Free Flap Reconstruction of the Oropharynx

Beatrice C. Go, MD[1], Alex J. Gordon, MD[2], Robert M. Brody, MD, Steven B. Cannady, MD*

KEYWORDS

• Oropharynx • Reconstruction • Free flap • Microvascular • Radial forearm • Anterolateral thigh

KEY POINTS

- Adequate reconstruction of the oropharynx is essential for speech and swallow function after cancer resection.
- Free flaps are useful in the reconstruction of large defects, coverage of the internal carotid artery, and prevention of communication between the pharynx and neck.
- Donor-site morbidity and functional status are important considerations when choosing the optimal reconstructive option.
- Postoperative complications after oropharyngeal free flap reconstruction are relatively infrequent.

INTRODUCTION

Oropharyngeal cancer is an increasingly prevalent disease in the United States, largely due to the rise human papillomavirus (HPV)-related disease over recent decades.[1,2] The recent predominance of HPV-related oropharyngeal cancer, which tends to have a more indolent clinical course than non-HPV oropharyngeal cancer, has increased the necessity of treatment options that improve survival outcomes while preserving quality of life and functional status.[3] While chemotherapy and radiation are mainstays in the treatment of oropharyngeal cancer, surgical resection provides potential for deintensification of postoperative adjuvant therapy.[4] Furthermore, this may avoid long-term complications associated with curative radiation such as dysphagia, dysarthria, and osteonecrosis.[5,6]

Though surgical treatment of oropharyngeal cancers was historically limited due to access requiring a mandibular swing, the advent of transoral robotic surgery (TORS) in addition to technological and technical advances has allowed for larger and more complex resections.[7,8] Up-front TORS for clinically staged locally advanced HPV cancers (cT3/T4) has been shown to offer favorable survival outcomes while avoiding adjuvant therapy.[9,10] Furthermore, this treatment option is associated with favorable quality-of-life outcomes, particularly for speech and swallow function.[11]

At the same time, increasing the extent of surgical defects of the oropharynx requires careful consideration to select the most ideal reconstructive option to reduce morbidity and improve functional outcomes. The oropharynx is crucial for critical physiologic functions such as swallowing and speech. Failure to appropriately reconstruct the palate can result in velopharyngeal insufficiency, nasal regurgitation, nasopharyngeal stenosis, and sinusitis. Complications of inadequate reconstruction of the pharynx can lead to fistula, chronic neck infection, and carotid artery hemorrhage. Maintaining bulk and sensation in the base of the tongue is vital to reduce the risk of

B.C. Go and A.J. Gordon have contributed equally to this work.
Department of Otorhinolaryngology–Head and Neck Surgery, Hospital of the University of Pennsylvania, 5th Floor Ravdin, 3400 Spruce Street, Philadelphia, PA 19104, USA
[1] Present address: 2040 Ludlow Street, Apartment 1209, Philadelphia, PA 19103.
[2] Present address: 111 South 15th Street, Apartment 1501, Philadelphia, PA 19102.
* Corresponding author.
E-mail address: Steven.Cannady@pennmedicine.upenn.edu

Facial Plast Surg Clin N Am 33 (2025) 77–84
https://doi.org/10.1016/j.fsc.2024.07.005

aspiration pneumonia and improve dysphagia and speech articulation. Appropriate reconstruction of the oropharynx plays an increasingly significant role in patient quality of life and the avoidance of disastrous postoperative complications.

DISCUSSION

Indications and Contraindications

There are a variety of viable options for the reconstruction of the oropharynx, and several algorithms have been suggested in the literature. One such algorithm by de Almeida and colleagues[12] includes a classification system based on subsite involvement and presence of adverse features (carotid artery exposure in the pharynx, communication with neck, >50% soft palate resection). Patients without any adverse features (Class I/II) were typically reconstructed with secondary intention, primary closure, or local flaps utilizing nearby tissue from the posterior pharynx and superior constrictors. Patients with adverse features (Class III/IV) required regional tissue transfer with consideration of free flap reconstruction. Regional flaps such as submental island flap,[13] pectoralis major flap,[14] and sternocleidomastoid flap[15] have all been well described in the literature. Free tissue transfer was performed for extensive palatal and pharyngeal defects, and in patients likely requiring adjuvant radiotherapy based on disease severity.

