoperatively. There were 3 cases each of arterial and venous thrombosis that caused flap failure. A summary of the 6 cases is shown in Table 2. In 3 of the 6 cases, re-jejunal transfer was performed successfully. Gastric pull-up reconstruction was adopted for 2 cases. In 1 case (patient 6) involving jejunal transfer to rescue partial necrosis of the gastric tube following subtotal esophagectomy, the patient's poor medical condition prohibited a lengthy procedure and an external stoma was created. For that patient, reconstruction of the alimentary tract was eventually abandoned because of tumor recurrence.

In 2 cases (patients 1 and 3), direct wound closure was abandoned because of swelling at the salvage surgery site, and the wound was left open; however, those 2 wounds closed spontaneously. In 1 case (patient 2), a small area of neck skin necrosis occurred but healed spontaneously. Pneumonia occurred in 1 case (patient 5). No fistula formation was observed in the 5 cases of alimentary tract reconstruction with either a jejunal flap or gastric pull-up. One case (patient 6) in which an external stoma was created developed respiratory failure postoperatively and required prolonged intensive care unit stays. The perioperative mortality rate was 0%.

The postoperative follow-up period for 5 cases with successful alimentary tract reconstruction ranged from 8 months to 6 years and 2 months. All 3 cases with re-jejunal transfer and 1 case with gastric pull-up (patients 1–4) recovered to resuming a normal diet. However, 1 gastric pull-up case (patient 5) could orally ingest a liquid diet but required supplemental feeding with a jejunostomy tube. Patient 4 developed stenosis of a tracheostoma 1

**Table 1. Patient Characteristics**

Patient	Age, Sex	Primary Diagnosis	Comorbidity	Previous Treatment	Surgical Procedure
1	72, M	Hypopharyngeal cancer	None	CRT (66 Gy)	TPLE
2	49, M	Hypopharyngeal cancer	Hypertension	CRT (66 Gy)	TPLE
3	77, M	Cervical esophageal cancer	History of surgeries for gastric and thoracic esophageal cancer	CRT (60 Gy), gastrectomy, subtotal esophagectomy, and pedicled jejunal transfer	Cervical esophagectomy
4	51, M	Hypopharyngeal cancer	None	CRT (66 Gy)	TPLE
5	75, M	Cervical esophageal cancer	Hypertension, arrhythmia, HBV+	CRT (60 Gy)	Cervical esophagectomy
6	65, M	Thoracic esophageal cancer	Hypertension, brain infarction	Chemotherapy, failed G-PU	Removal of necrotic portion of gastric tube

CRT, chemoradiotherapy; G-PU, gastric pull-up; HBV, hepatitis B virus; M, male; TPLE, total pharyngolaryngo-cervical esophagectomy.

**Table 2. Salvage Procedures**

Patient	Clinical Signs of Flap Failure	Onset of Flap Failure (d)	Cause of Flap Failure	Salvage Surgery	Oral Intake Start	Dietary Recovery
1	Mouth bleeding	1	Venous thrombosis	Re-FJ	10	Normal
2	Necrosis of the monitor	1	Arterial thrombosis	Re-FJ	14	Normal
3	Neck reddening	3	Arterial thrombosis	Re-FJ	10	Normal
4	Salivary fistula	8	Arterial thrombosis	G-PU	13	Normal
5	Contrast-enhanced CT	3	Venous thrombosis	G-PU	25	Oral liquid diet + jejunostomy tube feeding
6	Neck bleeding	6	Venous thrombosis	External stoma	N/A	N/A

CT, computed tomography; G-PU, gastric pull-up; N/A, not available; Re-FJ, re-free jejunal transfer.

year postoperatively that required expansion under local anesthesia.

Regarding a review of the literature, the search resulted in 94 hits on PubMed. After screening, 6 articles satisfied the inclusion criteria (Table 3).

#### Representative Case

A 49-year-old man (patient 2) with cancer of the hypopharynx underwent total pharyngolaryngo-cervical esophagectomy (TPLE) and bilateral neck dissection. Immediate reconstruction was performed with a jejunal flap. The second jejunal artery and vein were anastomosed to vessels on the left side of the neck (Fig. 1A), but the flap failed because of arterial thrombosis on postoperative day 1 (Fig. 1B). Salvage second jejunal transfer was performed on that day, and vessels on the right side of the neck were used for vascular anastomosis (Fig. 1C). The postoperative course was uneventful except for a small area of neck skin necrosis, which was treated conservatively.

## DISCUSSION

Free jejunal transfer is used in pharyngoesophageal reconstruction as a reliable procedure with a low complication rate.<sup>1,2,4-9</sup> However, microsurgical construction has not completely eliminated thrombosis of the anastomotic site and subsequent total flap necrosis. Furthermore, jejunal flaps are extremely vulnerable to vascular compromise, unlike other flap types such as fasciocutaneous and musculocutaneous flaps.<sup>16</sup> Salvage of jejunal flaps by removal of thrombi is difficult, and surgeons must therefore be prepared for jejunal flap necrosis.

