Implementation of Transoral Robotic in Head and Neck Surgery: A Systematic Review

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Abstract

The prevalence and incidence of Oropharyngeal Squamous Carcinoma (OPSCC), caused by Human Papilloma Virus, have been considerably increasing over the last few years. Currently, there are no other diagnostic methods suggested for cancers other than diagnostic imaging or endoscopy. These conditions give a clear view on how diagnostic and treatments for carcinomas are still a great challenge. Currently, Transoral Robotic Surgery (TORS) is widely discussed by surgeons as an alternative treatment for OPSCC. It has also been proven that it decreases morbidity and has an equal oncology result towards open surgery and primary radio chemotherapy. The goal of this study is to provide an overview of the implementation of TORS as an alternative idea for head and neck disease through its clinical outcome, postoperative procedures and clinical efficiency by conducting a systematic review of the literature. Data collection techniques were carried out in the PubMed database, ScienceDirect, and Wiley.

The keywords used are "transoral robotic surgery", "robotic surgery", and “head and neck surgery” and received nine main datas. Data analysis was carried using the NIH Study Quality Assessment Tool. TORS is a robotic surgery technology that has advantages in clinical efficiency in terms of lowering surgical morbidity, facilitating cancer diagnosis, shorter operating and recovery time. However, TORS has several complications such as intraoperative and postoperative bleeding, the risk of difficulty swallowing and respiratory disorders, although in some studies these complications remain relatively lower than conventional surgery. Therefore, the use of TORS needs to be further developed.

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Introduction

The prevalence and incidence OPSCC, caused by Human Papilloma Virus (HPV), have been investigated considerably increasing over the last few years. [1] The condition also caused another prevalence to spike up, namely Carcinoma of Unknown Primary (CUP) which affects the head and neck region with the prevalence of 22-91% globally.[2] Currently, there are no other diagnostic methods suggested for CUP other than diagnostic imaging (CT/PET/MR) or endoscopy. [3] These conditions give a clear view on how diagnostic and treatments for carcinomas are still a great challenge.

Oropharynx disease requires a significant detail in its treatments due to the anatomical complexity, hence difficulties in its procedures are often found. [4] Conventional treatment thus causes inaccessibility when transoral resection should be performed. [4] This makes open surgery a risky treatment for OPSCC in regard to its mobility and cosmetical aspects.[1] Nevertheless, it is still utilized in a large scale, as the procedure itself has been a gold standard treatment approach for several decades.[4]

Open surgery is known to result in low cure and high complication rates, as well as destructive effects towards Health-Related Quality of Life of patients (HRQOL). One of the most reliable conventional treatments, the Trans-mandibular approach has notably high morbidities and complication rates. Lymph Node surgery, added with Adjuvant Radiotherapy (RT)

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treatment, has been a choice for surgeons for over three decades, however it is 7]associated with patients' quality of life reduction.[1] OPSCC-Patients that struggle with alcohol and tobacco consumption, especially elderly patients with a long history of dependence typically are much more affected. With the conventional treatment of CRT they are prone to be exposed to complications such as xerostomia, mucositis, and fibrosis in stomatognathic muscles. [1]

Currently, TORS is widely discussed by surgeons as an alternative treatment for OPSCC.[1,5] It has also been proven that it decreases morbidity and has an equal oncology result towards open surgery and primary radio chemotherapy.[3] In terms of its technology , it is supported with an HD camera to guide surgeons's visualization, tremor filtration, high precision dissection and other features to reach narrow anatomical spaces.[6]

The present study aims to provide an overview of the implementation of TORS as an alternative idea for head and neck disease through its clinical outcome, postoperative procedures and clinical efficiency by conducting a systematic review of the literature. [7]

Materials and methods

Data collection techniques were carried out in the PubMed database, Science Direct, and Wiley. The last source search was conducted on Sunday, May 29, 2022. The keywords used are *"transoral robotic surgery*", "*robotic surgery*", and "*head and neck surgery*". The author uses the study design inclusion criteria clinical trials, systematic reviews, and meta-analyses that have interventions in the form of practical education using transoral robotic surgery, published in the last five (5) years. Meanwhile, the exclusion criteria were the unavailability of the full version, incomplete study results, clinical studies without a control group, and languages other than English. The next step is data processing using PRISMA Flow Diagrams and habit analysis using the NIH Study Tool (Figure 1, 2, 3, 4, 5).

Data Processing and Analysis

From the most recently accessed PubMed, ScienceDirect and Wiley databases, last on 30 May 2022. Sixty-eight (68) search results were filtered as sources with nine (9) main data in the form of three (3) clinical studies, four (4) systematic reviews, and two (2) meta-analyses (shown on Fig.1).

