

# Patient-Perceived and Objective Functional Outcomes Following Transoral Robotic Surgery for Early Oropharyngeal Carcinoma

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**Objective:** To evaluate changes in patient-perceived swallowing function over time following transoral robotic surgery (TORS) for primary T1 and T2 oropharyngeal squamous cell carcinomas.

**Design:** Prospective case series.

**Setting:** Academic tertiary referral center.

**Patients:** Forty-two patients with T1 or T2 oropharyngeal squamous cell carcinomas.

**Intervention:** TORS-assisted resection of indicated tumors.

**Main Outcome Measures:** Changes in patient-perceived swallowing function over time (using the M. D. Anderson Dysphagia Inventory) and gastrostomy tube dependence.

**Results:** Between March 19, 2007, and April 21, 2010, forty-two patients with primary T1 or T2 oropharyngeal squamous cell carcinomas underwent TORS-assisted resection. Most (76% [32 of 42]) patients had stage III disease; 93% (39 of 42) of patients underwent staged neck dissection. The median postoperative fol-

low-up time was 17 months (range, 4-40 months). There were no complications or tumor recurrences. Postoperative chemotherapy use predicted gastrostomy tube retention for longer than 3 months ( $P=.01$ ). Immediate mean postoperative M. D. Anderson Dysphagia Inventory scores in each assessed domain (global, emotional, physical, and functional) decreased compared with preoperative baseline scores; however, ongoing improvement in all domains was observed over time. Nodal status ( $P=.049$ ), follow-up time of less than 12 months ( $P=.03$ ), and preoperative physical scores of less than 100 ( $P=.01$ ) predicted poorer physical M. D. Anderson Dysphagia Inventory outcomes. Positive pathological margins predicted poorer functional scores ( $P=.03$ ).

**Conclusions:** After TORS-assisted resection of T1 and T2 oropharyngeal squamous cell carcinomas, approximately one-third of patients will experience a sustained decrease in perceived swallowing function. However, ongoing improvement of swallowing function over time is likely even after 12 months. Patients receiving adjuvant chemotherapy after TORS should be counseled about the possibility of prolonged gastrostomy tube dependence.

*Arch Otolaryngol Head Neck Surg.* 2011;137(11):1112-1116

**N**ATIONAL COMPREHENSIVE Cancer Network guidelines<sup>1</sup> recognize surgical and chemoradiotherapeutic organ preservation strategies as first-line treatment for T1 and T2 carcinomas of the oropharynx. However, early primary carcinomas of the oropharynx are more frequently treated using nonsurgical organ preservation therapies because of concerns about poorer functional outcomes with open surgical resection owing to the need for access procedures like mandibulotomy or pharyngotomy.<sup>2,3</sup> It is also recognized that dysphagia after oropharyngeal organ preservation therapy is significantly affected by the radiation dose to the pharyngeal constrictor muscles and by the use of adjuvant chemotherapy.<sup>4,5</sup> Transoral ro-

botic surgery (TORS) was first described by Weinstein et al<sup>6</sup> in 2005 and has gained increasing popularity with head and neck surgical oncologists during the past 5 years. For early oropharyngeal tumors, the 3-dimensional visualization afforded by the



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surgical robot has overcome the line-of-sight access limitations associated with traditional endoscopic procedures while maintaining a minimally invasive approach, resulting in lower morbidity with comparable oncologic outcomes.<sup>7-9</sup> To date, there have been no studies of patient-perceived swallowing outcomes over time after TORS-assisted resection of T1 and T2

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primary oropharyngeal squamous cell carcinomas. This study was designed to evaluate the pretreatment and post-treatment subjective and objective functional outcomes of patients undergoing TORS for early oropharyngeal carcinoma.

## METHODS

### PATIENT SELECTION

A prospective nonrandomized study was conducted at The University of Alabama at Birmingham among patients with primary T1 and T2 oropharyngeal squamous cell carcinomas resected using a robot (da Vinci Surgical System; Intuitive Surgical, Inc, Sunnyvale, California) between March 19, 2007, and April 21, 2010. Institutional review board approval was obtained before commencement of the study. Exclusion criteria included patients who had undergone prior nonrobotic surgical resection (3 patients) or radiation therapy (15 patients), as well as patients who had inadequate postoperative functional follow-up data (4 patients).

