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Conference Paper

Endoscopic-assisted Transoral Approach to Parapharyngeal Space Tumours

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Abstract: Parapharyngeal space tumours are rare, mostly benign and present few symptoms, being difficult to diagnose it early. CT scan and MR are necessary for topographical diagnosis. Surgical resection is the best possible treatment option, but the approach remains a challenge, as there are several vital elements contained in the parapharyngeal space and, thus, adequate visualization is needed. Different surgical approaches have been described: transcervical-submandibular, transparotid, transmandibular, transoral and combined approaches. Transoral approach is the most controversial one due to cited limited exposure, which can lead to neurovascular injury or incomplete removal of the lesion. It is seldom performed and only for small, extra-parotid and non-vascular tumours of the parapharyngeal space. Wide access to endoscopic equipment in our institute allowed us to perform medium to large benign parapharyngeal tumour resection usig the transoral approach. The use of endoscopic assistance for transoral approach provided direct and magnified visualization of the parapharyngeal space, reducing tissue damage, ensuring adequate hemostasis (which lead to less amount of bleeding) and also confirming complete resection prior to closure. In addition, compared to transcervical approach, transoral approach shortened hospitalization time and improved cosmetic appearance. Benign parapharyngeal space tumours not involving critical structures from the parapharyngeal space can be completely resected by an endoscopic-assisted transoral approach with good functional and cosmetic outcome.

Keywords: Parapharyngeal, Transoral, Endoscopic

1. Introduction

Parapharyngeal space (PPS) is a challenging anatomic region hidden in the depth of the neck, containing vital structures and having limited access. Its content is heterogeneous and, therefore, tumours that develop in this space are diversified. Most of them are of salivary or neurogenic origin, although metastatic lesions, lymphoreticular lesions and a variety of uncommon masses may arise in this location [1, 2]. They are rare tumours, representing less than 1% of all head and neck neoplasms. 70–80% are benign, while 20–30% are malignant [3]. The clinical presentation is often as an asymptomatic bulge medially displacing oropharyngeal structures or as an asymptomatic neck mass, remaining undetected for a long period of time. Sometimes, other variable symptoms may appear: dysphagia, dyspnea, obstructive sleep apneea, unilateral conductive hearing loss, deficit of cranial nerves IX, X, XI, XII, Horner's syndrome, pain, trismus, symptoms of catecholamine excess [4, 5]. Pain is unusual with benign lesions and may be due to compression or hemorrhage into the lesion; however, pain and neurologic dysfunction are more often indicative of

malignancy with infiltration of the skull base. Also, trismus results from malignant invasion of the pterygoid musculature [5].

The CT and MR scan can provide excellent imaging of the parapharyngeal space. The imaging characteristics and anatomic location of the tumour (prestyloid or poststyloid compartment) can help in diagnosis and also in choosing the right approach [6].

Fine needle aspiration cytology (FNAC) is helpful, with a diagnostic accuracy of 73.1% [1], but it cannot be performed in cases of suspicion of a vascular tumor such as a paraganglioma.

Angiography may be required in specific cases of vascular tumours, especially for the carotid body and glomus tumours where there is the higher chance of neurovascular damage. In these cases, MR angiography can help to look for the predominant vascular involvement and the spatial relationship of the tumour to the great vessels [7].

The PPS is a space situated lateral to the upper pharynx, shaped like an inverted pyramid, extended from the skull base (superiorly) to the greater cornu of the hyoid bone (inferiorly). The parapharyngeal space is limited as it follows (Figure 1):

1. Superior: the skull base.
2. Posteromedially: the prevertebral muscles.
3. Anteromedially: the superior pharyngeal constrictor muscle.
4. Laterally: the condyle of the mandible and the medial pterygoid muscle.

The parapharyngeal space consists of two compartments: prestyloid (anteromedial) and poststyloid (posterolateral), separated by the styloid process, tensor veli palatini muscle and its fascia (Figure 1).