The indications for TORS free flap reconstruction serve as guidelines, and each individual patient necessitates careful and tailored decision-making to select the optimal reconstructive strategy. In our experience, we perform soft palate reconstruction in individuals with at least one-third of a soft palate defect or with a resection extending anteriorly to the hard palate, therefore resulting in a break in the velopharyngeal sphincter. Lateral extension including the medial pterygoid and exposure of the internal carotid artery are also considerations for free tissue transfer. Patients with involvement of the pharyngeal constrictor and at least one-half of the base of tongue with a significant impact on postoperative dysphagia also typically undergo microvascular reconstruction. Finally, history of prior radiation therapy, which can negatively impact wound healing and is an independent risk factor for aspiration, is another important factor.[16]

Surgical Options

There are a variety of free flaps that can be used in oropharyngeal reconstruction including enteric free flaps and fasciocutaneous free flaps. While the jejunal free flap is a viable option for the oropharynx, this strategy is typically utilized for pharyngoesophageal reconstruction due to its unique tubular, mucosal structure. Furthermore, major disadvantages include requiring a laparotomy with increased donor-site morbidity and potential for intra-abdominal complications.[17] In contrast, the most commonly used free tissue options in the oropharynx include the radial forearm free flap (RFFF) and anterolateral thigh (ALT) free flap, 2 flaps with excellent functional outcomes and low donor-site morbidity. Other flaps including the latissimus dorsi flap, thoracodorsal artery perforator flap, medial sural artery perforator flap, and superficial circumflex iliac flap have all been reported in the literature.[18]

The RFFF has become a widely used and popular flap for oropharyngeal reconstruction. Based on the radial artery, the flap has a reliable and long vascular pedicle, making it an ideal option to cover defects in the oropharynx. In addition, the radial forearm is pliable with the option of harvesting a thin skin paddle, allowing for appropriate coverage of the resection bed without adding unnecessary tissue bulk. Though the versatility of this flap allows for a wide range of use, morbidity at the donor site including flexor tendon exposure, skin graft breakdown, esthetic deformity, and reduced sensation and motion can occur.[19] An alternative option for the oropharynx is the ALT flap, which is based on perforator vessels from the descending branch of the lateral circumflex femoral artery. Advantages of this flap include low donor-site morbidity, adjustability of flap thickness, and long vascular pedicle. When comparing RFFF with thinned ALT flaps in the oropharynx, one comparative study found that flap survival rates and functional results at the receiving sites were equivalent.[20] Permanent forearm movement impairment was seen in 35% of the cases, and patient satisfaction was overall decreased in the RFFF group. Similar findings have been reported among other studies, emphasizing a lower likelihood of donor-site morbidity among patients with ALT though with no significant differences in swallowing, speech, or quality of life.[21] However, there is no clear consensus for reconstruction in the oropharynx and surgeons need to take into consideration any pertinent patient circumstances, comorbidities, and disease burden to select the optimal flap approach.

Though free flap reconstruction after TORS is relatively safe, there are several complications associated with the procedure. One systematic review on free flap reconstruction after TORS including 23 primary studies identified infection as the most prevalent complication occurring in 9% of patients.[22] Other perioperative complications including fistula, postoperative bleed, intra/postoperative blood transfusion, flap necrosis, flap wound dehiscence, chyle leak, hematoma, and aborted flap were also reported. There were no mortalities due to microvascular reconstruction.

Patient Satisfaction

Complex coordination of the oropharyngeal muscles is required to produce a swallow response while maintaining and protecting the airway. Extensive resection of the palate, base of the tongue, or pharyngeal muscles can impair this multifaceted process, leading to dysphagia, regurgitation, and aspiration. Patients with base of tongue resection, large tumor size, and postoperative radiation or chemoradiation therapy are particularly at risk for dysphagia.[23–25] Other functional impairments including xerostomia, trismus, mucositis, salivary issues, and oral pain can further exacerbate an already limited swallowing mechanism.[26] As swallowing function and nutritional intake impact quality of life, assessing and evaluating the role of free flap reconstructive surgery on these functional outcomes remain important.

