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Swallowing Outcomes in Elderly Patients following Microvascular Reconstruction of the Head and Neck

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Abstract

Objective—To describe swallowing outcomes in elderly patients undergoing microvascular reconstruction of the upper aerodigestive tract and identify risk factors for poor postoperative swallowing function.

Study Design—Case series with chart review.

Setting—Academic medical center.

Subjects and Methods—Sixty-six patients aged 70 years underwent microvascular reconstruction of the upper aero-digestive tract. The primary outcome measure was the Functional Oral Intake Scale (FOIS); preoperative and postoperative scores were dichotomized to define

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Author Contributions

Mitchell L. Worley, concept and design, data acquisition, analysis and interpretation, drafting of manuscript, final approval, accountable; **Evan M. Graboyes**, concept and design, data acquisition and interpretation, revision of manuscript, final approval, accountable; **Julie Blair**, data acquisition and interpretation, revision of manuscript, final approval, accountable; **Suhael Momin**, data acquisition, revision of manuscript, final approval, accountable; **Kent E. Armeson**, data analysis and interpretation, revision of manuscript, final approval, accountable; **Terry A. Day**, concept and design, revision of manuscript, final approval, accountable; **Andrew T. Huang**, concept and design, data acquisition and interpretation, revision of manuscript, final approval, accountable.

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“good swallowing” and “poor swallowing.” Logistic regression was performed to identify risk factors for poor postoperative swallowing function.

Results—In total, 91% of reconstructions were performed for oncologic defects. The most common defect site was the oral cavity (67%), and the anterolateral thigh (29%) was the most frequently used donor site. At 3-year follow up, 75% of patients had good swallowing function with 95% of patients who achieved good swallowing function doing so within 6 months of surgery. On multivariable analysis, patients with pT4 tumors (odds ratio [OR], 5.2; 95% confidence interval [CI], 1.0–25.6) and those undergoing at least partial glossectomy (OR, 4.7; 95% CI, 1.1–20.7) were more likely to experience poor swallowing function at 6-month follow-up.

Conclusion—Approximately half of elderly patients achieve good swallowing function within 6 months following microvascular reconstruction of the upper aerodigestive tract. Elderly patients with pT4 tumors and those requiring glossectomy are at highest risk for poor swallowing outcomes. These data can be used to inform preoperative patient counseling and design interventions aimed at improving swallowing function in those at high risk for poor outcomes.

Keywords

elderly; microvascular; free flap; swallowing; outcomes

Head and neck cancer is common in the elderly, with individuals >70 years of age accounting for 31.3% of new oral cavity and oropharyngeal cancer diagnoses.¹ As a result, head and neck surgeons frequently evaluate older patients for consideration of primary surgical management requiring microvascular reconstruction. Multiple studies have demonstrated that microvascular reconstruction following head and neck cancer surgery in elderly patients >70 years of age is safe, with high rates of flap success and acceptable rates of postoperative complications.^{2–7}

Although literature supports the appropriate treatment of elderly patients with head and neck cancer, they are less likely to receive standard therapy or undergo surgery.^{8,9} Elderly patients with cancer show a preference for quality over quantity of life, and this has been suggested as one factor affecting their treatment decisions.^{8,10} Among patients with head and neck cancer, swallowing function plays an important role in quality of life and remains one of their most significant priorities.^{10,11} However, baseline swallowing dysfunction is prevalent among healthy older adults, and even higher rates of dysphagia (up to 59%) have been reported in patients with head and neck cancer.^{12,13}

Despite our knowledge about the success and safety of head and neck cancer microvascular reconstruction in the elderly, there is a significant knowledge gap about their short- and long-term swallowing function. Given the prevalence of dysphagia in the elderly patient population and the importance of swallowing function to quality head and neck cancer care, we sought to investigate the following questions. For elderly patients undergoing microvascular reconstruction of the upper aerodigestive tract: (1) What are their short- and long-term swallowing outcomes? and (2) What are the risk factors for poor postoperative swallowing function?

Methods

Study Cohort

The study was approved by the Medical University of South Carolina Institutional Review Board. Departmental billing records were searched for all patients aged ≥ 70 undergoing free flap reconstruction between January 2010 and July 2015. Patients ≥ 70 years of age were selected for inclusion based on numerous prior studies examining free flap outcomes in elderly patients using this age cutoff.^{2–4,6} In total, 109 patients aged ≥ 70 were identified and 43 were excluded for reconstruction of defects outside the aerodigestive tract (skin, sinonasal, lateral skull base) or for having less than 12 months of postoperative follow-up. Patients who died within 12 months of surgery were included in the study as their final swallowing outcome was known.