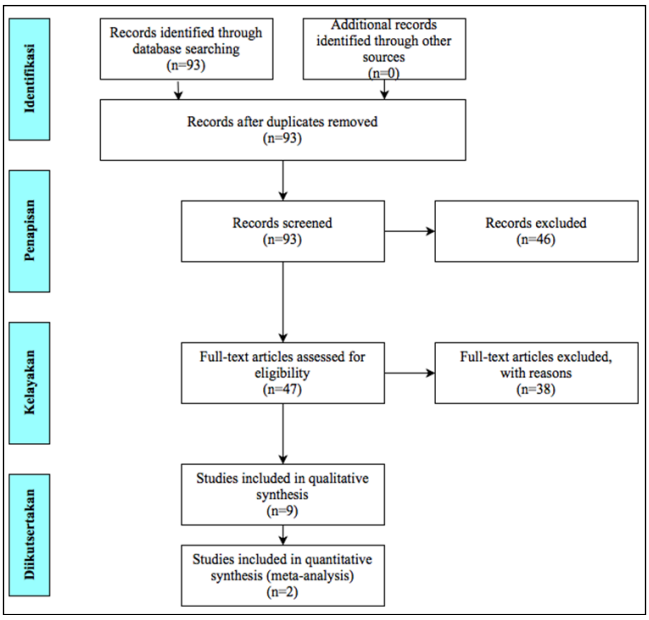

Figure 1. PRISMA Flow Diagrams.

Study / Criteria	Ionna *et al.*, 2020	Nguyen *et al.*, 2020	Ozer *et al.*, 2022
C1	Y	Y	Y
C2	Y	Y	Y
C3	Y	Y	Y
C4	Y	Y	Y
C5	Y	Y	N
C6	Y	Y	Y
C7	Y	Y	Y
C8	Y	Y	Y
C9	Y	Y	Y
C10	Y	Y	Y
C11	Y	Y	Y
C12	N	Y	N
C13	Y	Y	Y
C14	Y	Y	Y

Information :

Y = Yes
N = No
CD = *Cannot Determined*
NR = *Not Reported*

Adapted from :
https://www.nhlbi.nih.gov/health-topics/study-quality-assessment-tools

Figure 2. Risk of Bias Assessment for Clinical Studies.

Study / Criteria	Dobbs *et al.*,2017	Farooq *et al.*, 2019	Cammarotto *et al.*, 2020	Rosello *et al.*, 2020	Weert *et al.*, 2020	Lai *et al.*, 2021
C1	Y	Y	Y	Y	Y	Y
C2	Y	Y	Y	Y	Y	Y
C3	Y	Y	Y	Y	Y	Y
C4	Y	Y	Y	Y	Y	Y
C5	Y	Y	N	CD	Y	Y
C6	Y	Y	Y	Y	Y	Y
C7	Y	Y	Y	Y	Y	Y
C8	N	Y	Y	Y	Y	CD
C9	Y	Y	Y	Y	NR	Y

Figure 3. Risk of Bias Assessment for Systematic Reviews and Meta-Analyses.

Data analysis was carried out on seven study sources using the Study Quality Assessment Tool (National Heart Lung and Blood Institute, 2014), as seen on Fig.2.

In the study of this system, the authors use the PICO analysis as follows:
Problem (P) : head and neck disease
Intervention (I) :intervention using transoral robotic surgery (TORS)
Comparison (C) : study comparing TORS and conventional surgery
Outcome (O) : TORS excels in head and neck operations with high accuracy, time efficiency, and fewer postoperative complications.

Results

The results from the nine main sources used can be summarized as follows in table 1.

Discussion

According to Weert et al., (2020), the popularity of TORS as a surgical alternative to treat OPSCC and carcinoma of unknown primary (CUP) has been rising as surgeons have become much more accepting towards the alternative.[7] The procedures and results made by TORS are less invasive, as its technology and advancement provide better precision and visualization (Fig.4 and Fig.5). The statement is followed by the description of TORS that it is possible to reach the complex anatomical regions in head and neck, thus feasible to treat and diagnose multiple pathologies. Therefore, this paper aims to review TORS in the aspects of its clinical outcome, postoperative complications and clinical efficiency.[3]

In terms of the clinical outcome of TORS, it is shown that it has the same clinical outcome as conventional surgery.[1,2] This is also supported by the study of Ionna et al., (2020) which states that the results of treatment using TORS have the same oncological and functional results as conventional surgery. [4] However, TORS can be helpful in diagnosing cancers that cannot be identified by PET CT. [2] From this robotic technology, TORS has features that provide better visualization of the operating process, so that the results of this diagnosis and surgery are reported to be useful and accurate which is higher than conventional surgery.[3,7,5] TORS was also reported in meta-analysis that it had a high survival rate and a low recurrence rate.[6.8] The results of this robotic surgery have positive surgical margins, although these results differ from the clinical trial by Ozer et al., (2022) who found negative surgical margins in all patients.[6,9]

