

## Hypopharyngeal Reconstruction with Free Jejunum Transfer After Total Pharyngo-Laryngectomy: Technical, Oncological and Functional Results

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### ABSTRACT

Free jejunum transfer for hypopharyngeal reconstruction is rapidly evolving and preferred in many centers. Fourteen consecutive patients, who underwent primary hypopharyngeal reconstruction with a free jejunum loop transfer, after resection of a hypopharyngeal carcinoma, were included in this prospective descriptive study. TNM stage was T3 in 4 (28.6%) and T4 in 10 (71.4%) patients. The surgical technique was described. Average operating time was 8.2 hours. Ischemia time of the flap before complete revascularization by microvascular anastomosis ranged between 35-80 minutes. Two transplants were lost due to venous thrombosis (14.3%) with subsequent death of the two patients due to systemic sepsis. The surgical resection margins were uninvolved by the tumor in 13 cases (92.9%) and invaded in 1 case (7.1%). The lymph nodes were positive for malignancy in all patients. Hospital stay ranged from 18 to 50 days. Salivary fistula developed in 3 patients (3/12 = 25%) that closed by conservative treatment. All the patients were able to swallow normal diet within 10-50 days after surgery. The quality of speech was unsatisfactory in all patients. The survived 12 patients tolerated well postoperative radiotherapy. By the end of this study, 9 patients (9/12 = 75%) have died due to causes related to the tumor in a period of 9-15 months after surgery and 3 were alive (3/12 = 25%) with metastasis in the lung (6-16 months after surgery). Hypopharyngeal reconstruction with free jejunum after total pharyngo-laryngectomy is recommended in selected cases of hypopharyngeal carcinoma being a single stage operation with quick return of swallowing and reasonable quality of life after reconstruction.

### INTRODUCTION

Hypopharyngeal carcinoma is a bad reputation entity, the symptoms appear late and it is usually diagnosed at an advanced stage resulting in poor prognosis. In the majority of these patients, surgical resection offers the only hope of alleviation of symptoms and control of the

disease [1]. Following hypopharyngeal resection, a number of reconstructive options are available. These include pectoralis major myocutaneous flap [2,3], gastric transposition [4,5] and radial forearm free flap [6-8]. During the last two decades, the jejunal free flap has emerged as a popular reconstructive procedure as evident in the large number of series. One stage repair and quick return of swallowing are among the factors cited for the increasing role of such flap [9-15]. We present our experience with the use of free jejunum transfer for hypopharyngeal reconstruction after total pharyngo-laryngectomy.

### PATIENTS AND METHODS

This prospective study was conducted at the Departments of General Surgery (Plastic Surgery Unit) and Otorhinolaryngology at Zagazig University Hospitals, Zagazig, Egypt during the period from June 1998-May 2002. Fourteen patients with hypopharyngeal carcinoma were included in this study. The tumor and patients' characteristics are illustrated in Table (1).

Preoperative TNM staging was done by clinical examination, Chest X-ray, gastrograffin swallow (Fig. 1), CT scan of the neck (Fig. 2) and mediastinum, abdominal ultrasonography in addition to Panendoscopy of the upper respiratory and digestive tracts to show the extent of the disease and to take a biopsy for histological diagnosis. Doppler ultrasonography examination of carotid arteries and jugular veins was carried out in all patients. Selection criteria for total pharyngo-laryngectomy and reconstruc-

tion with free jejunum transfer were the absence of apparent involvement of cervical esophagus and good blood flow in the supraaortic branches.

Table (1): Patients and tumor characteristics.

Patient / tumor characteristic	No. (%)
<b>Sex:</b>	
Male	5 (35.7%)
Female	9 (64.3%)
Age in years	54-63 (mean 56)
Preoperative radiotherapy	5 (35.7%)
<b>Site of the tumor:</b>	
Postcricoid region	8 (57.1%)
Pyriform fossa	4 (28.6%)
Multiple	2 (14.3%)
<b>TNM stage:</b>	
T3	4 (28.6%)
T4	10 (71.4%)
<b>Lymph nodes:</b>	
Clinical	8 (57.1%)
Pathological	14 (100%)
<b>Pathological type:</b>	
Squamous cell carcinoma	14 (100%)



Fig. (1): Gastrograffin swallow showing postcricoid carcinoma.

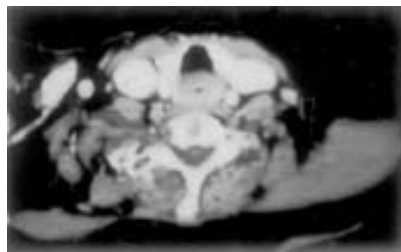


Fig. (2): CT scan of the neck showing postcricoid carcinoma.