After microvascular reconstruction, patients at our institution are typically made nil per os (NPO) for a period of 1 to 3 weeks depending on their history of radiotherapy. If wound healing is adequate, they undergo swallowing evaluation by a head and neck speech-language pathologist 1 to 3 weeks postoperatively prior to resumption of oral intake. All patients seen by the speech-language pathologist are provided with regular follow-up and education on swallowing maneuvers and exercises.

Outcome Measures

The primary outcome measure was the Functional Oral Intake Scale (FOIS) (Table 1).¹⁴ The FOIS grades swallowing performance on a 1 to 7 ordinal scale and has been frequently used in studies of functional swallowing outcomes in patients with head and neck cancer.^{15,16} Scores of 1 to 3 represent poor swallowing function with at least partial reliance on alternative enteral nutrition, while scores of 4 to 7 correspond to various total oral diets.

Study Variables

Patient characteristics, including sociodemographics, oncologic and treatment details, and measures of swallowing function, were extracted from the electronic medical record. Defects requiring microvascular reconstruction were classified into 4 head and neck subsites: oral cavity, oropharynx, larynx/hypopharynx, and all other.

Statistical Analysis

Swallowing performance was categorized based on FOIS scores. Medical records were reviewed for nutritional intake data to calculate FOIS scores that were assessed preoperatively and then at or near 1, 3, 6, 12, 24, and 36 months postoperatively. We categorized patients' swallowing function into poor swallowing (FOIS 1–3) or good swallowing (FOIS 4–7) at each time point. Nearly all patients (94.6%) who achieved good swallowing function had done so by 6 months postoperatively, and this time point was chosen as the benchmark to assess risk factors for long-term swallowing dysfunction.

Pearson χ^2 and Fisher exact tests were used to compare categorical variables, including patient demographics, oncologic, and treatment details between groups. Univariable logistic regression analysis was performed to estimate the odds of having poor swallowing function

at 6 months postoperatively with surviving patients with swallowing data at this time point included in the model. The number of variables taken forward in the multiple regression model was determined based on the number of events (subjects with poor swallow function at 6 months) per variable (EPV). Simulations have shown that an EPV as low as 5 produces reliable estimates in logistic regression models.¹⁷ With 24 events in our multiple regression data set, 5 variables with the highest univariable odds ratios were included in the multivariable model. Odds ratios (ORs) with their respective 95% confidence intervals (CIs) were estimated for each factor. The multivariable model excluded 6 patients with indications other than malignancy for their reconstruction. Statistical analysis was performed using SAS 9.3 (SAS Institute, Cary, North Carolina) and SPSS 24 (SPSS, Inc, an IBM Company, Chicago, Illinois). All significance tests were 2-sided with $\alpha = .05$ used for determining statistical significance.

Results

Patient Characteristics

Sixty-six patients 70 years of age who underwent microvascular reconstruction of the upper aerodigestive tract were included. The overall flap survival rate was 98.5% (65/66), with 1 patient having complete flap loss and requiring a second free flap. The median follow-up was 27 months (range, 1–77), with 45.5% (30/66) of patients experiencing mortality during the 36-month follow-up period.

Preoperative characteristics of study subjects and their relation to swallowing function at 6-month follow-up are depicted in Table 2. Most patients were white (84.8%; 56/66) men (59.1%; 39/66) in their seventh decade of life (mean age, 73.9 years; interquartile range, 71–76 years). Most patients had a history of smoking (72.7%; 48/66), which was associated with poor swallowing function at 6-month follow-up (OR, 3.8; 95% CI, 1.1–12.9). Forty-seven percent (31/66) of patients had been previously treated for head and neck cancer with radiotherapy or chemoradiotherapy. Prior to surgery, 74.2% (49/66) of patients had good swallowing function (FOIS 4–7), and 31.8% (21/66) of patients had a normal diet (FOIS 7).

