*The Laryngoscope*


# Gastrostomy in the Era of Minimally Invasive Head and Neck Cancer Surgery

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**Objective:** Minimally invasive transoral robotic surgery (TORS) is less likely to necessitate gastrostomy tube (GT) following resection of head and neck lesions versus conventional open procedures. However, the incidence of and indications for GT after TORS have not been reported in detail. This study defines the incidence of intra- and postoperative gastrostomy following robotic resection of advanced head and neck disease. It seeks to clarify the relevance of GT after TORS.

**Study Design:** Adult patients undergoing TORS and neck dissection from 2008 to 2014 were identified in the New York Statewide Planning and Research Cooperative System all-payer administrative database.

**Methods:** Demographic data and timing of GT in relation to surgery were recorded. Emergency department (ED) visits and inpatient readmissions were compared with multivariable logistic analysis.

**Results:** Of the 441 included patients, immediate, delayed, and total GT incidence within the first postoperative year was 9.5%, 11.6%, and 21.1%, respectively. Gastrostomy tube complications resulted in 4.5% of 30-day ED visits, 3.3% of 30-day readmissions, and 3.5% of 90-day readmissions. Thirty-nine percent of 90-day readmissions were linked to poor postoperative oral intake. Delayed GT status was associated with an increase in 30-day ED visits, and 30- or 90-day readmissions attributable to poor oral intake ($P = 0.10$, $P < 0.0001$, 0.002, respectively).

**Conclusion:** Even in the era of minimally invasive TORS, impaired oral intake is a significant postoperative burden to head and neck cancer patients with advanced disease. Attention to patient risk factors combined with a complicated hospital course may identify patients benefiting from early GT.

**Key Words:** Gastrostomy, PEG, g-tube, TORS, cancer.

**Level of Evidence:** 2c.

***Laryngoscope*, 128:847–851, 2018**

## INTRODUCTION

Gastrostomy tubes (GT) provide necessary alimentation for many patients with advanced head and neck cancer who require chemotherapy, radiation, and/or surgical treatment. They avoid nutritional deficits in patients recovering from morbid operations and in those patients with impaired postoperative functional outcomes, such as dysphagia. However, GT also can negatively impact patient quality of life, and placement is not without risk or complications.[1] The procedure should not be employed without calculation of the benefits versus the risks.

Prior to the emergence of minimally invasive surgical techniques, gastrostomy was routine for at-risk patients undergoing head and neck cancer therapies. Open resection of difficult-to-reach head and neck neoplasms frequently requires GT. High-risk patients undergoing definitive chemoradiotherapy often receive prophylactic gastrostomy.[2,3] However, the development of transoral robotic surgery (TORS) by the University of Pennsylvania (Philadelphia, PA) in 2004 shifted this paradigm.[4] Fewer TORS patients require gastrostomy than similar patients undergoing nonsurgical therapy or open resection.[5,6] Gastrostomy is not routine for TORS.[7]

There is a paucity of data regarding indications for gastrostomy in TORS, particularly in locally advanced stage III or IV (M0) disease. TORS is U.S. Food and Drug Administration- approved for resection of smaller (T1 and T2) malignancies; however, it is becoming increasingly utilized for more advanced lesions (up to T4a oropharyngeal), which may lead to greater nutritional challenges in the perioperative period.[8–10] Current reports on gastrostomy incidence in TORS have small numbers, often are institution-based, and have a high proportion of early-stage disease. The purpose of this study is to clarify the relevance of GT placement in the new era of minimal invasive TORS.

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Editor's Note: This Manuscript was accepted for publication July 5, 2017.

Presented at the Scientific Forum at the American College of Surgeons 2016 Clinical Congress, Washington, DC, U.S.A., October 16–20 2016.

This study was funded through the Stony Brook Medicine Surgical Outcomes Analysis Research (SOAR) Collaborative. The authors have no other funding, financial relationships, or conflicts of interest to disclose.