### *Surgical technique:*

Details of the technique have been described in detail elsewhere in the literature [10]. Figures 3-6 illustrate the stages of the operation. The operation was carried out by two surgical teams. Resection was carried out by the same ENT surgeon (second author). Similarly, a single plastic surgeon (the first author) performed the reconstruction. In the neck stage, total pharyngo-laryngectomy with bilateral functional neck dissection was carried out. The crucial point in selecting patients for free jejunal transfer is the lower extent of the tumor after complete mobilization of the laryngopharynx complex. Presence of a sufficient length of the esophagus in the superior mediastinum to permit suture application through the cervical incision was the guiding factor in patients' selection. While the cervical team carried out the pharyngeal circular resection, the second team carried out a paramedian laparotomy and selected the section of jejunum with appropriate vasculature for the preparation of a long vascular mesenteric pedicle. The third vascular segment was the most suitable in that it is supplied by a large and constant vascular pedicle. The segment was sectioned with preservation of the vascular pedicle attached to the superior mesenteric artery till complete preparation of the recipient vessels in the neck to shorten the ischemia time. External carotid artery was chosen as the recipient artery in all cases. It was dissected high up till its entrance in the parotid gland to have a good length to permit microvascular anastomosis without any tension. Internal jugular vein was the recipient vein in all cases. Before preparation of the recipient vessels and sectioning of the vascular pedicle of the jejunal transplant, 5000 IU of Heparin sulphate was injected intravenously. Preparation of the recipient vessels including trimming the adventitia of both the artery and vein was done completely before the vascular pedicle of the jejunal loop was sectioned to shorten the ischemia time as can as possible. The vascular pedicle of the transplant was cut in flush with the superior mesenteric artery to obtain an adequate length. Particular care was given to positioning the loop in an isoperistaltic direction to facilitate the subsequent passage of food and avoid persistent dysphagia. Under 4X-loupe magnification, microvascular arterial anastomosis was started with by end to end technique. After completing the arterial anastomosis, both the ar-

terial and venous microclamps were released to allow transient revascularization of the jejunal loop. The blood was allowed to pour from the venous end till the color of the blood became normal to wash out the metabolites accumulated in the tissue of the jejunum during the ischemia time. So, the first ischemia time was ended by the end of the arterial anastomosis. Then, the venous anastomosis was carried out by end to side technique in all cases. The perfusion of the flap was assessed and confirmed by the almost immediate return of peristalsis, visceral secretion in the jejunum loop, bleeding of the segment and restoration of the shiny pink color of the serosa. The jejuno-esophageal anastomosis was then carried out first as this provided better control of the esophagus and allow gaining additional some centimeters as safety margin if required. Then, oropharyngeal to jejunal anastomosis was carried out after enlarging the jejunal opening by a longitudinal slit along the antimesenteric border to be compatible with the opening of the oropharynx. A nasogastric tube was placed for feeding. While the operation was continued in the neck region, restoration of the continuity of the jejunum in the abdomen by end to end technique was performed.

#### *Early postoperative follow-up:*

Flap viability was monitored in 10 patients through an anterior neck window, closed on the third day; in the other 4 patients the monitoring took place via direct observation of a segment of loop positioned externally to the surgical wall and removed on the fifth post-operative day. From the third day onwards, the patients underwent daily examination of the flap by direct laryngoscopy. A gastrograffin swallow was carried out 10 days post-operatively (Fig. 7) and once dehiscence of the sutured mucosa had been excluded, oral alimentation was recommenced, first with liquids and then with semi-solids for the first 15 days, then, a full range of food was allowed.

#### *Late postoperative follow up:*

Postoperatively, these patients had one monthly follow-up. Subjective evaluation of swallowing was carried out by a swallowing questionnaire (SQ). Objective evaluation was done by endoscopic upper GIT and respiratory examination performed six monthly and con-

trast studies with gastrograffin done after first, sixth and 12 month of reconstruction for living patients.

Qualitative evaluation of speech was based on the following voice parameters: intelligibility, pleasantness and acceptability. By vocal intelligibility we mean the ability for the listener to fully understand a verbal message. The term pleasantness was used to indicate a subjective evaluation of vocal esthetics. By acceptability we mean an overall judgement taking into account both these parameters. Both evaluations were performed at three and six months postoperatively [16].

The assessed variables were operation time, blood loss, ischemia time before revascularization of the flap, flap survival and hospital stay. Early postoperative complications and mortality were recorded.