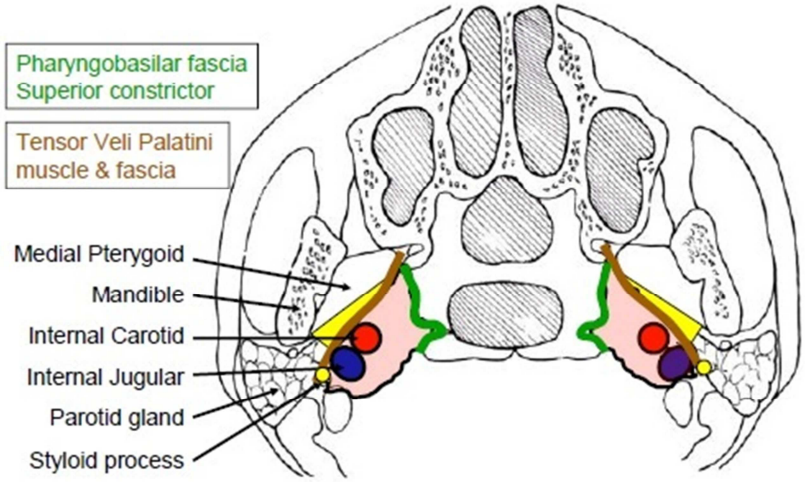

Figure 1. *Axial view of the prestyloid (yellow) and poststyloid (pink) compartments of the parapharyngeal space, separated by the styloid diaphragm (brown) [8].*

Prestyloid space contains: mainly adiposse tissue, the retromandibular portion of the deep lobe of the parotid gland and lymph nodes associated with the parotid gland. On CT or MRI, prestyloid tumours displace the PPS fat anteromedially and the carotid sheath posteriorly. Patients typically present with a bulge of the lateral oropharynx, displacing the tonsil medially. Most PPS tumours in the prestyloid compartment have salivary origin.

Poststyloid space contains: the internal carotid artery (ICA), the internal jugular vein (IJV), IX– XII cranial nerves, the sympathetic chain and lymph nodes [9, 10]. On CT or MRI, poststyloid tumours typically displace the PPS fat anterolaterally and the internal carotid artery in an anteromedial direction [11]. Patients typically present with a mass extending into the upper lateral neck, in the lateral oro- or nasopharynx, or with the dysfunction of IX-XII cranial nerves, or with Horner' syndrome. The most commonly encountered tumours in this space have neurogenic origin.

Surgery is the main therapy option for PPS tumours. The choice of surgical approach depends on the size of the tumour, its location, its relationship to the great vessels, and the suspicion of malignancy [3, 4] and it should meet a wide intra-operative visibility for safe radical dissection and minimal functional or cosmetic morbidity [12]. A variety of surgical approaches have been described: the transcervical approach, the transparotid approach, the transcervical-transmandibular approach, and combinations of the above [13]. The transoral approach is the most controversial one as it offers poor exposition and does not give adequate control in the event of a haemorrhage. It is seldom performed and only for small, extra-parotid and non-vascular tumours of the parapharyngeal space.

Recent technological innovation adopted in other areas, such as robotic or endoscopic surgery, made possible the resection of wider PPS tumours using the transoral approach [14]. Several studies have suggested the feasibility of transoral robotic surgery (TORS) for the resection of appropriately selected parapharyngeal tumours [15]. Favorable characteristics for TORS resection include benign pathology, lack of poststyloid extension and close proximity to the pharyngeal constrictor muscle and oral mucosa [16]. Other authors have suggested that combining the transoral

approach with a transcervical approach, as well as incorporating endoscopic techniques, can be useful in resecting tumors in the PPS [17, 18]. Endoscoic equipment provides direct and magnified visualization, less amount of bleeding, reduced tissue damage, improved cosmetic appearance, fewer wound-related complications and less postoperative morbidity [19].

Other primary treatment options for malignant tumours of PPS are radiotherapy and chemoradiation. Post-operative radiotherapy can be an option, too [1].

Postoperative complications after surgery of the PPS include cranial nerve injury, tumor spillage, infection, Horner's syndrome, first bite syndrome, trismus, hematoma, vascular injury, dysphagia, and Frey's syndrome. According to literature, the most common complication is injury to the vagus nerve and the risk of postoperative cranial nerve deficit is higher in patients with malignancies or neurogenic lesions [12, 20]. When compared with the traditional transcervical approach, the endoscopic transoral approach may also have potential complications like tumor spillage, neurovascular injury and infection.

2. Methodology

We propose the transoral approach to PPS tumours, along with direct visualization of the surgical field with the assistance of endoscopic surgery and image guidance.