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**DOI: 10.1002/lary.26829**

## MATERIALS AND METHODS

### *Study Design*

Following institutional review board approval, the New York Statewide Planning and Research Cooperative System (SPARCS) all-payer administrative database was used to identify all TORS.[7] Patients were tracked with a unique patient identifier. Neck dissection (ND) and robotic procedures (International Classification of Diseases, Ninth Revision [ICD-9] 17.41–17.45, 17.49, or Current Procedural Terminology [CPT] S2900) were identified through ICD-9/CPT codes. Patients who were < 18 years, had multiple resections (n = 2), or had procedures staged with > 6-month intervals (n = 19) were excluded. Patient characteristics, including age, gender, race/ethnicity, region, facility type, payer, concurrent versus staged ND, surgical site, and comorbidities were identified. Inpatient complications, readmissions, and emergency department (ED) visits were evaluated. Inpatient complications were defined as occurring during surgical admission, not readmission. Readmissions were evaluated 30 and 90 days following surgery. For patients with GT, only those placed during or after TORS + ND were considered (n = 98). Patients receiving GT within the first postoperative year were further analyzed (n = 93). Surgeon volume was considered. Low-volume surgeons performed an average of ≤ five TORS/year over nonzero years.[8] High-volume surgeons performed > five TORS/year. Diagnosis codes for readmission and ED visits were analyzed. Gastrostomy tube complications were identified (ICD-9 536.4). Patient records demonstrating a GT complication without record of GT placement (n = 3) were included for the purpose of calculating overall GT complication rates, but these patients were excluded from further subgroup analyses. Frequency of diagnoses attributable to poor oral intake (ICD-9 276, 536.2, 783, 787.0, 787.2) were compared between no GT, immediate, and delayed GT groups.

### *Statistical Methods*

A chi-square test with exact $P$ values based on Monte Carlo simulation was used to compare categorical variables among patients having immediate GT, delayed GT, and not having a GT. Logistic regression models were used to compare differences in readmission or ED visits. Any GT, as well as variables that were significant in the univariate analysis at the significance level of 0.1, were further included in the multivariable regression models while applying the forward selection process considering the number of events per variable issue.[11] All analyses were performed using SAS 9.3 (SAS Institute Inc., Cary, NC), and statistical significance was set at 0.05. SPARCS restricts reporting cell size < 6.

## RESULTS

There were 441 patients who underwent TORS + ND from 2008 through 2014. In this group, 9.5% of patients underwent immediate GT (n = 42) and 90.5% did not undergo immediate GT (n = 399). Of those patients who did not receive an immediate GT, 12.8% required delayed GT placed within the first postoperative year (n = 51). The average time to delayed GT was 62 ± 59 days. At 1 year, the total incidence of having had a GT placed was 21.1% (n = 93). No significant differences existed between patients with and without GT in terms of age, gender, race, ND timing, or surgeon volume (Table I). Medicare/Medicaid patients had slightly higher GT rates than commercially insured patients ($P = 0.06$). The patient factors that were associated with need for and timing of GT included fluid and electrolyte disorder or weight loss (FED), liver disease, alcohol abuse, paralysis, and hypertension. Inpatient GT complications occurred in 2.4% (n = 1) of the immediate GT group. Gastrostomy tube complications resulted in 4.5% (n = 4) of 88 ED visits within 30 days, 3.3% (n = 2) of 61 readmissions within 30 days, and 3.5% (n = 4) of 114 readmissions within 90 days.

A minority of patients harbored the diagnosis of FED preoperatively (4.8%, n = 21). Of the 21 patients with preoperative FED, 61.9% (n = 13) did not receive an immediate gastrostomy. However, patients with preoperative FED were more likely to receive a GT within 1 year of surgery (FED, 52.4% vs. no FED, 19.5%, $P < 0.001$). At the time of postoperative discharge, 36 patients carried a diagnosis of FED, but only 50% (n = 18) had or subsequently received a GT.

Immediate GT placement was most frequently associated with a complicated hospital course. All patients with an immediate GT (n = 42) experienced at least one complication throughout their operative hospital course, compared to 70.6% of patients with a delayed GT (n = 36) and 57.5% patients without GT (n = 200, $P < 0.0001$). However, the delayed GT group had the highest rates of ED visits and readmission within 30 days and 90 days when compared to immediate GT and no GT groups ($P = 0.03, < 0.01, < 0.0001$, respectively) (Table II).

