CASE REPORT

Transoral (transvestibular-paramandibular) endoscopic approach for benign tumours in the infratemporal fossa

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SUMMARY

We describe a minimally invasive transoral approach to the infratemporal fossa, by means of endoscopy, which facilitates examination and resection of lesions in this area. Furthermore, we outline the technique employed and a case treated with this approach, which permits a rapid access with very low patient morbidity, due to the use of endoscopy and of transoral access, instead of traditional transfacial approaches.

BACKGROUND

Schwannomas are slow-growing benign tumours. Sixty per cent of them come from the neurilemma of the cranial nerves, most frequently affecting the sensory nerves. Generally, schwannomas constitute around 8%–10% of intracranial tumours, most frequently in the superior ramus of cranial nerve VIII, and much less commonly, deriving from cranial nerves V, IX, X and VII (in descending order). The ones originating from the trigeminal nerve represent 0.8%–8% of all intracranial schwannomas. They may arise from the trigeminal nerve root, the Gasserian ganglion or one of the three peripheral branches.¹ The infratemporal fossa (ITF) is a retromaxillary space, where neoplasms may appear, either primary or secondary to adjacent regions, such as the middle cranial fossa, orbit or the maxillary sinus. To access the area, surgeons traditionally used approaches such as transfacial through transmandibular anterior corridor and transcranial lateral and posterolateral corridors.² Neurosurgeons have described endoscopic transpterygoidal approaches via the transmaxillary corridor to reach the ITF. The latter endoscopic approach is recommended as a minimal access, less invasive alternative to transsphenoidal, transcranial or transfacial approaches to the cranial base.³ The benign behaviour of schwannomas makes the transoral (transvestibular-paramandibular) endoscopic approach an excellent alternative for removal, with much lower morbidity.

CASE PRESENTATION

A 41-year-old male patient was admitted with right side tinnitus and headache developing over several years. No hearing loss, neuropathic pain or any other neurological symptoms were indicated by

the patient. MRI scan evaluation by the otorhinolaryngology and neurology departments revealed a 27.3 mm mass with benign characteristics, located in the ITF (figure 1). Our maxillofacial department was subsequently consulted. Clinical examination found no trismus, extraoral or intraoral palpable tumour, or any other significant findings. There was no clinical or radiological evidence pointing towards a specific nervous branch, but its location suggested it would probably be a branch of V3 (mandibular nerve). A fine needle aspiration was requested, and in view of the results, alongside the radiological characteristics of the mass, the tumour was diagnosed as a schwannoma. A transoral (transvestibular-paramandibular) endoscopic approach was chosen for the tumour exeresis.

TREATMENT

Surgical technique began with a mucoperiosteal incision in the retromolar trigone, which continued ascending through the vertical ramus of the mandible, until it reached the insertion of the temporal muscle in the coronoid process. Once the incision was made, a subperiosteal dissection of the medial face of the mandible guided us to the ITF. We introduced the Cottle-Killian nasal speculum in this plane of dissection (figure 2). At this stage, moving towards the ITF, it was likely that the buccal fat pad would prolapse and impede view of the surgical field, so we positioned a Langenbeck separator at the superior region for retraction (figure 3).

A 5 mm diameter, 18 cm long, 0° rod panoramic wide-angle lens (HOPKINS II, Karl Storz Endoscopia Ibérica) was inserted in the surgical field and caudal dissection from the speculum was performed. The first structure we encountered was the medial pterygoid muscle. Retracting the muscle medially, we could identify an important surgical landmark, the inferior alveolar nerve along its fascial border. Following its course cranially, on its medial side we can identify the lingual nerve (figure 4). If we continue both superiorly, we get to the oval foramen.⁴

The lateral pterygoid muscle occupies most of the ITF. As we manipulated and exposed the muscle, we found the pterygoid plexus and the maxillary artery with its ramus. Adequate bleeding management is of utmost importance at this point. The pterygoid plexus is easily controlled with haemostatic

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Figure 1 Preoperative MRI reveals an ovoid, lobed, encapsulated, well-defined tumour measuring 2×1.5×2.7 cm in the right infratemporal fossa (ITF), with heterogeneous T2 signal and late heterogeneous enhancement. No signs of invasion of adjacent structures or anatomical spaces.

agents, mainly bipolar electrosurgical instrument, whereas major arteries should be retracted or ligated. We proceeded to divide the lateral pterygoid muscle with blunt dissection, without the need for muscular resection, and in between its two heads we are able to expose the roof of the ITF and identify structures such as the middle meningeal artery entering the foramen spinosum.⁴

Once the tumour was completely in our field of view, we identified a well-defined and encapsulated neurofibroma (figure 5). Via blunt extracapsular dissection, we safely attain resection of the lesion (figure 6). After precautionary haemostasis, closure of the incision with absorbable 3-0 Vicryl rapid sutures was performed, with no drains left in the surgical site.

