

# Comparison of Surgical Outcomes of Transoral Robotic Surgery and Conventional Surgery in Oropharyngeal Carcinoma - A Systematic Review

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### Abstract

**Background:** Transoral robotic surgery (TORS) has recently emerged as a surgical technique for oropharyngeal carcinoma. We performed a systematic review to investigate the clinical safety and effectiveness of robotic surgery compared with conventional open surgery in oropharyngeal carcinoma.

**Material and Methods:** A literature search was conducted using the English-language databases EMBASE, MEDLINE, PUBMED and the COCHRANE LIBRARY, as well as local databases containing publications from 2013 to 2020. The outcomes included complications, as well as oncologic, and functional outcomes.

**Results:** twelve studies (n=4802 patients) met the inclusion criteria. Overall, TORS, when compared with open surgery, appears to have better functional results (less hospital time, decannulation) and fewer intraoperative and post-operative complications. There is no significant difference when assessing the oncological outcomes (positive margins, survival rate) when comparing both techniques.

**Conclusion:** Trans Oral Robotic Surgery (TORS) is advantageous over open surgery with the incidence of the complications rate, post operative oncologic outcome, functional outcome in the surgical management of early-stage oropharyngeal carcinoma.

**Keywords:** TORS in Oral cancer', 'Open surgery in oral cancer', 'Transoral robotic surgery', 'Management of head and neck cancer', 'conventional surgery in oral cancer', and 'Management of oropharyngeal cancer.

## INTRODUCTION

Head and neck cancer comprises a group of malignancies that affect mucosal lining at the different anatomical sites and upper aerodigestive tract. These are anatomically complex structures that play an important role in speech, swallowing, and respiration which are essential for maintaining quality of life.

Treatment for oropharyngeal carcinoma includes surgery, chemotherapy, and radiotherapy. Open surgery may lead to functional issues such as dysphasia and phonation problems due to resection of lesions. However, the approach to treating oropharyngeal carcinoma has evolved towards minimally invasive surgeries like Transoral Laser Surgery (TLS) and Transoral Robotic Surgery (TORS).

Surgical robots serve multiple functions, including enabling remote telesurgery and reducing human tremors. Since their introduction in 1985, they've been utilized across various surgical fields. Transoral robotic surgery provides some unique advantages like three-dimension visualization of the operating field greater than 10X visual magnification, improved surgical dexterity by hand tremor stabilization using fine controlled robotic arms, fine tissue manipulation and preservation.

Therefore this systematic review of the relevant literature comparing the two techniques, transoral

robotic surgery and open surgery, aimed to evaluate and compare complications, oncologic outcome and functional outcome in oropharyngeal carcinoma.

## MATERIAL AND METHODS

### Search Approach

A thorough search was carried out using electronic databases like PUBMED, EMBASE, MEDLINE, COCHRANE LIBRARY, with search phrases including 'TORS in Oral cancer', 'Open surgery in oral cancer', 'Transoral robotic surgery', 'Management of head and neck cancer', 'conventional surgery in oral cancer', and 'Management of oropharyngeal cancer'. Following this, reference articles were manually searched to identify additional relevant articles for final selection.