Functional outcome regarding swallowing and quality of speech were evaluated. Oncological outcome regarding surgical resection margin infiltration with malignant tissue, lymph node affection, development of secondaries and patients survival were reported.

## **RESULTS**

The mean duration of the operation was 8.2 hours (5-12 hours). The total ischemia time of the free jejunum ranged between 35-80 minutes with an average 45 minutes. All patients needed blood transfusion in the form of 2-4 units of blood. Two of the transplants failed because of venous thrombosis on days 2 and 3. The two patients died (14.3%) as a result of systemic sepsis. The overall success rate was 85.7%.

There were no general complications. wound infection and delayed wound healing with salivary fistula developed in 3 patients (3/12 = 25%). The fistulae were proved by gastrograffin swallow to be present at the proximal anastomosis with the pharynx. They were treated conservatively by antibiotics and leaving the nasogastric tube for longer periods for feeding till complete closure of the fistula as proved by gastrograffin swallow. No complications of the donor site were reported. Complications are summarized in Table (2). Hospital stay ranged between 18-50 days.



Fig. (3): Defect after total pharyngolaryngectomy. The oropharyngeal and esophageal ends are held with Babcock forceps.



Fig. (4): The third jejunal loop with the vascular pedicle completely dissected before sectioning.



Fig. (5): The free jejunal loop completely sectioned and ready for anastomosis.

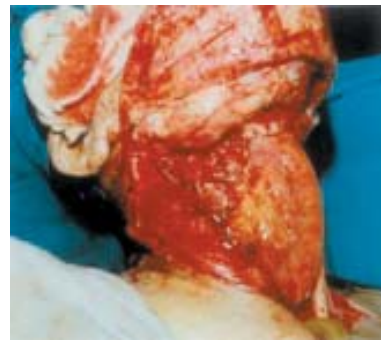


Fig. (6): The jejunal loop in place after complete microvascular anastomosis with the upper end anastomosed to the oropharynx and the lower end anastomosed to the esophagus.

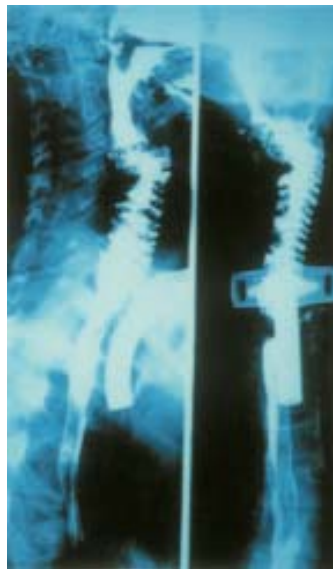


Fig. (7): Gastrograffin swallow 10 days after the operation with free flow of dye without fistula or stricture.

#### *Oncological results:*

Bilateral modified functional block neck dissection was carried out in all cases. The excised lymph nodes were found to be infiltrated by malignant tissue in all cases. The surgical resection margins were uninvolved by the tumor in all cases except one (7.1%) in whom the histopathological examination showed invasion by malignant tissue in spite of the absence of infiltration on clinical backgrounds. The surgical esophageal safety margin was more than 3 cm in all specimens. The follow up period ranged from 9-16 months. By the end of this study, 9 patients ( $9/12 = 75\%$ ) have died due to causes related to the tumor in a period of 9-15 months after surgery and 3 were alive ( $3/12 = 25\%$ ) with metastasis in the lung (6-16 months after surgery). Concerning the patients died from the tumor, 6 died from lung metastases, 1 had a recurrence on T and 2 on N (Table 3).

Table (2): Early complications.

Complication	No. (%)
General	0
Donor site complications	0
Flap necrosis	2/14 (14.3%)
Mortality	2/14 (14.3%)
Wound infection	3/12 (25%)
Delayed wound healing	3/12 (25%)
Salivary fistula	3/12 (25%)

Table (3): Oncological follow up 9-16 months after surgery.

State	No. (%)
No evidence of disease	0
Alive with secondary	3/12 (25%)
Died due to causes related to the tumor	9/12 (75%)

*Functional results:*

Overall, the nasogastric tube was removed after a mean of 15 days (range 10-50 days). Two months after operation, all the living patients were able to eat a reasonably normal diet and none of them needed a gastrostomy. Follow-up gastrograffin swallow for living patients revealed no strictures. Radiotherapy was tolerated well and the swallowing function had shown no impairment.

Voice quality (intelligibility, pleasantness and acceptability) was unsatisfactory in all patients.

