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Clinical Study

# Endoscopic endonasal management of trigeminal schwannomas extending into the infratemporal fossa

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ABSTRACT

Extracranial trigeminal schwannomas extending into the infratemporal fossa are rare. The traditional surgical approaches to the infratemporal fossa are associated with complications, such as facial nerve dysfunction, hearing loss, dental malocclusion and cosmetic problems. We report eight patients (four males, four females, age range = 31–62 years) who were treated between 2004 and 2009 for extracranial trigeminal schwannomas extending into the infratemporal fossa. Schwannomas were surgically removed using a purely endoscopic endonasal approach. The maximum diameters of the tumours ranged from 30 mm to 70 mm and all tumours were completely removed. There were no intraoperative or postoperative complications in this series. There were no recurrences during the follow-up period which ranged from 10 to 74 months (mean = 30 months). The purely endoscopic endonasal approach may provide a minimally invasive and safe approach to remove extracranial trigeminal schwannomas extending into the infratemporal fossa. Radical resection was associated with an excellent long-term outcome in this series.



## 1. Introduction

Trigeminal schwannomas arising from the distal branches of the trigeminal nerve with extracranial extension (Jefferson's Type D tumours) are rare; only 61 patients have been reported in the English literature since 1955. Surgery is the preferred treatment for this tumour and all types of trigeminal schwannoma can be cured if the tumour is removed completely. Surgical approaches are chosen depending on the type of tumour extension. For Type D tumours, the middle fossa extradural approach, infratemporal extradural approach, transmaxillary approach, transmandibular approach and transcervical approach have been used.[1–10] However, these approaches have a risk of complications, including cosmetic problems, facial nerve dysfunction, hearing loss, dental malocclusion and lacrimal dysfunction. We report eight patients who underwent removal of Jefferson's Type D trigeminal schwannoma using a purely endoscopic endonasal approach. The surgical technique and the results of follow-up were reviewed retrospectively.

## 2. Materials and methods

Between November 2004 and July 2009, eight patients (four male, four female, mean age = 27.6 years, range = 31–61 years) with extracranial trigeminal schwannomas extending into the infratemporal fossa were surgically treated using a purely endoscopic endonasal approach. The major symptoms and signs were as follows: facial numbness (six patients), headache (three), hypopsia (three), hearing loss (three), facial sensory disturbance (two), masticatory muscle dysfunction and atrophy (one), nasal obstruction (one), toothache (one), tinnitus (one) and dysosmia (one).

### 2.1. Surgical technique

The surgical technique involved 0° and 30° wide-field endoscopes that were 4 mm in diameter and 18 cm in length (Karl Storz, Tuttlingen, Germany). All patients were placed in the supine position with their heads elevated. The bilateral nasal membranes were decongested twice by insertion of cotton pieces soaked with 1% dicaine and 1:100 000 adrenaline.

If the lesion was on the patient's right side, the bilateral transnasal approach was used, namely, the "three- or four-handed technique". The primary surgeon operated through the right nasal cavity, and the second surgeon worked at the appropriate angle. Continuous suction was used to keep the surgical field clear through the left nasal cavity while the surgery was performed. If the lesion was on the patient's left side, in most instances we used the three-handed sino-nasal cavity approach as an alternative. Part of the middle turbinate was removed to expose the paraclival region and pterygoid process. The posterior septal artery, originating from the lateral sphenopalatine artery and lying between the anteroinferior wall of the sphenoid sinus and the posterior septum, was

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coagulated first. The inferior turbinate was crushed or cut with scissors. An incision was made through the posterior septal mucosa to expose the rostrum of the sphenoid sinus. Excessive bleeding was controlled with bipolar forceps (Karl Storz). When the anterior wall of the sphenoid sinus was removed, the landmarks on the posterior wall of the sphenoid sinus, including the sellar floor, optic nerve protuberance, internal carotid artery (ICA) protuberance, clival indentation and optic-carotid recess, were exposed and identified. The uncinate process was removed to open the maxillary sinus and expose the posterior wall of the maxillary sinus and the inferior wall of the orbit. The posterior wall of the maxillary sinus involved was usually pushed forward or thinned by a large tumour extending to the pterygopalatine fossa or the infratemporal fossa. The bone of the posterior wall of the maxillary sinus was removed using a diamond drill, elevator and rongeur to expose the boundaries of the tumour. If necessary, the bone of the inferior wall of the orbit, pterygoid process, foramen rotundum and foramen ovale were removed laterally to the optic-carotid recess so the boundary between the tumour and the dura of the lateral skull base could be identified clearly. The internal maxillary artery, which was always pushed anteriorly and inferiorly by the tumour, was divided after coagulation to avoid excessive bleeding during removal of the tumour. The tumour was separated with an elevator, and appropriately angled suction was maintained along the plane between the tumour and the dura of the lateral skull base and other surrounding structures. Usually, the tumour could be dissected from the nerve, and the nerve was preserved as it entered from the foramen rotundum or the foramen ovale. Thus, total removal of the tumour was achieved. It was also feasible to remove the capsule after an intracapsular excision. After tumour resection, haemorrhage from the pterygopalatine fossa venous plexus was controlled by compression with absorbable haemostatic gauze and dry gauze. Bleeding from the maxillary artery was controlled by coagulation during compression with dry gauze. After the bleeding ceased, the surgical field was irrigated with antibiotics. The surgical field was examined for residual tumour with 0° and 30° wide-field endoscopes. A gelatin sponge and absorbable haemostatic gauze were used to cover the surgical cavity, which was then packed with iodoform gauze. The dura defect was repaired using autologous muscle, fascia and artificial dura.