As a preliminary step to the surgical procedure, it is mandatory to visualize the fundamental endoscopic anatomic landmarks of this region as the field may be complicated by the distortion of the PPS due to the tumour's presence.

2.1. Endoscopic Anatomy of PSS

2.1.1. Prestyloid Compartment

The transoral approach of PPS tumours is similar to an extended tonsillectomy. After the insertion of a mouth gag, an intraoral incision is made, from the posterior edge of the hard palate, passing along the lateral edge of the soft palate and the medial edge of the glossopalatine arch, to the posterolateral aspect of the tongue base. Under endoscopic view, the mucosa, submucosa and the superior pharyngeal constrictor muscle are sequentially identified, sectioned and retracted medially to enter the prestyloid space. Laterally, the medial pterygoid muscle is identified as the lateral surgical landmark together with its tendon easily recognizable (Figure 2). The area between the medial pterygoid muscle (laterally) and superior pharyngeal constrictor muscle (anteromedially) represents the prestyloid space; it is usually occupied by fat and some blood vessels that suply the tonsillar fossa. After carefully removing the fat tissue in the prestyloid space, one can gain access to the poststyloid space. Running along the medial side of the medial pterygoid muscle, the styloid diaphragm (SD) becomes visible. The SD is a key anatomic landmark for the transoral approach to the PPS that separates the prestyloid and poststyloid compartments. It is a thick gray fascia extending from the styloid process and contains the styloid group of muscles (stylohyoid, styloglossus, and stylopharyngeus), the posterior belly of the digastric muscle and stylomandibular ligaments [21].

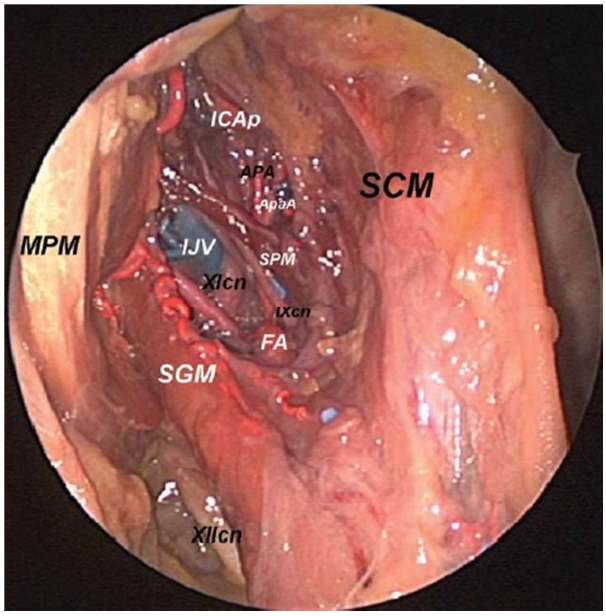

Figure 2. *Anatomic dissection showing the critical role of the styloglossus muscle (SGM), stylopharyngeus muscle (SPM), and superior pharyngeal constrictor muscle (SCM) in the transoral approach to the parapharynx. APA- ascending pharyngeal artery; ApaA- ascending palatine artery; FA- facial artery; ICAp- parapharyngeal portion of the internal carotid artery; IJV- internal jugular vein; MPM- medial pterygoid muscle; IXcn- glossopharyngeus nerve; XIcn- spinal accessory nerve; XIIcn- hypoglossal nerve [22].*

Stylopharyngeus and styloglossus muscles are important elements of the styloid diaphragm (Figure 2). In Iacopo Dallan's anatomic report [22], it is underlined the role of the stylopharyngeus muscle and the styloglossus muscle as cardinal points for orientation in parapharyngeal space. Deep-lobe parotid tumours or ectopic salivary gland tumours classically occupy the prestyloid space and their growth displaces the other anatomic elements posteriorly: in these cases, the styloglossus muscle and stylopharyngeus muscle can be considered the safe posterior boundary of the dissection that protects the important anatomic structures of the poststyloid space (ICA, IJV, cranial nerves).

