13 Transoral Robotic Resection of Parapharyngeal Space Tumors

Moran Amit, Irit Duek, and Ziv Gil

13.1 Introduction

Parapharyngeal space tumors (PPSTs) account for only 0.5% of head and neck neoplasms. However, many types of tumors can involve this region. The relationship of these tumors to the styloid process, i.e., prestyloid and post-styloid, aids in their classification. Prestyloid PPSTs deflect the internal carotid artery (ICA) posteriorly and are most commonly benign salivary gland tumors; poststyloid tumors push the ICA anteriorly and are most commonly paragangliomas and nerve sheath tumors (Fig. 13.1). These tumors are most commonly managed by surgical resection via transcervical or transmandibular approaches. The efficacy and limitations of these approaches are well established [1–3]. Very large PPSTs, or those that are located high at the base of the skull, often require combined approaches, which may include mandibulotomy or infratemporal fossa approaches. Since the latter carries a considerable risk for morbidity, there is increasing interest in the use of the da Vinci surgical robotic system (Intuitive Surgical, Sunnyvale, CA). This system obviates the need for a mandibulotomy to approach the oropharynx [4–6] and enables a transoral approach to resect PPSTs [7]. The da Vinci robotic apparatus provides high magnification three-dimensional (3D) visual access to lateral-based structures and enables direct angular visualization and instrumentation at and around structures. The 5 mm robotic-guided arms enable an assistant to introduce additional instruments into the operating field to aid retraction, suction, and cauterization. This approach is expected to reduce tumor spillage and morbidity, to shorten the length of hospital stay, and to achieve early

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M. Amit, MD, PhD
The Laboratory for Applied Cancer Research, Department of Otolaryngology Head and Neck Surgery, the Head and Neck Center, Rambam Healthcare Campus, Clinical Research Institute at Rambam, Rappaport Institute of Medicine and Research, The Technion, Israel Institute of Technology, Haifa, Israel

I. Duek, MD
Department of Otolaryngology Head and Neck Surgery, the Head and Neck Center, Rambam Healthcare Campus, Clinical Research Institute at Rambam, Rappaport Institute of Medicine and Research, The Technion, Israel Institute of Technology, Haifa, Israel

Z. Gil, MD, PhD (✉)
The Laboratory for Applied Cancer Research, Department of Otolaryngology Head and Neck Surgery, the Head and Neck Center, Rambam Healthcare Campus, Clinical Research Institute at Rambam, Rappaport Institute of Medicine and Research, The Technion, Israel Institute of Technology, Haifa, Israel

Department of Otolaryngology, Rambam Medical Center, The Technion, Israel Institute of Technology, Haifa 66036, Israel
e-mail: ziv@baseofskull.org

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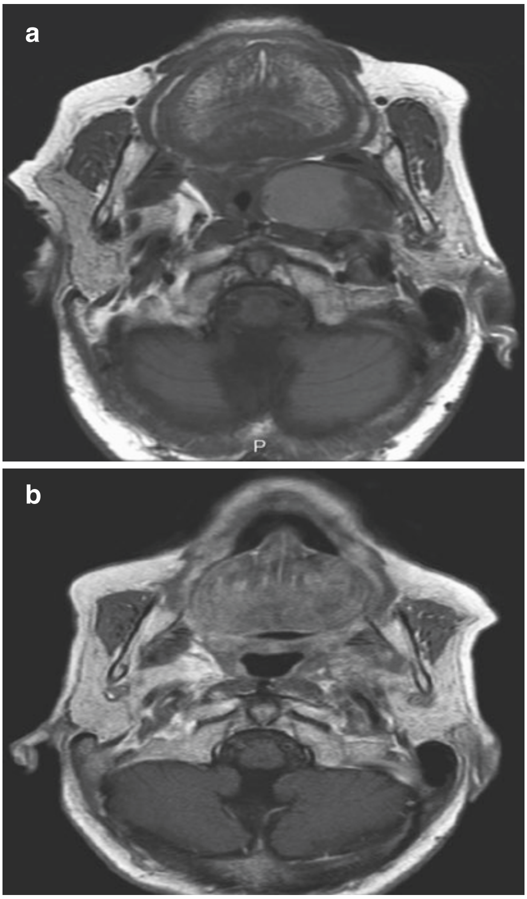

