**ABSTRACT**

**Objectives:** To discuss feasible approaches using transoral robotic surgery (TORS) to access the skull base and describe a novel approach for nodal dissection in the retropharyngeal space.

**Study Design:** A case series at a tertiary academic center.

**Methods:** The da Vinci Robotic Surgical System (Si) was used for complete resection of four skull base tumors. Two pleomorphic adenomas in the parapharyngeal space, one pleomorphic adenoma in the infratemporal fossa and one metastatic papillary thyroid cancer node in the high retropharyngeal nodal basin were resected. A transpalatal approach was used to access the infratemporal fossa (n=1) and retropharynx (n=1). Lateral pharyngotomies were performed to access parapharyngeal spaces (n=2). All mucosal incisions were closed primarily.

**Results:** TORS allowed for visualization of the internal carotid arteries and cranial nerves and adequate exposure for complete resection in all patients. There were no intraoperative arterial injuries or other complications. Postoperatively, one patient experienced an episode of transient 1mm ptosis which resolved spontaneously. There were no cranial neuropathies and no cases with velopharyngeal insufficiency. All patients regained normal swallowing function within 5 days of surgery. Postoperative imaging (MRI in 1 patient, CT scan in 1 patient, and I-123 in 1 patient) confirmed complete resection. No cases of recurrence were found within short follow-up (8-14 months). Advantages, limitations and specific surgical pearls from this series will be discussed.

**Conclusions:** Novel approaches using TORS offers potential for safe and successful resection of skull base tumors. Future advances will include new technology and better understanding of skull base anatomy via the TORS approaches.

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**INTRODUCTION**

- Robot-assisted surgery in the field of head and neck has been gaining popularity due to appeal in using minimally invasive approaches, obtaining excellent visualization, and overall low risk.
- Techniques for resecting skull base cancers are traditionally performed through large incisions and require mobilization of large amounts of tissue.
- The objective of this study is to discuss feasible approaches using transoral robotic surgery (TORS) to access the anterior and lateral skull base and describe a novel approach for nodal dissection in the retropharyngeal space.

**METHODS AND MATERIALS**

- The da Vinci surgical robot (Intuitive Surgical, Inc., Sunnyvale, CA) was applied for off-label use to completely resect skull base tumors in four patients.
- The pathological diagnosis on patients are shown in Table 1.
- A transpalatal approach was used to access the infratemporal fossa (n=1) and retropharynx (n=1). Lateral pharyngotomies were performed to access parapharyngeal spaces (n=2).
- All mucosal incisions were closed primarily.

**RESULTS**

- Two patients with pleomorphic adenomas in the lateral parapharyngeal space required lateral pharyngotomies. Partial pharyngotomies were performed with the aid of the robot.
- The patient with a pleomorphic adenoma in the infratemporal fossa and patient with a metastatic papillary thyroid cancer node in the retropharynx (Figure 1A) required a lateral transpalatal approach. Palate resection with dissection of the soft palate to the level of the lateral glosso-pharyngeal fold was accomplished with the aid of the robot, as well as manual aid from the bedside assistant.
- Complete excision of the skull base mass was performed en bloc (n=3) or piece-meal (n=1) fashion using TORS (Figure 1B). Postoperative imaging confirmed complete resection (Figure 2).
- Two patients had a mass near the carotid artery and blunt dissection was performed without violation of the carotid sheath.
- Postoperatively, one patient experienced an episode of transient 1mm ptosis that resolved spontaneously prior to the first clinic visit. There were no cranial neuropathies and no cases with velopharyngeal insufficiency. All patients regained normal swallowing function within 5 days of surgery.
- No cases of recurrence were found within a short follow-up (8-14 months).

**DISCUSSION**

- Advantages of robotic-assisted surgery include small incision sites, 3D vision, high precision with increased freedom of instrument movement, tremor filtration, and ability to have 4 working instruments to operate simultaneously.
- Patients underwent exclusive TORS without the need for an external port. Transpalatal or lateral pharyngeal approaches provide access to the infratemporal fossa and parapharyngeal space.
- Despite one patient who had a transient episode of ptosis, these patients had favorable clinical outcomes and improved functional abilities than expected by an invasive open procedure.
- Limitation of tactile feedback when using the robot along the carotid is an issue.
- Real risks given the parapharyngeal and infratemporal fossa anatomy require preparation for possible conversion to open procedure.

**CONCLUSIONS**

- Access to the skull base is feasible via transpalatal or lateral pharyngeal approaches.
- Development of surgical robotic technology may provide greater opportunities to treat difficult to access skull base masses.

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**Table 1: Demographics and Pathology on Patients**

<table>
<thead>
<tr>
<th>Patient</th>
<th>Age (years)</th>
<th>Gender</th>
<th>Race</th>
<th>Site</th>
<th>Histology</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>78</td>
<td>M</td>
<td>Caucasian</td>
<td>R parapharyngeal space</td>
<td>Pleomorphic adenoma</td>
</tr>
<tr>
<td>2</td>
<td>40</td>
<td>M</td>
<td>Caucasian</td>
<td>L parapharyngeal space</td>
<td>Pleomorphic adenoma</td>
</tr>
<tr>
<td>3</td>
<td>49</td>
<td>M</td>
<td>Caucasian</td>
<td>R infratemporal fossa</td>
<td>Pleomorphic adenoma</td>
</tr>
<tr>
<td>4</td>
<td>36</td>
<td>F</td>
<td>Caucasian</td>
<td>L retropharyngeal nodal basin</td>
<td>Papillary thyroid cancer</td>
</tr>
</tbody>
</table>

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**Figure 1: Intraoperative Robotic Resection**

A

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**Figure 2: Pre- and Post-operative Imaging of Complete Resection**

A

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(A) Patient with left retropharyngeal node from metastatic papillary thyroid cancer. T1 with contrast, axial and sagittal.
(B) Resection of left parapharyngeal mass using 5mm robotic arm and Omnidisc laser dissector with robotic arm.
(C and D) Post-operative MRI scan, coronal, (C) showing superior aspect of mass; (D) post-operative MRI scan, axial showing inferior aspect of mass.