Regarding its postoperative complications, the most common case for TORS is postoperative bleeding, which consisted in 4.9% cases. [2] However in one study from Lai et al., (2021), it is reported that the complications didn't result in a severe blood loss which is reported to be 55 ml or any requirement for transfusion. [8] Another data shows where 1 patient underwent a post-operative bleeding of 15.4 ml for 25.3 minutes and other study reported 1 respiratory failure, 1 massive 20 days post-surgery bleeding, swallowing difficulties, and a following aspiration.[8,9] Yet, it has less complications relative to traditional surgery by the research. [4] The explanation follows other benefits which are accessibility in intraoperative bleeding control and sophisticating swallowing functions in comparison to other surgical techniques and primary chemotherapy. In regards to the patient's healing, it results in a brief hospital stay and recovery.[6]

Through the reports of its clinical efficiency, a comparison between TORS and radiotherapy shows that TORS is more expensive which will impact the availability of the clinical procedure towards patients. However, the research shows through massive use of TORS, the cost is expected to be reduced. It also presents data that TORS surgical morbidity is evidently lower.[1] According to Farooq et al., (2019), through cases of negative investigations, ⅔ of the cases were identified with the unknown primary tumor in the head and neck by the use of TORS, which makes TORS a useful tool for tumor diagnosis in the region. [2] There is also less necessity to involve adjuvant chemoradiotherapy, a greater long-term survival rate and around 25% decrease of mortality rate decrease compared with other treatments.[5] Subsequent to the approval of TORS by the US Food and Drug Administration in 2009, various research have reported that TORS is characterized with less operative duration, shorter hospitalizations and a greater score for postsurgical quality of life.

TORS technology can be seen in Indonesia as a visualization to achieve national and regional indicators for the attempt to achieve SDG Goal 3, which aims to achieve healthy lives and well-being of the nation, as well as Goal 9, which promotes to build durable infrastructure, support inclusive and sustainable industrialization and foster innovation. The application of Robotic

Surgery in Indonesia was pioneered by Bunda Hospital Jakarta, which was used for the first time in 2012, including the application of TORS until nowadays. Seeing this technological progress from the patient's perspective to gain an efficient clinical procedure and outcome, there seems to be a high level of interest and demand. Additionally, the progress of robotic surgery in Indonesia is also in line with efforts to reduce the high number of Indonesian people seeking treatment abroad, which puts patients in high risk of medical complications if those treatments are not possible to be reached .[11]

TORS is a robotic surgery technology that has advantages in clinical efficiency in terms of lowering surgical morbidity, facilitating cancer diagnosis, shorter operating and recovery time. However, TORS has several complications that need to be considered such as intraoperative and postoperative bleeding, the risk of difficulty swallowing and respiratory disorders, although in some studies these complications remain relatively lower than conventional surgery.[12] Therefore, the use of TORS needs to be further developed to minimize complications and risks of robotic surgery, so as to maximize the goals of TORS. In addition, the use of TORS in Indonesia can be reintroduced to the community in the means to inform them regarding the advances of this technology with robotic surgery and the possibility of the procedure to be an option. Although the procedures by TORS tend to be expensive, if the use of TORS is widely applied in Indonesia[13,14], there would be a possibility that the cost of this robotic surgery treatment will be decreased.

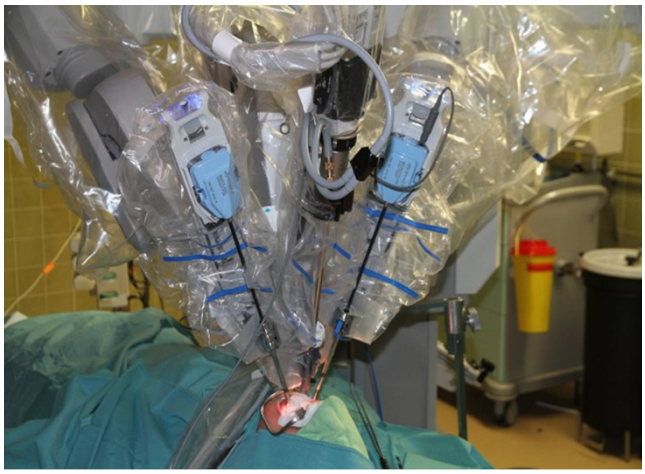

Figure 4. Head and Neck surgery with Trans Oral Robotic Surgery. [10]

Conclusions

TORS was created with technological advances in this field to achieve several benefits in order to reduce the disease and surgical complications. The features are advanced, compared to conventional surgery such as minimally invasive procedures and clear visualizations which helps the operative and patient's healing process. However, the surgical outcome of TORS still results in complications such as post-operative bleeding, impaired swallowing and breathing. In addition, there are result differences in the advantages and disadvantages of TORS by distinct studies. This shows that although TORS might be a beneficial tool for surgical procedure, extensive research and study are still needed to be conducted to enhance the application. Regardless, the expansion of application and research regarding TORS will be helpful in Indonesia, as the SDG Goal 3 and 9 can be actualized to foster health and innovations in the nation.