Oncologic and Treatment Characteristics

The oncologic and treatment characteristics of the study population and their relation to swallowing function at 6-month follow-up are depicted in Table 3. Most patients underwent microvascular reconstruction for a head and neck malignancy (90.9%; 60/66), most frequently in the oral cavity (66.7%; 44/66). The most common free flap donor sites were the anterolateral thigh (28.8%; 19/66) and fascio-cutaneous scapula (24.2%; 16/66). The ablative surgery included at least a partial glossectomy in over half (53%; 35/66) of patients. Pathologic American Joint Committee on Cancer (AJCC) T4 category disease occurred in 61.7% (37/66) of patients, and 59.1% (39/66) received adjuvant radiotherapy or chemoradiotherapy. On univariable analysis, poor swallowing function at 6-month follow-up was associated with pT4 category tumors (OR, 4.4; 95% CI, 1.4–17.1), pN2+ category disease (OR, 4.7; 95% CI, 1.1–19.9), and ablative surgery that included at least a partial glossectomy (OR, 5.0; 95% CI, 1.6–15.8). Free flap donor site, need for osseous

reconstruction, and receiving adjuvant radiotherapy or chemoradiotherapy were not associated with poor swallowing function at 6-month follow-up.

Swallowing Outcomes

Overall, 56% of patients (37/66) demonstrated good swallowing function postoperatively (compared to 74.2% preoperatively). Of these patients, 89.1% (33/37) had an oral intake within 1 point of their preoperative FOIS level (eg, a patient with preoperative FOIS 7 [normal diet] achieved at least a FOIS 6 [normal diet with limited specific food restrictions]). The median time to achieving good swallowing function was 1 month postoperatively, and almost all patients (94.6%; 35/37) who achieved good swallowing function did so within 6 months of surgery. In total, 65.5% (19/29) of patients with persistent poor swallowing function postoperatively experienced mortality during the 36-month study period compared to 29.7% (11/37) of patients who were able to achieve good swallowing function.

Longitudinal Analysis of Swallowing Function

The longitudinal swallowing function for the entire cohort of patients is shown in Figure 1. The percentage of patients with good swallowing function reached a nadir of 36.4% at 1 month following microvascular reconstruction. At 3 months postoperatively, which in general corresponds with the end of the administration of adjuvant treatment, the percentage of patients with good swallowing improved slightly to 45.8%. From 3 months postoperatively, the percentage of patients with good swallowing steadily improved over time. At 6, 12, 24, and 36 months postoperatively, the percentage of living patients with good swallowing was 50.9%, 54.2%, 66.7%, and 75%, respectively. The 75% rate of good swallowing function among living patients at 36 months postoperatively was similar to the 74.2% rate of preoperative good swallowing. Swallowing function at 1-month follow-up contained significant prognostic value as only 29.4% of patients with poor swallowing function at 1-month follow-up achieved good swallowing function by 6-month follow-up.

Longitudinal swallowing function stratified by pathologic AJCC T category and undergoing at least a partial glossectomy is shown in Figures 1 and 2. Patients with pT4 category tumors had significantly worse swallowing function at all time points postoperatively compared to pT1–3 patients. At 6-month follow-up, 73.7% of patients with pT1–3 disease had good swallowing function compared to 36.7% of those with pT4 disease. Patients undergoing concurrent glossectomy also had significantly worse swallowing outcomes at all time points postoperatively relative to those who did not have concurrent tongue surgery. Patients who had a concurrent glossectomy had a 32.1% rate of good swallowing at 6-month follow-up compared to a rate of 70.4% in those who did not.

Risk Factors for Poor Swallowing at 6 Months Postoperatively

To identify which patients were at highest risk of having poor swallowing outcomes following free flap reconstruction, a multivariable logistic regression analysis was performed (Table 4). On multivariable analysis, AJCC pT4 category and concurrent glossectomy were independently associated with poor swallowing function at 6 months postoperatively. Patients with pT4 category tumors had a 5-fold greater risk of poor swallowing function at

6-month follow-up compared to patients with pT1–3 category tumors (OR, 5.2; 95% CI, 1.0–25.6). Likewise, undergoing concurrent glossectomy at the time of microvascular reconstruction increased the odds of poor swallowing function at 6-month follow-up nearly 5-fold (OR, 4.7; 95% CI, 1.1–20.7).

Discussion

Microvascular free tissue transfer is now the primary reconstructive approach for large oncologic and traumatic head and neck defects. As the US population continues to age, these techniques have been increasingly used in older adults, with most studies reporting rates of surgical success comparable to those in younger patients and an acceptable rate of postoperative surgical complications.^{2–5} Now that the safety and efficacy of microvascular free tissue transfer in the elderly population have been established, there is an increasing need to study long-term functional outcomes. We therefore undertook this study to characterize long-term swallowing outcomes, identify risk factors for poor postoperative swallowing function, and provide data to assist in perioperative patient counseling and management for elderly patients undergoing head and neck free flap reconstruction.

