

A Comparison of Exposure Techniques for Transoral Robotic Surgery

Kevin J. Carlson MD¹; Reem Sharaf Alddin PhD²; Jeffrey J. Houlton MD³; Matthew J. Bak MD¹; Daniel W. Karakla MD¹; Jonathan R. Mark MD¹

¹Eastern Virginia Medical School Department of Otolaryngology; ²Eastern Virginia Medical School-Sentara Healthcare Analytics and Delivery Science Institute; ³University of Washington Department of Otolaryngology



Introduction

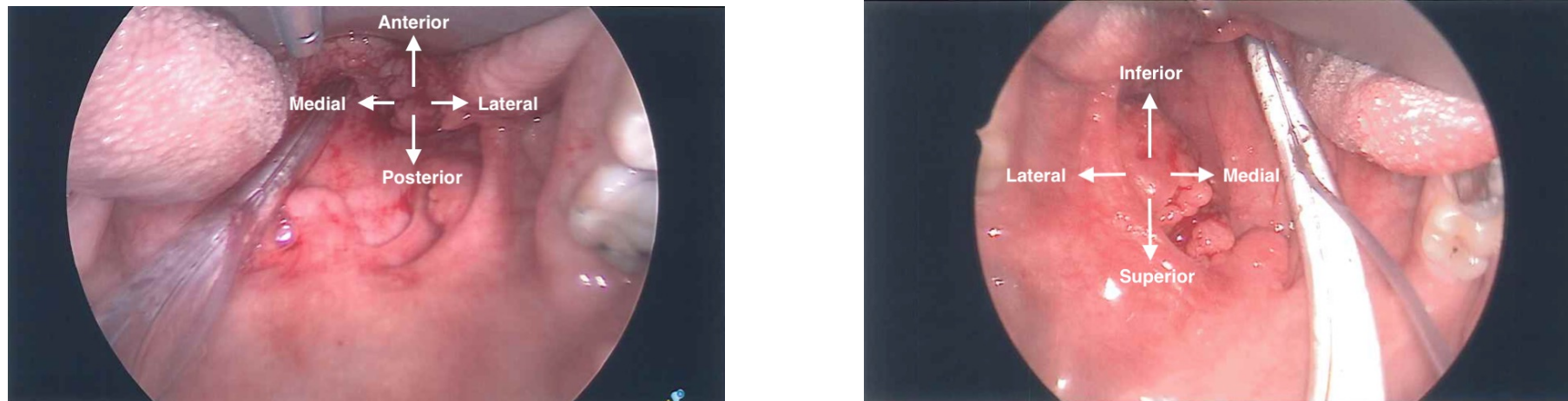
- Transoral robotic surgery (TORS) may offer improved quality of life in specific domains while providing similar oncologic outcomes to radiation or chemoradiation in appropriately selected patients with oropharyngeal cancer.¹⁻⁴
- Adequate oncologic surgical resection to de-escalate or avoid adjuvant therapy is made difficult by exposure of crowded anatomy.
- Surgeons have experimented with novel techniques to maximize the exposure offered by robotic surgical systems though the optimal method is often patient and device dependent.⁵⁻⁷
- The feasibility of TORS and ideal exposure technique can be assessed during staging endoscopy though objective communication of findings can be difficultly.
- Placement of a tongue retraction stitch is a commonly utilized technique to manipulate exposure in transoral surgery. Although somewhat counterintuitive, tongue-in positioning may optimize exposure to some subsites.
- We aim to compare the surgical exposure of the oropharynx with tongue-in and tongue-out positioning.
- The utility of a novel grading score of oropharyngeal exposure is assessed.