OUTCOME AND FOLLOW-UP

The patient was discharged after 48 hours with no complications observed, with adequate oral opening and without bleeding or nerve injuries. The patient was instructed on muscular and stretching exercises. Histopathology of the surgical piece confirmed the schwannoma diagnosis; a nodular and encapsulated lesion composed of fusiform cells and not well-defined cytoplasm. In our 2-year follow-up, no trismus or other sequels were observed (figure 7) and postoperative MRI scan revealed no tumour (figure 8).

Figure 2 Cottle-Killian speculum.

Figure 3 Transoral (transvestibular-paramandibular) approach exposing medial surface of the mandible (M) and the medial pterygoid muscle (MPM).

DISCUSSION

Historically, open access to the ITF with direct view has been the most used approach. Ugo Fisch introduced three surgical approaches in ITF surgery to access a progressively larger area of the fossa. It was clear that a greater field of view was attained.^{5 6} On the other hand, the temporal muscle, the parotid gland and the facial nerve are frequently mobilised. Moreover, on some occasions, these need to be used in combination with mandibular or orbitozygomatic osteotomies, increasing the risk of hearing

Figure 4 Exposure of the inferior alveolar nerve (IAN) and lingual nerve (LN) in the infratemporal fossa (ITF).

Figure 5 A well-defined and encapsulated tumour is revealed via blunt dissection.

loss, facial weakness and hypoesthesia, mastication difficulty and cerebrospinal fluid leakage.²

Schwartz *et al* classify endoscopic approaches via different corridors to reach different targets; in the specific case of the ITF, via the transmaxillary corridor and through the pterygopalatine fossa. It is a minimally invasive approach compared with traditional transfacial accesses. In order to expose the ITF, however, it is necessary to make an opening in the uncinate process, perform an antrostomy, open the ethmoid cells, ligate the sphenopalatine artery and drill the orbital process of the palatine bone, the posterior wall of the maxillary sinus and the pterygoid process. Special care must be taken not to damage structures such as the Vidian nerve, pterygopalatine ganglion, second division of the cranial nerve V or maxillary nerve and artery.³

Abuzayed *et al* describe a lateral sublabial endoscopic approach to the foramen ovale, via a corridor under the zygomatic process of the maxilla and lateral to the pterygoid plate. It provides adequate exposure to the ITF, without the need for bone removal, and permits visualisation of major structures such as the distal end of the maxillary artery and segments of the mandibular nerve, which also lead to the foramen ovale.⁷

In a cadaveric study, Yacoub *et al*⁸ recently trialed a double-portal endoscopically assisted lateral approach to the ITF. Based on Hartnick *et al*'s⁹ endoscopic approach, they add a posterior port, expanding the approach by increasing the working area and enabling a bimanual dissection technique, which among other advantages may improve bleeding control.

Figure 6 Surgical piece.

Figure 7 Photograph taken 7 years postoperative, showing adequate oral opening and imperceptible scar.

This provides good access to the posteromedial and far lateral areas of the ITF. However, in order to gain access to the first area, they detach the lateral pterygoid muscle from the skull base and require resection of the lower head, which may cause post-operative trismus.

As Yacoub states, these ITF areas may compliment trans-nasal anterior approaches, as they expose the undersurface of the greater wing of the sphenoid bone of the ITF, unlike lateral approaches. In cases of larger primary ITF tumours or contagious pathologies which spread from surrounding structures to the ITF, the combination of a lateral approach such as Yacoub's, with an anterior one, such as the transvestibular-paramandibular approach we recommend, may expose wider areas of the ITF with minimal invasiveness and help the surgeon resection increasingly complex lesions.