### PREOPERATIVE AND PERIOPERATIVE PROCEDURE

Disease in all patients was initially staged by clinical and radiological examination. Operative treatment involved general anesthesia, transnasal intubation, and exposure of the oropharynx using the Feyh-Kastenbauer laryngeal retractor or the Crowe-Davis retractor. Patients with positive cervical lymphadenopathy underwent delayed unilateral or bilateral neck dissection depending on the nodal status. After surgery, patients were assessed for their need for radiation therapy on the basis of overall disease stage. Concomitant chemotherapy was administered for patients with positive pathological margins or extracapsular spread on permanent histopathological examination. The administration of postoperative radiation therapy (PORT) with or without chemotherapy was performed at The University of Alabama at Birmingham or at other cancer centers in the state.

### OUTCOME MEASURES

The M. D. Anderson Dysphagia Inventory (MDADI)<sup>10</sup> was used to assess patient-perceived dysphagia-specific quality of life. The MDADI is divided into several subscales (global, emotional, physical, and functional) designed to assess the overall effect of the disorder on quality of life. The global subscale consists of a single question assessing the patient's perception of the degree of swallowing impairment. The emotional subscale (6 questions) assesses the degree to which swallowing problems upset or embarrass the patient. The physical subscale (8 questions) assesses the effects of dysphagia on the patient's reports of dietary consistency, aspiration, maintenance of weight, and fatigue. The functional subscale (5 questions) assesses ease of food preparation and eating in public. Patients completed the questionnaire before surgery (within 2 weeks of their operation date) and at each postoperative visit. To better standardize MDADI results on the basis of follow-up time, MDADI scores were analyzed from preoperative, immediate postoperative, and last follow-up (>3 months after surgery) visits. The MDADI was scored according to a scale by Chen et al,<sup>10</sup> with a range of 0 (extremely low functioning) to 100 (high functioning). Poor swallowing function on any subscale was defined before surgery as a score of less than 60 or after surgery as a decrease from preoperative baseline scores by more than 20 points at the last fol-

**Table 1. Patient, Tumor, and Treatment Characteristics**

Characteristic	No. (%) (n = 42)
Sex	
Male	29 (69)
Female	13 (31)
Oropharyngeal tumor site	
Tonsil	29 (69)
Base of tongue	13 (31)
Tumor size	
T1	19 (45)
T2	23 (55)
Nodal status	
N0	10 (24)
N1	5 (12)
N2	27 (64)
Overall disease stage	
I	3 (7)
II	7 (17)
III	32 (76)
Staged neck dissection	
Yes	39 (93)
No	3 (7)
Postoperative radiotherapy	
Yes	32 (76)
No	10 (24)
Postoperative chemotherapy	
Yes	13 (31)
No	29 (69)

low-up visit. These values were chosen because they were believed to be representative of a clinically significant decline in a patient's swallowing ability. Although all included patients had complete MDADI scores for their preoperative visit, 4 patients had incomplete immediate postoperative MDADI scores, and 5 patients did not consent for MDADI data collection past 3 months and thus had no analyzable last follow-up results. Other outcome measures analyzed included dosage and type of adjuvant therapies, need for a postoperative gastrostomy tube, gastrostomy tube retention for longer than 3 months, and airway management. Factors predictive of poorer posttreatment swallowing function and percutaneous endoscopic gastrostomy (PEG) tube retention were determined.

Descriptive characteristics were summarized using means (SDs) for continuous outcomes and percentages for categorical variables. Factors that were associated with at least a 20% decrease in MDADI scores on each subscale were identified by  $\chi^2$  test or Fisher exact test. Significant factors at the univariate level were considered in multivariate logistic models.