Swallowing Outcomes

Our finding that most of our elderly patients were able to achieve good swallowing function following microvascular reconstruction of the upper aerodigestive tract is in accordance with prior smaller studies. Although not specifically designed to evaluate swallowing outcomes, Weaver et al² in their analysis of 44 patients aged 70 years and Wester et al¹⁸ in their study of 10 patients 90 years of age both found that most elderly patients were able to achieve total oral diets following microvascular head and neck surgery. This present study adds to the growing body of literature supporting the use of microvascular reconstruction in elderly patients by demonstrating their frequent success in achieving good swallowing outcomes.

Swallowing Function over Time

Our longitudinal analysis of swallowing function allowed us to assess patients' swallowing function immediately after surgery, through adjuvant treatment, and in long-term follow-up. We found that early recovery of good swallowing function was common among our elderly patients, with a median time to achieving good swallowing function of 1 month. Swallowing function as early as 1 month postoperatively contained prognostic value as only 29.4% of patients with poor swallowing function at 1-month follow-up achieved good swallowing function by 6-month follow-up. While patients continued to recover swallowing function several months after surgery, only 2 patients in our cohort achieved good swallowing function after 6-month follow-up. Our finding that the percentage of patients with good swallowing function increased over time (at 12, 24, and 36 months postoperatively) was primarily a reflection of higher rates of early mortality in patients with poor swallowing function. This observation is consistent with previous studies that have demonstrated that severe dysphagia is an independent predictor for mortality in patients with head and neck cancer.^{19–21} While patients with advanced disease requiring adjuvant treatment are likely at increased risk for both death and dysphagia, authors have suggested that severe dysphagia could also represent the interaction between multiple other demographic and comorbidity

variables that portend an overall worse prognosis in these patients.²⁰ It is also possible that dysphagia directly contributes to increased rates of mortality through aspiration events leading to pneumonia.²¹ Unfortunately, our retrospectively collected data do not help answer this question. Future studies should explore the relationship between poor swallowing and increased rates of mortality in elderly patients with head and neck cancer.

Risk Factors for Poor Swallowing Function

Multivariable analysis revealed that patients with pT4 tumors and those undergoing at least a partial glossectomy had a 4.7- to 5.2-fold increased risk for poor swallowing function at 6 months postoperatively. Generally, higher T category tumors are associated with resections that remove larger volumes of native tissue that is then reconstructed with an adynamic piece of tissue that is typically also insensate. Our findings reinforce previous literature demonstrating an association between higher AJCC T category and the need for enteral nutrition in patients with head and neck cancer following surgery.^{22–24} Our data also demonstrated that elderly patients undergoing glossectomy are at higher risk of swallowing dysfunction, which is also in line with prior studies that have also shown that resection of the oral tongue and tongue base is associated with increased swallow dysfunction and postoperative aspiration.^{25,26} Elderly adults have been found to have decreased lingual strength and swallowing pressure at baseline.^{27,28} These age-related changes in swallowing physiology may place elderly patients at an even higher risk for swallowing dysfunction following tumor resection and reconstruction with an adynamic free flap.

A variety of free flaps were used in our patient cohort, and we observed that choice of donor site choice did not affect long-term swallowing outcomes. A study investigating risk factors for postoperative aspiration following microvascular reconstruction of the oral cavity and oropharynx similarly found no association with choice of donor site.²⁵ These data suggest the reconstructive approach should be individualized to each patient's defect, donor site anatomy, and the surgeon's comfort. Similar swallowing outcomes are achievable with multiple reconstructive donor sites.

Implications for Patient Care

Describing postoperative swallowing outcomes and the risk factors for poor postoperative swallowing function following free flap reconstruction in elderly patients has important implications for preoperative patient counseling and selection. Our study suggests that prior to free flap reconstruction, elderly patients who are expected to have a pT4 tumor or require a glossectomy should be counseled regarding their high risk for poor postoperative swallowing function. Given the importance of swallowing to overall quality of life and the negative impact on quality of life of gastrostomy tube feedings, this information may play a role in patients' decisions to proceed with surgery vs other forms of treatment.^{11,29} Appropriately stratifying elderly patients at high risk for poor postoperative swallowing may allow for health care cost savings and decreased length of stay through preoperative gastrostomy tube placement.³⁰ In terms of longitudinal swallowing function, these data can be used to counsel elderly patients that most patients who achieve good swallowing function do so within 1 month of surgery.