Thirty- and 90-day readmissions and 30-day ED visits occurred overall in 12.2% (n = 54), 19.3% (n = 85), and 14.1% (n = 62) of patients. Reasons for ED visits and readmission were then reviewed, comparing immediate or delayed GT and no GT groups (Table III). Twenty-seven percent of total ED visits (n = 23) were linked to poor postoperative oral intake. Thirty-six percent of 30-day readmissions (n = 22) and 38.6% of 90-day readmissions were linked to poor postoperative oral intake. Delayed GT status was associated with an increase in 30-day ED visits attributable to poor oral intake; however, this was not statistically significant ($P = 0.10$). Delayed GT status was significantly associated with an increase in 30 and 90-day readmissions attributable to poor oral intake ($P < 0.0001$, 0.002, respectively) (Fig. 1).

## DISCUSSION

Our study is the first to consider the clinical impact of potential GT underutilization in minimally invasive TORS patients with locally advanced head and neck cancer. We clearly identify a subpopulation of TORS patients treated for stage III or IV disease who fail to thrive in the immediate postoperative period and ultimately require GT. We uniquely propose an aggressive early GT strategy aimed to minimize the delayed GT subset of the studied population. Their poor oral intake is a common cause of both readmission and return to the ED following TORS + ND. Postoperative readmission rates are increasingly used as proxy indicators of surgeon performance and hospital system quality. Targeting nutrition with or without GT in these patients could significantly improve surgeon operative outcomes and hospital reimbursement.

Other studies have considered post-TORS GT rates and potential predisposing factors.[12–16] Gastrostomy tube rates generally are low for TORS. For early-stage

TABLE I.
Characteristics and Comorbidities of Patients Undergoing Gastrostomy.

| | | Total, n | No GT, n(%) | Delayed GT n(%) | Immediate GT n(%) | *P* Value |
|---|---|---|---|---|---|---|
| Age | < 55 | 138 | 116 (33.3) | 11 (21.6) | 11 (26.2) | 0.3 |
| | 55–75 | 288 | 207 (59.5) | 33 (64.7) | 24 (57.1) | |
| | > 75 | 39 | 25 (7.2) | 7 (13.7) | 7 (16.7) | |
| Gender | Male | 345 | 269 (77.3) | 43 (84.3) | 33 (78.6) | 0.54 |
| | Female | 96 | 79 (22.7) | 8 (15.7) | 9 (21.4) | |
| Race | Caucasian | 338 | 266 (76.4) | 42 (82.4) | 30 (71.4) | 0.88 |
| | African American | 29 | 23 (6.6) | < 6 | < 6 | |
| | Spanish/Hispanic | 24 | 18 (5.2) | < 6 | < 6 | |
| | Other | 50 | 41 (11.8) | < 6 | < 6 | |
| Insurer | Medicaid | 10 | 6 (1.7) | < 6 | < 6 | 0.14 |
| | Medicare | 126 | 92 (26.4) | 19 (37.3) | 15 (35.7) | |
| | Commercial | 302 | 247 (71.0) | 31 (60.8) | 24 (57.1) | |
| | Other | <6 | < 6 | 0 | 0 | |
| Surgery type | Concurrent | 349 | 281 (80.8) | 37 (72.6) | 31 (73.8) | 0.28 |
| | Staged | 92 | 67 (19.2) | 14 (27.4) | 11 (26.2) | |
| Surgeon volume | Low | 180 | 149 (42.8) | 16 (31.4) | 15 (35.7) | 0.24 |
| | High | 261 | 199 (57.2) | 35 (68.6) | 27 (64.3) | |
| FED | Absent | 405 | 330 (94.8) | 45 (88.2) | 30 (71.4) | 0.0001 |
| | Present | 36 | 18 (5.2) | 6 (11.8) | 12 (28.6) | |
| Comorbidity | Congestive heart failure | 7 | < 6 | < 6 | < 6 | 1.00 |
| | Valvular disease | 18 | 13 (3.7) | < 6 | < 6 | 0.63 |
| | Peripheral vascular disease | 11 | 6 (1.7) | < 6 | < 6 | 0.09 |
| | Chronic pulmonary disease | 62 | 44 (12.6) | 9 (17.7) | 9 (21.4) | 0.23 |
| | Diabetes, uncomplicated | 51 | 39 (11.2) | < 6 | 7 (16.7) | 0.50 |
| | Hypothyroidism | 23 | 18 (5.2) | < 6 | < 6 | 0.50 |
| | Renal failure | 16 | 10 (2.9) | < 6 | < 6 | 0.17 |
| | Liver disease | 10 | < 6 | < 6 | < 6 | < 0.01 |
| | Obesity | 43 | 34 (9.8) | < 6 | < 6 | 0.81 |
| | Paralysis | < 6 | < 6 | < 6 | < 6 | 0.03 |
| | Alcohol abuse | 27 | 14 (4.0) | < 6 | 9 (21.4) | < 0.0001 |
| | Depression | 27 | 22 (6.3) | < 6 | < 6 | 0.95 |
| | Hypertension | 215 | 156 (44.8) | 35 (68.6) | 24 (57.1) | < 0.01 |

