Transoral Robotic Surgery (TORS): The Natural Evolution of Endoscopic Head and Neck Surgery

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The article presented by Bhayani, Holsinger, and Lai thoroughly evaluates the emergence of transoral robotic surgery (TORS) as a technique in the field of otolaryngology. Transoral approaches to the upper aerodigestive tract, whether for diagnostic or therapeutic purposes, represent core tenets of the discipline and formed one of the bases for the inception of the specialty. Innovations and refinements in optics and materials have steadily increased the view, reach, and, consequently the effectiveness of the endoscopic surgeon with each passing decade. In the past thirty years, the introduction of the laser has further enhanced the capabilities of the surgeon, augmenting treatment options beyond open tumor resection and chemoradiation. The introduction of the daVinci robot is an incremental step in the development of techniques that have been evolving over the past one hundred and twenty years.

Transoral resection for malignancy of the oral cavity, oropharynx, hypopharynx, and larynx is well established.[1-6] Traditionally, transoral endoscopic surgery uses a rigid endoscope secured via a suspension apparatus to facilitate exposure of the tumor. A microscope, often coupled to a camera, enhances the view. A laser directed via a micromanipulator (or endoscopic instruments such as graspers and electrocautery), are used for resection and hemostasis. There are limitations with the technique, however—for one, the endoscope constrains the operative field to that which is viewable at the moment. Instruments introduced through the endoscope are similarly constrained. As only the surgeon can operate at any time, one is limited to two instruments; and teaching can be inhibited by restricting the observer’s view and limiting the observer’s active participation. Periodic repositioning of the endoscope is necessary for larger tumors, which also increases operative time.

As the authors and others have noted, transoral endoscopic surgery affords several potential advantages over traditional treatment options: avoidance of incisions, maximal preservation of normal tissues, and shorter hospitalizations associated with lower financial costs. This is associated with improved postoperative function and reduction in the need for supportive measures such as tracheostomy and gastrostomy. Endoscopic resection may preserve better salvage options should this intervention fail.

TORS offers several key incremental advantages over conventional transoral surgery: elimination of the restrictions associated with the endoscope; optical innovations providing a three-dimensional, nearly panoramic view of the operative landscape; and haptic instrumentation capable of six degrees of freedom. Experience with robotics in other otolaryngological procedures has demonstrated further potential advantages: enhanced precision and accuracy of movement;[7, 8] minimization of tremor; rapid return to predesignated spatial coordinates in certain stereotyped maneuvers; and decreased need for human assistance.[9,10]

The scientific literature on TORS is in an early stage: most studies describe feasibility, applications, and complications. Oncological assessment has been limited to margin status, functional outcomes, and short-term local control. Nevertheless, these data are highly encouraging. Compared to traditional transoral surgery, the learning curve for TORS has demonstrated similar complications.
rates, functional outcomes, and local control rates, while improving exposure and shortening operative time.[11-15] Free flap reconstruction for extensive oropharyngeal defects is possible using TORS,[16-17] and TORS has been reported to be useful in treating sleep apnea.[18] Cadaveric modeling has shown promise in facilitating access to more remote head and neck regions such as the craniocervical junction,[19] infratemporal fossa,[20] clivus,[21] nasopharynx,[22] and thyroid.[23]

As TORS develops, instrumentation will likely continue to evolve. Currently the large diameter (5-8mm) of endoscopic instruments can be a limiting factor in achieving access to the larynx and hypopharynx, especially in children, and even with spontaneous ventilation without an endotracheal intubation.[24] Refinement in instrument design may lead to grasping forceps capable of handling bulky tissue (such as at the tongue base), and dexterous enough to manipulate a CO2 laser fiber. As the review states, cost remains an impediment to the establishment of TORS programs. These costs include purchase (~$1.5 million), annual maintenance (~ $100,000), and a cost per case (~$200).[25] Weinstein and O'Malley note that centers already possessing robots for high-volume endoscopic procedures at other anatomic locations (such as prostatectomy) are more likely to expand into otolaryngology. By expanding patient access to minimally invasive techniques, increasing surgical case load, and increasing revenue stream, all parties—patient, hospital, and surgeon—benefit from the establishment of a TORS program.

Inherent in the discussion of TORS is the tacit assumption, which some feel requires further validation, that refinements in technique and surgeon experience will translate into improved long-term patient outcomes and associated overall long-term reduction in societal (and insurance) costs. If this is true, then the significant initial cost in this incremental developmental stage will have been justified. In addition, as with other computer-based technologies, it would not be at all surprising if, over time, capabilities increase even as purchase and maintenance direct costs come down.

Finally, as with any new technologically intensive surgical procedure, provision must be made for training and credentialing not only the initial core group of surgeons who will pioneer the techniques, but also the residents in training who will incorporate these skills into future practice. Some institutions, such as the University of Pennsylvania, have already incorporated TORS into basic resident surgical training,[25] while other programs have established educational programs to teach basic robotic skills.[26,27] Given that the first TORS procedure was performed only five years ago,[28] it is impressive to see how enthusiastically otolaryngologists have embraced this technology and begun laying an infrastructure for its incorporation into routine practice. Clearly, as Bhayani, Holsinger, and Lai have described, transoral robotic surgery has a chance to play an important role in the future management of selected head and neck cancer patients, with a reasonable likelihood of both improving outcomes and reducing overall costs.

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