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RESEARCH

Are new and young generations of surgeons more aware of transoral robotic surgery than older ones? An international survey

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Abstract

The objective of this study is to investigate adoption, perception, and awareness of otolaryngologist-head neck surgeons (OTO-HNS) toward transoral robotic surgery (TORS) according to the surgeon experience. A total of 1,383 OTO-HNS of YO-IFOS and IFOS received an online survey dedicated to the adoption, perception, and awareness toward TORS. The following outcomes were compared between residents and fellows, young/middle-aged and older OTO-HNS: awareness/perception; indications; advantages; barriers and expected improvements of TORS practice. From the 357 responders (26%), 147 participants were residents and fellows; while 105 and 105 OTO-HNS reported 10 to 19, and more than 20 years of practice. The main barriers of using TORS included the cost and the availability of robot, and the lack of training opportunity. The better view of the operative field and the shorter patient hospital stay were considered as the main advantages. Older surgeons trust more likely in TORS benefits ($p=0.001$) and surgical field view advantages ($p=0.037$) compared to younger participants. TORS is an important surgical minimal invasive approach for the future for 46% of residents and fellows *versus* 61% of older OTO-HNS ($p=0.001$). Compared to older OTO-HNS, residents and fellows reported more frequently that the lack of training opportunity is the main barrier of TORS (52% *versus* 12%; $p=0.001$). Residents and fellows did not share the same expectations of robot improvement for the future than older OTO-HNS. Experienced OTO-HNS had better perception and trust toward TORS than residents and fellows. Residents and fellows identified the lack of training opportunity as the main barrier to the use of TORS. TORS access and training programs need to be improved in academic hospitals for residents and fellows.

Keywords Transoral · Robotic · Robot · Otolaryngology · Head–Neck · Surgery · Survey · Awareness

Introduction

The development of new minimal invasive approaches is an important issue in the field of modern surgery. In Otolaryngology–Head and Neck Surgery, technologies changed the management of many sinonasal, otological, or laryngopharyngeal diseases over the past 3 decades [1]. The development of functional endoscopic sinus surgery (FESS) is one of the most significant examples with better operative and postoperative outcomes compared to open sinonasal surgeries [1, 2]. When Stammberger proposed the first FESS procedures in the eighties, he met a high degree of rejection and scepticism [2]. Since then, FESS is considered as the gold standard for sinonasal diseases in most cases. The first transoral robotic surgery (TORS) carried out in 2005 [3]. Since then, the number of publications dedicated to TORS was significantly increased [4]. Nowadays, TORS appears as a minimal invasive surgical approach, which ensures

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appropriate oncological and functional outcomes for oropharyngeal squamous cell carcinoma (OSCC) or selected supraglottic carcinoma [5–7]. Despite a growing literature describing the benefits of TORS, the *Da Vinci* and other robots remain less used in head and neck surgery compared to other specialties, such as urology or gynecology [8, 9]. The lack of awareness toward TORS is a potential explanation, but, to date, there is no international survey assessing the perception, awareness, and attitudes of otolaryngologist-head and neck surgeons (OTO-HNS) toward TORS.

The aim of the present brief report was to study the influence of the surgeon experience on perception, awareness, and adoption toward TORS. We expected that the young OTO-HNS, including residents and fellow-in-training, were more aware toward robotics than older ones.

Methods

Setting

An international survey was developed in iterative fashion by the Robotic Study Group of the Young Otolaryngologists of the International Federation of Oto-rhino-laryngological Societies (YO-IFOS). The group is composed of robotic experts from Europe, Asia, Oceania, and America. The survey was created with SurveyMonkey® (SurveyMonkey Inc., San Mateo, California, USA). Each participant could complete the survey only once. The questions were chosen to study otolaryngologist adoption, awareness, and perception toward TORS.

The survey included 18 questions dedicated to: demographic data; TORS experience (practice); training/access; perception; advantages; barriers; indications; and future considerations. Precisely, the participants were invited to determine the best indications of TORS with a 5-point Likert scale ranging from "No indication" (0) to "Perfect indication" (4) in a predefined list of benign and malignant conditions. Institutional Review Board (CHU Saint-Pierre, Brussels) was not required for the study (IRB-Brussels, 2022).