Methodology

- Prior to offering TORS a primary treatment modality, our institution routinely simulates oropharyngeal exposure with multiple techniques and retractors with photo-documentation at the time of staging endoscopy.
- We retrospectively identified patients undergoing staging endoscopy between 7/1/2018 and 7/1/2020, with photo-documentation of oropharyngeal exposure with the tongue positioned under the mouth-gag (In) and pulled laterally, from under the mouth gag (Out), using the tongue stitch technique.
- Four fellowship trained head and neck surgeons (JH, MB, DK, and JM) graded oropharyngeal exposure using a novel grading score (Table 1) on an electronic based survey while blinded to patient and exposure technique. The electronic survey can be viewed at <https://nala.evms.edu/redcap/surveys/?s=KL34J4JAPA>
- Exposure grading for each technique (In v. Out) is compared and agreement on exposure scores between reviewers is assessed.

Methodology

Table 1: Original grading scale used to assess oropharyngeal exposure. Orientating examples are given of base of tongue and tonsil primary tumors.



Please rate the exposure of the following areas of the pictured mass on a scale of 1 (completely unable to visualize, would require repositioning of mouth gag) to 5 (completely visualized, any repositioning of the mouth gag would negatively affect exposure)

Anterior/Superior Margin	1	2	3	4	5
Medial Margin	1	2	3	4	5
Lateral Margin	1	2	3	4	5
Posterior/Inferior Extent	1	2	3	4	5

Please rate the overall exposure of the pictured mass on a scale of 1 (would require numerous attempts at repositioning the mouth gag to excise) to 5 (would require no repositioning of the mouth gag to excise).

Overall Exposure	1	2	3	4	5
------------------	---	---	---	---	---

Results

Table 2: Patient and Disease Characteristics of Study Participants (n=19)

Demographics	
Age (years), median (IqR)	68 (56 – 72)
Gender	
Male	14 (74%)
Female	5 (26%)
Race	
White	17 (89%)
African American	2 (11%)
BMI kg/m ² , median (IqR)	26 (23 – 32)
Mallampati score, median (IqR)	2 (2-3)
Hyomental Distance (in cm), median (IqR)	5.5 (4.6 – 6)
Prior radiation	0
Disease Characteristics	
Tumor site	
Base of the Tongue	9 (47%)
Tonsil	10 (53%)
Pathology	
Squamous cell carcinoma	18 (95%)
P16+	15 (83%)
Benign Tonsil	1 (5%)
T-Stage	
0	1 (5%)
1	5 (26%)
2	8 (42%)
3	4 (21%)
4a (p16-)	1 (5%)
Treatment	
Offered TORS	10 (53%)
TORS as Primary Treatment	5 (28%)
Clear Margins	5
Adjuvant Radiation	1
Adjuvant Chemoradiation	2
Chemoradiation	12 (63%)
Primary Radiation	2 (11%)

Nineteen patients were identified in the study period with adequate photo-documentation of oropharyngeal exposure using the two techniques. All exposures were obtained using the MedRobotics (Raynham, MA, USA) FlexRetractor System. Patient, disease and treatment characteristics are shown in Table 2.

Results

Table 3: Comparison of Exposure Techniques from 4 Blinded Reviewers

Technique	Tongue positioned In		Tongue positioned Out		p-value
	Mean/Median	(SD/IqR)	Mean/Median	(SD/IqR)	
Anterior/superior, median (IqR)	4	(3 – 4.75)	4	(3.5 – 4.75)	0.406
Base of Tongue Primary	3.5	(3 - 4)	3.75	(2.25 – 3.75)	0.271
Tonsil Primary	4.25	(3.75 – 5)	4.5	(4 – 4.75)	0.679
Medial, median (IqR)	4.25	(4 – 4.5)	4.25	(3.75 – 4.75)	0.685
Base of Tongue Primary	4	(3.25 – 4.5)	4	(3.75 – 4.25)	0.858
Tonsil Primary	4.25	(4.25 – 4.5)	4.5	(3.75 – 4.75)	0.717
Lateral, mean (SD)	4.10	(0.54)	3.75	(0.83)	0.0361
Base of Tongue Primary, median (IqR)	4	(3.75 – 4.25)	3.25	(2.75 – 4)	0.050
Tonsil Primary, median (IqR)	4.37	(3.75 – 4.75)	4.25	(3.75 – 4.5)	0.365
Inferior/Posterior, mean (SD)	3.25	(1.00)	3.14	(1.00)	0.582
Base of Tongue Primary, median (IqR)	2.5	(2.25 – 2.75)	2.25	(2 – 3)	0.856
Tonsil Primary	3.8	(0.81)	3.7	(0.91)	0.668
Overall, median (IqR)	3.5	(3.25 – 4.25)	3.75	(3 – 4.25)	0.273
Base of Tongue Primary	3.25	(3 – 3.25)	3.25	(2.5 – 3.75)	0.231
Tonsil Primary, mean (SD)	4.05	(0.64)	3.97	(0.70)	0.738