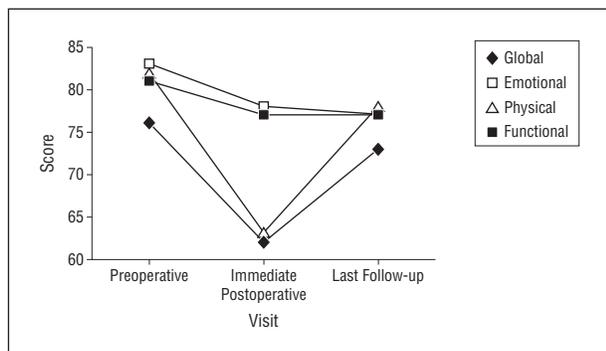
## RESULTS

### PATIENT, DISEASE, AND TREATMENT CHARACTERISTICS

Forty-two patients were included in the study. The mean patient age was 55 years, and 69% (29 of 42) were male. Tumors were more commonly located in the tonsil than the base of tongue, and 76% (32 of 42) of patients were seen with positive cervical node disease (**Table 1**). There were no postoperative complications. Neck dissection was performed in 93% (39 of 42) of patients, and most (76% [32 of 42]) patients received PORT, at a mean dose of 61.6 Gy. Thirteen patients received postoperative che-

**Table 2. Preoperative and Postoperative M. D. Anderson Dysphagia Inventory Subscale Scores**

Visit	Size of Sample	Score, Mean (SD)			
		Global	Emotional	Physical	Functional
Preoperative	42	76 (23)	81 (14)	82 (17)	83 (15)
Immediate postoperative	38	62 (27)	77 (15)	63 (17)	78 (14)
Last follow-up	37	73 (26)	77 (17)	70 (21)	77 (19)



**Figure.** Changes in the mean M. D. Anderson Dysphagia Inventory subscale scores over time.

motherapy for positive pathological margins alone (1 patient), positive pathological margins and extracapsular spread (3 patients), and extracapsular spread alone (9 patients). The median postoperative follow-up time was 17 months (range, 4-40 months), and the median hospital stay was 1 day (range, 0-2 days). There were no disease recurrences or mortalities.

### FUNCTIONAL OUTCOMES

Most patients exhibited some degree of preoperative dysphagia, with 81% (34 of 42) of patients having baseline MDADI scores of less than 100. All preoperative MDADIs were administered within 2 weeks of operation, and there was no observable trend between poorer preoperative MDADI subscale scores and timing of questionnaire administration with respect to operation date. The mean timing of the immediate postoperative MDADI was at 0.82 (0.67) months, and the mean timing of the last follow-up MDADI was at 13.6 (17.3) months. The mean MDADI scores at the immediate postoperative visit on each assessed subscale (global, emotional, physical, and functional) decreased compared with preoperative baseline scores (**Table 2** and **Figure**). Scores for 15 of 38 patients (40%) improved or remained unchanged at the immediate postoperative visit (**Table 3**). Compared with immediate postoperative scores, the mean MDADI subscale scores at the last follow-up visit increased or remained constant (Table 2). Eleven of 42 patients (26%) had identical global immediate postoperative and last follow-up scores. Similarly, for each of the other MDADI subscales, fewer than 5 patients had identical immediate postoperative and last follow-up scores. The percentages of scores that had decreased from baseline by more than 20 points at the last follow-up visit were 29% global (11 of 38 patients), 32% emotional (12 of 38 patients),

**Table 3. Changes in Individual M. D. Anderson Dysphagia Inventory Subscale Scores From Baseline Over Time**

Variable	No. (%)		
	Increased	Unchanged	Decreased
Baseline to immediate postoperative visit (n = 38)			
Global	7 (18)	8 (21)	23 (61)
Emotional	12 (32)	5 (13)	21 (55)
Physical	2 (5)	4 (11)	32 (84)
Functional	7 (18)	5 (13)	26 (68)
Baseline to last follow-up visit (n = 37)			
Global	9 (24)	13 (35)	15 (41)
Emotional	13 (35)	4 (11)	20 (54)
Physical	8 (22)	7 (19)	22 (60)
Functional	9 (24)	6 (16)	22 (60)
Immediate postoperative visit to last follow-up visit (n = 33)			
Global	16 (48)	11 (33)	6 (18)
Emotional	18 (55)	5 (15)	10 (30)
Physical	21 (64)	1 (3)	11 (33)
Functional	15 (46)	4 (12)	14 (42)

42% physical (16 of 38 patients), and 29% functional (11 of 38 patients). On univariate analysis, no factors (including age, preoperative MDADI score, oropharyngeal tumor subsite, TNM classification, PORT, follow-up time of less than 12 months, or positive pathological margins) were predictive of poorer postoperative global or emotional scores. Nodal status ( $P = .049$ ), follow-up time of less than 12 months ( $P = .03$ ), and preoperative physical scores of less than 100 ( $P = .01$ ) predicted poorer physical MDADI outcomes. However, only the latter was significant on multivariate analysis. Positive pathological margins predicted poorer functional scores on univariate and multivariate analysis ( $P = .03$ ), which did not correlate with postoperative chemotherapy use in these patients.