**DISCUSSION**

The poor prognosis of hypopharyngeal cancers compels the surgeon to choose a technique which allows wide surgical resection associated with a reconstruction procedure resulting in prompt restoration of physiological functions, low morbidity and a short period of hospitalization. Total pharyngolaryngectomy has certainly made some impact on the prognosis, but above all on the quality of life of these patients [17,18]. The revascularized free flap of jejunum has been shown to be a flap with anatomophysiological features suitable for the reconstruction of the hypopharyngo-esophageal tract [9,11,12&15].

The surgical technique used in this study is quite similar to that described by Reece et al. [10] and Julieron et al. [13]. However, we have chosen the external carotid artery as the recipi-

ent artery instead of the commonly used superior or inferior thyroid arteries [11&14]. We feel it is better than the two mentioned arteries being of wider caliber, higher blood flow, easier in preparation and the ability of obtaining a longer length that facilitate the microvascular anastomosis. Also, the external carotid artery is less liable to be injured during neck dissection. The discrepancy in the diameter between the external carotid artery and the artery of the jejunal loop can be overcome by cutting the arterial pedicle of the jejunal loop obliquely so that the resultant arterial orifice will match that of the external carotid artery.

We divided the ischemia time of the flap into two parts by releasing the clamps transiently to allow temporary revascularization of the jejunum before starting the venous anastomosis. This will decrease the mucosal changes that start to develop as early as 30 minutes of ischemia time [19]. The main disadvantage of this maneuver is some blood loss that can be compensated by blood transfusion. The ischemia time is a detrimental factor for survival of free flaps. In the present study, total ischemia time of the jejunal loop ranged between 35-80 minutes. This is in agreement with previous reports [13-15]. Increased experience with free jejunal transfer will ultimately decrease the ischemia time. The ischemia time of the two flaps lost in our series was more than 1 hour. This agrees with experimental studies that proved that the longer the ischemia time for free jejunal flaps, the lower the survival of these flaps [19-21].

The blood loss in our series is apparently more than other reports [13&14]. This may be due to the early experience of the operating teams. Moreover, the blood lost after temporary release of the clamps before doing the venous anastomosis added to the increased need for blood transfusion.

The operative time in our series is near to other series [13&14]. The synchronization of the resection with harvesting of the flap greatly decreased the operative time. The operative time was found to be shorter in the later cases than the earlier cases denoting increasing experience of the operating team.

One of the difficulties in hypopharyngeal reconstruction is the flap monitoring. In our study, we used both neck window and exteriorized segment for early postoperative monitoring

followed by direct laryngoscopy starting from the third day. One of the lost flaps was monitored by exteriorization technique and the other one was monitored by neck window technique. However, late discovery of color changes in both flaps resulted in loss of them with subsequent patients' death. We agree with Maamoun [14] that exteriorization and neck window are faced with some difficulties. In neck window technique, early formation of granulation tissue in the wound within 48 hours hindered visualization the flap in some cases. Also, segment exteriorization technique, though popular [10], may be twisted or constricted during exteriorization resulting in false impression of ischemia or venous congestion. The other problem is the postoperative care of this segment as moisture is essential to prevent the false impression of color changes that accompany the dryness of this segment. In the view of our limited experience, we agree with Julieron et al. [13] and Maamoun [14] that direct laryngoscopy is a reliable method for postoperative monitoring as the mucosa is the first layer to suffer from perfusion changes [19].

Although this series represents our early experience, the survival rate of our jejunal flaps (85.7%) is in line with the previous reports. In the literature, the survival rate of jejunal flaps ranged between 80-100% with shift towards higher survival rate in the more recent series [9-15]. It is not lower than the flap survival rate of the relatively simpler techniques like pectoralis major myocutaneous flaps [2&3]. This high survival rate of the jejunal flap adds to the reliability of this technique as a one-stage procedure for hypopharyngeal reconstruction.

The mortality rate in our series (14.3%) is higher than previous reports which was in the range of 3-9% [9-15]. However, it is still lower than that of gastric interposition reconstruction [4,5]. The cause of mortality in our series was systemic sepsis as a result of late discovery of the flap failure. This reflects the importance of close postoperative monitoring to discover any vascular changes that occur in the flap with subsequent early trial at salvage.