The use of endoscopy is currently a powerful tool for ITF and cranial base surgeries. As Chan *et al* describe, the transoral (transvestibular-paramandibular) approach is considered a minimally invasive technique for selected lesions compared with the former, permitting resection of tumours localised in regions of difficult access such as the ITF. Besides this, there is lower morbidity, improved tolerance in patients and quicker postoperative recovery in comparison with traditional approaches. Hence, the endoscopic approach is especially useful for resection benign lesions in the ITF, taking biopsies of malignant

Figure 8 Two-year postoperative MRI, showing absence of lesion.

Table 1 Comparison between classic open approaches and contemporary endoscopic approaches to the ITF: advantages and limitations

	Advantages	Limitations
ITF Classic open approaches	<ul style="list-style-type: none"> ▶ Wide exposure of surgical field. ▶ Better surgical control over surrounding structures. 	<ul style="list-style-type: none"> ▶ Greater morbidity and damage of healthy structures. ▶ Facial nerve injury. ▶ Cosmetic defects. ▶ Facial swelling. ▶ Trismus. ▶ CSF leak. ▶ Sigmoid or jugular vein thrombosis.
ITF Endoscopic approaches	<ul style="list-style-type: none"> ▶ Minimally invasive. ▶ Minimal or no bone removal (depending on approach). ▶ Localised lesions. ▶ Most approaches with no skin incisions. 	<ul style="list-style-type: none"> ▶ Narrow surgical field. ▶ Need for spatial orientation. ▶ Slow learning curve. ▶ Restricted exposure of structures outside the ITF.

CSF, cerebrospinal fluid; ITF, infratemporal fossa.

neoplasms and exploring the trigeminal nerve for rhizotomy or biopsies, among others.⁴

Tables 1 and 2 show a comparison of advantages and limitations between classic open approaches and endoscopic approaches, and lateral and anterior endoscopic approaches, respectively.

Intraoperative navigation seems a pretty interesting tool which helps localise important anatomic structures in the complex ITF, such as the internal carotid artery, especially once we have surgically traversed the lateral pterygoid muscle. It provides an

effective and safer approach. Nonetheless, systematic anatomical dissection and a perfect knowledge of the area and anatomical references are essential and the key to a satisfactory outcome.

As with every surgical technique, there are advantages and limitations. Endoscopic transoral approaches to the ITF offer access without the need for bone removal via a natural corridor between the maxilla and the mandible, which is wide enough to fit the endoscope and other surgical instruments. Once the narrowest region of the corridor is traversed, the endoscopic cone of light provides broad visualisation of the surgical field. In addition, the endoscope provides great depth perception of the surgical field. The Cottle-Killian speculum is easily handled and fixed into position. For our case, a straight endoscope was used, but angled endoscopes may also provide advantages.

There are also some limitations to the technique, such as a narrow bony corridor, mentioned above, which may restrict manoeuvrability. Furthermore, the technique does not afford complete exposure of the ITF. In addition, endoscopic approaches can be a handicap in the total resection of tumours in which oncologic margins are desirable, or in cases where the lesion is wrapped by a displaced carotid artery (or a ramus). The ITF is a complex anatomical area involving major structures that are immersed in the surgical field and that need to be preserved. The need for qualified personnel trained in this specific region and in endoscopy use may be considered another limitation.

Selection of the most suitable approach should always depend on the location of the lesion, as each approach has intrinsic advantages with regard to better manoeuvrability and visualisation of a specific area. Similarly, the approach should be chosen according to the pathology, opting for more aggressive approaches only when strictly needed, such as in complex cases,