There is a lack of randomized controlled data available assessing swallowing function in patients undergoing oropharyngeal resection with free flap reconstruction compared to primary radiation therapy. One systematic review combining oral cavity and oropharyngeal patients receiving free flap reconstruction found a positive association between postoperative radiotherapy and decreased swallowing function.[23] Presence of aspiration on flexible nasopharyngeal laryngoscopy and videofluoroscopic swallowing study (VFSS) was reported in 15% of patients and correlated with amount of oral tongue or base of tongue resected. There was no difference in aspiration rates between flaps used, and gastrostomy dependence was reported in 8% of patients. Results from this study were used to develop a protocol for identifying low-risk and high-risk patients (defined as large resection involving base of tongue/oral tongue/soft palate with radiotherapy) and suggested that high-risk patients be monitored with validated quality-of-life metrics and VFSS postoperatively. Smaller case series and cohort studies specifically assessing swallow function following TORS with free flap reconstruction have found good long-term function with minimal intake restrictions. A review including 42 patients found that 93% of patients could tolerate oral intake postoperatively with 87% taking an entirely oral diet at 1 year.[27] Another series reported an initial decline in functional oral intake scale at the first postoperative appointment but a progressive improvement after 1 year.[28]

Free flap surgery for the base of tongue and palate resection allows for reconstruction and augmentation of shape, volume, and mobility to aid in speech production. One systematic review assessing free flap reconstruction in oral tongue and base of tongue cancers found a significant decline in speech in the early postoperative phase but a significant recovery to preoperative levels after 1 year.[29] Extent of soft tissue resection can also impact speech outcomes. Patients with resections of half or greater than half of the soft palate were shown to have higher nasalance values and poorer velopharyngeal function.[30,31] A series of 29 patients treated with free flap reconstruction reported satisfactory speech outcomes with normal or slightly below normal speech intelligibility in 76% of patients and moderate or no rhinolalia in 72%.[32] Mean quality of life and functioning scales were above 80%, suggesting that free flap reconstruction is a viable option with slight handicap on speech function.

Expected postoperative edema in the oropharynx often necessitates routine placement of a tracheostomy during time of surgery. Decannulation occurs in the majority of patients, with a reported overall mean airway decannulation time of 17 days.[22,27] As a temporary adjunct procedure for airway protection, the high rate of decannulation after free flap reconstruction is important given the profound impact of a tracheostomy on speech, swallow, and body image perception.[33]

Challenges

The indications and options for free tissue repair of oropharyngeal defects are clear; however, there are several patient and disease characteristics that may increase the difficulty of successful reconstruction. Gaino and colleagues[34] proposed a “Pharyngoscore” system to predict difficulty of oropharyngeal exposure during TORS. They found that male sex, increased neck circumference, smaller inter-incisor gap, and Modified Mallampati classification of class III or greater corresponded were associated with greater difficulty of exposure. Similarly, these anatomic characteristics would be expected to limit transoral visibility and range of motion during the inset of free tissue to repair oropharyngeal defects. Prior history of neck dissection or radiation can cause significant fibrosis and distortion of tissue planes, limiting options for recipient vessels in the neck and increasing the challenge of microvascular anastomosis.[35] Radiation can also contribute to jaw trismus, further limiting intraoral access.[34,36]

Larger defects and those involving multiple oropharyngeal subsites require greater intraoperative planning and greater volume of tissue transfer.[12] Some surgeons have proposed using 2 dimensional templates to guide free tissue harvesting, with distinct soft tissue domains or “petals” representing each subsite requiring reconstruction.[37,38] This technique may result in reconstruction that more closely resembles the native oropharyngeal configuration; however, it also requires delicate thinning and shaping of each domain, with care to avoid devascularization.