Fig. 13.1 Axial T1-weighted with gadolinium magnetic resonance images of a 78-year-old patient with prestyloid parapharyngeal pleomorphic adenoma; (**a**) preoperative, (**b**) 2 months postoperative

reinstatement of quality of life. A recent meta-analysis presented the utility of TORS as a single or combined approach for PPST in nearly 50 patients with minimal surgical morbidity [8]. In this chapter, we describe the indications and surgical technique of TORS for resection of PPST.

13.2 Surgical Anatomy

The parapharyngeal space (PPS) is a potential space lateral to the oropharynx. The PPS is shaped like an inverted teepee, extending from the skull base superiorly to the greater cornu of the hyoid bone inferiorly. The PPS is bound medially by the superior pharyngeal constrictors and laterally by the medial pterygoid muscle, mandibular ramus, and deep lobe of the parotid gland. The anterior border of the PPS is the pterygomandibular raphe and the pterygoid fascia. Posteriorly, the PPS extends to the cervical vertebrae and prevertebral muscles. An important landmark in the PPS is a fascial band extending from the styloid process to the tensor veli palatini. This structure further divides the PPS to an anteromedial compartment (i.e., prestyloid) and a posterolateral (i.e., poststyloid) compartment. The prestyloid compartment contains the retromandibular portion of the deep lobe of the parotid gland, adipose tissue, and lymph nodes associated with the parotid gland. The poststyloid compartment contains vital structures like the internal carotid artery, the internal jugular vein, CNs IX–XII, and the sympathetic chain.

13.3 Preoperative Evaluation

Patients should be assessed for cranial neuropathies, breathing disturbances, and trismus. Physical examination should include palpation of the neck and the parotid gland in search of lymph node metastases. Cranial nerves are evaluated. Mouth opening might be limited due to extension of the tumor into the pterygopalatine fossa. Mouth opening is particularly important since relative contraindications to TORS include inadequate oral exposure and limited cervical spine mobility. The extent of the oropharyngeal mass should be evaluated with flexible fiber optic evaluation of the oropharynx**.**

Imaging should include magnetic resonance imaging (MRI); however, contrast computerized tomographic (CT) scans are acceptable. Visualization of a vascular flow void on an MRI study is usually sufficient for the diagnosis of a vascular tumor such as a paraganglioma, but magnetic resonance angiography (MRA) may be added for a more precise diagnosis. If a malignant tumor is suspected, radiological staging is completed using a positron emission tomography-CT hybrid (PET-CT) for assessing the presence of regional and distant metastases. Surgeons must be acutely aware of a more medial position of the carotid artery as it passes through the PPS.

Preoperative tissue evaluation with fine needle aspiration (FNA) biopsy should be obtained, particularly in the setting of a suspected salivary gland malignancy or an enlarged lymph node. When radiographic studies are diagnostic of a vascular lesion, biopsy is not recommended. Awareness of the potential pathologies that might be encountered is important, and imaging should precede FNA, to avoid potential bleeding.

13.4 Operative Technique

13.4.1 Patient Positioning

The patient is placed in a supine position and is nasally intubated via the contralateral nostril. The operating table should be positioned with the patient's head away from the ventilator to allow space for the robotic cart to fit under the bed. The patient should be positioned in the patient supine with a horizontally oriented shoulder roll. The patient's arms do not need to be tucked for TORS; however, if a transcervical approach is expected, both arms should be tucked. Sterile draping is not required if TORS is done alone.

Suspension pharyngoscopy using the Feyh-Kastenbauer (FK) laryngeal retractor (Gyrus AMI, Southborough, MA) is performed, and the patient is placed in suspension. A 2-0 silk suture through the anterior tongue is placed for retraction to maximize exposure; gauze is positioned between the teeth and tongue to avoid tongue laceration. The patient's eyes are protected with Opti-Guard® safety goggles.