Four reviewers, blinded to patient and exposure technique, non-sequentially graded the exposure of each patient in the “In” and “Out” position using the original grading scale. Results of this assessment are shown in Table 3, with subgroup analysis for each primary site. There was modest, though statistically significant, improvement of exposure for BOT primaries with the tongue positioned under the mouth gag, in the “In” position.

Table 4: Agreement between reviewers is assessed using the Kappa Test for Agreement

Exposure	Grade	Kappa	P-value
Anterior/Superior	1	-0.0179	0.6598
	2	0.0255	0.2785
	3	0.0767	0.0384
	4	-0.0128	0.6161
	5	0.2641	<0.001
Medial	1	0.0251	0.2815
	2	0.1211	0.0026
	3	0.1094	0.0058
	4	0.0077	0.4293
	5	0.0543	0.1054
Lateral	1	-0.0093	0.5845
	2	-0.0115	0.6049
	3	-0.0026	0.5244
	4	0.0296	0.2473
	5	0.1375	<0.001
Posterior/Inferior	1	0.0932	0.0157
	2	-0.0179	0.6598
	3	-0.0478	0.8649
	4	0.0246	0.2856
	5	0.2786	<0.001
Overall	1	0.0952	0.0140
	2	0.0449	0.1501
	3	0.0314	0.2343
	4	0.0195	0.3266
	5	0.2541	<0.001

Inter-reviewer agreement exposure scores were assessed between using the Kappa Test for Agreement (Table 4). Overall, reviewers agreed when an exposure could be graded 5, completely exposed requiring no repositioning of the mouth gag. There was poor agreement between reviewers when an exposure offered an incomplete view of resectability .

