Transoral Excision of Parapharyngeal Space Tumors

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KEYWORDS

• Parapharyngeal space tumors • Salivary neoplasm • Salivary tumors
• Transoral surgery • Transoral robotic surgery • TORS • Endoscope-assisted surgery
• Minimally invasive

KEY POINTS

- Transoral robotic surgery and endoscope-assisted transoral surgery are helpful adjuncts that can enhance exposure and delivery of parapharyngeal space (PPS) masses approached transorally.
- With the advent of these technological advancements, indications for transoral removal of PPS masses have expanded to include larger tumors and those with lateral or poststyloid extension or location.
- When considering a transoral approach to removing a PPS mass preoperatively, a surgeon should consider multiple patient and tumor factors, including, but not limited to, cytopathology, lateral and superior extent of tumor, tumor relationship to the carotid artery, and any patient trismus or limitation in neck flexion/extension.
- For a large or lateral-extending PPS tumor, transcervical assistance through a 2.5- to 4-cm neck incision may be used to facilitate tumor mobilization and transoral tumor delivery.
- Transoral PPS tumor excisions can eliminate the risk of first bite syndrome and a neck incisional scar.

INTRODUCTION

The parapharyngeal space (PPS) is a complex anatomic space lateral to the oropharynx and medial to the mandible. The PPS can generally be conceptualized as an inverted pyramid with the base of the pyramid at the skull base and the apex at the hyoid bone.[1,2] The PPS is typically considered to be bounded medially and

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anteriorly by the buccopharyngeal fascia surrounding the superior constrictor muscle, laterally by the medial pterygoid muscle, and posteriorly by the prevertebral fascia. The space is divided by the stylohyoid ligament into prestyloid and poststyloid compartments. The prestyloid compartment consists of fat, lymph nodes, and the deep medial extent of the deep lobe of the parotid gland. The poststyloid compartment contains neurovascular structures, including the internal jugular vein, internal carotid artery, and cranial nerves IX, X, XI, and XII.[3]

Although the traditional approach to PPS masses has been transcervical, the transoral approach to the PPS was described as early as 1963 by McIlrath and ReMine.[4] It was not until the 1980s that in a series of cases a range of pathologic conditions were reported to be safely removed via an open transoral approach.[5,6]

With the expansion of intraoperative technology, including rigid endoscopy, and, in particular, transoral robotic surgery (TORS), transoral approaches to PPS masses have been enhanced with the improved visualization and tissue manipulation. Although most tumors removed via a transoral approach are benign and salivary in origin, most commonly pleomorphic adenoma, multiple tumor types have been removed according to published reports (**Box 1** provides a full list).[2,7–14]

In this review article, the authors highlight indications for transoral removal of PPS masses, delineate techniques for the transoral approach to the PPS with an emphasis the on the TORS method of dissection, underline limitations to the transoral approaches, and summarize the outcomes and complications data currently available for tumors removed transorally.

INDICATIONS FOR THE TRANSORAL APPROACH

Before the advent of endoscopic-assisted and TORS approaches, many surgeons considered only small lesions that project into the oropharynx without poststyloid extension to be amenable to open transoral excision.[15,16] Safety concerns of the open transoral approach with limited exposure and poor visualization of key structures included major vascular injury, tumor spillage/capsule violation, incomplete tumor excision, and a presumed possibility of infection with exposure to intraoral microbiome.[11,16–19]

Box 1
Parapharyngeal pathologic condition reported to be removed via transoral approach in existing literature

Pathologic condition
Benign salivary neoplasm (most commonly pleomorphic adenoma)
Hemangioma
Lipoma
Lymphoepithelial cyst/benign cyst
Schwannoma
Parathyroid adenoma
Venous malformation
Malignant salivary neoplasm
Metastatic thyroid carcinoma

The indications for transoral excision of PPS masses have expanded with TORS and transoral endoscopy. Larger, well-circumscribed tumors even with poststyloid involvement can be removed transorally with an acceptable safety profile.[20] Tumors up to 8 cm in diameter have been reported to be successfully removed solely via a transoral TORS approach.[2] Important factors to consider preoperatively include any trismus, which may limit the intraoral exposure and prohibit proper placement of robotic instruments, and the relationship of the tumor to the carotid artery. Tumors that displace the carotid laterally are amenable to transoral excision; however, if the tumor appears infiltrative radiographically, has a poorly defined plane with the great vessels, or displaces the carotid medially, a transcervical approach should be considered.[21]

