

# Reconstruction of the Hypopharynx After Surgical Treatment of Squamous Cell Carcinoma

Pen-Yuan Chu, Shyue-Yih Chang\*

*Department of Otolaryngology, Taipei Veterans General Hospital, and  
National Yang-Ming University School of Medicine, Taipei, Taiwan, R.O.C.*

Squamous cell carcinoma of the hypopharynx (HPSCC) tends to present with an advanced stage. Surgery with postoperative radiation or chemoradiation therapy has been the standard treatment for HPSCC. Radical surgery may result in a large surgical defect of the hypopharyngeal and cervical esophageal regions. Reconstruction of the surgical defect is also important after ablation procedures. Many reconstructive methods have been developed. However, each method has its own advantages and disadvantages. The ideal method for hypopharyngeal reconstruction should have the following attributes if possible: single-stage procedure, high success rate of tissue transfer, low donor-site morbidity, low fistula and stenosis rates, restoration of the ability to speak and swallow, able to achieve successful reconstruction in a heavily radiated area and tolerance of postoperative radiotherapy. In this review article, we discuss the indications and drawbacks of several reconstructive methods that have been frequently used in our clinical practice. Finally, we will introduce the technique of laryngotracheal flap reconstruction, which was developed in our institution and has proved to be a simple and reliable method for hypopharyngeal reconstruction. [*J Chin Med Assoc* 2009;72(7):351–355]

**Key Words:** hypopharyngeal cancer, pharyngoesophageal reconstruction, surgery

## Introduction

Squamous cell carcinoma of the hypopharynx (HPSCC) usually presents with an advanced stage and generally has a poor prognosis. The reasons for this poor prognosis are late presentation,<sup>1</sup> submucosal spreading and early lymphatic/distant metastasis. Surgery with postoperative radiation or chemoradiation therapy has been the standard treatment for HPSCC, although an organ preservation protocol with chemoradiation therapy has become more popular in recent years.<sup>2,3</sup> In a review of the literature, only 15–34% of HPSCC patients are suitable for conservation surgery that is able to preserve laryngeal functioning.<sup>4–6</sup> Most patients need radical surgery, which includes total laryngectomy, partial or total pharyngectomy and/or esophagectomy. Radical surgery may result in a large surgical defect of the

hypopharyngeal and cervical esophageal regions. Therefore, reconstruction of the surgical defect is important in order to restore the continuity of the gastrointestinal tract and allow oral alimentation.

Reconstruction of a hypopharyngeal defect is one of the most challenging and controversial problems facing the head and neck reconstructive surgeon, especially when treating a circumferential defect. The reconstructive options have evolved over many years from multistaged procedures with poor surgical outcome to single-stage reconstruction with a superior functional result. The ideal method for hypopharyngeal reconstruction should have the following attributes if possible: single-stage procedure, high success rate for tissue transfer, low donor-site morbidity, low fistula and stenosis rates, restoration of the ability to speak and swallow, able to achieve a successful



\*Correspondence to: Dr Shyue-Yih Chang, Department of Otolaryngology, Taipei Veterans General Hospital, 201, Section 2, Shih-Pai Road, Taipei 112, Taiwan, R.O.C.  
E-mail: sychang@vghtpe.gov.tw • Received: October 31, 2008 • Accepted: April 6, 2009

reconstruction in heavily radiated areas and tolerance of postoperative radiotherapy.<sup>7</sup> Up to the present, many reconstructive methods have been used to repair a hypopharyngeal defect, including local flaps, myocutaneous flaps, free fasciocutaneous flaps, free jejunal interposition, and gastric pull-up, with each method having its advantages and disadvantages. The choice of reconstruction method depends on the size and level of the defect, the complication rate, overall morbidity, the patient's general medical health, functional outcomes in terms of speech and swallowing, and the need for adjuvant therapy. The surgeon's familiarity and experience with the different reconstructive techniques also play an important role in the method chosen. Currently, there is no general consensus with regard to what constitutes the best method of reconstruction after laryngopharyngectomy.

For hypopharyngeal cancers that are too large for a conservation procedure, radical surgery that includes total laryngectomy and partial pharyngectomy is needed. When the residual mucosa of the hypopharyngeal defect is > 3 cm in width, this will allow primary closure of the pharynx without the need for tissue transposition.<sup>7</sup> If insufficient mucosa remains, pedicled or free tissue transfer patch flaps may be inserted into the defect site to allow reconstruction. The following reconstruction methods have been commonly used in our clinical practice.