The type of free tissue utilized may also contribute to the difficulty of the flap inset. One advantage of the ALT flap over the radial forearm is the ability to harvest a thicker and broader tissue graft with relatively lower donor-site morbidity. This same thickness and bulk may also be a hindrance, limiting maneuverability and visibility within the oropharynx when compared to the radial forearm. In one study, 29% of cases using an ALT flap to reconstruct a lateral oropharyngeal defect experience early local complications requiring reoperation.[39]

Complications

While free flap reconstruction of the oropharynx has overall high success rates, postoperative complications are not uncommon, as with all complex surgical procedures. In a recent systematic review including 132 patients who underwent TORS with free flap oropharyngeal reconstruction, the most commonly reported complications were infection (8.9%) and flap dehiscence (4.2%).[22] In another analysis of 1115 patients who had undergone free flap reconstruction for head and neck cancer, reoperation within 30 days was necessary in 20.2% of patients.[40] In this study, 54.3% of secondary procedures were due to urgent flap concerns, hematoma, or wound closure, 32.1% were for infection control, and 13.6% were for enteral or airway intervention.

Several studies have attempted to identify risk factors and special patient populations that may predispose to greater flap complications. One study of 1643 head and neck free flaps from the American College of Surgeons—National Surgical Quality Improvement Project dataset found that greater operative time was associated with both greater overall complications and serious complications (reoperation, deep surgical-site infection, death, cardiac arrest, etc.).[41] Another study assessed the association between body mass index and complications after head and neck free flap surgery; they found that significant weight loss and underweight status were associated with greater 30 day mortality, though neither were associated with greater flap loss.[42]

Several studies have shown that greater time to perform microvascular anastomosis was associated with a higher incidence of flap necrosis or dehiscence, suggesting that ischemic time should be limited to 30 minutes per vessel.[43] At the same time, it is undetermined whether greater ischemic time is directly responsible for these complications and is therefore a modifiable risk factor, or if the ischemia reflects baseline characteristics of the donor and recipient vessels that predispose to subsequent complications.

Current Controversies

Given the relative infrequency of oropharyngeal free flap reconstruction, the postoperative management of these cases is not uniform, with considerable variation based on institution and individual surgeon preference. This variation is particularly prominent with regard to the use of prophylactic anticoagulation, routine flap monitoring, and blood pressure management.[44]

It is well known that vascular compromise after free flap reconstruction is most likely to occur in the first 72 hours after surgery, and early detection is associated with greater chances of flap salvage; however, there is little agreement in the literature as to the optimal frequency and total duration of flap monitoring.[45] Furthermore, there is no consensus as to the best method of monitoring, with myriad options including direct clinical assessment, implantable Doppler ultrasonography, handheld Doppler ultrasonography, and microdialysis.[46,47] Each of these options requires significant effort and time from skilled clinicians, the proportions of salvaged free flaps attributable to each method of postoperative monitoring have not been thoroughly compared. At the same time, a unique advantage of using implantable Doppler probes is the detection of intraoperative vascular compromise, which can be repaired immediately.[48] Even so, there is inter-surgeon variability in the use of implantable Doppler probes to measure arterial signals, venous signals, or both.[49]

Anticoagulation is commonly used after free flap reconstruction to prevent thrombosis of the pedicle anastomosis. One systematic review of postoperative anticoagulation techniques among patients with head and neck cancer undergoing free flap reconstruction found that anticoagulation protocols included heparin, low molecular weight heparin, aspirin, dextran-40, prostaglandin E1, and, in some cases, no anticoagulation.[50] This study included several types of donor sites and was not limited to oropharyngeal reconstruction; however, it is reasonable to assume that similar variation in postoperative anticoagulation protocols exists within the context of oropharyngeal reconstruction. Across all methods, the rate of postoperative thrombosis was low, ranging from 0.8% for aspirin to 7.8% for dextran-40. Interestingly, the thrombosis rate among patients who did not receive anticoagulation was 4.3%. The heterogeneity of the anticoagulation protocols among the studies included in this review precluded a meta-analysis. Another review of 8 studies on postoperative anticoagulation after head and neck free flap reconstruction found that anticoagulation did not significantly decrease the rates of flap thrombosis and subsequent failure, while the rate of hematoma formation significantly increased.[51] Prospective studies may be warranted to directly compare different methods of postoperative anticoagulation and determine whether any anticoagulation is warranted at all.

