Improved Glottic Exposure for Robotic Microlaryngeal Surgery: A Case Series

***Dehra A. McGuire, †Jennifer P. Rodney, and †Nilesh R. Vasan,** **†Oklahoma City, Oklahoma*

Summary: Robotic surgery has become the standard of care for many procedures outside of otolaryngology and now is gaining momentum within our specialty. The da Vinci (Intuitive Surgical, Sunnyvale, CA) robot has several advantages to human hands, including removal of tremor and better access to lesions because of increased degree of movement of the articulated instruments. The glottis has rarely been addressed using robotic surgery because access was previously thought to be difficult because of the limitations of currently used retractors, which include poor base of tongue and oral commissure retraction resulting in lack of exposure of the glottis in many patients and lack of space for the robotic instruments to occupy. We present a case series using the Modular Oral Retractor (MOR) system to show that the glottic larynx can be accessed by the da Vinci instrumentation. The MOR system provides better exposure of the anterior commissure and by using oral commissure retraction provides excellent space for the robotic arms to work. The MOR system potentially makes robotic microlaryngeal surgery more feasible for the otolaryngology-head and neck surgeon.

Key Words: Modular oral retractor–Transoral robotic surgery–Robotic microlaryngeal surgery–Supraglottic surgery–Laryngeal surgery.

INTRODUCTION

Robotic surgery is quickly gaining traction in many areas of surgery because of the many benefits it provides over traditional methods. It eliminates human tremor and can be less invasive than open procedures, often resulting in decreased hospital stay and faster recovery.[1,2] The larynx has remained a difficult anatomical area to address with robotic surgery. Transoral robotic surgery has steadily been gaining ground in otolaryngology, specifically for oropharyngeal and supraglottic resections for both benign and malignant neoplasms as well as sleep-disordered breathing. However, the larynx has remained a difficult area to address via robotic surgery, being limited by poor visualization of the larynx as well as the size and space requirements of the robotic arms. A small number of studies have assessed the potential of robotic microlaryngeal surgery (RMLS), all using different methods of exposure. A recurring theme during these investigations is that multiple instruments have to be used to obtain access to the glottis, and space for the robotic instruments is limited.[3–5] Traditional microlaryngeal surgery is limited to direct laryngoscopes, which do not allow 360° access to glottic lesions. Twenty-five-centimeter-long instruments are introduced through the laryngoscope to reach the vocal folds, magnifying the surgeon's tremor. The procedure is analogous to an attempt to write fine cursive by holding on to the distal end of a 25-cm-long pen. Visualization is limited to the small view provided through the laryngoscope using a microscope.

Several retractors have been used in RMLS including the Feyh-Kastenbauer, Laryngeal Advanced Retractor System, and Dingman retractors. A common theme in the literature is the armamentarium of robotic retractors often provides inadequate access to the glottis, especially in the area of the anterior commissure because of poor tongue retraction. Oral commissure retraction has also been reported to be insufficient.[3–10]

We had previously proposed a device called the Modular Oral Retractor (MOR) system that is able to easily obtain a view of the glottis with the robot and maximize space in the glottic region to allow the robotic arms to function (see Figure 1). The device potentially enables RMLS to be performed. It provides improved oral commissure and tongue base retraction, allowing room for the robotic arms to work and excellent anterior commissure exposure. The face frame is open to allow more space for the robotic arms to move during a procedure. The MOR system eliminates the need for a rigid laryngoscope, which narrows the visual field, increases the distance of the working view to the surgical site, and serves as an obstacle around which robotic arms have to work. The 360° axis of rotation at the juncture of the base of the blade and the inferior portion of the mouth retractor allows superb exposure of the entire glottis, which may eliminate the need for a tongue suture, potentially decreasing incidence of tongue edema, airway complications, and postoperative patient discomfort. The axis of rotation at the base of the blade optimizes elevation of the tongue and allows for retraction of the tongue down to the vallecula, an option not available

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Conflict of interests: Nilesh Vasan is the inventor of the retractor described in this case report, with an International Patent application for the device filed in 2013 through the University of Oklahoma. Jennifer Rodney and Dehra McGuire do not have any conflicts of interest to disclose.

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Informed consent was obtained from the participants included in the study. Additional informed consent was obtained from the participant for whom identifying information is included in this article.

Consent to publish: Written consent to publish has been obtained from the participant to report individual patient data. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

Ethical approval: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. This article does not contain any studies with animals performed by any of the authors.

From the *University of Oklahoma College of Medicine, Oklahoma City, Oklahoma; and the †Department of Otorhinolaryngology, University of Oklahoma, Oklahoma City, Oklahoma.

Address correspondence and reprint requests to Dehra McGuire, The University of Oklahoma, College of Medicine, Health Sciences Center, 800 Stanton L. Young Blvd, suite 1400, Oklahoma City, OK 73104. E-mail: Dehra-McGuire@ouhsc.edu

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FIGURE 1. The Modular Oral Retractor (MOR) system with a removable tongue blade that allows for anterior and posterior advancement.

with other retractors. The maxillary brace also has a 360° axis of rotation that further augments the ability of the retractor to push the tongue and the epiglottis forward, allowing visualization of the glottis. The MOR system includes 15 different blades that are interchangeable based on each patient's unique anatomy to provide an optimal view of the glottis (Figure 2).

We present a case series of three patients, which further demonstrates the ease with which the MOR retractor can facilitate visualization and access to the glottic area.

FIGURE 2. The different blades available to use with the MOR system.

Case #1

A 56-year-old man with a long history of smoking initially presented with progressive hoarseness and dysphagia for 8 months and underwent direct laryngoscopy and biopsy at an outside facility, which showed squamous hyperplasia of the bilateral true vocal folds and diffuse, severe supraglottic hypertrophy. Nasopharyngoscopy performed in our clinic revealed redundant supraglottic mucosa that prolapsed into the glottic airway with associated plicae ventricularis, retroflexed epiglottis, and prolapsed aryepiglottic folds. It was not possible to view the glottis because of the redundant mucosa. The remainder of the head and neck examination was unremarkable. The patient was deemed a good candidate for robotic-assisted surgery using the MOR system. Informed consent was obtained for examination of the larynx and removal of the obstructing mucosa with a CO2 laser. He consented for use of the MOR system under an institutional review board (IRB)-approved protocol.

Procedure

After general anesthesia was induced and a shoulder roll was inserted, the MOR was inserted into the oral cavity using an appropriate curved blade and was suspended using the MOR suspension block. The retractor gave excellent access to the larynx (see Figure 3). The tongue blade used was a curved type that was inserted into the vallecular space. There are multiple blade types available with the MOR system that takes into account the differences in anatomy between patients. When initially inserting the retractor using a headlight, the curve of the tongue blade provided elevation of the epiglottis, which exposed the arytenoid mucosa. In some patients, more of the glottic larynx may be seen and these patients are easier candidates for robotic surgery. Following docking of the robot, the entire glottis including the anterior vocal folds could be visualized with the 30° upward directed scope, but more importantly, accessed by the robotic arms (see Figure 4). Ultrafine microlaryngeal procedures cannot be

FIGURE 3. The MOR system in place demonstrating the access available to the supraglottic and glottic regions of the throat for surgery.