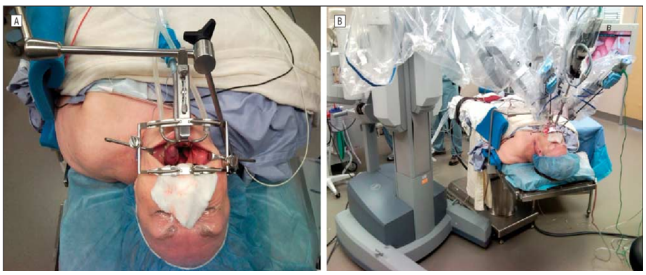

Figure 5. Transoral robotic-assisted surgery set-up. A, Patient is supine; exposure obtained via Feyh-Kastenbauer retractor; B. positioning of robotic arms.[12]

Declaration of Interest

The authors have no conflict of interest regarding the design and result presented in the manuscript.

No	Author, (year)	Study Design	Subject	Intervention	Outcome
1	Dobbs *et al.,* 2017.[1]	systematic review	68 from 7,904 studies		Clinical Outcome It has the same result as conventional surgery. Post-Operative Complications not reported. Clinical Efficiency high cost of purchasing and maintaining
2	Farooq *et al.,* 2019.[3]	meta-analysis	556 patients from 21 studies	TORS for mucosectomy and diagnosing cancer in the head and neck region.	Clinical Outcome helped to diagnose cancer that was not identified by PET CT, also had the same result as conventional surgery. Post-Operative Complications 5% of the patients went through haemorrhage. Clinical Efficiency helped to diagnose cancer which was time efficient.
3	Cammarotto *et al.*, 2020.[4]	systematic review	103 studies		Clinical Outcome has high-definition camera, 3D imaging, and motion tremor filtration technology, which allows better visualization of the surgery field Post-Operative Complications not reported. Clinical Efficiency time efficient rather than conventional surgery. but high cost.

4	Ionna *et al.*, 2020. [8]	controlled clinical trial	67 patients, divided into TORS and controlled groups equally	including lymphomas, squamous cell carcinomas, benign salivary glands tumors, and miscellaneous cases.	Clinical Outcome same oncological and functional results Post-Operative Complications fewer results than the controlled group. bleeding in 3 patients, 1 respiratory failure, 1 massive bleeding for 20 hours post surgery. Clinical Efficiency not reported.
5	Nguyen *et al.*, 2020.[2]	controlled clinical trial	7051 patients divided into two groups	TORS for oropharyngeal SCC surgery.	Clinical Outcome longer survival and higher accuracy rather than conventional surgery. Post-Operative Complications not reported. Clinical Efficiency less use of adjuvant chemoradiotherapy which was time and money efficient.
6	Rosello *et al.*, 2020.[9]	meta-analysis	4 clinical studies that included 371 patients	the usage of TORS for 186 patients that went to OPSCC surgery	Clinical Outcome high survival rate, positive margin Post-Operative Complications fewer complications such as bleeding and swallowing difficulties. Clinical Efficiency time efficient in hospitalized duration and decannulation
7	Weert *et al.*, 2020.[7]	systematic review	274 cases with TORS	TORS for diagnostic and surgery of patients with HPV-positive OPSCC	Clinical Outcome useful and accurate in diagnosis and surgery. Post-Operative Complications not reported. Clinical Efficiency not reported.

8	Lai *et al.*, 2021.[6]	systematic review	11 studies including 137 patients with head and neck tumors.	TORS	Clinical Outcome successful and low recurrence rate. Post-Operative Complications 55 ml of blood loss in a study, swallowing difficulties, aspiration.
9	Ozer *et al.*, 2022.[5]	controlled clinical trial	126 patients that were divided into two groups (TORS and controlled) equally	TORS procedure for supraglotic laryngectomy	Clinical Outcome negative surgical margins were achieved in all patients. Post-Operative Complications a patient went through blood loss for 25.3 minutes and 15.4 mL. Clinical Efficiency time efficient but 2 patients needed radiation therapy to make sure no recurrence.

Table 1. The results from the nine main sources summary.

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