External stoma creation and subsequent conservative treatment for failed jejunal transfer are common practices to reduce cervical inflammation and infection.<sup>10,15</sup> However, recent reports have used more radical approaches to salvage failed jejunal flaps, that is, second jejunal transfer, gastric pull-up, and colon interposition.<sup>10-15</sup> Previously reported salvage procedures and outcomes are summarized in Table 3. According to them, rejejunal transfer seems

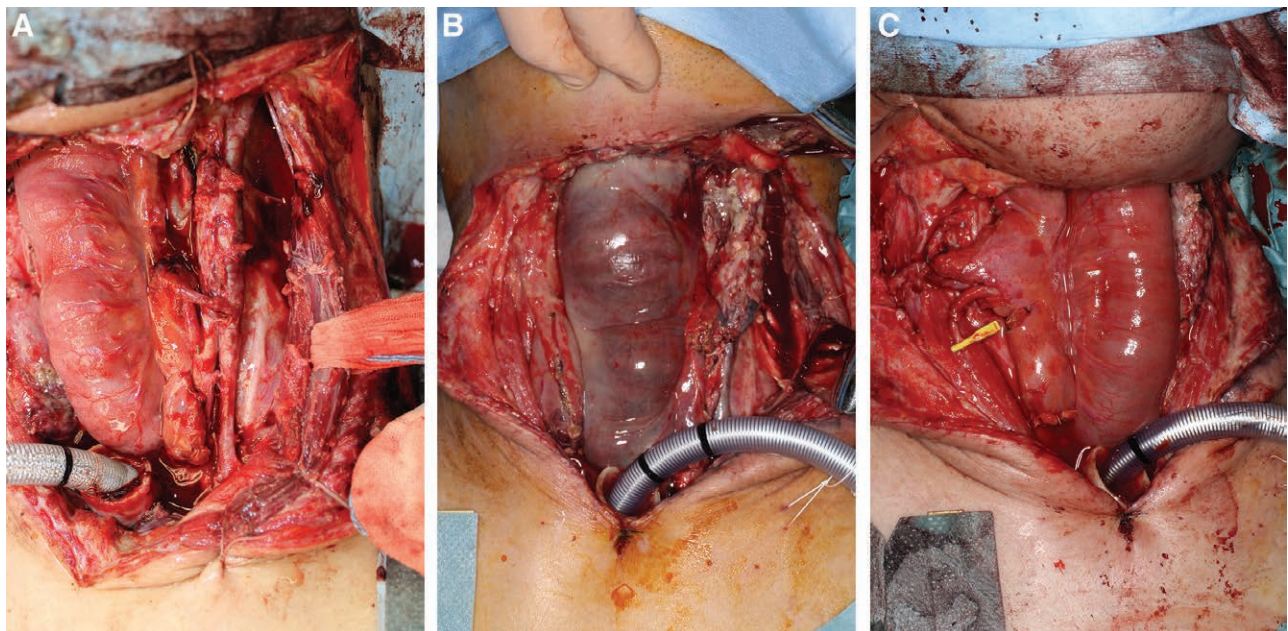
**Table 3. Review of Salvage Procedures for Failed Jejunal Transfer**

Authors	No. Cases	Salvage Procedures				External Stoma
		Rejejunal Transfer (Complications)	Gastric Pull-up (Complications)	Colon Interposition (Complications)	PMMC (Complications)	
Okazaki et al. <sup>11</sup>	4	2 (no leakage)	—	—	—	2
Bertino et al. <sup>14</sup>	5	3 (no leakage)	—	—	2 (1 fistula)	—
Oki et al. <sup>13</sup>	3	1 (enteral alimentation)	—	1 (no leakage)	1 (no leakage)	—
Keereweer et al. <sup>12</sup>	4*	2 (1 leakage, 1 failure)	2 (1 fistula)	1 (1 failure)	1 (pharynx closed)	—
Onoda et al. <sup>10</sup>	11	5 (no leakage)	—	—	—	6
Ni et al. <sup>15</sup>	5†	1 (1 failure)	2 (1 partial necrosis)	—	—	3
Current study	6	3 (no leakage)	2 (1 jejunostomy tube feeding)	—	—	1

\*Salvage jejunal transfer failed, then salvage colon interposition failed, and finally PMMC was performed to close the pharynx in 1 patient.

†Salvage jejunal transfer failed, and then an external fistula was created in 1 patient.

PMMC, pectoralis major musculocutaneous flap.

