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# Single-port transoral robotic surgery hypopharyngectomy

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**Abstract**

Transoral robotic surgery (TORS) is an established treatment for many subsites of Head and Neck cancer. With the improved flexibility and access of the single-port (SP) robotic system, tumors within the distal upper aerodigestive tract can now be reached and successfully treated with all the published advantages of transoral endoscopic surgery. Here in we offer the first published surgical technique for SP TORS for resectable hypopharyngeal carcinoma. The video presented demonstrates many important aspects utilizing the enhanced robotic system, including adjustments of the semi-flexible endoscope and use of the third transoral surgical instrumentation. As previously reported, TORS hypopharyngectomy should be considered for resectable tumors to improve upon the deleterious effects of open surgical resection or chemoradiation therapy.

**KEYWORDS**

HPV, robotic surgery, single port, throat cancer, TORS

## 1 | INTRODUCTION

Over the past decade, rapid advances in minimally invasive surgery have resulted in decreased recovery times and improved patient outcomes. One of the most significant developments during this time has been the adoption of surgical robotic systems transorally providing advanced visualization and dexterity, termed transoral robotic surgery or TORS. While this minimally invasive approach had been popularized specifically for oropharyngeal cancers, with increased flexibility and access afforded with newer technologies, distal portions of the upper aerodigestive can now be readily accessed.

Recently, we have published[1] on a growing experience regarding hypopharyngeal cancer resections via TORS with encouraging outcomes. The adaptation of TORS for hypopharyngeal cancers is of particular importance given the poor functional outcomes of non-surgical (i.e., radiation with or without chemotherapy).[2,3] In comparison, the endoscopic resection literature, commonly reported utilizing transoral laser microsurgery (TLM) approach, has shown excellent cancer cure rates with improved functional outcomes.[4,5]

Overall, patient selection for TORS hypopharyngectomy should follow well-established practice patterns concentrating on optimal transoral exposure, with clinical factors that commonly limiting access including trismus, tori mandibularis, and severely acute angle of the mandibular parasymphysis. In previous experience with the multiport robotic systems,[1] it would be advisable to assess the transoral exposure under general anesthesia prior to scheduling robotic surgery; however, with the dramatic improvements in reach and flexibility inherent to the SP system such staging endoscopies are not universally necessary. Patients considered for this procedure must be good candidates for endoscopic laryngeal conservation surgical options,[4,5] with clinical factors considered either relative or strict contraindications including invasion of the pyriform sinus apex, vocal fold fixation, and invasion of the inner perichondrium thyroid cartilage. Lastly, patients who should be considered for TORS

  

hypopharyngectomy should be able to tolerate not only the extended general anesthesia but the acute postoperative sequelae impacting swallowing and pulmonary function.

To date, no clinical report has been shared regarding the technique of transoral hypopharyngectomy specifically utilizing the newest robotic surgical system, da Vinci SP (Intuitive Surgical Inc, Sunnyvale, California), for transoral hypopharyngectomy. As the availability of this technology continues to be more available, the authors sought to share the surgical technique of TORS hypopharyngectomy utilizing the SP robotic system.

## 2 | VIDEO DESCRIPTION

The case presented in our video is of an 82-year-old gentleman with past smoking history (30 pack year history) who presented with persistent throat discomfort and globus sensation. Following clinical and radiographic evaluation, the patient was identified to have a $T_1N_0M_0$ lesion arising from the medial wall of the right pyriform sinus. Following biopsy confirmation of the diagnosis of squamous cell carcinoma, the patient was counseled regarding his curative treatment options, namely radiation therapy (with or without chemotherapy) or primary endoscopic resection followed by adjuvant therapy as indicated by pathologic analysis of the primary site and regional lymphatic burden. Following the consultations, the patient decided to proceed with upfront surgical resection.

The da Vinci SP surgical system (Intuitive Surgical Inc, Sunnyvale, California) was utilized in this video. The SP system, as previously described in detail,[6] offers one semiflexible endoscope along with three semiflexible surgical instruments through a single 2.5 cm cannula. As such, the third instrument, which is not in active use, can be readily utilized for distal retraction. Therefore, a major shift from the multiport robotic systems is that previously retraction was required to concentrate on achieving anterior tension on the larynx to provide adequate working space. However, with the SP system oral retraction is concentrated on achieving the necessary interincisal space to allow access for the single wide cannula while the extra robotic surgical instrument can function as critical distal point of retraction.