Data collection and statistical analysis

The survey was emailed on two occasions to a list of members of YO-IFOS/IFOS, which are the world ear, nose, and throat federations for young (age < 45 years) and all OTO-HNS, respectively. The email was received by 1,383 members. The responses were collected anonymously. Only complete responses were considered for the analysis.

Statistical analyses were performed with the Statistical Package for the Social Sciences for Windows (SPSS version 22.0; IBM Corp, Armonk, NY, USA). The responses were described considering three groups of participants: 1) residents and fellow-in-training who had 1 to 9 years of post-graduation practice; 2) practitioners with 10 to 19 years of post-graduation practice (young and middle-age board certified OTO-HNS); and 3) OTO-HNS with more than 20 years of practice (older practitioners). Moreover, additional statistics were performed in each group according to TORS access/practice. The statistical differences between groups were assessed through a Kruskal–Wallis test or $\chi 2$ test according to data type.

Results

Participants

From the 1383 OTO-HNS who received the email 359 completed the survey (26%). Two responses were incomplete and, consequently, were excluded from the analysis. There were 147 (41.2%), 105 (29.4%), and 105 (29.4%) participants in the groups 1 (residents and fellows), 2 (young and middle-aged OTO-HNS), and 3 (older OTO-HNS), respectively.

The features of participants are available in Table 1. Residents and fellows worked more frequently in academic center than other participants ($p = 0.001$). Despite the presence of residents and fellows in the group 1, the groups were comparable regarding the experience or access to robot

Table 1 Cohort features

Outcomes	Residents/fellows	Young and middle aged	Older	*P* value
Gender (F/M)	57/90	23/82	16/89	0.010
World regions				
Europe	60 (41)	39 (37)	21 (19)	NS
North America	18 (12)	8 (8)	9 (8)	
Asia	33 (22)	32 (30)	29 (27)	
South America	23 (16)	21 (20)	40 (37)	
Africa	10 (7)	3 (3)	3 (3)	
Oceania	3 (2)	2 (2)	3 (3)	
Places of practice				
Academic/university	95 (45)	65 (62)	47 (44)	0.001
Private	11 (7)	20 (19)	19 (18)	
Academic and private	41 (28)	20 (19)	39 (36)	
TORS practice				
No practice	110 (75)	67 (64)	65 (62)	NS
Practice	37 (25)	38 (36)	35 (38)	

The results are reported in number of responders (%)

F/M female/male, *NS* non-significant, *TORS* transoral robotic surgery

(Table 1). In other words, the proportions of OTO-HNS who commonly used robot were similar between groups.

Perception, benefits, and barriers

The data about TORS perception, barriers, and benefits are reported in Table 2. The main barriers to the use of TORS were the cost of the robot, the access to robot, the cost related to the robot disposable accessories, and the lack of training opportunity. The main benefits were the 3D view of the operative field; the better postoperative quality-of-life outcomes for patients (e.g., scar and shorter hospital stay); and the movements of robot arms in the operative field. Benefit and barrier responses reported some significant differences between groups (Table 2).

Overall, older OTO-HNS trust more likely in TORS benefits ($p=0.001$) and surgical field view advantages ($p=0.037$) compared to younger participants. Moreover, they believed more likely that TORS is important for the future of the minimal invasive surgery in otolaryngology-head and neck surgery compared to younger participants (Table 2). Residents and fellows reported that the lack of training opportunity is a key barrier in 52% of cases, while this statement was supported by 12% of older participants ($p=0.001$).

These results were confirmed when we analyzed the responses of participants who never performed TORS. Thus, 47 older OTO-HNS (72%) believed in TORS benefits compared to 51 (46%) residents and fellows and 28 (41.8%) young and middle-aged OTO-HNS, respectively ($p=0.001$). There were 33 (32%), 25 (37%), and 44 (68%) OTO-HNS who trust in TORS in residents and fellows, young and middle-aged OTO-HNS, and older participants, respectively ($p=0.001$). TORS was considered as the future of minimal invasive head and neck surgery by 42 (65%) older non-TORS OTO-HNS *versus* 53 (48%) non-TORS residents and fellows ($p=0.024$).