2.1.2. Poststyloid Compartment

Behind the styloid diaphragm lies the poststyloid compartment. In the space between the stylopharyngeus muscle and the superior pharyngeal constrictor muscle, the dissection becomes more complex because, among the fat, the area is occupied by the pterygoid venous plexus; it is extreme variable, so dissection should be done as carefully as possible. Once the pterygoid plexus is removed, the surgical corridor between the two muscles gives direct access to the internal carotid artery (Figure 2). Moreover, the ICA can be easily identified on the lateral surface of the superior pharyngeal constrictor muscle. Lateral to the ICA is the internal jugular vein. The recognition of these two vital elements represents the key point to perform poststyloid tumour removal safely. In the small angle comprised between

these 2 major vessels, the initial exocranial portion of the lower cranial nerves (IX through XI) can be seen. The most medial of the 3 nerves is typically the glossopharyngeal nerve (IX). The vagus nerve (X) is consistently found in the posterior carotido-jugular angle. Its identification is possible only by means of a gentle dissection and after stretching apart the 2 vessels [22].

Endoscopic assisted transoral approach can provide a direct route to the middle and lower PPS. Also, adequate access to the upper PPS can be achieved by using angled endoscopes (30˚ or 45˚). However, it is difficult for the endoscopic transoral approach to expose the area around the Eustachian tube; this can be achieved via transnasal transpterygoid endoscopic assisted approach, which can provide a direct route to the upper PPS [21].

A cadaver study by Ferrari et al indicated that in parapharyngeal space surgery, the upper PPS can be exposed via the transnasal approach, while exposure of the middle PPS, allowing minimization of the neurovascular structures crossed, can be achieved with the transoral approach and the entire PPS can be exposed through the transcervical (transcervical, transparotid, transmandibular, transmastoid) approach [23]. When choosing the right approach, two important considerations are vascular control and exposure of the cranial nerves.

2.2. Case Report

We present a case of a 19 years old female pacient with a large parapharyngeal space tumour which clinically developed as an oral mass medially displacing the right lateral wall of the oropharynx. She related symptoms of a sore throat that lasted for the past 2 years and was repeatedly treated with antibiotics due to a suspected chronic amigdalitis. The treatment was uneffective.

In the moment of the examination, she had no fever or general fatigue. Clinical exam of the oral cavity and pharynx revealed a bulge in the posterolateral wall of the oropharynx, displacing the palatine tonsil in an anteromedial direction and a mild degree of erythema of oropharyngeal mucosa, without any local edema (Figure 3). Fiberoptic examination of the nasopharynx revealed the extension of the oropharyngeal mass up to the inferior pole of the right Eustachian tube. The mucosa was normal and there were no other modifications found in the hypopharynx or larynx. No neck lymph nodes were palpated, but instead, a precisely delimited oval shaped hard tumour could be palpated under the right mandibular region and it seemed to correspond to the oropharyngeal mass. A parapharyngeal tumour was suspected. The MRI put the diagnostic. The contrast enhanced MR images showed a clearly limited, oval-shaped lesion in the right parapharyngeal space, with heterogenous structure, presenting several small central areas of necrosis. The size of the tumour was 68/44/36,5 mm and it extended from the pterygomaxilary fosa superiorly to the hyoid bone inferiorly, imprinting the tongue base and the lateral pharyngeal wall and displacing the vascular elements of PPS (ICA, IJV) posterolaterally (Figure 3).

The tumour had benign features, wasn't involving the critical structures in PPS and its clinical as well as imagistic characteristics suggested to be a prestyloid compartment tumour of PPS, so, the endoscopic assisted transoral approach was the first surgical option. The large dimension of the tumour was not an impediment, considering our previous experience with similar large PPS tumours. However, we discussed with the patient the possibility of an intraoperative conversion to a transcervical approach in case of insufficient space to remove the tumour completely or in case of hemorrhage. Also, we explained her the benefits, risks and complications of the transoral approach, as well as those of the alternative approaches.