The resection begins with the camera in the "down" position as is standard with anteriorly facing operative fields such as the base of tongue. The down position provides the opportunity to flex the endoscope "up" to the maximal 28° of angulation, which is just shy of the 30° maximal angulation of the multiport systems. The flexible endoscope is then used to carefully inspect the boundaries of the tumor ensuring resectability, specifically ensuring that the apex of the hypopharynx is free of involvement (Figure 1).

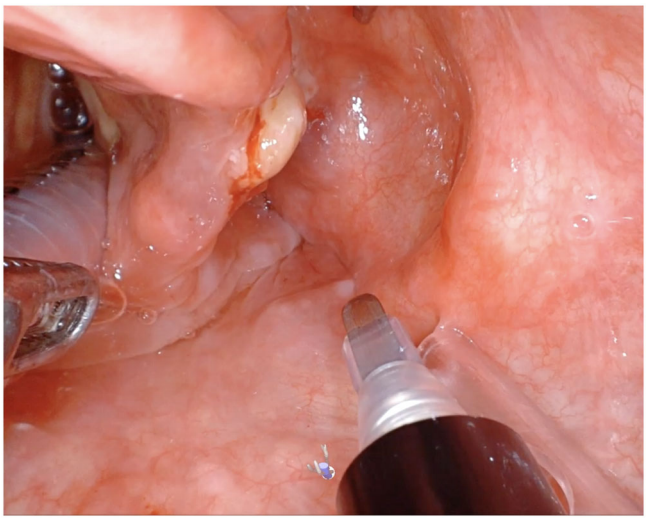

**FIGURE 1** Preoperative endoscopic view of hypopharyngeal tumor. Seen is the larynx to the left of the screen. The pyriform sinus apex is seen below (inferior to) the exophytic tumor arising from the medial wall of the hypopharynx. At the very top of the image, the third instrument can be seen briefly providing anterior retraction on larynx providing an excellent working space. At the bottom of the image, the real-time tele-illustration of the position and angulation of the instruments and camera is an important feature of the SP system [Color figure can be viewed at wileyonlinelibrary.com]

With the robotic-assisted diagnostic endoscopy complete, the resection began with the posterior mucosal incisions. The posterior incisions should be performed first whenever possible as this will provide optimal visualization of mucosal margins, which may be obscured later on in the surgery at this gravity most-dependent portion of the laryngopharynx. The mucosal incision was carried medially into the supraglottis and laterally along the lateral wall of the pyriform sinus all the while achieving visually clear mucosal margins of approximately 5–10 mm. As expected, given the excellent vocal fold motion preoperatively, the tumor did not have a significantly invasive component and therefore the resection did not require manipulation of the neurovascular bundle or of the laryngeal intrinsic musculature.

Continuing anteriorly, there was difficulty in visualizing the anterior-most aspect of the intended resection area. Therefore returning to the bedside, the cautery wires were disconnected momentarily, and the robotic head was rotated 180° to allow the camera to be in the "up" position. With the head now flipped, the spatula cautery instrument that is preferably in the surgeon's dominant hand (in this case right-handed) had to be changed positions as well. This adjustment in camera

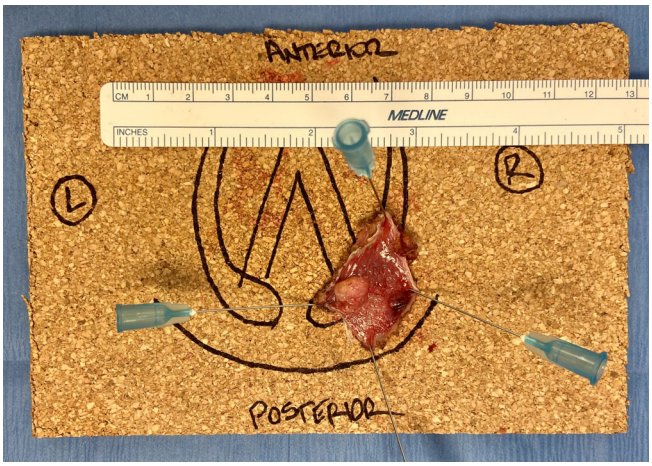


**FIGURE 2** Anatomic orientation of hypopharyngectomy specimen. Seen is a pathology corkboard that has been marked by the surgeon, which allows for understanding of the complex three-dimensional anatomy. The specimen is fixed using standard 25-gauge needles [Color figure can be viewed at wileyonlinelibrary.com]

position and instrument exchange is seen in the unedited surgical video.

