Pharyngeal Reconstruction with Microvascular Free Tissue Transfer

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Abstract

Keywords

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Reconstruction of pharyngoesophageal defects after total laryngectomies and extirpation of hypopharyngeal and upper esophageal carcinomas presents a challenging task. Goals of reconstruction include adequate voice rehabilitation and restoration of normal swallowing. The reconstructive armamentarium contains many options for reconstruction and creation of a new upper digestive tract. This review article focuses on the most commonly used free tissue transfer options for the reconstruction of these defects, with an assessment of their advantages and disadvantages.

Reconstruction of pharyngoesophageal defects presents a unique challenge to the reconstructive surgeon. The goals of reconstruction include adequate voice rehabilitation, restoration of an acceptable swallowing conduit, and avoidance of dehiscence or fistula formation.^{1–4}

Reconstructive options include pedicled flaps such as pectoralis major and supraclavicular artery island flap; free fasciocutaneous flaps such as anterolateral thigh, posterolateral thigh, lateral arm, lateral thigh tensor fascia, ulnar forearm, radial forearm, and free enteric flaps such as jejunum, colon, ileocolic, and gastro-omental jejunal free flap.^{2,3,5–9}

Patients with a history of prior radiation have been reported to be more likely to have wound complication such as fistula formation.^{1–4,10} Furthermore, strictures associated with scarring and poor healing are also associated with poorer patient voice and swallowing outcomes.^{1–4,10}

Utilization of free tissue transfer confers multiple advantages in reconstruction of pharyngeal defects. It offers the

ability to withstand adjuvant radiation therapy due to their vascularized nature. Free flaps also allow for two-team, single-stage reconstruction. Fasciocutaneous flaps offer thin, pliable tissue which can be tubed and tailored to the defect with a long reliable pedicle.^{3,4,8,9}

In this article, we will explore the nuances of different free tissue reconstructive options and discuss advantages and disadvantages well as operative pitfalls to avoid. Pedicled flaps such as supraclavicular flaps and pectoralis myocutaneous flaps are beyond the scope of this article.

Anatomy and Physiology of the Upper Aerodigestive Tract

The upper aerodigestive tract is a unified conduit for passage of nutrition and air. This conduit allows for passage of food while protecting the airway through intricate voluntary and involuntary movements controlled by central nervous system. The

complex function for these two features presents a challenge in reconstruction. The pharyngeal mucosa is lined with non-keratinizing stratified squamous mucosa. The nasopharynx, however, is lined with respiratory ciliated columnar epithelium. The underlying muscles in the pharynx function to propel the food bolus through the upper aerodigestive tract toward the upper esophageal sphincter. This is performed through relaxation and contraction of muscles simultaneously to allow for pressure generation permitting propulsion of the bolus. The “pharynx” is anatomically divided into nasopharynx, oropharynx, and hypopharynx. The nasopharynx extends from the skull base the soft palate; the oropharynx extends from the palate to the level of the hyoid bone, including the tonsils, base of tongue, and vallecular, while the laryngo/hypopharynx extends from the upper border of the epiglottis to the lower border of the cricoid cartilage.

Fasciocutaneous Free Flaps

Anterolateral Thigh Free Flap

Anterolateral thigh (ALT) free flap is a fasciocutaneous flap based on the descending branch of the lateral femoral circumflex artery. It is a frequently used flap in the reconstruction of upper alimentary tract after total laryngopharyngectomy defect. It offers two-team approach, minimal donor-site morbidity, considerable amount of tissue, and ease of harvest. Rates of fistula formation reported at 9% and strictures reported at 6%.^{3,5-7,9,11,12} The ALT flap can be harvested as a chimeric free flap. Multiple skin paddles can be used based on different perforators. This can be used for both nasopharyngeal and pharyngeal reconstructions.^{7,12} Sharaf et al proposed an algorithm for the reconstruction of circumferential and partial laryngopharyngeal defects and skin resurfacing. In their approach, they utilize two skin paddles; the proximal segment for the reconstruction of nasopharynx and the distal segment for pharyngoesophageal.⁷ The artery is usually ~1.5 to 2.5 mm in diameter, and the pedicle length can be up to 7 cm based on the location of the skin paddle. Disadvantages of the ALT in pharyngeal reconstruction include donor-site morbidity and the need for split-thickness skin grafting of the donor site.