No patient required a tracheostomy. Ten patients required a postoperative gastrostomy tube (9 PEG and 1 nasogastric). The indication for PEG tube placement in all patients was PORT, and no patient used their PEG tube before commencement of radiation therapy. One patient who did not receive PORT required a nasogastric feeding tube for 3 weeks because of immediate postoperative dysphagia, which subsequently resolved. Five of 42 patients (12%) retained their PEG tube for longer than 3 months, with 2 patients using the PEG tube beyond 6 months and none beyond 12 months. Postoperative chemotherapy use predicted gastrostomy tube retention for longer than 3 months on univariate and multivariate analy-

ses ( $P = .01$ ). No other factors (including age, preoperative MDADI score, oropharyngeal tumor subsite, TNM classification, PORT, or positive pathological margins) were predictive of gastrostomy tube retention.

#### COMMENT

Treatment options for early primary oropharyngeal cancers include surgery vs nonsurgical organ preservation therapies. Although recurrence and survival rates are similar for both modalities, chemoradiotherapy is the preferred treatment option at most large cancer centers because of concerns about poorer functional outcomes with surgical approaches and the frequent need for postoperative adjuvant radiation therapy.<sup>2,3</sup> Functional swallowing morbidity associated with open oropharyngeal surgery is generally attributed to the need for access procedures like mandibulotomy or pharyngotomy to overcome line-of-site visibility issues. TORS-assisted resection of oropharyngeal tumors eliminates the need for such access procedures and potentially affords significant advantages with regard to postoperative functional outcomes. Prior studies<sup>9,11-13</sup> addressing functional outcomes following TORS for oropharyngeal cancer used PEG tube retention and the need for tracheostomy insertion as the primary end points. However, few patients require tracheostomies or retain PEG tubes; therefore, these outcome measures fail to provide an adequate assessment of swallowing function. No published studies have yet addressed patient perception of swallowing ability and changes in this perception over time following TORS-assisted resection of early oropharyngeal carcinoma. We showed herein that approximately one-third of patients after surgery will experience a sustained decrease in perceived swallowing function. However, ongoing improvement of swallowing function over time is likely even after 12 months. Poorer preoperative or postoperative MDADI scores do not predict PEG tube dependency, but postoperative chemotherapy predicted PEG tube retention for longer than 3 months.

The MDADI questionnaire is a validated disease-specific 20-item instrument that has been shown to be sensitive and reliable with regard to swallowing-related quality-of-life issues among the population with head and neck cancer. Previous investigations demonstrated that patients with primary tumors of the oral cavity and oropharynx exhibit significantly greater swallowing disability than patients with tumors in other head and neck subsites.<sup>10</sup> Therefore, inclusion of some form of dysphagia-specific quality-of-life assessment with any new treatment modality for oropharyngeal cancer is particularly important to allow comparisons of treatment-related swallowing morbidity. Prior investigations have not reported MDADI subscale scores but instead have used the mean global scores or an overall score from all subscales combined.<sup>8,14</sup> In our study, all subscales exhibited similar trends in scores over time, indicating that in this patient population, reporting the mean global results alone is fairly representative of scores on other subscales. In addition, the observed increase in postoperative subscale scores over time suggests that ongoing improve-

ment in swallowing function may be expected even after 12 months. Preoperative physical MDADI scores of less than 100 and positive pathological margins may predict poorer long-term swallowing function on the physical and functional MDADI subscales, respectively. This may be helpful to identify patients who would benefit from more intensive preoperative and postoperative swallowing therapy.

Global MDADI results from this study compare favorably with those reported in the literature. Iseli et al<sup>8</sup> reported that the mean global scores dropped from 75 before surgery to 65 after TORS for carcinomas of the oropharynx, larynx, and hypopharynx combined. Gillespie et al<sup>14</sup> reported the mean MDADI scores for all subscales combined after open surgery or chemoradiotherapy for oropharyngeal carcinomas of all sizes. After 12 months of follow-up care, the open surgery group had lower MDADI scores (mean, 57.1) than the chemoradiotherapy group (mean, 76.9). Using the same scoring method, our mean MDADI score after TORS was 74.3 at the last follow-up visit, comparable to that of the organ preservation group in the study by Gillespie et al.