The visualization of the aryepiglottic fold as well as the lateral pharyngoepiglottic fold were thereby enhanced. With this, the remainder of the tumor was resected *en bloc* according to standard TORS and TLM technique. Importantly, just prior to the final fascial separation, the surgeon ensures accurate anatomic orientation for transoral delivery and fixation to a previously marked pathologic corkboard (Figure 2). Margins were assessed from the specimen side, confirmed both intraoperatively and on formal pathologic analysis as negative for carcinoma or dysplasia.

Returning to the robotic console, the video continues with transoral dissection of the superior laryngeal artery, which arises reliably from the posterior aspect of the origin of the pharyngoepiglottic fold. Blunt dissection revealed a pulsatile vascular structure, which was ligated with 5-mm titanium surgical clips. Following which, the defect was irrigated with sterile saline solution. Robotic-assisted endoscopy of the surgical cavity demonstrated excellent hemostasis (Figure 3).

Following the completion of the video, the case proceeded with an uncomplicated sentinel lymph node dissection (radiolabeled technetium was injected prior to resection). 10F nasogastric feeding tube was inserted at the conclusion of the case. The patient was extubated in the operating room. The patient demonstrated excellent voice and airway throughout his postoperative course. Oral feeds were initiated on postoperative Day 3 following inpatient swallow evaluation. The patient was discharged home in stable condition on postoperative Day 4.

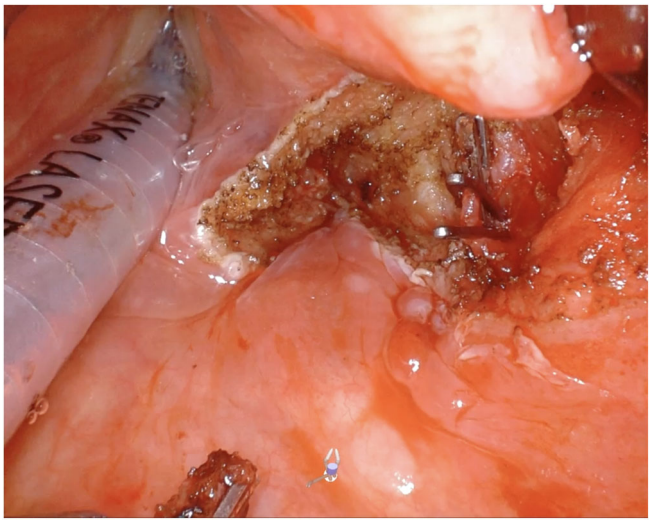

**FIGURE 3** Post-resection view of the hypopharyngectomy defect. Seen are the titanium clips providing surgical control of the superior laryngeal artery, which was dissected during the provided surgical video. Despite some limited edema along the right arytenoid mucosa, the glottis remains patent and provided a safe airway for immediate extubation following the surgery. At the bottom of the image, the tele-illustration now shows the endoscope now in the "up" position, which was a necessary adjustment performed midway through the resection video [Color figure can be viewed at wileyonlinelibrary.com]

The patient's pathology confirmed the clinical staging of $T_1N_0M_0$ without adverse histopathologic features and therefore adjuvant therapy was not indicated. The patient's postoperative laryngoscopy confirmed full and symmetric vocal fold mobility and motion. Several months following the operating, the patient continues to do well from both a functional and oncologic standpoint.

## 3 | CONCLUSIONS

Applications for TORS continue to advance due to improved flexibility and dexterity of the surgical systems. With the availability of the SP system, primary cancer sites previously thought to be unreliably accessible, such as the hypopharynx, will likely be amenable to primary surgical resection. This surgical technique video demonstrates some of the important aspects of the newer system, particularly regarding camera placement and distal retraction. With the continued published experience demonstrating the safety and efficacy of primary endoscopic resection of hypopharyngeal cancers, SP TORS is expected to provide an excellent option for our patients.

## CONFLICT OF INTEREST

Dr. Mendelsohn serves a surgical proctor with reimbursements by *Intuitive Surgical*.

## DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

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## SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.

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