The general and local complications rate in our series is in agreement with previous reports [9-15]. Of importance is salivary fistula development. The salivary fistula rate in our series was 25%. This is in agreement with previous reports

with a fistula rate reaching 19-33% in larger series [9,11]. In our series, all salivary fistulae closed spontaneously with conservative measures. This was also reported by Maamoun [14]. However, Reece et al. [11] reported the need for other flaps to close some of their fistulae. The rate of fistula development is much lower than that reported by the use of tubed skin-lined flaps like pectoralis major myocutaneous flap and forearm flaps. Also, the rate of spontaneous closure of these fistulae is much higher than the tubed skin-lined flaps [2,3,6,7&8]. This is obviously due to the better healing of muco-mucous anastomosis in jejunal free flap than the mucocutaneous anastomosis in tubed skin lined flaps [11].

One of the criticisms to free jejunal transfer is the need for laparotomy and the possibility of its complications. However, donor site complications were absent in our series. Minimal or no donor site complications were also reported in the literature [11,14&15]. This adds to the safety of free jejunal transfer.

In our study, the hospital stay was 18 days for patients who did not develop salivary fistula, increased to as long as 50 days in fistulated patients. This is in line with other previous reports [9,11]. This is obviously much shorter than the hospital stay reported for skin lined tubed flaps [2,3,6,7&8]. This is mainly due to the lower fistula rate with free jejunal transfer and the tendency towards spontaneous healing in comparison to the tubed skin-lined flaps which have lower rates of spontaneous closure [2,7].

The hypopharyngeal cancer is still a very poor prognosis tumor. Our oncological results are in line with the other authors where this kind of surgical technique was applied [11-15]. The need for bilateral block neck dissection as well as the positive lymph nodes affection by malignant tissue in all cases of our series proves this aggressive nature of the disease. Esophageal safety margin is a major issue that debated the use of jejunal flaps. It is generally accepted that a 2-cm safety margin is oncologically safe [22]. In this series, the least esophageal safety margin was more than 3 cm. With this distance, only one specimen showed infiltration of the resection safety margin. This means that this distance is accepted as a resection safety margin, which is usually obtainable.

The 2 years survival rate could not be calcu-

lated in our study due to the small number of cases. However, it has been reported to be in the range of 5-10% [1]. Non of our patients was found to be free from the disease 9-16 months after surgery. This agrees with previous reports [5,23]. Cahow and Sasaki [5] reported 75% recurrence rate in their patients.

Concerning the functional results, good swallowing has been restored in all our patients. We have not recorded problems with gastric reflux, in contrast to reports from authors using gastric pull-up for reconstruction [4,5]. This is due to the preservation of gastroesophageal junction and meticulous care taken during the reconstruction to position the jejunal loop in an isoperistaltic direction [10,24]. No patient has a feeding tube and all patients were eating a reasonably normal diet within 2 months after surgery. This agrees with other reports using free jejunum for reconstruction [11,14&15]. This is obviously better than that reported by other authors who have used tubed skin-lined flaps for reconstruction [2,7]. The good swallowing obtained after reconstruction with free jejunum transfer may be due to the peristaltic function of the jejunum that is absent with tubed skin-lined flaps [15].

No strictures were reported in our series during the follow-up period. The rate of stricture in larger series using free jejunal transfer in hypopharyngeal reconstruction reached 15% without significant affection of swallowing [11]. These results are far more better than tubed skin-lined flaps which was reported to be as high as 29% [2].

All flaps tolerated well postoperative radiation therapy without complication. Cole et al. [25] showed that the radiation tolerance of the transplanted jejunum is higher than doses accepted for the small intestine in its native location. Their histologic study showed only damage to intestinal absorptive cells that has no influence on the new function of the jejunal loop as a conduit.

The speech results in our series were not satisfactory. Speech retraining after reconstruction with a jejunal loop is difficult. There are no many reports in the literature on speech restoration following reconstruction of the upper digestive tract using a free jejunum flap. Menedelsohn et al. [16] found that patients treated with total laryngectomy have superior scores

for objective intelligibility, subjective intelligibility and acceptability than patients with total laryngo-pharyngectomy and jejunal free flap reconstruction. However, both groups showed similar amplitude and frequency parameters during normal conversation with equal patient acceptance. This could be due to the lack of a muscular layer and/or of a normal motor innervation in the jejunum graft wall [11,13]. Recently, phonatory prosthesis was used with creation of tracheojejunal fistula with improvement of the speech results [26].

#### Conclusion:

We assume that the indications of this kind of surgical technique are strict. The choice of the jejunum free flap depends on both the general condition of the patient and the extent of cancer. Although the prognosis of these tumors remains poor, jejunum autografts are shown to be an excellent choice for the reconstruction of the cervical hypopharyngo-esophagus tract offering the patient one stage reconstruction, rapid return to swallowing and a reasonable quality of life. In the view of the unsatisfactory speech results, phonatory prosthesis can be used in a trial to improve the speech.

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