### **Pectoralis Major Myocutaneous Flap**

The pectoralis major myocutaneous flap (PMMCF) is based on the pectoral branch of the thoracoacromial artery and was described in 1979 by Ariyan.<sup>8</sup> It is one of the most frequently used myocutaneous flaps for the reconstruction of a partial hypopharyngeal defect. It is a reliable pedicled flap with excellent blood supply that allows single-stage reconstruction and provides muscle bulk, which is useful when filling a large defect and helps to protect the carotid artery after neck dissection. The flap can be rapidly raised from the anterior chest wall and no additional expertise in microvascular or abdominal surgery is needed. Morbidity of the donor site is minimal. However, the flap is often too bulky to allow tailoring into a tube for the reconstruction of circumferential defects of the pharyngoesophageal segment, especially when the patient is female or obese. Some modifications of the PMMCF have been made to allow tubed reconstruction,<sup>9-11</sup> but the fistula and stricture rate are still high, and the long-term functional results have been disappointing. PMMCF remains the reconstructive technique

of choice for salvage procedures, for elderly patients and for patients with severe medical comorbidities in which an extended surgical time is contraindicated.

### **Radial Forearm Free Flap**

The increased availability of surgeons trained in microvascular reconstruction and the continued high published success rates have made free flaps an attractive option for hypopharyngeal reconstruction. Both the radial forearm free flap (RFFF) and free jejunal flap are often used methods. The RFFF, based on the radial artery and cephalic vein, has been the best choice for near-total laryngopharyngectomy defects. Unlike the PMMCF, this thin, pliable fasciocutaneous flap can be easily contoured into a partial or complete tube for pharyngoesophageal reconstruction. The diameter of the tailored tube can be carefully adjusted to fit the unequally sized pharyngeal and esophageal lumens. Furthermore, there is minimal donor-site morbidity in terms of functional and esthetic deficiencies. A simultaneous harvesting of the flap during the surgical ablation procedure reduces operative time. The tissue tolerates postoperative radiotherapy very well. Speech rehabilitation is superior compared with other reconstructive methods, including PMMCF, gastric pull-up and free jejunal flap.<sup>12-14</sup> The stricture rate (10-36%) and the fistula rate (17-28%) are relatively high, especially with a tubed flap rather than a patch-on flap,<sup>15-17</sup> because there is a third suture line to close the flap on itself to create a tube in addition to the proximal and distal anastomosis. However, such leaks are relatively minor, and most of them resolve after a brief period of conservative treatment.

### **Free Jejunal Flap**

The free jejunal flap has been increasingly used as the first reconstruction option for circumferential pharyngoesophageal defects above the sternal notch. The jejunal flap seems to be an ideal reconstructive choice<sup>18</sup> as it allows the surgeon to replace a hollow muscular tube (the pharynx) with a hollow muscular tube (the jejunum). Due to the segmental blood supply of the jejunum, up to 20 cm of jejunum can be harvested based on a single vascular arcade. The transfer of the vascular mesentery with the jejunum is another advantage to this flap, because it allows for the obliteration of any dead space and coverage of any important vascular structures. For patients with limited esophageal

extension, free jejunal flaps have an overall success rate of 90–100%; furthermore, the fistula and stricture rates are acceptable.<sup>18,19</sup> Clinical experience with the jejunal flap has demonstrated a high rate of successful restoration of deglutition, and this has allowed earlier rehabilitation and restoration of deglutition compared to other reconstructive methods. However, some patients may suffer intermittent dysphagia due to uncoordinated peristalsis during deglutition. Voice rehabilitation is a major problem with this visceral transfer.<sup>20</sup> Tracheoesophageal puncture usually results in a less satisfactory voice than that obtained with skin flaps. Excessive mucus production tends to clog the prosthesis and results in a typically moist voice that lacks volume. The free jejunal flap needs a microvascular reconstructive team and also needs a laparotomy to harvest the graft. The need for intra-abdominal surgery exposes the patient to abdominal-related morbidity and even mortality.<sup>7,20</sup> Adhesions, intestinal bleeding, bowel obstruction and anastomotic or abdominal wound dehiscence are among the possible complications.