13.4.2 Robot Setup

The da Vinci Surgical System (Intuitive Surgical, Inc., Sunnyvale, CA) is docked diagonally to the patient's bed. The bed should be lowered to accommodate the robotic arms. A 0° 8°mm camera is installed and inserted to the mouth. The robotic arm ipsilateral to the lesion is installed with a 5 mm monopolar cautery with a spatula tip. Maryland dissector forceps is installed in the arm contralateral to the tumor. The robotic arms are positioned so that instrument tips are within the field of view of the endoscope with minimal angulation. As such, they are approximately parallel to the optical arm, minimizing collision with each other.

An assistant is positioned at the head of the bed. The assistant must be familiar with endoscopic techniques since he will be working off of the screen rather than by direct visualization. Moreover, the assistant must be familiar with the robot to troubleshoot device failures and interference of the arms. The assistant is equipped with a Yankauer suction, bipolar diathermy and LigaSure™ 5 mm blunt tip 23 cm for vessel sealing, atraumatic grasping, and blunt dissection. The latter enables cutting independent of sealing.

13.4.3 Dissection

The procedure is initiated with an incision over the prominent aspect of the mass, through the oropharyngeal mucosa, from superior to inferior. In case there is no prominence at the oropharynx, an inverted L-shaped incision is used along the lateral aspect of the anterior tonsillar pillar (Fig. 13.2). Next, dissection is undertaken through the submucosal muscle layer (Fig. 13.3). Traction and countertraction are important for dissecting through the superior constrictor musculature. Dissection through the superior constrictor muscles with the tip of the Bovie cautery eventually leads to an identification of the mass capsule (Fig. 13.4). At this stage, a well-defined plane is identified, and dissection proceeds along the mass (Fig. 13.5). As mucosal flaps are developed, lateral retraction of the anterior tonsillar pillar using pillar retractor or a suture increases exposure to the parapharyngeal space. The palate can be retracted anteriorly using a soft rubber catheter placed in the nose.

The Maryland dissector is used to gently grasp the superior constrictor musculature and pull it medially, and a combination of Bovie electrocautery and blunt dissection is used to further define the capsule. At this stage, the parapharyngeal fat may be visualized. The assistant can help with blunt dissection and retraction of soft tissues. When the anteromedial aspect of the mass is defined, a higher magnification can be used to appreciate its size and extent. If accessible, the inferior aspect of the mass is grasped and pulled medially to assist with the lateral dissection (Fig. 13.6). In case of a benign cystic mass, it can be decompressed at this stage, to facilitate its mobilization within the narrow confines of the oral cavity and to address the remaining superior-lateral attachments. The more cephalad medial pterygoid muscle may be visualized, and further lateral dissection should be avoided to minimize exposure of the carotid artery.

During this portion of the resection, branches of the external carotid artery traversing the PPS are encountered and should be clipped or cauterized. After the superior and lateral attachments are removed, the assistant retracts the tumor medially. If a tumor's inferior aspect is fully visualized, inferior dissection is completed and the lesion is removed (Fig. 13.7). The remaining cavity is copiously irrigated with 37 °C saline, hemostasis is confirmed before and after the robotic arms are removed, and the incision is closed primarily with 2-0 Vicryl sutures.