In addition, if the surgeon is contemplating a solely transoral approach to a PPS mass, the superior and lateral extent of the tumor must be carefully considered. Even when the TORS system is used, lateral extension of the tumor through the stylomandibular tunnel may require a transcervical assist approach through an ipsilateral neck incision that can be less than 4 cm.[20,22] Accordingly, if there is concern for lateral extension of the tumor radiographically during the preoperative consultation, consenting the patient for possible transcervical approach is advised. Furthermore, extension of the tumor toward the skull base may create difficulties with visualization and dissection of the superior portion of the tumor transorally, possibly leading to tumor capsule disruption. Boyce and colleagues[20] suggested that tumors greater than 10 mm from the skull base radiographically are appropriate for TORS excision. A combined transoral-transcervical approach, or an even altogether different skull base approach, should be used to safely access tumors closer than 1 cm to the base of skull.

ADVANTAGES AND DISADVANTAGES OF THE TRANSORAL APPROACH

The main advantages of pursuing a transoral approach to a PPS mass include lack of an external neck scar, avoidance of neck numbness, and near elimination of the possibility of first bite syndrome. A transoral approach also diminishes the risks of facial nerve (in particular, the marginal mandibular branch of the facial nerve) and hypoglossal nerve injury, although the glossopharyngeal nerve is at greater risk during a transoral dissection. In addition, the transoral approach also avoids the risk of Frey syndrome and sialocele from transparotid salivary tissue dissection.[1,17,18,23]

There are drawbacks to the transoral approach. The main drawback of transoral approaches is the more limited exposure. The narrow corridor of dissection can present challenges to dissecting around the full tumor and to controlling bleeding. However, rapid conversion to an open transcervical approach for control of bleeding with vessel ligation is an option. The transoral approach does involve an incision through the superior constrictor and soft palate muscles and dissection through the parapharyngeal fat where vagal nerve branch contributions to the palate and superior constrictor muscles may be affected by interruption or traction injury. Despite these anatomic and surgical factors, patients typically initiate a diet on the first day after surgery.[8] However, longer-term functional and/or quality-of-life (QOL) data comparing swallowing outcomes between transcervical and transoral approaches are not available to fully understand the consequences of the transoral incision and dissection. Bimanual palpation is not possible via a transoral approach. The TORS dissection specifically lacks haptic feedback from the robotic instruments, which may lead to higher rates of tumor capsule disruption. For this reason, one can interrupt the robotic dissection to perform blunt finger dissection of the tumor transorally to digitally gauge the tumor and gently dissect the tumor from surrounding fascial

attachments.[15] Pressure on the skin overlying the parotid can result in a push of the parapharyngeal tissue medially that can in turn improve angles of dissection.

The tight corridor for dissection can also challenge a surgeon not facile with endoscopic or robotic dissection. There is a learning curve for a head and neck surgeon to develop these techniques. TORS offers the 3-dimensional optical magnification, a maneuverable endoscope with multiple angles of visualization, and increased degrees of freedom of movement of the robotic arms, all of which can help circumvent the geometric challenges presented by transoral PPS surgery.[24] Ultimately, a simple head light-guided dissection with loupe magnification is an option that can work well for some tumors.

PREOPERATIVE EVALUATION

Careful review of preoperative cross-sectional imaging, typically a computed tomographic (CT) scan or MRI, the latter of which is preferred (**Fig. 1**), is critical to understand the size, location, extent, and presence of infiltration of tumor into surrounding tissues. Cross-sectional imaging should evaluate the skull base, to understand the relationship of the tumor to the skull base, and the full extent of the neck to the clavicles for possible lymphadenopathy. Contrast is helpful to understand the anatomic relationship of the common, internal, and external carotid arteries to the tumor, identify any large feeding vessels, and ensure the appearance of a clear plane between the carotid artery and tumor. Diffusion-weighted MRI additionally can help clarify the malignant potential of salivary tumors preoperatively.[25]