TORS surgical indications

Diseases thought to be highly indicated for TORS were cT1-T2 oropharyngeal squamous cell carcinoma (SCC), tongue base resection in sleep apnea syndrome or in unknown primary SCC, and cT1-T2 supraglottic SCC (Table 3). Older OTO-HNS advocated more frequently the following

Table 2 Perception, barriers, and benefits of TORS according to participants

Overall opinion	Residents/fellows	Young and middle aged	Older	P value
There are many surgical and hospital stay benefits	67 (46)	51 (49)	75 (71)	0.001
There are more disadvantages to TORS than advantages	10 (7)	6 (5)	6 (6)	NS
I trust in TORS for the future	47 (32)	42 (40)	64 (61)	0.001
I advocate TORS to my colleagues	16 (11)	10 (9)	38 (36)	0.001
I encourage colleagues to use TORS in the future	32 (22)	13 (12)	49 (47)	0.001
TORS is important for the future of the minimal invasive surgery	68 (46)	44 (42)	64 (61)	0.014
Main barriers of TORS				
Robot cost and availability	112 (76)	74 (71)	79 (75)	NS
Cost related to TORS in my healthcare system	104 (71)	75 (71)	67 (64)	NS
Time restraint	29 (20)	25 (24)	19 (18)	NS
Low volumes of procedures performed in my center	49 (33)	22 (21)	27 (26)	NS
Low theoretical volumes of procedures performed with TORS	31 (21)	31 (30)	34 (32)	NS
Lack of personal training possibilities	76 (52)	47 (45)	13 (12)	0.001
Lack of interest	8 (5)	12 (11)	2 (2)	0.015
Docking time (setting robot)	24 (16)	18 (17)	9 (9)	NS
Difficulty of exposure of the surgical field	23 (16)	19 (18)	24 (23)	NS
Main benefits				
1. Esthetic benefit (scar)	78 (53)	49 (47)	51 (49)	NS
2. Avoid of tracheotomy in some selected cases	74 (50)	55 (52)	58 (55)	NS
3. Shorter hospital stay time	79 (54)	56 (53)	64 (61)	NS
4. Better patient postoperative quality of life	102 (69)	55 (52)	68 (65)	0.020
5. Better view of the operative field	88 (60)	67 (64)	79 (75)	0.037
6. Better movements of robot arms in the operative field	73 (50)	64 (61)	60 (57)	NS

The results are reported in number of responders (%)

NS non-significant, *TORS* transoral robotic surgery

Table 3 Indications of TORS according to practitioners

Indications	Residents/fellows					Young and middle-aged					Older					*P* value
	0	1	2	3	4	0	1	2	3	4	0	1	2	3	4	
Oropharynx																
cT1-T2 oropharyngeal cancer	2	2	8	50	38	4	2	14	46	34	1	1	2	32	64	0.001
cT3 oropharyngeal cancer	6	22	29	32	11	11	20	31	31	7	1	20	39	32	8	NS
cT4a oropharyngeal cancer	28	40	19	8	4	33	33	18	13	3	42	40	8	7	3	NS
Base of tongue																
Sleep apnea syndrome	1	1	17	53	28	5	1	10	47	37	6	3	15	36	40	NS
Unknown primary cancer	2	5	22	50	21	4	2	17	45	32	5	6	14	36	38	0.040
Larynx																
cT1-T2 supraglottic cancer	1	3	15	51	30	5	2	16	53	24	2	4	7	39	48	0.012
cT3 supraglottic cancer	7	27	28	29	9	11	25	30	29	5	7	33	38	20	2	NS
cT4a supraglottic cancer	24	39	22	12	3	34	31	23	8	4	45	41	11	1	2	0.002
Total laryngectomy	32	21	22	12	3	31	31	23	13	2	30	29	29	10	2	NS
cT1-T2 vocal fold cancer	7	16	23	35	18	17	25	17	30	11	22	25	28	20	5	0.001
Hypopharynx																
cT1-T2 hypopharyngeal cancer	2	8	25	50	15	9	9	28	43	11	6	10	23	35	26	0.023
cT3 hypopharyngeal cancer	15	35	30	15	5	18	34	30	14	4	19	50	25	5	1	NS
cT4a hypopharyngeal cancer	33	33	26	5	3	36	30	26	4	4	57	34	8	0	1	0.001