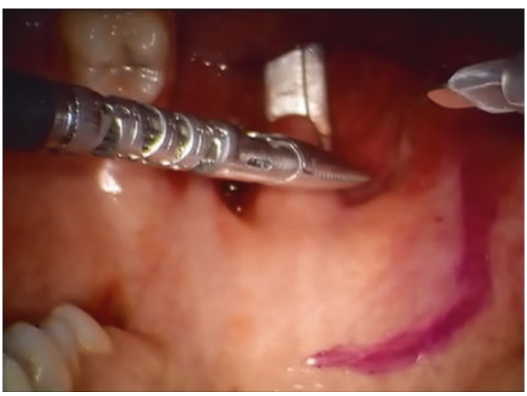

Fig. 13.2 Inverted L-shaped incision over anterior pillar mucosa

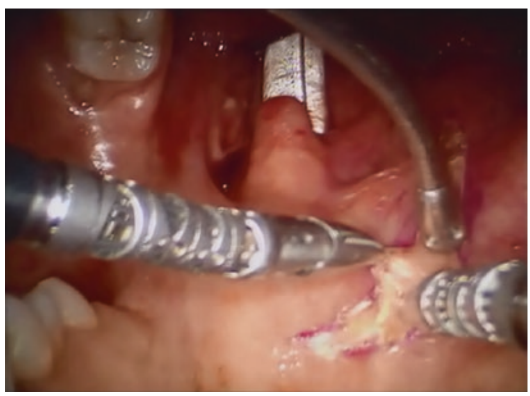

Fig. 13.3 Raising submucosal flaps at the palatoglossal fold

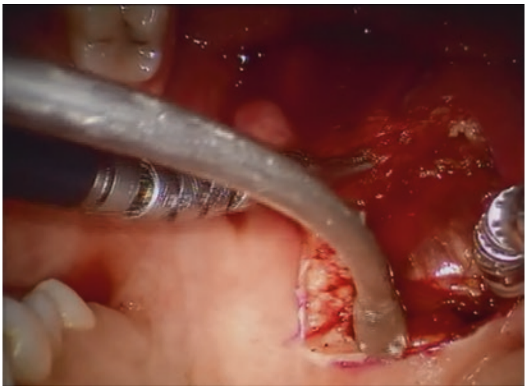

Fig. 13.4 Exposure of the superomedial aspect of the tumor

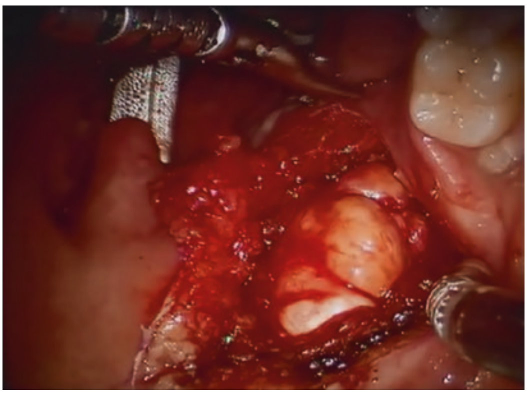

Fig. 13.5 Anterior tumor exposure

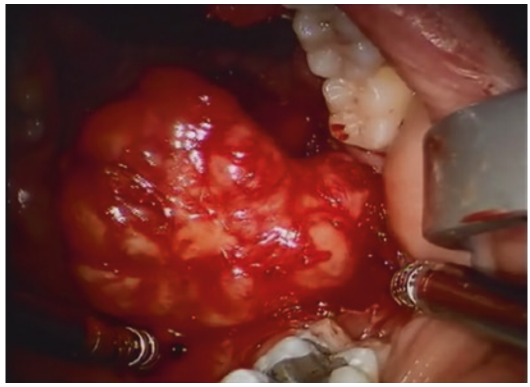

Fig. 13.6 After inferomedial release, the tumor is medially retracted

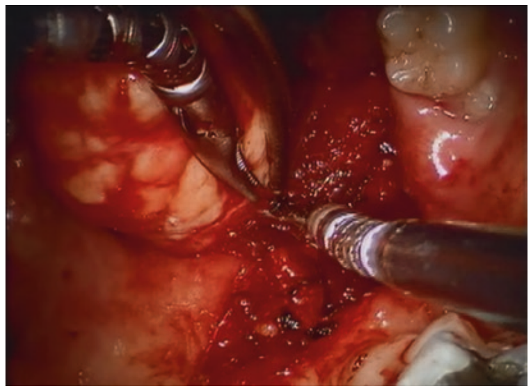

Fig. 13.7 Lateral dissection at the parapharyngeal space. During this portion of the resection, branches of the external carotid artery traversing the PPS are encountered and should be clipped or cauterized