Fine needle aspiration (FNA) is a critical component of the workup of PPS masses. Unless the tumor appears radiologically to be a vascular malformation on MRI, FNA is

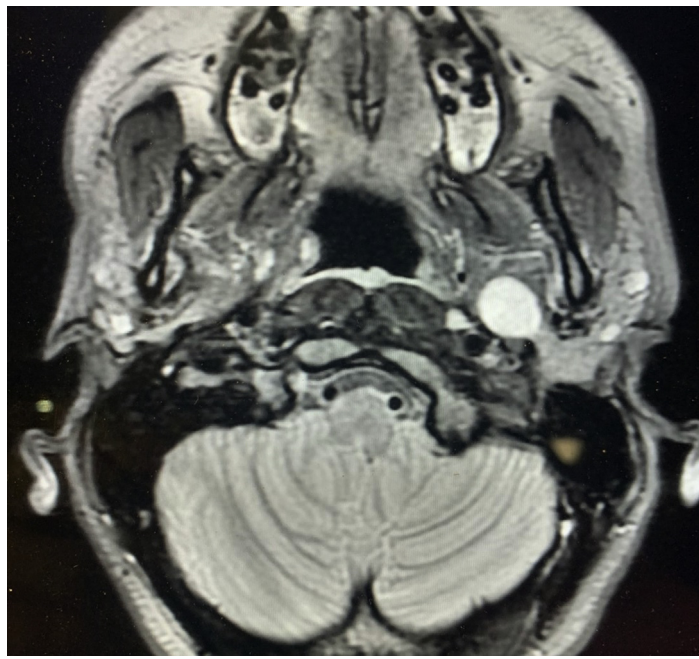

Fig. 1. Sequence of transoral approach to excision of a left PPS acinic cell carcinoma. MRI showing a 2-cm left PPS mass. CT-guided fine needle biopsy showed this to be an acinic cell carcinoma.

recommended for all PPS tumors to clarify the tumor type. In some benign or equivocal tumors, observation with serial imaging of the tumor for growth or changes in imaging characteristics can be a reasonable option; however, an in-depth discussion of the complex decision making surrounding PPS masses is beyond the scope of this article.

The patient's oropharynx should be carefully examined preoperatively to evaluate the following: (1) the extent of tumor visible submucosally; (2) general dental condition for assessing the degree of difficulty with placement of oropharyngeal retractors and if there is a heightened risk for dental damage from loose/decayed teeth; and (3) the presence of trismus, which not only challenges oropharyngeal exposure but also may indicate tumor infiltration into pterygoid musculature. In addition, limited neck mobility, in particular, flexion and extension, can create challenges for the oropharyngeal exposure intraoperatively.

EXPOSURE AND SETUP

Transoral PPS surgery is performed under general anesthesia. Nasotracheal intubation by the anesthesiologist affords maximal exposure of the oropharynx and greater freedom of transoral instruments. Nasotracheal intubation also allows for full closure of the mouth to enable transcervical exposure if needed. The table is turned 180° to allow maximal surgical access around 270° of the head. The neck is extended. The face is protected with a circumferential towel head wrap. The authors typically first attempt exposure with a Crowe-Davis retractor ((Storz, Tuttlingen, Germany) **Fig. 2**). If the soft palate, tonsil, and lateral pharyngeal wall are not well exposed, then exposure with a Feyh-Kastenbauer Weinstein-O'Malley (Olympus Corp., Tokyo, Japan) retractor can be attempted. Generally, retraction of the tongue anteriorly outward with a silk suture passed through the midline tongue is not necessary for the PPS approach. Such retraction can also put the tongue at risk of devascularization from extended compression. If retraction of the tongue with this technique is necessary before engagement of the retractor, the authors recommend regular evaluation of the tongue and intermittent release of the retractor during the course of the operation to allow for tongue revascularization. Facial nerve monitoring should be used for lateral PPS tumors abutting the deep aspect of the parotid to assist with facial nerve identification transorally or if a possible transcervical/transparotid approach is anticipated.