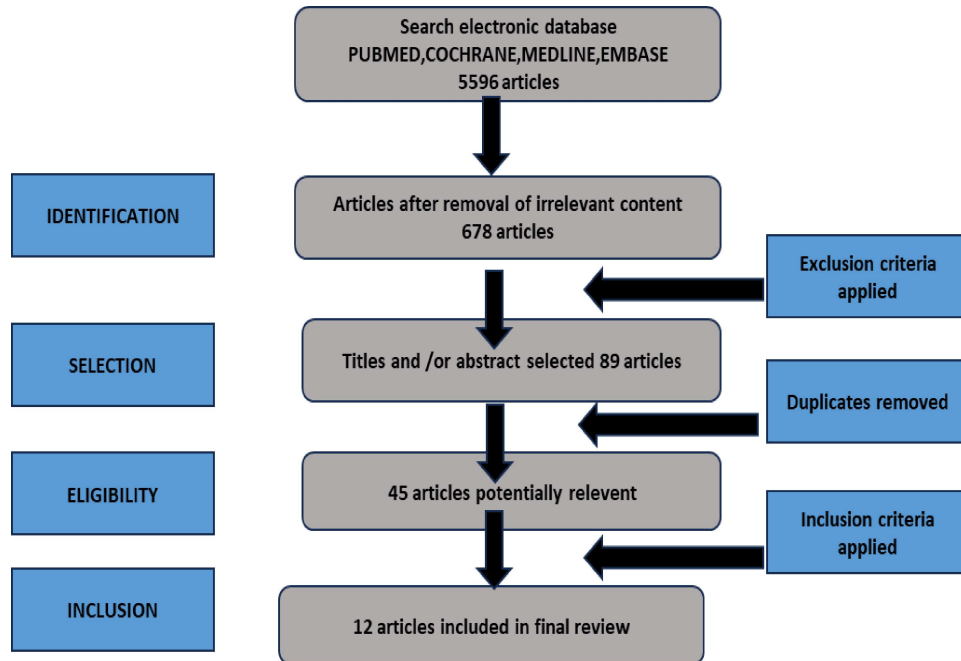
### Inclusion Criteria

Cross sectional studies, clinical observational studies, prospective studies, retrospective studies, Case control and cohort studies, Controlled-clinical trials, English language, Studies comparing TORS with conventional open surgery.

### Exclusion Criteria

Inaccurate and Incomplete data for analysis, Literature review, Author debate, Letter to editor, In vitro studies, Clinical studies involving animal, Biomechanical studies, Preclinical and model studies.

## SEARCH RESULTS



**TABLE 1: INTRAOPERATIVE AND POSTOPERATIVE COMPLICATIONS OF TORS AND OPEN SURGERY**

AUTHER	GROUP (T/C)	INTRA OPERATIVE COMPLICATIONS		POST OPERATIVE COMPLICATIONS			
		Blood Loss	Operative Time	Post Operative Infection	Post Operative Fistula	Post Operative Airway Edema	Post Operative Bleeding
WHITE AT AL. 2013	TORS	49ml	111 ± 48.5 min.	6(10%)	00	13 (20%)	7 (11%)
	OPEN SURGERY	331ml	350 ± 134.6 min.	14(22%)	4 (6%)	12 (19%)	8 (13%)
PARK AT AL 2013	TORS	302.2 ml	410.7 ± 290.9 min.	NR	00	NR	1 (3.33%)
	OPEN SURGERY	572.6 ml	911.2 ± 320.6 min.	NR	2 (7.69%)	NR	5 (19.23%)
LEE AT AL 2014	TORS	NR	48.3 ± 7.5 min.	NR	00	NR	NR
	OPEN SURGERY	NR	35.2 ± 9.3 min.	NR	00	NR	NR
		NR	75.5 ± 5.8 min.	NR	00	NR	NR
Karel Slama 2016	TORS	29 ml	NR	NR	NR	NR	NR
	OPEN SURGERY	405 ml	NR	NR	NR	NR	NR

AUTHER	GROUP (T/C)	Hematoma	Seroma	Wound Dehiscence	Chyle Leak	Skin Flap Necrosis	Marginal Nerve Palsy	Recurrence
Kim at.al 2013	TORS	2 (10%)	4 (20%)	NR	2 (10%)	NR	NR	NR
	OPEN SURGERY	1 (3.33%)	5 (15.15%)	NR	4 (12%)	NR	NR	NR
	P value	0.549	0.715	NR	1.0	NR	NR	NR
Kyung Tae at.al 2013	TORS	1 (8.3%)	1 (8.3%)	NR	0	NR	1(8.3%)	0
	OPEN SURGERY	2 (9.5%)	3 (14.3%)	NR	1 (4.8%)	NR	1(4.8%)	2(10.5%)
	P value	NR	NR	NR	NR	NR	NR	0.520
Yong Bae Ji at.al 2017	TORS	2 (5%)	7 (18%)	0	1 (3%)	1 (3%)	4 (11%)	3 (7.9%)
	OPEN SURGERY	2 (2.6%)	17 (23%)	1 (1.3%)	2 (2.6%)	0	1 (1.3%)	9 (12.0%)
	P value	0.601	0.602	1.0	1.0	1.0	0.043	0.748

**TABLE 2: ONCOLOGICAL OUTCOME OF TORS & OPEN SURGERY**

AUTHER	GROUP (T/C)	FOLLOW UP (Month)	POSITIVE SURGICAL MARGIN		RECCURENCE FREE SURVIVAL		OVER ALL SURVIVAL	
WHITE AT AL. 2013	TORS	24	6 (9%)	p-value 0.007	74%	p-value 0.01	74%	p-value 0.02
	OPEN SURGERY	24	19 (29%)		43%		43%	
PARK AT AL 2013	TORS	36	3 (10%)	p-value 0.007	81%	p-value 0.820	85%	p-value 0.560
	OPEN SURGERY	36	3 (12%)		76%		78%	
LEE AT AL 2014	TORS	24	1 (3.7%)	p-value 0.682	95.7%	p-value 0.733	100%	p-value 0.352
	OPEN SURGERY	24	2 (12.5%)		91.6%		96.7%	
		24	1 (7.1%)					
FORD AT AL 2014	TORS	36	10 (15%)	p-value 0.52	75%	p-value 0.035	NR	NR
	OPEN SURGERY	36	12 (18%)		73%		NR	