Maintaining adequate perfusion to free flaps in the immediate postoperative period is paramount to flap viability, though the acute blood loss and lingering effects of anesthesia present several challenges.[52] Common interventions to maintain perfusion such as fluid resuscitation and blood transfusions can alter the viscosity and coagulability of blood in the flap microvasculature, impacting blood flow.[53] Several studies have found that aggressive crystalloid resuscitation, typically with more than 130 mL/kg per 24 hour period, was associated with free flap compromise and general medical complications among patients with head and neck cancer.[54–56] At the same time, it is unclear whether the resuscitation efforts or the hemodynamic circumstances that necessitated these interventions are responsible for the observed impact on flap outcomes. Furthermore, while maintaining an adequate hematocrit is beneficial to tissue oxygenation, blood transfusions may increase blood viscosity and decrease circulation through microvascular anastomoses.[55] At present, no prospective studies have determined optimal protocols for hemodynamic intervention among patients with head and neck free flap.

Future Developments/Considerations

While the success rates of oropharyngeal free flap reconstruction are high, quantitative data on functional outcomes after reconstruction are limited in the present literature. One recent systematic review of studies describing reconstruction after TORS found that only 3 of 26 included studies characterized postoperative swallowing function using quantitative measures, concluding that further investigation with quantitative measures is warranted to describe functional outcomes after oropharyngeal reconstruction.[57] The M.D. Anderson Dysphagia Inventory and the Functional Outcomes of Swallowing Scale are 2 examples of validated metrics that could be used to characterize speech and swallow function prior to and following oropharyngeal reconstruction.[58,59] In particular, these tools could be useful in allowing direct comparison of quantitative functional outcomes between different methods of reconstruction (eg, ALT vs radial forearm).

As previously stated, the postoperative management protocols of oropharyngeal free flap reconstruction are highly variable, which presents an opportunity for greater standardization through outcomes-focused prospective studies. Furthermore, many of the aforementioned studies regarding postoperative protocols included all head and neck free flaps and were not limited to the oropharynx.[50,51] Optimization of postoperative anticoagulation and fluid resuscitation protocols has the potential to lead to greater rates of successful reconstruction and decreased complications.

SUMMARY

Several recent technological and surgical advancements including TORS have allowed for more extensive resection of locally advanced oropharyngeal cancers while allowing deescalation of adjuvant therapy. Reconstruction with free tissue provides adequate approximation of the native oropharyngeal anatomy in the majority, contributing to favorable speech and swallow function, and subsequently, patient satisfaction and quality of life. Numerous free flap reconstructive options exist, allowing surgeons to repair defects of a variety of sizes and configurations. Postoperative complications including reoperation and wound infection are not uncommon; however, several recent studies have identified patient populations that may be predisposed to greater complication rates. Future studies attempting to obtain quantitative functional outcome measurements or provide greater standardization of postoperative care may lead to greater rates of successful reconstruction and avoidance of complications.

CLINICS CARE POINTS

- Literature supports reconstruction with free flap for advanced oropharyngeal defects involving half or more of the soft palate, base of the tongue, and for carotid exposure/fistula risk.
- There are multiple reconstructive options for the oropharynx with similar functional outcomes.
- There is no clear consensus for optimal flap in the oropharynx, and consideration on an individual basis is important.

- Swallowing, speech, and quality-of-life data suggest that advanced tumor resection with free tissue reconstruction is reasonable and results in adequate function.

DISCLOSURE

The authors have nothing to disclose.