The numbers in the table consist of the % of surgeons who rated the indication as perfect (4), good (3), 2 (neutral), 1 (not good), or 0 (contra-indication). *NS* non-significant, *TORS* transoral robotic surgery

indications than younger participants: cT1-T2 oropharyngeal SCC ($p=0.001$); tongue base resection for unknown primary SCC ($p=0.040$), cT1-T2 supraglottic SCC ($p=0.001$), and cT1-T2 hypopharyngeal SCC ($p=0.001$; Table 3). However, they did not support more likely the following indications than younger responders: cT4 supraglottic SCC ($p=0.002$), cT1-T2 vocal fold SCC ($p=0.001$), and cT4a hypopharyngeal SCC ($p=0.001$). At the exception of the findings of unknown primary SCC and cT4 supraglottic SCC, all of these differences were confirmed when statistical analyses were performed on participants without TORS experience/practice.

Improvements and perspectives

Participants were surveyed about their expectations for the future of TORS. The participant expectations included the development of more flexible instruments (16% *versus* 7% *versus* 65%; $p=0.001$), the incorporation of laser in the robot arms (10% *versus* 8% *versus* 64%; $p=0.001$), and the use of GPS tracking system based on preoperative imaging (9% *versus* 4% *versus* 43%; $p=0.001$; Appendix 1 and Fig. 1).

Residents and fellows expected better accesses to oropharynx (23%), supraglottic space (20%), and glottis with future generations of robot (18%; Appendix 1 and Fig. 1). Young and middle-aged OTO-HNS proposed preferably better accesses to hypopharynx (26%), glottis (23%), and oropharynx (20%). In the same vein, older OTO-HNS expected improvements for better accesses to hypopharynx (23%), glottis (21%), and oropharynx (20%). The differences between residents and fellows and the two other groups were significant ($p=0.001$). As for the perception findings, there were no significant differences when the analyses were carried out on non-TORS OTO-HNS groups.

Discussion

The number of head and neck robotic procedures has increased over the past 2 decades [10, 11]. As for other minimal invasive approaches, we should expect a growing use of robots in the field of otolaryngology for the next decades. The development of new technologies and surgical innovations requires the adoption of practitioners, which may take time regarding the dissemination of the new material, the get of first positive results, and modification of practice habits [14]. Young generations are often considered as more aware about new technologies than older ones [15]. To the best of our knowledge, this survey is the first international evaluation of the adoption and the perception of OTO-HNS toward TORS considering the years of practice.

The primary finding on the present study was the highlight of significant differences between residents and fellows and older OTO-HNS in the perception and the adoption toward TORS. Precisely, older OTO-HNS reported better outcomes