Discussion and Conclusion

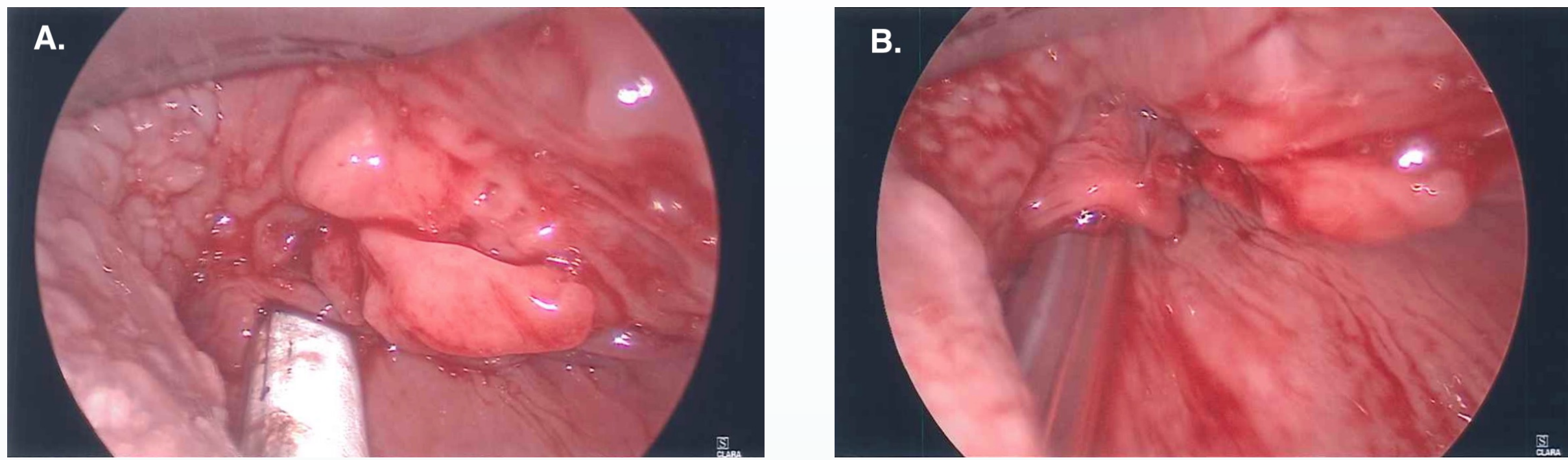


Figure 1: An example of exposure of a base of tongue primary is given in the tongue “Out” (A.) and tongue “In” (B.) position. When compared side to side one, the tongue “In” position (B.) may allow for better appreciation of the inferior and lateral aspects of the tumor and its relationship with the epiglottis. However, differences are subtle and patient specific.

- Among 19 patients evaluated for TORS during staging endoscopy, reviewers found minimal difference between oropharyngeal exposure offered when the tongue is positioned under (“In”) the mouth gag and pulled lateral (“Out”) of the tongue gag using a tongue stitch.
- In our experience, tongue-in positioning may offer improved exposure of the tonsil-base of tongue junction in certain patients while avoiding increased edema from tongue stitch retraction.
- Differences in exposure are subtle, patient specific and not easily appreciated with a 2-dimensional assessment
- While reviewers agreed when an exposure offered complete view an oropharyngeal tumor, there was poor agreement when a view suggested borderline resectability.
- The utility of a numerical grading scale to assess TORS candidacy is limited when resectability is borderline.
- Providers should simulate TORS exposure at the time of staging endoscopy, utilizing multiple mouth gags and exposure techniques, to assess candidacy. This may require repeat endoscopy when a patient is evaluated at a tertiary-referral center after being diagnosed elsewhere.

References

- Yeh DH, Tam S, Fung K, et al. Transoral robotic surgery vs. radiotherapy for management of oropharyngeal squamous cell carcinoma - A systematic review of the literature. *Eur J Surg Oncol.* 2015;41(12):1603-1614.
- Yeh DH, Tam S, Fung K, et al. Transoral robotic surgery vs. radiotherapy for management of oropharyngeal squamous cell carcinoma - A systematic review of the literature. *Eur J Surg Oncol.* 2015;41(12):1603-1614.
- Dhanireddy B, Burnett NP, Sanampudi S, et al. Outcomes in surgically resectable oropharynx cancer treated with transoral robotic surgery versus definitive chemoradiation. *Am J Otolaryngol.* 2019;40(5):673-677.
- Nichols AC, Theurer J, Prisman E, et al. Radiotherapy versus transoral robotic surgery and neck dissection for oropharyngeal squamous cell carcinoma (ORATOR): an open-label, phase 2, randomised trial. *Lancet Oncol.* 2019;20(10):1349-1359.
- Hasskamp P, Lang S, Holtmann L, Stuck BA, Mattheis S. First use of a new retractor in transoral robotic surgery (TORS). *Eur Arch Otorhinolaryngol.* 2016;273(7):1913-1917.
- Mattheis S, Hasskamp P, Holtmann L, et al. Flex Robotic System in transoral robotic surgery: The first 40 patients. *Head Neck.* 2017;39(3):471-475.
- Miller MC. Tongue base exposure during TORS without the use of a mouth prop. *J Robot Surg.* 2016;10(4):347-352.