### 2.2. Follow-up

All patients underwent axial, coronal and sagittal MRI examinations preoperatively and 10 days, three months and every year postoperatively to identify residual or recurrent tumour. Total removal was defined based on the intraoperative view and a postoperative MRI showing no residual tumour. If residual tumour was detected by MRI, the removal was defined as subtotal or partial.

## 3. Results

The clinical data of the patients is shown in Table 1. The maximum diameter of the tumours ranged from 30 mm to 70 mm. All tumours were completely removed. There were no obvious intraoperative or postoperative complications in this series. There was no recurrence during the follow-up period which ranged from 10 to 74 months (mean = 30 months).

### 3.1. Illustrative patients

#### 3.1.1. Patient one

A 52-year-old male had complained of headaches and right-side facial numbness for one year and visual dysfunction for six months. The preoperative CT scan showed an oval, smooth-edged tumour, approximately $70 \times 53 \times 61$ mm in size, which was located in the right infratemporal fossa, protruding to the middle cranial fossa, and compressing the right orbital apex and optic nerve. MRI showed that the tumour was an extradural lesion (Fig. 1a,b,c). The preoperative diagnosis was trigeminal schwannoma. The patient underwent transnasal endoscopic surgery, and the tumour was completely removed. The volume of intraoperative bleeding was approximately 1500 mL and there were no intraoperative or postoperative complications. The postoperative histopathological findings indicated schwannoma. No residual tumour was identified by MRI 10 days after the surgery and no recurrence occurred during the follow-up period of 24 months (Fig. 1d,e,f).

### 3.2. Patient two

A 36-year-old female had complained of headaches for four years and right-side facial numbness for one year. The admission examination showed hypoaesthesia in the distribution of the third branch of the trigeminal nerve. A dumbbell-shaped tumour involving the right infratemporal fossa and right petrous apex was identified by MRI (Fig. 2a). The patient underwent transnasal endoscopic surgery with image guidance and the tumour was completely removed. The volume of intraoperative bleeding was approximately 700 mL anad there were no intraoperative or postoperative complications. The postoperative histopathological findings indicated schwannoma. No residual tumour was identified by MRI 10 days after the surgery and no recurrence occurred during the follow-up period of 65 months (Fig. 2b).

## 4. Discussion

The most commonly used classification scheme for trigeminal schwannoma was formulated by Jefferson in 1953.[1] He described three types of tumours based on their location. Type A intracranial tumours are located predominantly in the middle cranial fossa, and are derived from the Gasserian ganglion of the trigeminal nerve with extension to the petrous apex. Type B intracranial tumours are located predominantly in the posterior cranial fossa, and are derived from the root of the trigeminal nerve and located in the cerebellopontine angle. Type C tumours span both the middle and posterior cranial fossa (dumbbell-shaped tumours), and are derived from the Gasserian ganglion of the trigeminal nerve and extend forward to the cavernous sinus and simultaneously backward to the cerebellopontine angle. In 1999, Yoshida and Kawase modified Jefferson's classification scheme by adding a fourth type of tumour, Type D, which denoted extracranial tumours with intracranial and infratemporal fossa extension.[2] Depending on the division of the trigeminal nerve involved, Type D tumours can be further sub-classified into orbital, pterygopalatine and infratemporal fossa types. Type D tumours are rare; only 61 patients have been recognised in the English literature since 1955.[1,4,5]

The early symptoms of reported trigeminal schwannomas with infratemporal fossa extracranial extension are often subtle. The majority of the tumours had become quite large before being diagnosed. The appearance of symptoms such as facial numbness, headache, facial sensory disturbance, masticatory muscle atrophy, toothache, hypopsia, nasal obstruction, hearing loss or dysosmia indicates tumour enlargement. A CT scan performed at the initial diagnosis usually shows widening of the foramen ovale and foramen rotundum, and MRI clearly shows the location, shape, size, and extent of the tumour and its relationship to neighbouring structures. Trigeminal schwannomas appear iso- or slightly hyperintense on T1-weighted MRI, with significant enhancement after gadolinium diethylenetriamine penta-acetic acid (DTPA) injection, and hyperintense on T2-weighted MRI sequences. Preoperative