Radial Forearm Free Flap

The use of radial forearm free flap was first reported by Harii et al in the reconstruction of pharyngoesophageal defects.^{13,14} It has now become the workhorse of pharyngeal free tissue reconstruction. The harvested tissue can be tubed upon itself before inseting the flap into the neck.^{13,14} Forearm free flap offers a thin, pliable, and versatile fasciocutaneous tissue with a long and reliable pedicle^{1,3,4,7,9,14,15} (► **Figs. 1, 2**). The flap is based on the radial artery and the venae comitantes of the radial artery or cephalic vein. The vessels can also be dissected up to the takeoff from the brachial artery just distal to the antecubital fossa, remarkably increasing its length. Ulnar forearm free flaps can also be harvested based on the ulnar artery and the basilic vein. Li et al reported harvesting ulnar forearm free flap for reconstruction of pharyngoesophageal defects in 20 patients with 95% successful transfer rate.¹⁴ The main disadvantage of the

Fig. 1 Radial forearm free flap tubed at the forearm after elevation but before harvest.

Fig. 2 Tubed radial forearm free flap after inset and microvascular anastomosis.

forearm flaps is the need for split-thickness skin graft covering of the donor site leading to potentially poor functional and aesthetic outcomes.^{9,14,15}

Enteric Free Flaps

Free Jejunal Free Flap

Free jejunal free flap provides small bowel tissue vascularized by branches of the superior mesenteric artery and vein. It was first used for pharyngoesophageal reconstruction in 1957 and later reported by Seidenberg et al in 1959.^{5,16} It offers optimal mucosal matching, peristalsis, a tubular structure, and lower rates of fistula formation and strictures.^{1,2,5,9,14,17-19} Disadvantages include susceptibility to ischemia secondary to high metabolic rate, increased risk of infection due to high bacterial count of the lower digestive tract, necessity for laparotomy/laparoscopy, postoperative ileus, and longer hospital stays.^{3,5,8,9,14,20} Contraindications to using jejunal free flaps are history of multiple abdominal surgeries, diseases of the liver, and intestinal diseases.²

Modifications and Combinations

Many authors have published modifications and combination of free and pedicled flaps to reduce the tension at the

anastomosis and to prevent fistula or stricture formation. Garg et al reported a snake flap technique to harvest the radial forearm free flap allowing the donor site to be closed primarily eliminating the need for split-thickness skin graft and improving aesthetic outcomes.¹⁵ Matsumine et al reported using bilateral deltopectoral flaps and pedicled pectoralis major flap for reconstruction of cervical esophagus in light of free jejunal flap necrosis.²⁰ The use of longstanding salivary bypass stents have been reported to have significant reduction of pharyngocutaneous fistula and pharyngoesophageal strictures.^{3,21,22} However, this is not uniformly used in practice. Ni et al reported combining gastric pull up and free jejunal free flap for pharyngoesophageal reconstruction after pharyngolaryngectomy in two patients with early return to oral intake and no incidents of fistula formation.²³

Conclusion

Reconstruction of circumferential and near-total-circumferential defects after laryngopharyngectomy in the management of hypopharyngeal and upper esophageal carcinomas presents as a challenging task to the reconstructive team. A thorough assessment of the patient's comorbidities, functional status, available reconstructive options, and degree of aggressiveness to manage these defects are prudent in successful outcomes. Over the past couple of decades, there have been significant advances in microsurgical techniques and numerous reports of different techniques and approaches in reconstruction. The reconstructive options have expanded to support the surgical team with adequate number of approaches, and understanding the advantages and disadvantages of each approach permits the surgical team to deliver the best outcomes to the patients.

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None

Conflict of Interest

None of the authors have any relevant conflicts of interest to disclose.

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