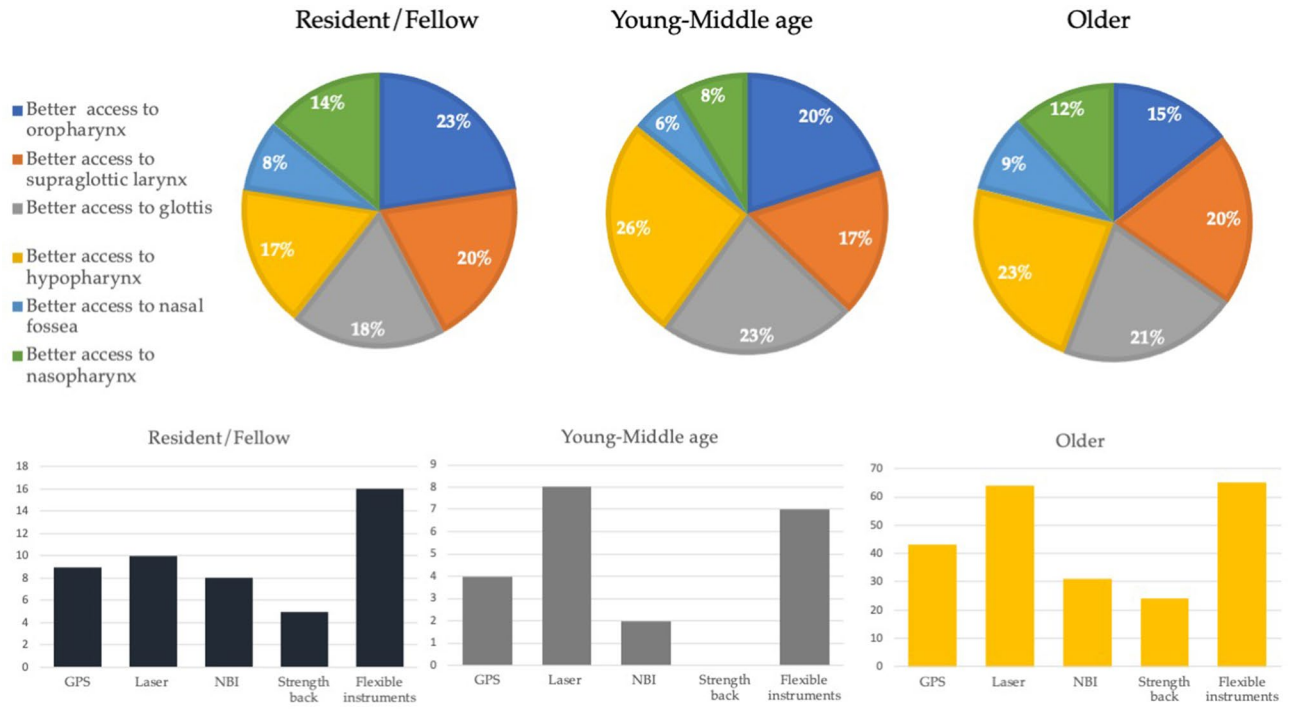

Fig. 1 Key points of indication and technology improvements according to surgeons. The desired improvement for the access of several otolaryngological regions varied between groups (top of the figure). For the lower part of the figure, the x-axis consists of percentage of TORS surgeons who reported that the proposition is a priority for the future. *MRI/CT* magnetic resonance imaging/computed tomodensitometry, *NBI* narrow banded imaging, *NS* non-significant, *TORS* transoral robotic surgery

in perception of TORS-related surgical and hospital benefits, trust, and importance of robotic surgery for the future compared to younger ones. This age-related difference of perception was confirmed by additional statistics considering participants without TORS practice. Many factors may influence the perception and the adoption of a paradigm shift in surgery. A better access to robotic programs is the first step to have an appropriate adoption by OTO-HNS [14, 15]. The several robotic programs are mainly proposed in academic hospitals and ensure the spread of knowledge about the indications, the benefits, and the disadvantages of TORS. In this study, residents and fellows reported the lack of personal training opportunity as the main barrier to TORS use, which was not similarly perceived by older participants. However, this perception needs to be confirmed in future cross-sectional studies. The lack of personal training opportunity may support the lower TORS trust adoption, personal interest, and knowledge of young OTO-HNS compared to older participants. Similar results were showed in the study of Mandapathil and Meyer [15], who reported that German OTO-HNS believed that the lack of cooperation opportunity with academic hospitals, and hospital support played a negative role in the acceptation of TORS. In the present study, the lack of knowledge and awareness of residents and fellows and young and middle-aged OTO-HNS was highlighted in their beliefs about the most validated indications of TORS. Indeed, as supported by older OTO-HNS, clinical studies suggested that TORS is associated with appropriate functional and oncological outcomes in cT1-T2 and some cT3 oropharyngeal or supraglottic SCC [5, 6, 16–18], obstructive sleep apnea syndrome [19, 20], or unknown primary SCC [21]. The improvement of robotic programs in academic hospitals is an important step to improve the perception, the awareness and the indication knowledge of residents, fellows, and middle-aged OTO-HNS. The importance of robotic programs was supported by Kim et al. who reported that non-fellowship-trained surgeons favored more likely radiotherapy for cT1-T2 oropharyngeal SCC compared to fellowship-trained and experienced TORS surgeons [22]. Chen et al. observed a 67% increase in the use of TORS for oropharyngeal SCC in American academic centers when there was an appropriate access to TORS programs. Interestingly, authors reported that TORS was associated with a lower rate of positive margins compared to non-robotic surgery [23], which corroborates the findings of a recent large-cohort study [24]. Papazian et al. compared the clinical and survival outcomes of TORS versus transoral laser microsurgery (TLM) in early stage laryngeal SCC. Authors showed in a cohort of 1,603 patients that the 5-year survival was higher following TORS compared to open surgery. Moreover, TORS patients had the lowest rates of adjuvant treatment (28.4% *versus* TLM: 45.0%,

open surgery: 38.5%), and lower positive margin rates than TLM (16.9 *versus* 30.5%) [24]. The potential advantage of TORS in margin and overall survival outcomes needs to be confirmed in future large-cohort studies.