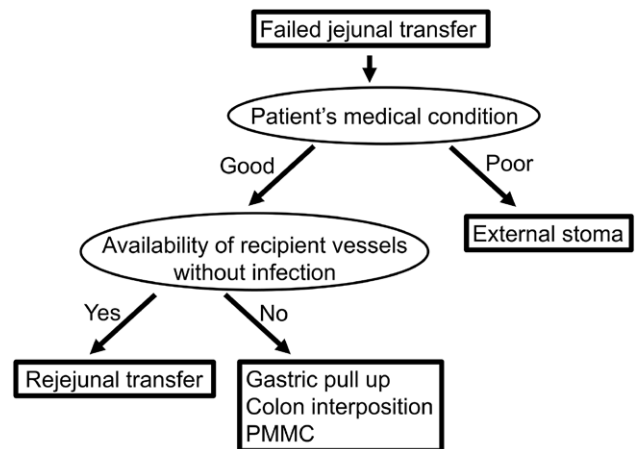


**Fig. 1.** Intraoperative view of patient 2. A, A 49-year-old man with cancer of the hypopharynx underwent TPLE and bilateral neck dissection. Immediate reconstruction was performed with a jejunal flap. The second jejunal artery and vein were anastomosed to vessels on the left side of the neck. B, The flap failed because of arterial thrombosis on postoperative day 1. C, Salvage second jejunal transfer was performed, and vessels on the right side of the neck were used for vascular anastomosis.

optimal from the viewpoint of less postoperative complications and swallowing functional recovery. Consistent with previous reports,<sup>10,11,14</sup> in our cases, rejejunal transfer was the best option in terms of perioperative morbidity and postoperative swallowing function. After success of a second jejunal transfer, all patients could begin oral intake within 2 weeks postoperatively and could eventually intake normal food. In addition, a second jejunal flap can be feasibly harvested from the same abdominal wound. Meanwhile, because the most adequate vessels for vascular anastomosis have already been chosen for the first transfer, the performance of a secondary reconstruction is always more difficult because of the selection of available recipient vessels.<sup>12</sup> Indeed, Keereweer et al.<sup>12</sup> and Ni et al.<sup>15</sup> reported repeated failure of jejunal transfer. In addition, anastomotic site thrombosis easily occurs when the anastomotic site is infected.<sup>17</sup> Therefore, careful decision making is necessary regarding a second jejunal transfer, considering the availability of recipient vessels, existence of infection, and also the patient's general condition.

Keereweer et al.<sup>12</sup> reported 2 cases of gastric pull-up for the salvage of failed jejunal flaps that showed acceptable functional results. In general, gastric pull-up is considered to have high morbidity and mortality, given the invasiveness of the procedure. However, according to a recent systematic review and meta-analysis by Butskiy et al.,<sup>18</sup> mortality and morbidity rates of gastric pull-up for pharyngoesophageal junction reconstruction have decreased in the past 2 decades and become similar to other methods, such as jejunal flap transfer. Therefore, they suggest that "gastric pull-up reconstruction continues to be a useful tool that should be kept in the arsenal of the head and neck reconstructive surgeon."<sup>18</sup> In our 2 cases of salvage gastric pull-up, both patients showed no postoperative salivary leakage. Regarding long-term swallowing function, 1 patient recovered to resuming a normal diet, whereas the other could take a liquid diet orally but required supplemental feeding with a jejunostomy tube. There is a relative lack of data regarding long-term functional outcomes after gastric pull-up pharyngoesophageal reconstruction, which is largely attributed to poor survival of patients with hypopharyngeal and cervical esophageal tumors.<sup>18</sup> Future studies will be needed to verify the long-term complications and functional outcomes of gastric pull-up for pharyngoesophageal reconstruction.

As for other visceral flaps, colon interposition has been used to salvage failed jejunal transfer.<sup>12,13</sup> However, colon interposition is widely considered to be a method of last resort, associated with high morbidity and mortality.<sup>19</sup> Sacak et al.<sup>20</sup> succeeded in the salvage of complicated gastric pull-up procedure using colon interposition for esophageal reconstruction. Especially, they demonstrated the usefulness of colon interposition when the anastomotic level of esophageal side was located below the sternoclavicular junction. Therefore, colon interposition may be an alternative when the stomach is not available. Although the risk of salivary fistulas is very high,<sup>15,21</sup> in case of an infection, secondary reconstruction using a pectoralis major musculocutaneous flap is a good choice for decreasing the risk of repeated failure of the reconstruction.<sup>12</sup>



**Fig. 2.** Our therapeutic algorithm in case of failed jejunal transfer. PMMC, pectoralis major musculocutaneous flap.

Finally, an algorithm describing our current preferred approach to failed jejunal transfer is shown (Fig. 2). When free jejunal transfer for pharyngoesophageal reconstruction fails, rejejunal transfer is optimal. However, in cases that lack suitable recipient vessels or have infection, a second jejunal transfer should not be considered. In such cases, gastric pull-up and colon interposition may be alternatives because they do not require vascular anastomosis. Pedicled pectoralis major flap is also an alternative, although the risk of salivary fistulas is very high.

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