SURGICAL TECHNIQUE: TRANSORAL OPEN APPROACH

In the case whereby a surgical robot or endoscopic instrumentation is not available to a surgeon, or if the surgeon has a greater comfort level with open surgery, an open transoral approach to a PPS tumor may be considered. Loupe magnification and headlight illumination are typically used to improve visualization. Once adequate exposure of the oropharynx has been obtained, an open transoral parapharyngeal dissection may be performed as described by Hussain and colleagues.[2] Palpation of the tumor or transoral ultrasound can be performed before making an incision to guide the extent of incision that is necessary.[12] An incision with monopolar cautery is made lateral to the palatoglossal fold; the incision may be extended superiorly to the soft palate and inferiorly to the base of the tongue and/or floor of mouth as needed to allow safe removal of the mass. A cuff of tissue medial to the gum mucosa is advised to allow for easier suture closure. Dissection through, or lateral to, the palatoglossus muscle will reveal the superior constrictor muscle. An incision made too far laterally and inferiorly will place the lingual nerve at risk of injury. The lingual nerve travels lateral to the medial pterygoid entering this area, and anterior to the medial

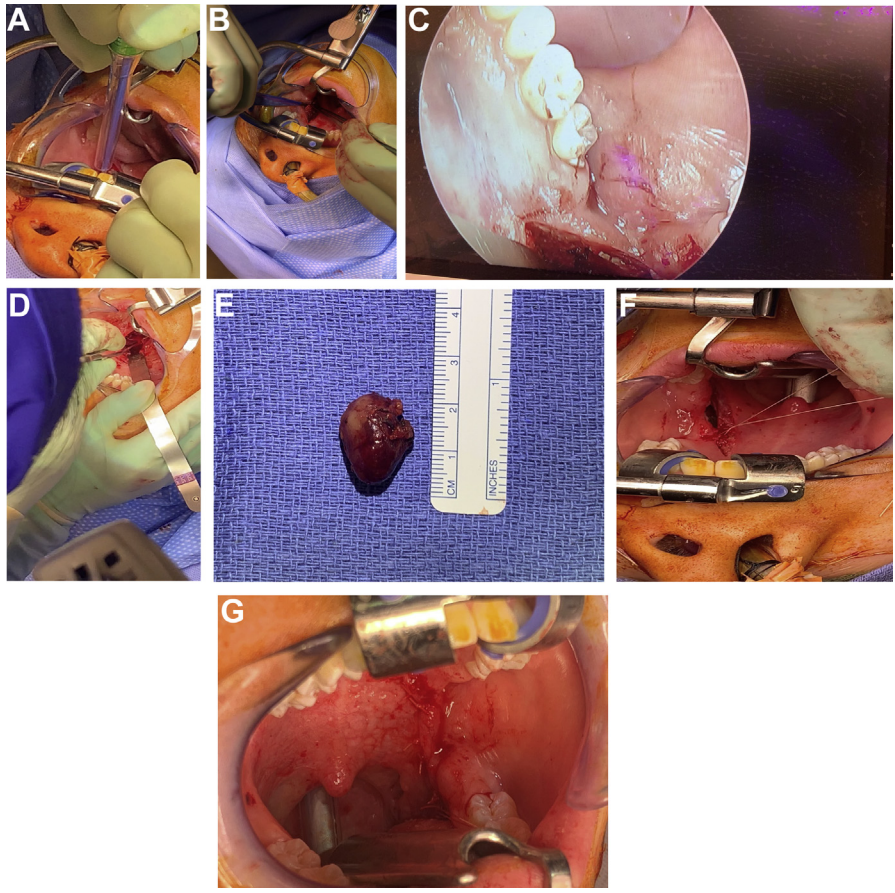

Fig. 2. Sequence of transoral approach to excision of a left PPS acinic cell carcinoma. (*A*) Oral exposure with incision in the left lateral palate and medial retromolar trigone area. (*B*) Incision through the superior constrictor muscle with medial retraction of the tonsil, palate mucosa, superior constructor, and palate musculature for access to the PPS. (*C*) Endoscopic video of the tumor in the PPS after initial medial dissection. (*D*) Transoral dissection of the tumor with blunt and sharp dissection and unipolar and bipolar electrocautery. (*E*) Tumor excised ex vivo. (*F*) Closure of superior constrictor and soft palate/retromolar trigone mucosa after excision of tumor. (*G*) Full mucosal closure.