Limitations

This study possesses a number of limitations. It is a single-institution study, and as such, the results may not be generalizable to other institutions with different patient populations or treatment practice patterns. The retrospective nature of the study is limited by the accuracy of medical record documentation. Given the small sample size, the power of the statistical analysis was limited and led us to dichotomize FOIS scores into good and bad, with subsequent loss of the more granular categorical data. Swallowing function was assessed by FOIS, a patient-reported swallowing scale. Other potentially more robust patient-reported measures of swallowing function such as the MD Anderson Dysphagia Inventory³¹ or the Sydney Swallow Questionnaire³² exist but were not used in this study and may have prevented us from seeing subtle differences in swallowing function. In addition, objective assessments of swallowing function were not regularly available to correlate with patient-reported swallowing measures. Quality-of-life measures were not collected, preventing determination of the relationship between poor swallowing function and quality of life. Data about patient compliance with swallowing therapy/exercises were not available and could potentially influence the likelihood of patients achieving improved swallowing function.^{33,34} Although risk factors for poor swallowing outcomes were described, the reasons for poor function were not, preventing design of interventions tailored to improving outcomes in this group of patients. Future studies evaluating swallowing function in patients following microvascular reconstructions should be prospective in nature and capture a robust set of objective and patient-reported measures of swallowing function to better characterize this problem.

Conclusions

Approximately half of elderly patients achieve good swallowing function within 6 months after microvascular reconstruction of the upper aerodigestive tract. Elderly patients with pT4 tumors and those requiring at least partial glossectomy are at highest risk for poor swallowing outcomes following microvascular reconstruction. These data can be used to inform preoperative patient counseling and design interventions aimed at improving postoperative swallowing function in those at high risk for poor swallowing outcomes.

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Figure 1.
Swallowing function of all patients and by pathologic American Joint Committee on Cancer T category.

Figure 2. Swallowing function of all patients and by concurrent tongue resection with microvascular reconstruction.

Table 1Functional Oral Intake Scale.¹⁴

Level	Type of Intake
1	Nothing by mouth.
2	Tube dependent with minimal attempts of food or liquid.
3	Tube dependent with consistent oral intake of food or liquid.
4	Total oral diet of a single consistency.
5	Total oral diet with multiple consistencies, but requiring special preparation or compensations.
6	Total oral diet with multiple consistencies without special preparation, but with special food limitations.
7	Total oral diet with no restrictions.

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Table 2

Preoperative Patient Characteristics.

Patient Variable	Total Patients ^a (n = 66), No. (%)	Poor Swallowing at 6 Months (n = 27), No. (%)	Good Swallowing at 6 Months (n = 28), No. (%)	P Value	OR (95% CI)
Sex				.08	
Female	27 (40.9)	9 (33.3)	16 (57.1)		1.0 (Reference)
Male	39 (59.1)	18 (66.7)	12 (42.9)		2.7 (0.9–8.0)
Race				.65	
White	56 (84.8)	23 (85.2)	25 (89.3)		1.0 (Reference)
All other	10 (15.2)	4 (14.8)	3 (10.7)		1.4 (0.3–7.2)
History of smoking				.03	
No	18 (27.3)	5 (18.5)	13 (46.4)		1.0 (Reference)
Yes	48 (72.7)	22 (81.5)	15 (53.6)		3.8 (1.1–12.9)
Prior RT or CRT				.23	
No	35 (53.0)	13 (48.1)	18 (64.3)		1.0 (Reference)
Yes	31 (47.0)	14 (51.9)	10 (35.7)		1.9 (0.7–5.7)
Preoperative swallowing				.10	
Good (FOIS 4–7)	49 (74.2)	18 (66.7)	24 (85.7)		1.0 (Reference)
Poor (FOIS 1–3)	17 (25.8)	9 (33.3)	4 (14.3)		3.0 (0.8–11.3)

Abbreviations: CI, confidence interval; CRT, chemoradiotherapy; FOIS, Functional Oral Intake Scale; OR, odds ratio; RT, radiotherapy.

^aSixty-six total patients with 55 living patients with swallowing data at 6-month follow-up.

Table 3

Oncologic and Treatment Characteristics.