**TABLE 3: FUNCTIONAL OUTCOME OF TORS & OPEN SURGERY**

AUTHER	GROUP (T/C)	Hospital Day		Cannulate			Feeding Tube			Swallowing	
				Tracheostomy Use at the Time of Surgery	De Cannulated	At the Time of Surgery	1 Year Post-Operative				
WHITE AT AL. 2013	TORS	3.8 days	p-value <0.001	14 (23%)	p-value <0.001	NR	23 (35%)	p-value <0.001	2 (3%)	p-value 0.002	NR
	OPEN SURGERY	8 days		50 (79%)		NR	48 (75%)		20 (31%)		NR
PARK AT AL 2013	TORS	26.1 days	p-value 0.045	30 (100%)	NR	7.2	P value <0.001	30(100%)	1(3.33%)	8.4 days	
	OPEN SURGERY	43.4 days		26 (100%)		15		26(100%)	3(11.54%)	20.6 days	
LEE AT AL 2014	TORS (MA)	14.6 ± 4 days	p-value 0.001	16 (59.26%)	NR	5.0 ± 1	p-value <0.001	00	NR	6.5 ± 4 days	
	OPEN SURGERY	14.0 ± 6.4 days		-		-		00	NR	7.0 ± 8 days	
		24.6 ± 5.9 days		14 (100%)		13.2 ± 6		00	NR	16.7 ± 5 days	
FORD AT AL 2014	TORS	NR		NR	NR	NR		NR		NR	
	OPEN SURGERY	NR		NR		NR	NR		NR		NR

**RESULT**

This systematic review included 12 studies (4802 patients) that reported the effectiveness of TORS compared with open surgery which were published from 2013 to 2020. Out of all the studies three were reported prospective studies, six were reported retrospective studies, one were reported comparative studies, two reported cohort study.

Out of 12 studies, 6 studies had evaluated gender and age distribution which included 518 patients out of which 241 patients treated with TORS where 277 patients treated with open surgery. With regard to the gender, there were 421(81%) male & 97(19%) female patients. The ratio between M:F was 8:1.8. the average age was 60.66 ± 8.

With regard to complication, the blood loss during surgery differed by over 300ml between TORS and open surgery in four studies. TORS had shorter operating times compared to open surgery. Among

postoperative complications, only White et al.'s study found significant differences in positive surgical margins. Postoperative fistulas occurred only in the open surgery group: 6% (White et al.) and 7.69% (Park et al.). For Marginal nerve palsy, Tae et al. found 8.3% in the TORS group and 4.8% in the open surgery group, while Bay ji et al. reported 11% and 1.3%, respectively (Table 1).

As regards the functional outcome, then we see the hospital stay time it was 3.8 days (white at.al), 26.1 days (park at.al) and 14.6 days (Lee at.al) against 8.0 days (white at.al), 43.4 days (park at.al) and 24.6 days (Lee at.al), with p value <0.001,0.045,0.001 respectively. TORS group reveals a better result. The Tracheostomy use at the time of surgery was 14(23%)<sup>(4)</sup>,30(100%)<sup>(2)</sup> and 16(59.26%)<sup>(3)</sup> in TORS group against 50(79%)<sup>(4)</sup>, 26(100%)<sup>(2)</sup> and 14(100%)<sup>(3)</sup> in open surgery group. Patients treated with TORS regained their swallowing ability much

quicker; 8.4 (park at.al) and 6.5 days (Lee at.al) on average compared with 20.6 (park at.al) and 16.5 (Lee at.al) days in patients treated with open surgery. The TORS group required feeding tube at the time of surgery in 23 (35%) Patients, & 30(100%) (Park at.al) while open surgery required 48 (75%) patients (White at.al), 26(100%) (Park at.al) (table 3).

With regards to the oncological outcome, 3 studies out of the 4 do not show any significant results in terms of disease-free and survival time, and the differences between the TORS and open surgery groups were very similar. Furthermore, the study by White et al. shows significant results in both disease-free time (74% TORS, 43% open surgery) and survival (74% TORS, 43% open surgery) (table 2).