pterygoid muscle in the posterior floor of mouth. The superior constrictor muscle and the buccopharyngeal fascia surrounding this should be divided. Elevation of a medial flap consisting of the superior constrictor muscle, tonsil, and palatoglossus and palatopharyngeus muscles will lead to the PPS. Identification of the medial pterygoid muscle, the pterygoid plates, and blood vessels, especially the fascia anteriorly overlying the internal carotid artery posteriorly, can be helpful for orientation. Review of the patient's radiologic scans intraoperatively can be helpful during the initial approach to the tumor if the tumor is small and lateral. Once the capsule of the mass has been encountered, careful blunt dissection around the tumor capsule should be performed to release surrounding fascial attachments. If possible, leaving an area of fat and fascia on the capsule of at least part of the tumor can be helpful to be able to manipulate

the tumor in different directions without causing an iatrogenic capsule violation. Blunt dissection can be performed at times with gentle finger dissection, the advantage of which is the sensory feedback and ability to adjust pressure. Division of the stylomandibular ligament may facilitate dissection and tumor removal if possible, although this maneuver transorally may be difficult. Once the tumor is removed en bloc, meticulous hemostasis should be achieved. The incision can be closed in 2 layers, with closure of the deeper superior constrictor and palate musculature in a simple interrupted manner and then the mucosa in a horizontal mattress manner with absorbable suture (typically, 3-0 Vicryl suture is used in the authors' practice). A 1-cm area of the inferior portion of the incision can be left open to allow gravity-dependent egress of fluid from the wound. A sequence of this technique is shown in **Fig. 2**.

SURGICAL TECHNIQUE: TRANSORAL ROBOTIC SURGERY APPROACH

When feasible, utilization of a TORS system for transoral removal of a PPS tumor is an option. After exposure of the oropharynx, with insertion of the surgical robot into the operating field, the authors recommend the dissector be placed in the surgical arm contralateral to the tumor and the monopolar cautery be placed on the ipsilateral side. A 0° robotic scope will often give adequate visualization for a PPS tumor; however, a beveled 30° can be used to visualize around more acute angles.

For a TORS transoral approach to the PPS, the dissection is performed similarly to the approach described above, but with some notable exceptions.[15,26] Again, an incision is made near the pterygomandibular raphe, through the palatoglossus and superior constrictor muscles into the PPS while avoiding the lingual nerve. Any tonsillar branches of the external carotid artery system encountered should be ligated with surgical clips deployed by an assistant at the head of the bed. Once the tumor is encountered, careful blunt dissection should be performed around the tumor capsule. Blunt dissection can be facilitated by finger or hand instrument dissection to remove surrounding fascial attachments, which necessarily involves removal of the robotic arms and endoscope from the oropharynx. Although this process of removing and replacing the robotic arms can be time-consuming, the safety and effectiveness of finger and possible hand instrument dissection, with the decreased risk of tumor capsule violation, make this maneuver a worthwhile addition to the operation. Once all fascial and muscular attachments have been released, the tumor is delivered through the incision transorally by the assistant. Again, having a handle of tissue to be able to grasp and move the tumor is helpful, if possible.

The tumor capsule should be carefully inspected for any evidence of violation or tumor spillage. If these are visualized on inspection of the tumor ex vivo, then the wound should be carefully evaluated for any remaining tumor and copiously irrigated with saline after hemostasis has been achieved. After the robotic arms and scope have been removed, the incision is closed in a similar fashion with surgical loupes and headlight as described above for the transoral open approach.

SURGICAL TECHNIQUE: ENDOSCOPE-ASSISTED TRANSORAL APPROACH

The endoscope-assisted transoral technique is similar to the transoral open approach described above, but with extra visualization provided by 0°, 30°, and 45° 5-mm endoscopes (see **Fig. 2**, part C). An assistant can help by holding the endoscope along with a retractor or suction, to allow for adequate multiple-instrument surgery. This technique can be a helpful adjunct to assist removal of these tumors. Numerous investigators facile in endoscopic surgery have reported a good experience with this technique for transoral removal of PPS tumors.[27–32]