It is recognized that dysphagia after oropharyngeal organ preservation therapy is significantly affected by the irradiation dose received by the pharyngeal constrictor muscles and by the use of adjuvant chemotherapy.<sup>4,5</sup> The ability to deintensify adjuvant therapies by decreasing the irradiation dose required or by avoiding chemotherapy offers significant potential benefits for improving long-term swallowing outcomes.<sup>15,16</sup> As demonstrated in our series, in which the mean PORT dose was 61.6 Gy, TORS-assisted resection of early oropharyngeal cancers allows for such deintensification of adjuvant therapies. Thirteen of 42 patients (31%) in this series received postoperative chemotherapy. Under organ preservation protocols, 32 patients (76%) in our series would have been eligible to receive chemotherapy on the basis of overall disease stage. Therefore, as many as 19 patients (45%) avoided chemotherapy by undergoing TORS-assisted resection of their early oropharyngeal carcinoma. Postoperative chemotherapy use was the only factor that predicted PEG tube retention for longer than 3 months. Notably, poorer preoperative MDADI scores on any subscale did not predict the need for prolonged gastrostomy tube dependence. Of 5 patients who retained their PEG tubes, only 1 had a decline in MDADI scores of at least 20% from baseline at the last follow-up visit, and none had preoperative MDADI scores of less than 60. This is in contrast to a smaller prior TORS series that included patients with oropharyngeal, laryngeal, and hypopharyngeal carcinomas, which found that poorer preoperative MDADI scores predicted PEG tube retention.<sup>7</sup>

This prospective case series had some limitations. Standardization of follow-up times for MDADI administration was poor; therefore, timing of immediate postoperative and last follow-up MDADI administration varied among patients. Direct comparison of functional outcomes among patients undergoing primary chemoradiotherapy for T1 or T2 oropharyngeal carcinomas was impossible because no prospective data were available for the organ preservation patients. Consideration should be given to a multi-institutional randomized controlled

trial of patient-perceived functional outcomes following TORS vs organ preservation therapy for this patient population.

In conclusion, TORS-assisted resection of T1 and T2 oropharyngeal squamous cell carcinomas achieves good functional and clinical outcomes. It allows for deintensification of postoperative adjuvant therapies and enables many patients to avoid chemotherapy. After surgery, approximately one-third of patients will experience a sustained decrease in perceived swallowing function. However, ongoing improvement of swallowing function over time is likely even after 12 months. Poorer preoperative MDADI scores do not predict gastrostomy tube retention in this patient population. However, patients receiving adjuvant chemotherapy after TORS should be counseled about the possibility of prolonged gastrostomy tube dependence.

**Submitted for Publication:** March 2, 2011; final revision received April 20, 2011; accepted June 7, 2011.

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**Author Contributions:** Drs Sinclair, Carroll, Rosenthal, and Magnuson had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. *Study concept and design:* Sinclair, Carroll, Rosenthal, and Magnuson. *Acquisition of data:* Sinclair and McCulloch. *Analysis and interpretation of data:* Sinclair, McCulloch, Rosenthal, and Desmond. *Drafting of the manuscript:* Sinclair and Desmond. *Critical revision of the manuscript for important intellectual content:* Sinclair, Carroll, Rosenthal, and Magnuson. *Statistical analysis:* Sinclair and Desmond. *Administrative, technical, and material support:* Sinclair, McCulloch, and Rosenthal. *Study supervision:* Carroll, Rosenthal, and Magnuson.

**Financial Disclosure:** Dr Magnuson is a consultant and instructor at Intuitive Surgical, Inc, Sunnyvale, California.

**Role of the Sponsor:** Intuitive Surgical, Inc had no role in the design and conduct of the study; in the collection, analysis, and interpretation of the data; or in the preparation, review, or approval of the manuscript.

**Previous Presentation:** This study was presented at the

American Head and Neck Society 2011 Annual Meeting; April 27, 2011; Chicago, Illinois.

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