P < 0.05 is highlighted. Data < 6 suppressed due to small cell size publication restrictions.
FED = fluid and electrolyte or weight loss disorder; GT = gastrostomy tube.

disease, few, if any, patients require GT.[17] Not surprisingly, more complicated TORS patients may have higher GT rates. Iseli et. al. demonstrate that T4 primary site disease is an independent predictor of GT after TORS.[18] Al-Khudari et al. sites that salvage TORS or TORS plus free flap have 50% and 80% GT rates, respectively.[14] However, Weinstein et al. showed that most stage III or IV TORS + ND patients do not require long-term GT.[9]

TABLE II.
GT Status and Postoperative Hospitalization.

| | GT Status, n (%) | | | |
|---|---|---|---|---|
| | None | Immediate | Delayed | *P* Value |
| Any 30-day ED visit | 41 (11.8) | 9 (21.4) | 12 (23.5) | 0.03 |
| More than one ED visit | 12 (3.4) | < 6 | 7 (13.7) | 0.05 |
| Any 30-day readmission | 34 (9.8) | 6 (14.3) | 14 (27.5) | < 0.01 |
| Any 90-day readmission | 51 (14.7) | 9 (21.4) | 25 (49.0) | < 0.0001 |
| More than one 90-day readmission | < 6 | < 6 | 10 (19.6) | < 0.001 |

*P* < 0.05 is highlighted. Values < 6 suppressed due to cell size restrictions.
ED = emergency department; GT = gastrostomy tube.

TABLE III.
Reasons for Postoperative Hospitalization.

| Visit Type | GT Status | Hospital Visits | | P Value |
|---|---|---|---|---|
| | | Total, n | Attributable to Poor Oral Intake, n(%) | |
| 30-Day, ED | No GT | 50* | 10 (20.0) | 0.10 |
| | Immediate GT | 13 | 4 (30.8) | |
| | Delayed GT | 20 | 9 (45.0) | |
| 30-Day, Readmission | No GT | 36 | 6 (16.7) | $<0.0001$ |
| | Immediate GT | 7 | 2 (28.6) | |
| | Delayed GT | 18 | 14 (77.8) | |
| 90-Day, Readmission | No GT | 55* | 14 (25.0) | 0.002 |
| | Immediate GT | 15 | 5 (33.3) | |
| | Delayed GT | 42 | 25 (59.5) | |

$P < 0.05$ is highlighted.
*Three patient records (five ED visits and two 90-day readmission) were excluded. Values < 6 suppressed due to cell size restrictions.
ED = emergency department; GT = gastrostomy tube.

Given the published data to date, our observation that approximately one-third of patients undergoing TORS for advanced disease may derive benefit from short-term perioperative improvements in nutrition—a benefit that appears unexpected and ultimately resulted in GT—is of clear value.