REFERENCES

1. Chaturvedi AK, Engels EA, Pfeiffer RM, et al. Human papillomavirus and rising oropharyngeal cancer incidence in the United States. J Clin Oncol 2011; 29(32):4294–301.
2. Damgacioglu H, Sonawane K, Zhu Y, et al. Oropharyngeal Cancer Incidence and Mortality Trends in All 50 States in the US, 2001-2017. JAMA Otolaryngol Head Neck Surg 2022;148(2):155–65.
3. Ang KK, Harris J, Wheeler R, et al. Human papillomavirus and survival of patients with oropharyngeal cancer. N Engl J Med 2010;363(1):24–35.
4. Moncrieff M, Sandilla J, Clark J, et al. Outcomes of primary surgical treatment of T1 and T2 carcinomas of the oropharynx. Laryngoscope 2009;119(2): 307–11.
5. Parsons JT, Mendenhall WM, Stringer SP, et al. Squamous cell carcinoma of the oropharynx: surgery, radiation therapy, or both. Cancer 2002;94(11): 2967–80.
6. Pernot M, Luporsi E, Hoffstetter S, et al. Complications following definitive irradiation for cancers of the oral cavity and the oropharynx (in a series of 1134 patients). Int J Radiat Oncol Biol Phys 1997; 37(3):577–85.
7. O'Malley BW Jr, Weinstein GS, Snyder W, et al. Transoral robotic surgery (TORS) for base of tongue neoplasms. Laryngoscope 2006;116(8):1465–72.
8. Weinstein GS, O'Malley BW Jr, Cohen MA, et al. Transoral robotic surgery for advanced oropharyngeal carcinoma. Arch Otolaryngol Head Neck Surg 2010;136(11):1079–85.
9. Weinstein GS, Quon H, O'Malley BW Jr, et al. Selective neck dissection and deintensified postoperative radiation and chemotherapy for oropharyngeal cancer: a subset analysis of the University of Pennsylvania transoral robotic surgery trial. Laryngoscope 2010;120(9):1749–55.
10. Yver CM, Shimunov D, Weinstein GS, et al. Oncologic and survival outcomes for resectable locally-advanced HPV-related oropharyngeal cancer treated with transoral robotic surgery. Oral Oncol 2021;118:105307.
11. Dziegielewski PT, Teknos TN, Durmus K, et al. Transoral robotic surgery for oropharyngeal cancer: long-term quality of life and functional outcomes. JAMA Otolaryngol Head Neck Surg 2013;139(11): 1099–108.
12. de Almeida JR, Genden EM. Robotic assisted reconstruction of the oropharynx. Curr Opin Otolaryngol Head Neck Surg 2012;20(4):237–45.
13. Maharaj K, Singh M, Siddiqi J, et al. Submental island flap for oropharyngeal reconstruction: UK experience of 25 cases. Br J Oral Maxillofac Surg 2019;57(10):1102–6.
14. Koh KS, Eom JS, Kirk I, et al. Pectoralis major musculocutaneous flap in oropharyngeal reconstruction: revisited. Plast Reconstr Surg 2006;118(5):1145–9.
15. Ariyan S. One-stage reconstruction for defects of the mouth using a sternomastoid myocutaneous flap. Plast Reconstr Surg 1979;63(5):618–25.
16. Smith JE, Suh JD, Erman A, et al. Risk factors predicting aspiration after free flap reconstruction of oral cavity and oropharyngeal defects. Arch Otolaryngol Head Neck Surg 2008;134(11):1205–8.
17. Razdan SN, Albornoz CR, Matros E, et al. Free Jejunal Flap for Pharyngoesophageal Reconstruction in Head and Neck Cancer Patients: An Evaluation of Donor-Site Complications. J Reconstr Microsurg 2015;31(9):643–6.
18. Gorphe P, Temam S, Moya-Plana A, et al. Indications and Clinical Outcomes of Transoral Robotic Surgery and Free Flap Reconstruction. Cancers 2021; 13(11). https://doi.org/10.3390/cancers13112831.
19. Fatani B. Radial Forearm Free Flap for Head and Neck Defect Reconstruction: An Up-to-date Review of the Literature. Cureus 2023;15(3):e35653.
20. Camaioni A, Loreti A, Damiani V, et al. Anterolateral thigh cutaneous flap vs. radial forearm free-flap in oral and oropharyngeal reconstruction: an analysis of 48 flaps. Acta Otorhinolaryngol Ital 2008;28(1): 7–12.
21. Ranganath K, Jalisi SM, Naples JG, et al. Comparing outcomes of radial forearm free flaps and anterolateral thigh free flaps in oral cavity reconstruction: A systematic review and meta-analysis. Oral Oncol 2022;135:106214.
22. Monroe D, Pyne JM, McLennan S, et al. Characteristics and outcomes of transoral robotic surgery with free-flap reconstruction for oropharyngeal cancer: a systematic review. J Robot Surg 2023;17(4): 1287–97.
23. Kao SS, Peters MD, Krishnan SG, et al. Swallowing outcomes following primary surgical resection and primary free flap reconstruction for oral and oropharyngeal squamous cell carcinomas: A systematic review. Laryngoscope 2016;126(7):1572–80.
24. Gross JH, Townsend M, Hong HY, et al. Predictors of swallow function after transoral surgery for locally advanced oropharyngeal cancer. Laryngoscope 2020;130(1):94–100.
25. Borggreven PA, Verdonck-de Leeuw I, Rinkel RN, et al. Swallowing after major surgery of the oral cavity