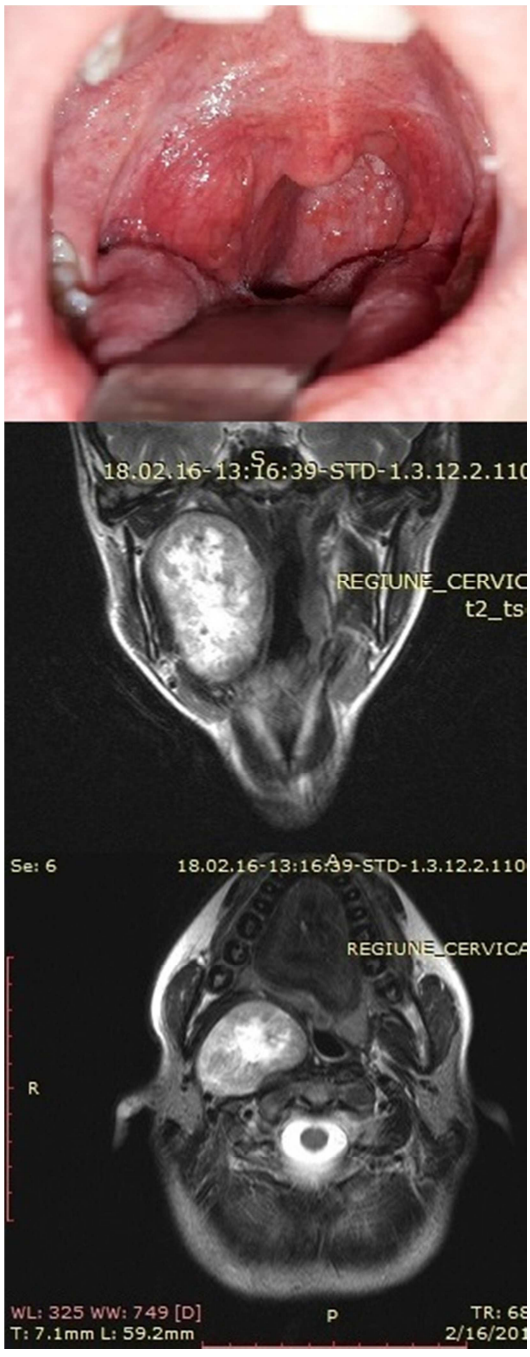

Figure 3. *Clinical and imagistic (MRI) aspects of parapharyngeal space tumour (prestyloid compartment).*

After the insertion of a mouth gag, an intraoral incision was made, from the posterior edge of the hard palate, passing along the lateral edge of the soft palate and the medial edge of the glossopalatine arch, to the posterolateral aspect of the floor of the mouth (Figure 4-1).

Under endoscopic view, the mucosa, submucosa and the superior pharyngeal constrictor muscle are sequentially identified and divided to enter the prestyloid space. Laterally, the medial pterygoid muscle is identified as the lateral surgical landmark. Usually, the prestyloid space is occupied by fat and some blood vessels. In this particular case, the prestyloid space was occupied by a well defined encapsulated tumour, that pushed the peripheral anatomic structures and the styloid group of muscles could not be identified. Therefore, once the incision was made on the oral mucosa and superior pharyngeal constrictor muscle, the blunt dissection was performed along the tumour's capsule, (Figure 4-2 and 4-3, Figure 5-A). The tumour was removed in one piece together with its capsule. After endoscopic control of adequate hemostasis and complete tumour resection, wound closure was meticulously done by layers (Figure 4-4, Figure 5-B). It was only need to use the 0˚ endoscope.

The specimen was sent to histopathological examination and resulted to be a schwannoma (Figure 5-C). Immunohistochemical tests confirmed the diagnostic of schwannoma.

Postoperative management included airway observation during the first postoperative day (because significant upper airway edema may result from surgical manipulation of the oral cavity and oropharynx, causing obstruction), perioperative steroid therapy, and intravenous antibiotics during the hospitalization period. The patient started on a liquid diet in the first postoperative day and was limited to a soft diet for 2 weeks.

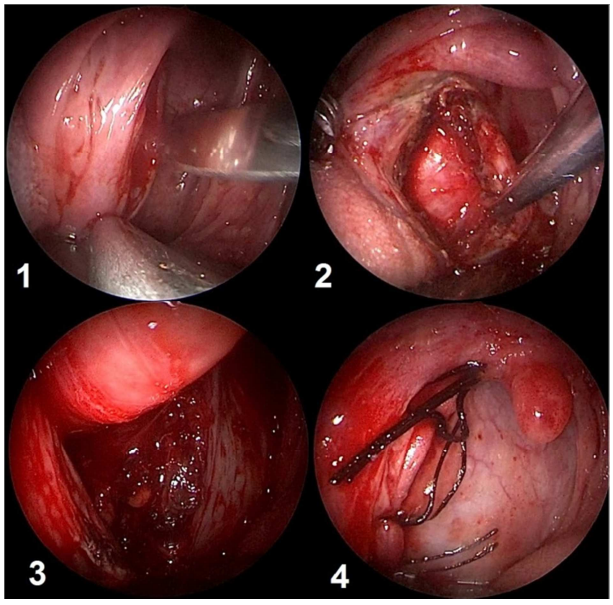

Figure 4. *Intraoperatory endoscopic images of PPS tumour resection (prestyloid compartiment) using endoscopic-assisted transoral approach. 1- incision; 2- dissection of the prestyloid space tumour; 3- half-removed tumour, leaving PPS free of tumour; 4- wound closure.*