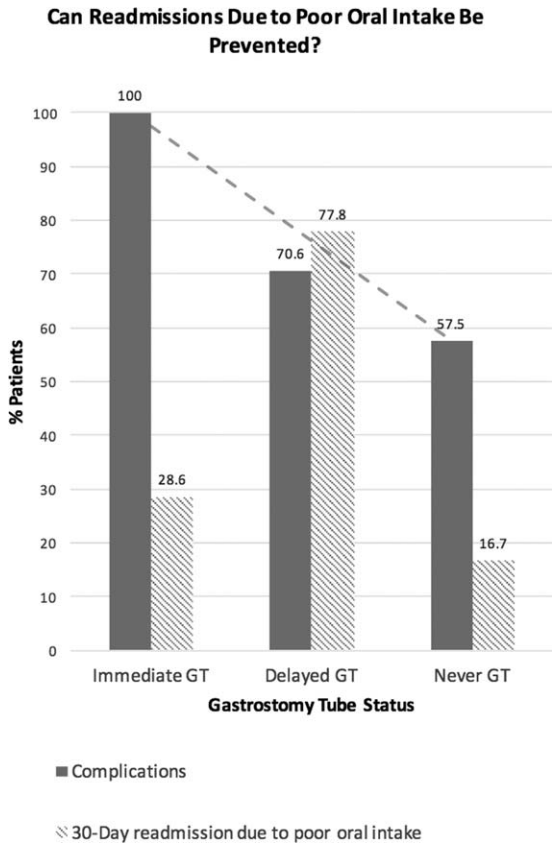


Fig. 1. Paradoxical increase in postoperative readmissions despite fewer perioperative complications in patient with delayed GT versus early GT. Delayed GT patients have increased 30-day readmissions attributable to poor oral intake ($P < 0.0001$).
$P < 0.05$ significant.
GT = gastrostomy tube.

The delayed GT patients in this study utilize significantly greater healthcare resources postoperatively. Paradoxically, however, they have a less complicated initial hospital course than immediate GT patients. It is unexpected for patients with a more benign hospital course to experience increased rates of fluid and electrolyte disruption, weight loss, failure to thrive, dysphagia, and inability to tolerate oral feeding. Future studies that are prospective and randomized, and that utilize clinical nutritional and functional outcomes data may better elucidate the nuances of why this discrepancy is observed in our study. Given that delayed GT patients represent a minority (11.5%) of the patients in this study, a refined rather than an overarching risk-screening strategy should be used to identify patients benefiting from early GT in minimally invasive robotic resection of advanced head and neck cancers.

Evidence-based guidelines to predict the need for gastrostomy exist, but high-quality evidence to support specific timing and screening criteria for tube feeds is lacking.[19] It is generally accepted that demographics, tumor site and staging, nutritional status, and the presence of dysphagia play a role in risk stratification. Brown et al. describes a validated high-risk stratification protocol for head and neck cancer patients undergoing chemotherapy and radiation in which patients meet gastrostomy criteria if they exhibit >10% unintentional weight loss or body mass index < 20 with 5% to 10% weight loss in past 6 months, or if they meet other criteria for severe malnutrition as judged by a dietician.[3] The findings of this study suggest that perioperative fluid and electrolyte disorders, weight loss, liver disease, alcohol abuse, paralysis, hypertension, and the presence of any perioperative complication contribute a high-risk nutritional status following TORS, and these patient characteristics could be included in future rubrics.

The benefit of early GT with respect to head and neck surgery is controversial. Specifically, for TORS,

26.7% of surveyed surgeons routinely do not place either nasogastric or gastrostomy feeding access, and only 2.2% of surgeons routinely place a PEG.[7] Chandler et al. outlines a preoperative scoring system to predict gastrostomy specific to head and neck reconstruction, with emphasis on low preoperative albumin as a major risk factor for postoperative complications.[20] Mays et al. found that perioperative GT with respect to head and neck tumor resection suggests a high-risk patient with a complicated hospital stay, but also that preoperative GT can protect against poor postoperative outcomes such as prolonged hospital length of stay, wound complications, and weight loss.[21] Our data also suggests that postoperative outcomes can be improved by aggressive nutritional screening and early GT in appropriate candidates undergoing robotic primary head and neck tumor resection.

This study is subject to the inherent limitations of a retrospective observational study, particularly surgeon selection bias when deciding on GT timing. The data are dependent on an administrative database, and thus are not clinically rich with tumor staging, histology, intraoperative details, or postoperative laboratory data. This data is specific to the SPARCS database, which only includes patients within New York State. Data may not be extrapolated for the remainder of the United States, where trends may be different.

## CONCLUSION

More than one-third of 30 and 90-day readmissions in TORS and neck dissection for advanced head and neck cancer in NY are related to impaired PO intake. A disproportionate number of these readmissions occur in patients with delayed GT. Patient risk factors combined with a complicated hospital course can identify patients benefiting from early GT, enhancing postoperative resource utilization. Future prospective studies are needed to evaluate the true benefit of early GT in appropriate head and neck cancer surgical candidates, and how improved risk-stratification for this intervention may effect postoperative outcomes. An improved understanding of the benefits of GT in this population can assist surgeons during informed consent and help them balance quality-of-life decisions versus potentially avoidable hospital readmissions.

### Acknowledgment

We acknowledge the biostastical consultation and support provided by the Biostatistical Consulting Core at School of Medicine, Stony Brook University, New York.

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