13.5 Combining the Transcervical Endoscopic with the Transoral Robotic Approach

While the transoral robotic approach to the PPS is feasible and safe, it carries limitations, such as exposure of the lateral and posterior aspects of the PPS. With such approach, the PPS tumor is situated between the robotic arm and the carotid artery. Since PPS tumors (pleomorphic adenomas, carcinomas, and schwannomas) cannot be manipulated by the robot, TORS requires finger dissection and separation of the tumor from the mouth or neck, especially in large PPS tumors. The traditional finger dissection, whether performed from the neck or the mouth, increases the risk of neurovascular injury and tumor spillage. To overcome these limitations, the authors utilize a combined approach with transcervical endoscopic dissection of the lesion through a small skin incision, followed by transoral robotic removal of the tumor (unpublished data). The technique enables release of the lesion from the neurovascular structures and muscles and safe peroral removal of the intact tumor using the da Vinci robotic system (Intuitive Surgical, Inc., Sunnyvale, CA).

The indications for this approach are (1) high small pleomorphic adenomas, (2) large pleomorphic adenomas of the PPS, and (3) symptomatic PPS schwannomas. Tumors with a large poststyloid extent or in close proximity to the carotid artery should be dissected under direct visualization to avoid vascular injuries. Combining the transcervical endoscopic technique with the transoral robotic approach allows for precise inferolateral dissection along the carotid artery as it passes through the PPS.

The procedure starts with the transcervical endoscopic dissection. The patient is positioned supine with a horizontally oriented shoulder roll in place. The patient's head is turned away from the operative side, and the table is rotated with the operative side away from the anesthesia machine. At this stage, no muscle relaxation is administered to facilitate CN XI identification. Along a transverse skin crest, 4 cm below the mandible, perform a 2.5 cm skin incision (Fig. 13.8). A superior subplatysmal flap is elevated to the level of the mandible (Fig. 13.9). In some cases, the submandibular gland should be excised to enhance exposure (Fig. 13.10). The posterior belly of the digastric muscle is identified, and dissection is performed along the medial aspect of the sternocleidomastoid muscle until the accessory nerve is identified (Fig. 13.11). Next, the hypoglossal nerve is identified and mobilized, and the internal jugular vein, common carotid artery, and vagus nerve are identified. The posterior belly of the digastric and stylohyoid muscles are then divided, and the styloid process with the stylomandibular ligament is divided to improve exposure.

At this stage, a 0° endoscope (KARL STORZ, Tuttlingen Germany) is delivered through the tunnel into the depth of the surgical incision (Fig. 13.12). The medial pterygoid muscle is visualized and dissected along its length to access the poststyloid space, while preserving the ascending pharyngeal artery and the hypoglossal nerve (Fig. 13.13). At this step, dissection along the inferolateral aspect of the tumor capsule is performed, to expose and define its upper limit (Fig. 13.14). The dissection is performed in parallel and anteriorly to the internal carotid artery superiorly up to its attachment to the skull base, avoiding the hypoglossal nerve (Fig. 13.15). After releasing the tumor (Fig. 13.16), the wound is irrigated and covered with moist gauze. Complete circumferential dissection is achieved with the complementary TORS approach described above. During the transoral resection, an assistant might apply external pressure on the tumor via a cervical wound to enhance tumor visualization. After resection, the cervical wound is irrigated and hemostasis is confirmed. The wound is closed over a suction drain with a 4-0 absorbable subcutaneous suture and a 5-0 nylon interrupted skin suture.