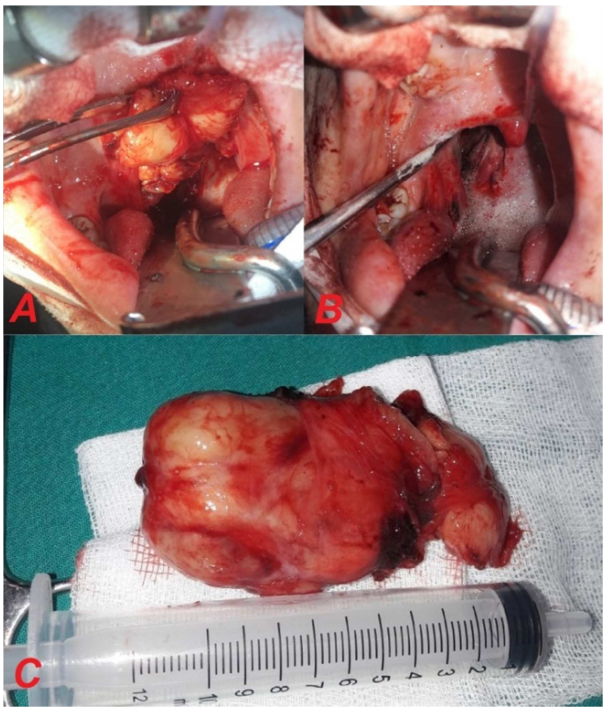

Figure 5. *Intraoperatory aspects of prestyloid PPS tumour resection with transoral approach. A- during the removal; B- PPS after the removal of the tumour; C- the removed tumour (schwannoma).*

Postoperative mild right palpebral ptosis and miosis were observed; the pacient declared no anhydrosis. Horner's syndrome might have resulted from injury to the cervical sympathetic chain.

3. Discussions

In cases that do not require extensive access, such as prestyloid benign tumours that can generally be removed by careful blunt dissection along the tumour's capsule, the transoral approach can offer the least amount of trauma: absence of facial scar, of osteotomies, of facial nerve injury, minimal post-operatory morbidities and immediate recovery of function.

The biggest disadvantage of transoral approach to PPS tumours is that the neck is not open and the vessels are not exposed widely in the event of a vascular injury. Hence, this approach requires appropriate patient selection.

It is recommendable not to use the transoral approach for malignancies, for tumours invading the bony skull base or invading intracranially, for vascular tumours or for tumours surrounding the facial nerve. In these cases, an open approach may be better suited.

When compared with the traditional transcervical approach, the endoscopic transoral approach may also have potential complications including: tumor spillage, neurovascular injury and infection.

Therefore, the patients should be selected appropriately and they should be informed about the benefits, risks and potential complications of the procedure, as well as about the possibility of a subsequent conversion to an external approach, if necessary.

4. Conclusions

Traditional surgeons were considering transoral rout to the parapharyngeal space as poor and unsafe, as it has limited exposure and possibility of neurovascular injury. Nevertheless, with the aid of video-endoscopic assistance, transoral route can now provide direct and magnified visualization of the lesion and anatomical elements of PPS. This allows excision of sizable benign tumours near critical anatomical structures and leads to a fast postoperative recovery of the patient. In order to perform this approach, the surgeon must have a comprehensive understanding of endoscopic anatomy of PPS and well developed surgical skills. Recognizing the key anatomical landmarks of PSS allows to perform the surgery safely.

Every case of parapharyngeal tumour should require distinct approach, after careful evaluation of risk-benefit ratio. When there is suspicion of malignancy, involvement of neurovascular structures or unreasonably large tumour, then the external approach is necessary in order to remove the tumour completely and safely. Otherwise, when tumour is benign and not involving the critical structures in PPS, the endoscopic assisted transoral approach should be one of the primary surgical options.

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