## DISCUSSION

Oropharyngeal carcinomas, refers to the cancer of the middle part of the pharynx, known as oropharynx, which includes the base and posterior one-third of the tongue, the tonsils, soft palate, and posterior and lateral pharyngeal walls.

The management of head-and-neck carcinoma has the primary goal of local control, organ preservation and best quality of life with low morbidity. Historically, surgical excision followed by Chemotherapy Radiotherapy (CTRT) was the treatment of choice for most oropharyngeal carcinoma. The surgical management of oropharyngeal carcinoma are the selective neck dissections, supra cricoid partial laryngectomies. When Open surgery had shown greater functional disability (swallowing, speech) with higher incidence of post operative complications and large surgical scar. In cases of primary tumor pT3 or pT4 along with the close margin (<5 mm) is present postoperative radiation is required likewise extracapsular nodal spread, multiple pathologic neck nodes, a positive margin on permanent pathology, perineural invasion or vascular embolism are present chemoradiotherapy is required. <sup>(3)</sup>

New minimally invasive treatments like transoral laser surgery (TLS) and transoral robotic surgery (TORS) offer advantages over traditional methods.

TLS, while effective, has limitations such as difficulty in removing tumors en-bloc and geometric resection due to microscope constraints. TORS, a more recent innovation, provides better tumor visualization and access, resulting in less morbidity. It improves disease-free survival, reduces the need for free flap reconstruction, and may shorten decannulation time and hospital stay. Despite the high cost of the robot, benefits such as shorter operative time and hospital stay may outweigh this drawback.

In the present systematic review, we analysed and compare complications, oncological outcome and functional outcome.

**1) Complications:** Out of 12, seven studies was analysed,

The blood loss during surgery was with a finding of a difference of over 300ml between TORS and open surgery (park.at.al, white at.al, slama k.et al). Three studies (Park.et al, Lee et.al, White at.al). analysed for operating time and found notable difference in operating time & concluded that TORS had shortest times than open surgery. Two studies (Park.et al, White at.al). analysed for post operative bleeding and fistula and found that TORS had lower chances of post op. bleeding while fistula only occur in open surgery group .one study analysed for post-op infection and found that TORS had lower chances than open surgery group. Chyle leak and seroma showed lower with TORS compare to open surgery but study had not significant difference (M.Ws at.al, Ji YB at.al, Tae k et al.). Hematoma <sup>(6,7,8)</sup> and marginal nerve paralysis <sup>(7,8)</sup> showed slightly higher with TORS than open surgery (table 1).

**2) Oncologic outcome are the most important objectives in determine clinically effectiveness any surgical procedure**

Our systematic analysis of four studies examined oncologic outcomes. Three studies (Park et al., Lee et al., Ford et al.) found no significant differences in safety margins. Only White et al.'s study reported significant results, with 9% positive margins in the TORS group versus 29% in the control group. Regarding recurrence-free survival rate, four studies

were analysed, with only two (White et al., Ford et al.) showing significant results, indicating higher rates with TORS compared to open surgery. Three studies assessed overall survival rate, with only White et al. reporting significant results, demonstrating higher rates with TORS. Overall, TORS was found to potentially increase disease-free survival compared to open surgery, with a significant difference in 3-year disease-free survival between the groups, consistent with the overall effect (table 2).

### 3) Functional outcome

Four studies analysed, with three (Park et al., Lee et al., White et al.) showing significant results on hospital stay. TORS led to notably shorter hospital stays. Tracheostomy use at surgery time was examined in three studies, with only one (White et al.) showing significance, while two (Lee et al., White et al.) found significant results on decannulation. TORS exhibited reduced tracheostomy use compared to open surgery. Regarding feeding tube usage, two studies (Park et

al., White et al.) indicated lower utilization during TORS. Swallowing ability was assessed in two studies (Park et al., Lee et al.), both showing significant early improvement with TORS over open surgery (table 3).

The limitation of this study was the number of the studies included are less. Another limitation is all the studies were conducted in early stage of oropharyngeal carcinoma.

### CONCLUSION

The result of this systematic review revealed that Trans Oral Robotic Surgery (TORS) is advantageous over open surgery with the incidence of the complications rate, post operative oncologic outcome, functional outcome in the surgical management of early-stage oropharyngeal carcinoma. However to draw a definitive conclusion more high quality, well designed observational and prospective studies to understand the effectiveness of TORS when compared with open surgery are required.

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