Premiere Publications from The Triological Society

Read all three of our prestigious publications, each offering high-quality content to keep you informed with the latest developments in the field.

**The Laryngoscope**
*Founded in 1896*

Editor-in-Chief: Michael G. Stewart, MD, MPH

The leading source for information in head and neck disorders.

[Laryngoscope.com](http://Laryngoscope.com)

**Laryngoscope Investigative Otolaryngology**
*Open Access*

Editor-in-Chief: D. Bradley Welling, MD, PhD, FACS

Rapid dissemination of the science and practice of otolaryngology-head and neck surgery.

[InvestigativeOto.com](http://InvestigativeOto.com)

**ENTtoday**
*A publication of the Triological Society*

Editor-in-Chief: Alexander Chiu, MD

Must-have timely information that Otolaryngologist-head and neck surgeons can use in daily practice.

[Enttoday.org](http://Enttoday.org)
INTRODUCTION

Chordomas are rare, infiltrative neoplasms derived from notochordal remnants. Both histologically malignant and locally aggressive, chordomas often invade nearby vertebrae and structures of the central nervous system.1–3 Metastases occur in 30% to 40% of patients.1 Chordomas predominantly appear near the cranial and caudal ends of the spinal column, with 35% presenting near the clivus and 53% near the sacrum. Meanwhile, only 6% are located in the cervical spine.4

Surgical resection is currently the mainstay of therapy, and extent of tumor removal is arguably the most significant prognostic factor.5 Damage to nearby structures such as brainstem, spinal nerve roots, and blood vessels may preclude en bloc resection of cervical and clival chordomas, resulting in high rates of recurrence. Multiple operative techniques have been reported in the literature for exposure of cervical chordomas, including transoral resection, endoscopic transpharyngeal, and posterior cervical approaches. The approach often depends on tumor stage, surgeon experience, and location (lateral vs. midline, axial vs. subaxial).5,7

Transoral access to the cervical spine can be challenging due to poor visualization of both the axial and subaxial segments and due to deep working distance through the oral cavity and oropharynx. Several techniques for transoral resection of cervical chordomas have been described.6,8–10 To achieve adequate visualization, these techniques often require invasive resection of nearby structures such as glossotomy, mandibulotomy, maxillotomy, and palatotomy. Transoral robotic surgery (TORS) offers several advantages over invasive standard transoral approaches. TORS advantages include telescopic visualization, binocular vision for depth perception, confined-space articulating instrumentation, tremor damping, and shared visual display for cosurgeons and staff in the operating room. TORS has been used to successfully treat neoplasms and airway obstruction of the tongue base, oropharynx, and hypopharynx, as well as the parapharyngeal and supraglottic lesions, with minimal damage to surrounding oral cavity or pharyngeal structures.11–15 We present the first documented case of transoral approach using TORS for en bloc resection of chordoma of the axial cervical spine.

CASE REPORT

A 27-year-old healthy male presented with an incidentally diagnosed mass in the cervical spine following a motor vehicle collision. Subsequent workup revealed a 2.2-cm lesion centered in the midline on the posterior aspect of the second vertebra of the cervical spine (C2) of
the spine (Fig. 3). Stylet guarded biopsy was performed and demonstrated chordoma. Initial neurosurgical evaluation recommended proton radiation therapy due to the challenges and risks of resection. Second opinion was sought at our institution, and it was agreed that surgical resection using TORS would provide an adequate result.
approach for oropharyngeal resection. Standard neck extension was possible because rods were not applied to screws until stage 3 of the procedure. A midline vertical incision was performed from nasopharynx down to the level of the tongue base using image guidance (Fiagon GmbH, Berlin, Germany) to correlate with extent of tumor. This was carried down to the subperiosteal plane, and dissection was carried out laterally to expose vertebral bodies C2 through C4 as well as the lateral linear osteotomies bilaterally. The C2 vertebral body was resected en bloc (Fig. 4). Anterior reconstruction was performed using the right iliac crest bone graft with anterior titanium plating. The pharynx was then closed in three layers using prevertebral fascia and longus colli muscle advancement bilaterally (Fig. 5). Tracheostomy and nasogastric feeding tubes were placed. Finally, the patient was turned prone to allow for posterior reconstruction, which included arthrodesis from occiput to C6. A Jackson-Pratt drain was left in place.