Fig. 13.8 The patient is placed in a supine position with his neck extended and rotated to the contralateral side. A 3 cm skin incision is made along a transverse skin crest, approximately 4 cm below the mandible

Fig. 13.9 A superior subplatysmal flap is elevated to the level of the mandible

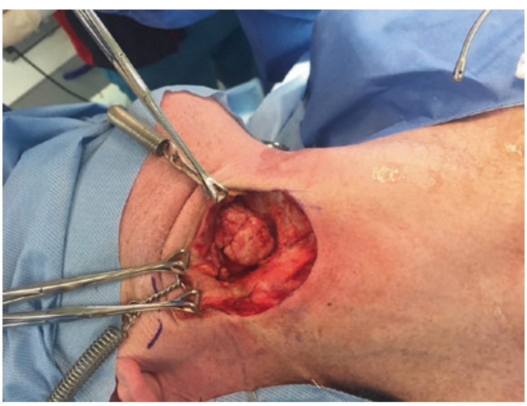

Fig. 13.10 The submandibular gland is exposed. It should be excised to enhance exposure after identifying facial vessels, hypoglossal nerve, and lingual nerve

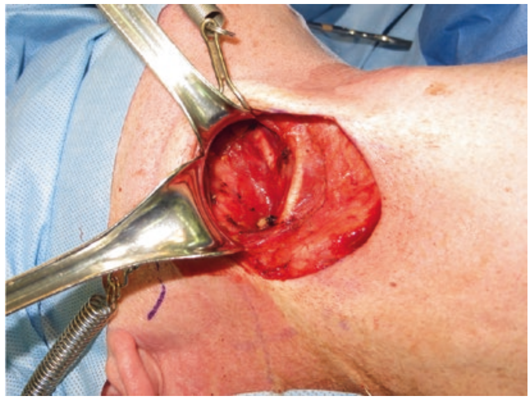

Fig. 13.11 The posterior belly of the digastric muscle, the medial aspect of the sternocleidomastoid muscle, the accessory nerve, the hypoglossal nerve, and the lingual nerve are identified and preserved

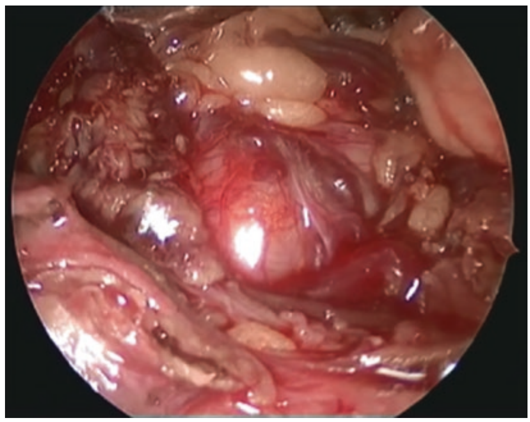

Fig. 13.12 A 0° endoscope is introduced into the depth of the surgical incision.

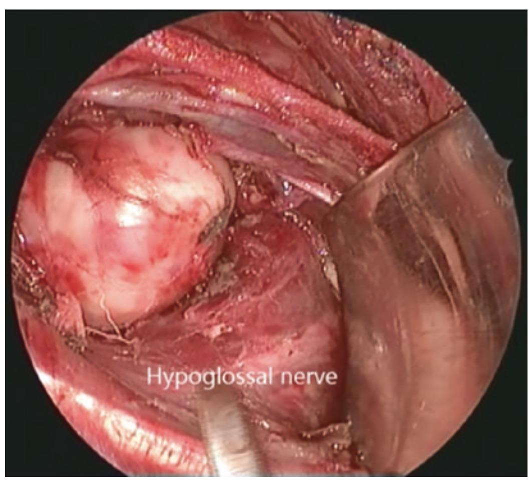

Fig. 13.13 The dissection is performed in parallel and anteriorly to the internal carotid artery, superiorly up to its attachment to the skull base, avoiding the tumor