or oropharynx: a prospective and longitudinal assessment of patients treated by microvascular soft tissue reconstruction. Head Neck 2007;29(7):638–47.
26. Crowder SL, Douglas KG, Yanina Pepino M, et al. Nutrition impact symptoms and associated outcomes in post-chemoradiotherapy head and neck cancer survivors: a systematic review. J Cancer Surviv 2018;12(4):479–94.
27. Hatten KM, Brody RM, Weinstein GS, et al. Defining the Role of Free Flaps for Transoral Robotic Surgery. Ann Plast Surg 2018;80(1):45–9.
28. Kaki PC, Lam D, Sangal NR, et al. Transoral robotic surgery with free flap reconstruction: Functional outcomes of 241 patients at a single institution. Head Neck 2024;46(7):1601–13.
29. Lam L, Samman N. Speech and swallowing following tongue cancer surgery and free flap reconstruction–a systematic review. Oral Oncol 2013;49(6):507–24.
30. Seikaly H, Rieger J, Wolfaardt J, et al. Functional outcomes after primary oropharyngeal cancer resection and reconstruction with the radial forearm free flap. Laryngoscope 2003;113(5):897–904.
31. McCombe D, Lyons B, Winkler R, et al. Speech and swallowing following radial forearm flap reconstruction of major soft palate defects. Br J Plast Surg 2005;58(3):306–11.
32. Melan JB, Philouze P, Pradat P, et al. Functional outcomes of soft palate free flap reconstruction following oropharyngeal cancer surgery. Eur J Surg Oncol 2021;47(9):2265–71.
33. Gilony D, Gilboa D, Blumstein T, et al. Effects of tracheostomy on well-being and body-image perceptions. Otolaryngol Head Neck Surg 2005;133(3):366–71.
34. Gaino F, Gorphe P, Vander Poorten V, et al. Preoperative predictors of difficult oropharyngeal exposure for transoral robotic surgery: The Pharyngoscore. Head Neck 2021;43(10):3010–21.
35. Wong KK, Higgins KM, Enepekides DJ. Microvascular reconstruction in the vessel-depleted neck. Curr Opin Otolaryngol Head Neck Surg 2010;18(4):223–6.
36. Karsten RT, Chargi N, van der Molen L, et al. Dysphagia, trismus and speech impairment following radiation-based treatment for advanced stage oropharyngeal carcinoma: a one-year prospective evaluation. Eur Arch Oto-Rhino-Laryngol 2022;279(2):1003–27.
37. Chepeha DB, Sacco AG, Erickson VR, et al. Oropharyngoplasty with template-based reconstruction of oropharynx defects. Arch Otolaryngol Head Neck Surg 2009;135(9):887–94.
38. Caliceti U, Piccin O, Sgarzani R, et al. Surgical strategies based on standard templates for microsurgical reconstruction of oral cavity and oropharynx soft tissue: a 20 years' experience. Microsurgery 2013;33(2):90–104.
39. Helmiö PM, Suominen S, Vuola J, et al. Clinical outcome of reconstruction of the lateral oropharyngeal wall with an anterolateral thigh free flap. J Plast Surg Hand Surg 2010;44(4–5):186–90.
40. Thomas WW, Brant J, Chen J, et al. Clinical Factors Associated With Reoperation and Prolonged Length of Stay in Free Tissue Transfer to Oncologic Head and Neck Defects. JAMA Facial Plast Surg 2018;20(2):154–9.
41. Cannady SB, Hatten KM, Bur AM, et al. Use of free tissue transfer in head and neck cancer surgery and risk of overall and serious complication(s): An American College of Surgeons-National Surgical Quality Improvement Project analysis of free tissue transfer to the head and neck. Head Neck 2017;39(4):702–7.
42. Crippen MM, Brady JS, Mozeika AM, et al. Impact of Body Mass Index on Operative Outcomes in Head and Neck Free Flap Surgery. Otolaryngol Head Neck Surg 2018;159(5):817–23.
43. Suyama Y, Yagi S, Fukuoka K, et al. Risk Factors of Free Flap Complications in Reconstruction for Head and Neck Cancer. Yonago Acta Med 2022;65(3):215–25.
44. Cannady SB, Hatten K, Wax MK. Postoperative Controversies in the Management of Free Flap Surgery in the Head and Neck. Facial Plast Surg Clin North Am 2016;24(3):309–14.
45. Chen KT, Mardini S, Chuang DC, et al. Timing of presentation of the first signs of vascular compromise dictates the salvage outcome of free flap transfers. Plast Reconstr Surg 2007;120(1):187–95.
46. Cervenka B, Bewley AF. Free flap monitoring: a review of the recent literature. Curr Opin Otolaryngol Head Neck Surg 2015;23(5):393–8.
47. Jyränki J, Suominen S, Vuola J, et al. Microdialysis in clinical practice: monitoring intraoral free flaps. Ann Plast Surg 2006;56(4):387–93.
48. Wax MK. The role of the implantable Doppler probe in free flap surgery. Laryngoscope 2014;124(Suppl 1):S1–12.
49. Klifto KM, Milek D, Gurno CF, et al. Comparison of arterial and venous implantable Doppler postoperative monitoring of free flaps: Systematic review and meta-analysis of diagnostic test accuracy. Microsurgery 2020;40(4):501–11.
50. Barton BM, Riley CA, Fitzpatrick JC, et al. Postoperative anticoagulation after free flap reconstruction for head and neck cancer: A systematic review. Laryngoscope 2018;128(2):412–21.
51. Dawoud BES, Kent S, Tabbenor O, et al. Does anticoagulation improve outcomes of microvascular free flap reconstruction following head and neck surgery: a systematic review and meta-analysis. Br J Oral Maxillofac Surg 2022;60(10):1292–302.