The patient tolerated the procedure well. Postoperative course was complicated by wound dehiscence and oral flora contamination of anterior hardware. This prompted a takeback to the operating room, where pharyngeal exploration showed intact hardware and healthily appearing pharyngeal tissue, prompting conservative management with intravenous antibiotics. A gastrostomy tube was also placed to avoid oral intake. The patient was discharged on postoperative day 30. The patient completed a 10-week course of intravenous antibiotics. The patient had the gastrostomy tube removed at 10 weeks and transitioned to oral food. The patient had tracheostomy decannulation at 14 weeks postoperatively. At the submission of this article, the patient is 9 months postoperative, has minimal deficits, shows no sign of infection or recurrence of tumor on radiographic imaging (Fig. 6), has avoided radiation, and has returned to work.

DISCUSSION

The central tenet of surgical treatment of chordomas is obtaining wide-margin, en bloc resection of tumor. It has been demonstrated that subtotal excision of

Fig. 5. Transoral view of posterior pharynx following resection of tumor. Cervical plate is seen within the incision. Palate is retracted superiority and anteriorly with bilateral red rubber catheters.

Fig. 6. Postoperative computed tomography scans 9 months after surgery, with no recurrence of tumor in the second cervical vertebra of the spine. Transverse (left) and sagittal (center) views show anterior fixation of right iliac crest bone graft with titanium plating. Coronal (right panel) view shows anterior titanium plating as well as screws from posterior arthrodesis.
chordomas results in significantly higher rates of local recurrence and shorter intervals of disease-free survival.\textsuperscript{3,5,16} Furthermore, it has been shown that violation of tumor margins can result in seeding and recurrence along the surgical pathway.\textsuperscript{17} Chordomas of the axial spine are not exempt from the challenges of surgical resection, and anatomical constraints make both exposure and sufficient resection of tumor very difficult; few cases of successful en bloc resection of axial chordomas have been previously reported.

Multiple factors such as size, location, and invasion of tumor need to be considered when contemplating the ideal anterior approach for chordoma resection in the axial spine, which can be classified broadly into transoral and extraoral techniques. Extraoral approaches such as the high anterior cervical, retropharyngeal approach have been deemed good options for subaxial or lateral lesions, as well as lesions that require an extraoral, sterile surgical field, such as intradural extension.\textsuperscript{2} There have been mixed results on the efficacy of extraoral approaches for axial cervical chordomas. Jiang et al. described an intralesional, extracapsular resection of a C2 chordoma using bilateral anterior cervical approaches, resulting in no lesional, extracapsular resection of a C2 chordoma using axial cervical chordomas. Jiang et al. described an intra-

...as glossotomy, mandibulotomy, maxillotomy, and palatotomy, are necessary to increase the operative space.\textsuperscript{10,21,22} Complications such as velopharyngeal insufficiency, dysphagia, nasal regurgitation, and dental malocclusion are uncommon but possible with these extensive surgical techniques.\textsuperscript{7,21} Other complications such as increased pain and risk of infection are also worth considering when attempting more aggressive operative techniques. Endoscopic transoral techniques have been successfully used for exposure of the anterior axial spine and have been shown to decrease the need for alteration of surrounding structures such as the soft and hard palate.\textsuperscript{8,22} TORS for head and neck lesions in living patients was described by O’Malley et al. in 2006\textsuperscript{13} and has since been used to successfully treat lesions of the oropharynx, base of tongue, tonsils, larynx, and parapharyngeal space.\textsuperscript{8,12,13,20} Via articulated instrumentation, angled-scpes, and tremor damping are consistently reported advantages for TORS. These also preclude the need for further surgery to access subaxial and clival lesions.

Our decision to utilize TORS for the exposure of this C2 chordoma was attributed to past successes of treating head and neck lesions using robotic technology as well as relative location of this patient’s chordoma. Although the position of the C2 lesion was relatively easy to expose with a midline incision in the oropharynx, we believe that TORS could be used for anterior exposure of cervical spine lesions while precluding the need for further invasive surgery to achieve adequate exposure and visualization. Our case demonstrates that exposure of cervical chordomas via a pharyngeal incision can provide the necessary exposure and visualization needed to achieve en bloc resection.

CONCLUSION
Tumors of the axial spine are associated with higher operative difficulty due to complex anatomy and limited access, resulting in less favorable margins and high rates of complications. Uncompromised access with acceptable morbidity is the goal of any surgery and was felt to be feasible in this case with the use of TORS. We obtained a successful en bloc resection, and although this patient’s postoperative course was prolonged, the patient made a complete recovery with minimal long-term side effects. Furthermore, we believe that TORS provides additional opportunities to achieve exposure of lesions that may require invasive surgery and encourage providers to consider using this technique.

BIBLIOGRAPHY