### Gastric Pull-up Reconstruction

Gastric pull-up reconstruction is often recommended for tumors that have invaded to the cervical esophagus because it allows an adequate inferior margin below the thoracic inlet and the removal of a potential skip lesion of the esophagus. This procedure involves releasing the stomach through a laparotomy and bluntly delivering it through the mediastinum to the neck along with the entire esophagus. The transposed tissue, pedicled on the right gastric and gastroepiploic vessels, can reach as high as the nasopharynx. Only 1 anastomosis between the pharyngostoma and the transposed stomach is required, potentially decreasing the chances for stricture formation. Gastric pull-up has a number of advantages, including being a 1-stage procedure with a single intestinal anastomosis, and having a high success rate due to excellent blood supply, and finally, the procedure allows for the removal of the entire esophagus, which has a high incidence of second primary malignancy in HPSCC patients. It has the lowest rate of stricture of all flaps and has a more than 90% flap success rate. However, gastric pull-up is a procedure with a higher morbidity; there is a reported mortality of between 5% and 25% together with an overall incidence of complications of between 26% and 55%.<sup>21–23</sup> Mediastinitis may result after flap necrosis and has serious consequences. Postoperative swallowing and voice rehabilitation are additional problems.

The absence of a gastroesophageal sphincter causes gastric reflux disease or dumping syndrome in 15–20% of all patients.<sup>23</sup> This can be minimized by instructing patients to take small, frequent meals and to sleep in a head-up position. The tracheoesophageal speech of these patients may be weak and gurgling because of the poorly vibrating nature of the segment of the flaccid stomach used and because of gastric secretions. Therefore, many surgeons reserve this procedure for lesions that descend into the thoracic esophagus.

### Laryngotracheal Flap

The laryngotracheal flap (LTF) was developed in our institution in 1991.<sup>24</sup> By using a laryngotracheal fissuring approach for hypopharyngeal tumor excision, the contralateral LTF can be used for the reconstruction of the hypopharyngeal defect. Although there is preservation of the contralateral uninvolved laryngotracheal tissue, this does not seem to increase the tumor recurrence rate. It can also reduce the use of complicated regional or free flaps. In our preliminary report, we showed that 75% of the hypopharyngeal defects could be reconstructed with this flap without other flaps. Postoperative complications are rare, with only 2% of patients experiencing pharyngoesophageal stenosis and 5% having pharyngocutaneous fistula. The oncological results are also satisfactory.

As our experience has increased, we have extended this technique to tumors showing cervical esophageal invasion, which was thought to be a contraindication of this technique.<sup>25</sup> The LTF has been proven to be safe for hypopharyngeal tumors with cervical esophageal invasion that is < 2 cm below the cricopharyngeal sphincter. Specifically, the preservation allowed by the LTF approach means that any defect in the pharyngoesophageal segment can be shifted from a circumferential defect to a partial defect. Only a patch-on PMMCF is needed for this reconstruction, which is familiar to all head and neck surgeons, including those without a microvascular team. In a series of 12 patients having HPSCC with esophageal invasion, only 2 minor postoperative complications occurred; these consisted of 1 local abscess and 1 hematoma over the donor site. Two thirds of the patients achieved satisfactory swallowing with a regular or soft diet. There was no local recurrence, with only 1 regional recurrence and 1 distant metastasis being identified.

A retrospective study was conducted to compare the postoperative complications and oncological results of 91 HPSCC patients treated with radical surgery in our institute between 1986 and 1995.<sup>26</sup> Before LTF

was developed, 44% of the defects needed a complicated flap for reconstruction; 26% of them involved tubed PMMCF and 18% of them were gastric pull-ups. After LTF was introduced, over 80% of the defects could be reconstructed with a primary closure, LTF or a combination of LTF and a patch-on PMMCF. Postoperative overall complications were significantly decreased from 71% to 30% after LTF was developed, and this included early complications (53% vs. 15%,  $p=0.0001$ ), the pharyngocutaneous fistula rate (32% vs. 6%,  $p=0.001$ ), and late complications (44% vs. 17%,  $p=0.003$ ). The surgical mortality rate dropped from 8% to 0%, and the median hospital stay was reduced from 27 days to 19 days. Although there was preservation of the contralateral LTF, the recurrence rate was found not to be significantly increased (34% vs. 38%,  $p=0.730$ ). The 5-year survival rates including overall survival, disease-specific survival and recurrence-free survival also showed no significant differences between before and after the introduction of LTF.

In this technique, it is important to preserve adequate blood supply to the LTF. Therefore, the method may be unsuitable for salvage surgery after radiotherapy or concurrent chemoradiation therapy, because the blood supply of the LTF would be compromised after these treatments.

## Summary

Many reconstructive methods have been used in a variety of different situations when carrying out reconstruction of the hypopharynx. All of the methods have their advantages and limitations. The LTF approach, developed in our institution, has proved to be a simple and reliable method for hypopharyngeal reconstruction. The need to use a complicated flap is decreased, and postoperative complications are reduced significantly. The oncological results are satisfactory. LTF has become the approach of first choice for hypopharyngeal reconstruction at our institution.

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