Table 2 Endoscopic approaches to the ITF: advantages and limitations

	Advantages	Limitations
Lateral approaches		
Hartnick's monoportal approach	<ul style="list-style-type: none"> ▶ Good instrument manoeuvrability in the anterior and lateral compartment. ▶ Good visualisation of the posteromedial ITF. 	<ul style="list-style-type: none"> ▶ Lack of proper instruments to work along the cranial base curvature. ▶ Skin incisions.
Yacoub's double-portal approach	<ul style="list-style-type: none"> ▶ Bimanual dissection. ▶ Improved bleeding control (due to continuous suction capacity thanks to double port). ▶ Good instrument manoeuvrability in the anterior and lateral compartment. ▶ Good visualisation of the posteromedial ITF. ▶ No need for drilling of the pterygoid plate. 	<ul style="list-style-type: none"> ▶ Skin incisions (temporal pain with affection of the temporalis muscle). ▶ Resection of the lower head of the lateral pterygoid muscle is required for complete exposure of the medial boundary (trismus). ▶ Not indicated in large primary tumours or contagious pathologies as single approach (need for combined lateral with anterior approach). ▶ Less specialised surgical instruments. ▶ Applicability not demonstrated in a clinical setting.
Anterior approaches		
Transpterygoid	<ul style="list-style-type: none"> ▶ No external skin incision. ▶ Exposure of paramedian and midline structures (undersurface of the greater wing of the sphenoid bone). 	<ul style="list-style-type: none"> ▶ Resection of bone (enlarging the ostium of maxillary sinus, posterior wall of maxillary sinus and part of the pterygoid process). ▶ Hindered visualisation of posteromedial ITF, or need for greater invasiveness for equal exposure to lateral corridor, and more complications if so. ▶ Difficult manipulation of lateral ITF. ▶ Access-related complications: trismus, palatal anaesthesia, lacrimal dysfunction, septal perforation, alar collapse, lesion of Vidian nerve, pterygopalatine ganglion, or infraorbital nerve (V2).
Transvestibular-paramandibular	<ul style="list-style-type: none"> ▶ Small gingivobuccal incision without external scarring. ▶ Minimal tissue dissection. ▶ Broad visualisation and direct access to the ITF. ▶ Minimal or no bone removal. ▶ Viable alternative or adjunct for minimally invasive multiport surgery. 	<ul style="list-style-type: none"> ▶ Narrow surgical corridor (particularly in the horizontal axis) limiting the ease of instrument manoeuvrability. ▶ Possible trismus. ▶ Limited access to PPF, requiring PWMS resection and drilling of pterygoid plates. ▶ Limited control of parapharyngeal ICA.

ICA, internal carotid artery; ITF, infratemporal fossa; PPF, pterygopalatine fossa; PWMS, posterior wall of the maxillary sinus; V2, maxillary nerve.⁸⁻¹⁰

on need for close control of the surrounding structures or when extensive resections are required, always assessing the risk-benefit relation. Therefore, using endoscopy assistance to dissect tumours located in the ITF is possible in several ways, depending

Patient's perspective

The tumor was diagnosed accidentally. My only symptoms were tinnitus and headache. By means of a series of imaging tests and puncture I was informed that it was a benign tumor which needed removal, because these types of tumors grow, slowly, but keep on growing. They proposed an endoscopic approach with no external scars, and I accepted.

My stay at the hospital was only for a day and a half or two, which I sincerely appreciated. I had no real pain after surgery, except maybe a little mild discomfort which I could control perfectly with paracetamol. For the first week or so I ate soft and tender meals, not because I had any pain or couldn't eat, but because I preferred to be cautious. Within a few weeks I was eating normally. The stitches fell off on their own, which was also appreciated.

Frankly, I am very happy with the surgery results. My life is exactly the same, but without the tumor!

Learning points

- ▶ Schwannomas are slow-growing benign tumours arising from the neurilemma, most commonly of sensory nerves.
- ▶ The infratemporal fossa (ITF) is an anatomically complex retromaxillary space containing major structures of difficult surgical access, such as the internal carotid and maxillary artery, pterygoid plexus and trigeminal rami.
- ▶ Endoscopy is a secure and minimally invasive surgical approach system, which makes it an option to consider in selected tumours located in areas with difficult access such as the ITF.
- ▶ Transoral endoscopic access results in lower morbidity, improved tolerance in patients and quicker postoperative recovery than traditional approaches.
- ▶ An endoscopic approach has limitations, such as the need for trained personnel, as well as the fact that not all tumours are endoscopically resectable.

on the surgical objectives, extension, consistency and nature of the tumour.

A combination of different approaches should sometimes be considered a feasible option when wider resections or greater visualisation is required.

The transvestibular-paramandibular endoscopic access to the ITF is a minimally invasive technique which should be among the first options considered in selected pathologies such as the case we present, always preceded by a thorough evaluation of the characteristics of each case.

Contributors All authors reviewed the literature of the previous surgery and discussed as a multidisciplinary committee the best possible approach to resect the lesion. Likewise, everybody was involved in the surgery procedure. MPT is the main surgeon. JTG and MMM provided surgical assistance. FJGC contributed with expertise providing guidance with endoscopy. Follow-up was carried out by MPT. JTG, MPT and MMM reviewed the literature for the writing of the manuscript. JTG wrote the manuscript, with supervision of MPT, MMM and FJGC.

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