Patient Variable	Total Patients ^a (n = 66), No. (%)	Poor Swallowing at 6 Months (n = 27), No. (%)	Good Swallowing at 6 Months (n = 28), No. (%)	P Value	OR (95% CI)
Indication for flap				.96	
Cancer	60 (90.9)	24 (88.9)	25 (89.3)		1.0 (Reference)
Other ^b	6 (9.1)	3 (11.1)	3 (10.7)		1.0 (0.2–5.7)
Defect site				.17	
Oral cavity	44 (66.7)	18 (66.7)	20 (71.4)		1.0 (Reference)
Larynx/hypopharynx	11 (16.7)	2 (7.4)	6 (21.4)		0.4 (0.1–2.1)
Oropharynx	7 (10.6)	5 (18.5)	1 (3.6)		5.6 (0.6–52.1)
Other ^c	4 (6.1)	2 (7.4)	1 (3.6)		2.2 (0.2–26.6)
AJCC pathologic T category ^d				.01	
T1–3	23 (38.3)	5 (20.8)	14 (56.0)		1.0 (Reference)
T4	37 (61.7)	19 (79.2)	11 (44.0)		4.4 (1.4–17.1)
AJCC pathologic N category ^e				.04	
N0–1	42 (71.2)	15 (60.0)	21 (87.5)		1.0 (Reference)
N2+	17 (28.8)	10 (40.0)	3 (12.5)		4.7 (1.1–19.9)
Concurrent tongue resection				.01	
No	31 (47.0)	8 (29.6)	19 (67.9)		1.0 (Reference)
Yes	35 (53.0)	19 (70.4)	9 (32.1)		5.0 (1.6–15.8)
Flap donor site				.88	
Anterolateral thigh	19 (28.8)	8 (29.6)	6 (21.4)		1.0 (Reference)
Fasciocutaneous scapula	16 (24.2)	5 (18.5)	7 (25.0)		0.5 (0.1–2.6)
Radial forearm	12 (18.2)	6 (22.2)	5 (17.9)		0.9 (0.2–4.4)
Osteocutaneous scapula	11 (16.7)	5 (18.5)	5 (17.9)		0.8 (0.1–3.8)
Other ^f	8 (12.1)	3 (11.1)	5 (17.9)		0.4 (0.1–2.7)
Osseous reconstruction				.43	
No	48 (72.7)	20 (74.1)	18 (64.3)		1.0 (Reference)
Yes	18 (27.3)	7 (25.9)	10 (35.7)		0.6 (0.2–2.0)
Adjuvant RT or CRT				.12	

Patient Variable	Total Patients ^a (n = 66), No. (%)	Poor Swallowing at 6 Months (n = 27), No. (%)	Good Swallowing at 6 Months (n = 28), No. (%)	P Value	OR (95% CI)
No	27 (40.9)	7 (25.9)	13 (46.4)		1.0 (Reference)
Yes	39 (59.1)	20 (74.1)	15 (53.6)		2.5 (0.8–7.7)

Abbreviations: AJCC, American Joint Committee on Cancer; CI, confidence interval; CRT, chemoradiotherapy; OR, odds ratio; RT, radiotherapy.

^a Sixty-six total patients with 55 living patients with swallowing data at 6-month follow-up.

^b Osteoradionecrosis, n = 5; iatrogenic esophageal injury, n = 1.

^c Other: esophagus (n = 2) and trachea (n = 2).

^d n = 60 due to patients who underwent free flap surgery for nonmalignancies (n = 6).

^e n = 59 due to patients who underwent free flap for nonmalignancy (n = 6) or who did not undergo therapeutic neck dissection (n = 1).

^f Other: fibula flap (n = 7) and latissimus flap (n = 1).

Table 4

Multivariable Logistic Regression of Poor Swallowing Function 6-Months Postoperatively.

Patient Variable	No.	P Value	OR (95% CI)
History of smoking		.16	
No	17		1.0 (Reference)
Yes	32		3.5 (0.6–19.9)
Preoperative swallowing		.17	
Good (FOIS 4–7)	39		1.0 (Reference)
Poor (FOIS 1–3)	10		2.8 (0.6–11.9)
AJCC pathologic N category		.06	
N0–1	36		1.0 (Reference)
N2+	13		5.7 (1.0–34.4)
AJCC pathologic T category		.04	
T1–3	19		1.0 (Reference)
T4	30		5.2 (1.0–25.6)
Concurrent tongue resection		.04	
No	22		1.0 (Reference)
Yes	27		4.7 (1.1–20.7)

Abbreviations: AJCC, American Joint Committee on Cancer; CI, confidence interval; FOIS, Functional Oral Intake Scale; OR, odds ratio.