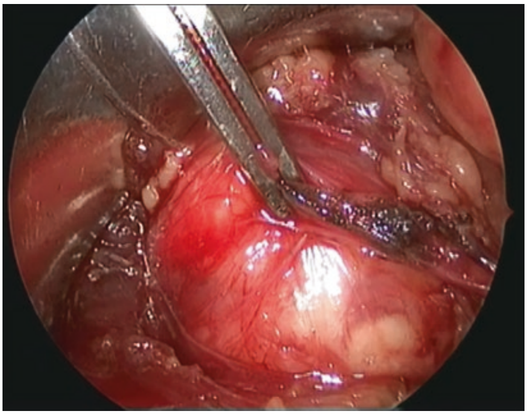

Fig. 13.14 The tumor, still tethered by surrounding tissues, is released circumferentially at the extracapsular plane

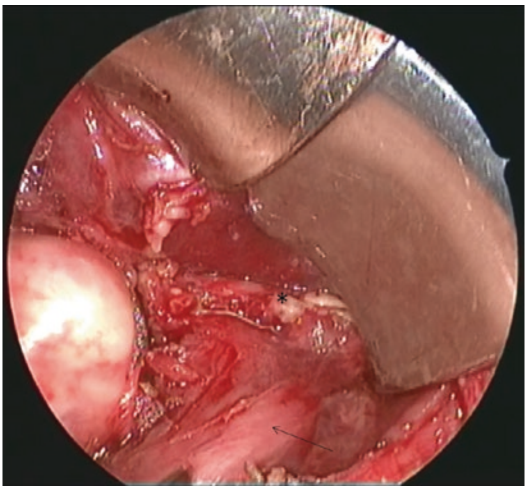

Fig. 13.15 Hypoglossal nerve (*black arrow*) and lingual nerve (*black asterisk*) are identified and preserved

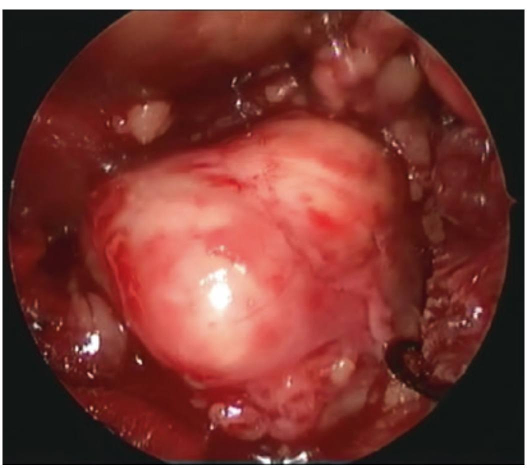

Fig. 13.16 The tumor inferolateral aspect is completely dissected at its capsule, to expose and define its surrounding limits

13.6 Postoperative Management

The patient is extubated and immediately transferred to the postsurgery care unit before transfer to the ward. Prophylactic antibiotic treatment is not indicated in the postoperative period. For pain control, patients are treated with nonsteroidal anti-inflammatory drugs (diclofenac 75 mg intramuscularly or orally) once daily or with tramadol 40–100 mg if requested by the patient or considered necessary by the nurses. Patients begin an oral diet on the following day and are discharged 1 or 2 days after the surgery. If drains are placed, they are removed on postoperative day 1 or 2.

13.7 Discussion

The complex 3D architecture of the PPS and various structures passing within it constitute the more challenging aspects in head and neck surgery. The technique described here provides safe dissection within this area. Tremor filtration, angled instrumentation, and increased freedom of instrument movement are ideal when approaching the PPS. Compared with conventional techniques, TORS allows for more delicate handling of tissues, hence healthy tissue preservation. The improved optics with 3D visualization of TORS, including the use of a stereo-optic 0° or 30°camera, enable identification of the important structures that are at risk and locate them in their 3D context prior to excision. As an individual's experience with the robotic technique increases, the need for identification of some structures may diminish under certain circumstances and shorten surgical time. Increased surgical precision enables precise resection with clear surgical margins and the potential sparing of adjuvant treatment in some patients.

Conclusions

Robotic surgery is rapidly becoming integrated into transoral head and neck surgery. As surgical robotics advances, instruments will become smaller and less expensive, and the technology will become available at peripheral medical centers. These advances will improve treatment of tumors in the parapharyngeal space, with minimal morbidity and excellent functional and cosmetic outcomes.

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