52. Hagau N, Longrois D. Anesthesia for free vascularized tissue transfer. Microsurgery 2009;29(2):161–7.
53. Brinkman JN, Derks LH, Klimek M, et al. Perioperative fluid management and use of vasoactive and antithrombotic agents in free flap surgery: a literature review and clinical recommendations. J Reconstr Microsurg 2013;29(6):357–66.
54. Haughey BH, Wilson E, Kluwe L, et al. Free flap reconstruction of the head and neck: analysis of 241 cases. Otolaryngol Head Neck Surg 2001;125(1):10–7.
55. Clark JR, McCluskey SA, Hall F, et al. Predictors of morbidity following free flap reconstruction for cancer of the head and neck. Head Neck 2007;29(12):1090–101.
56. Patel RS, McCluskey SA, Goldstein DP, et al. Clinicopathologic and therapeutic risk factors for perioperative complications and prolonged hospital stay in free flap reconstruction of the head and neck. Head Neck 2010;32(10):1345–53.
57. Barrette LX, De Ravin E, Carey RM, et al. Reconstruction following transoral robotic surgery for head and neck cancer: Systematic review. Head Neck 2022;44(5):1246–54.
58. Chen AY, Frankowski R, Bishop-Leone J, et al. The development and validation of a dysphagia-specific quality-of-life questionnaire for patients with head and neck cancer: the M. D. Anderson dysphagia inventory. Arch Otolaryngol Head Neck Surg 2001;127(7):870–6.
59. Salassa JR. A functional outcome swallowing scale for staging oropharyngeal dysphagia. Dig Dis 1999;17(4):230–4.