The postoperative outcomes (e.g., overall survival, recurrence-free survival and swallowing function) were compared between TORS *versus* TLM cT1-2 oropharyngectomy [25]. Authors suggested similar survival outcomes but better postoperative swallowing function in TORS compared to TLM patients. However, knowledge about TORS benefits compared with TLM is still scarce. The various trends in the literature about clinical advantages of TORS *versus* TLM suggest the need to determine specific indications for TORS or TLM considering cost and clinical outcomes [16]. The superiority of TORS over TLM or open surgery for some indications should be a convincing economic argument in the spread of robots and the related development of training programs in head and neck surgery departments. Indeed, better resection and histopathological outcomes could be associated with deintensification of adjuvant therapy and sequelae [26]. Other important factors that need to be considered in the cost analysis of TORS versus TLM or open surgery is the potential shorter duration of hospital stay of TORS patients who have fewer complications than open surgery [27, 28].

The low number of participants is the primary limitation of the present survey. It is well known that voluntary survey is vulnerable to sampling error and respondent bias. Our federations (YO-IFOS and IFOS) include most national oto-rhino-laryngological–head and neck societies, but most of our active members come from Europe, Asia, and South America, which explains the large representation of these world regions. Because U.S. developed earlier robotic programs than the rest of the world, the observations in the present survey may not represent the beliefs of U.S. OTO-HNS. Because there is no similar survey in otolaryngology, the originality of the present study is its primary strength. To date, there are few surveys with low number of participants dedicated to the OTO-HNS perception and the awareness toward TORS [15, 29] and, to the best of our knowledge, no survey compared the perception of residents, fellows, and young OTO-HNS *versus* older practitioners. The results of this study are furthermore surprising, because we expected better perception, interest, and awareness outcomes toward TORS in younger generations compared to older ones.

Conclusion

More experienced OTO-HNS had better perception and trust adoption toward TORS than residents and fellows. Residents, fellows, and middle-aged participants identified the lack of training opportunity as the main barrier to use TORS. Robotic programs need to be improved in academic hospitals for residents, fellows, and middle-aged OTO-HNS. The use of TORS simulators during residency, fellowship, clinical rotations, or surgical courses are important approaches to gain experiences with robotic surgery early in the career of the OTO-HNS and, consequently, to improve perception and skill outcomes.

Appendix 1

Priorities for future

Propositions of improvement	Residents/fellows	Young and middle aged	Older	*P* value
Access outcomes				
Better access to oropharynx	24 (16)	7 (7)	37 (35)	0.001
Better access to supraglottic larynx	21 (14)	6 (6)	52 (49)	0.001
Better access to glottis	19 (13)	8 (8)	53 (51)	0.001
Better access to hypopharynx	18 (12)	9 (9)	59 (56)	0.001
Better access to nasal fossae	9 (6)	2 (2)	23 (22)	0.001
Better access to nasopharynx	15 (10)	3 (3)	30 (29)	0.001
Devices				
GPS tracking based on MRI/CT	13 (9)	4 (4)	45 (43)	0.001
Laser (i.e., CO2)	14 (10)	8 (8)	67 (64)	0.001
Integration of NBI system	11 (8)	2 (2)	33 (31)	0.001
Better strength back	8 (5)	0 (0)	25 (24)	0.001
Flexible instruments/smaller arms	23 (16)	7 (7)	68 (65)	0.001

MRI/CT magnetic resonance imaging/computed tomodensitometry, *NBI* narrow banded imaging

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Data Availability Data are available on request.

Declarations

Conflict of interest The authors have no conflicts of interest.

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