SURGICAL TECHNIQUE: TRANSCERVICAL ASSIST TO THE TRANSORAL APPROACH

When a PPS tumor cannot be adequately mobilized for removal transorally, particularly when a tumor extends laterally through the stylomandibular tunnel, a transcervical approach may be used to facilitate transoral tumor removal, as descried by Boyce and colleagues[20]. To perform this, an ipsilateral horizontal neck incision as small as 2.5 to 4 cm can be made. The platysma is divided, and superior and inferior subplatysmal flaps are elevated. The posterior belly of the digastric muscle is identified, at which point the lateral attachments of the tumor can be dissected free with blunt finger dissection. The stylomandibular ligament may also be released from this approach, which facilitates mobilization of the tumor. Once fully mobile, the tumor can then be delivered transorally. The neck incision is then closed in a multilayer fashion. The authors prefer a closed suction neck drain be placed at the time of neck closure.

POSTOPERATIVE CARE

The patient is extubated in the operating room with admission for observation for 1 to 2 nights before discharge home. Liquid diet the first night and soft diet the next day are appropriate as tolerated by the patient. The patient is seen for a follow-up visit in clinic within 1 week postoperatively, at which time the diet can be advanced to a regular diet provided that healing is deemed to be adequate.

TRANSORAL PARAPHARYNGEAL SPACE DISSECTION: COMPLICATIONS AND OUTCOMES

Complications, although unlikely, include unanticipated cranial nerve deficits, including the sympathetic chain, major vascular injury, trismus, and oral mucosal incision dehiscence.[8,15] One report exists of CN X dysfunction following combined transoral-transcervical removal of a large neurogenic tumor, which was dissected free from the vagus nerve, but there are no reports, to the authors' knowledge, of cranial nerve deficits following a purely transoral approach to a PPS tumor.[22] Likewise, major intraoperative vascular injury during the transoral dissection requiring intervention by an interventional radiologist or vascular surgeon has not been reported in existing literature. Two reports of dehiscence of the pharyngeal incision following a TORS approach to PPS tumors highlight that this development can be managed conservatively with a nasogastric feeding tube and oral diet restriction until secondary healing has ensued, as both patients were treated successfully in this manner without further sequelae.[15]

One of the most frequent criticisms of the transoral approach to PPS tumors, in particular pleomorphic adenomas, is higher possible rates of tumor capsule disruption relative to transcervical approaches. Capsule disruption or tumor spillage during the dissection has been shown to be associated with higher rates of tumor recurrence.[33] Capsular disruption rates of pleomorphic adenomas of the PPS during TORS dissection have been reported to be as high as 27%, higher than those reported with transcervical approaches.[20,34] This may be at least partially due to the lack of haptic feedback during a robotic dissection, underscoring the importance of blunt transoral finger dissection during a TORS approach to these tumors.

Recurrent pleomorphic adenomas are not usually detected until, on average, around 10 years following initial resection.[35] As such, there are not yet enough long-term outcomes data from tumors removed via the relatively modern TORS or any oral approach to understand whether recurrence rates are different among PPS tumors removed with TORS, conventional transoral approaches, or more traditional

transcervical approaches. Recurrences of tumors in the PPS can be challenging to reresect and are more morbid, requiring possible pharyngeal resection, mandibulotomy/mandibulectomy, and possible free-flap reconstruction.[23,36]

Validated QOL data and objective functional outcomes data on speech, and in particular swallowing, are not yet published for patients having undergone transoral approaches to removal of PPS tumors. Such data could better illuminate the longer-term subjective outcomes of patients undergoing such procedures.

SUMMARY

Transoral excision of PPS tumors has expanded given the improvements in endoscopic and robotic surgical technology and comfort with transoral approaches in general. Even some large tumors with poststyloid extension can be removed safely via a transoral approach. When the lateral aspect of the tumor cannot be adequately mobilized transorally, a transcervical assist incision may be used to facilitate transoral tumor removal. Longer-term outcomes data will be necessary to delineate whether transoral excision of PPS tumors leads to differing recurrence rates of tumors and QOL/functional outcomes compared with those removed by traditional transcervical approaches. Care must be taken to avoid tumor spillage. Use of transoral, transcervical, or both approaches should be considered to enable the safest and most effective resection.

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