Endoscopic-Assisted Posterior Intradural Petrous Apicectomy in Petroclival Meningiomas: A Clinical Series and Assessment of Perioperative Morbidity

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OBJECTIVE: **To describe the clinical feasibility and outcome of the endoscopic-assisted posterior intradural petrous apicectomy approach (PIPA) for petroclival meningiomas extending into the supratentorial space.**

METHODS: **From 2005–2013, 29 patients with a petroclival meningioma underwent tumor removal through a PIPA approach. The approach consists of a retrosigmoid approach, intradural anterior resection of the petrous apex and microsurgical removal of the tumor, followed by endoscopic-assisted visualization and removal of tumor parts in the middle fossa or anterior to the brainstem.**

RESULTS: **Patients consisted of 7 men and 22 women; the mean age of patients was 52.7 years. In 24 patients, surgery was performed with the patient in a semisitting position; in 5 patients, surgery was performed with the patient in a supine position. A total resection was achieved in 19 patients (66%). A Karnofsky performance scale score >60% was recorded in 27 patients (93%), with surgical complications that involved a cerebrospinal fluid leak in 3 patients, bleeding in the surgical cavity in 2 patients, and pneumocephalus in 1 patient. The most frequent postoperative neurologic deficit was facial palsy (34%), which disappeared or improved consistently in all but 1 patient, who required a cranial nerve VII–cranial nerve XII anastomosis.**

CONCLUSIONS: **For petroclival meningiomas extending into the middle fossa, the endoscopic-assisted PIPA approach is safe and straightforward. The principal advantages of the PIPA approach are familiarity with the retrosigmoid route; the absence of temporal lobe retraction; and early control of the cranial nerves, vessels, and brainstem. However, careful patient selection regarding tumor extension is fundamental to obtaining optimal outcomes.**

INTRODUCTION

Because of the complex anatomy of the petroclival region, surgery of the central skull base has a potentially high morbidity rate, despite the generally "nonmalignant" biology of meningiomas, trigeminal schwannomas, epidermoid cysts, chordomas, and chondrosarcomas. These tumors frequently display an extension to some extent into the middle cranial fossa. They appear with a true supratentorial extension or dumbbell shape occupying Meckel's cave. Multiple strategies have been developed for treatment, ranging from wait and watch until relevant growth occurs to staged surgical procedures or treatment combinations with radiosurgery after subtotal microsurgical resection (31, 32). Various approaches have been described for reaching this region (subtemporal, presigmoid, transtemporal, extended transclival), all of which aim to increase the anatomic exposure, reduce the complication rates, and result in high reproducibility (3, 6, 32). Although each approach has been described as having promising results, they all have a range of advantages and disadvantages. During the last decade, minimally

Key words
- Endoscopy
- Meningioma
- Petroclival
- Retrosigmoid
- Skull base
- Subtemporal

Abbreviations and Acronyms
ASA: American Society of Anesthesiologists
CN: Cranial nerve
CSF: Cerebrospinal fluid
IAC: Internal auditory canal
KPS: Karnofsky performance scale
MRI: Magnetic resonance imaging
PIPA: Posterior intradural petrous apicectomy
VP: Ventriculoperitoneal

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invasive approaches and endoscopic-assisted techniques such as the retrosigmoid intradural suprameatal approach have been introduced, ensuring reduced approach-related morbidity and surgical times (4, 20-26, 28).

In this clinical series, we describe a variation of the retrosigmoid intradural suprameatal approach with resection of the petrous apex, known as the posterior intradural petrous apicectomy (PIPA) approach with endoscopic assistance. Although the endoscopic part is secondary to the microsurgical removal of the tumor, it became an indispensable part of the surgery. We discuss the indications, surgical strategy, and clinical outcomes, focusing on approach-related morbidity.

MATERIALS AND METHODS

Each patient gave informed consent for the scheduled surgery and evaluation of the clinical data for scientific purposes. Data were collected and treated according to the recommendations of the local ethics committee for retrospective studies. Between March 2005 and August 2013, 87 patients with petrous apex meningiomas underwent microsurgical resection at our institution. Among these, 29 patients underwent tumor removal through a PIPA approach because the tumor extension was predominantly in the posterior fossa with extension into the middle fossa.

The indications for surgery were brainstem compression, cranial nerve (CN) deficit, or radiologic evidence of significant tumor growth. Patient selection was based on preoperative contrast-enhanced cranial magnetic resonance imaging (MRI) and thinly sliced bone window cranial computed tomography scans (**Figures 1** and **2**). Patient charts, operative reports, and preoperative and postoperative neuroimaging were retrospectively analyzed. Patients' demographic information and surgical and clinical outcome data were recorded. The extent of the resection was assessed intraoperatively and was confirmed with postoperative contrast-enhanced cranial MRI (Simpson grading scale) (**Tables 1** and **2**, **Figure 3**) (29). Each patient's functional status was determined using the Karnofsky performance scale (KPS) at the time of admission and discharge (14); the KPS classifies functional impairment and assesses prognosis and quality of life. Each patient underwent medical and radiologic follow-up examinations 3 months after surgery and then every 12 months. Facial nerve function was graded according to the House-Brackmann scale (12).

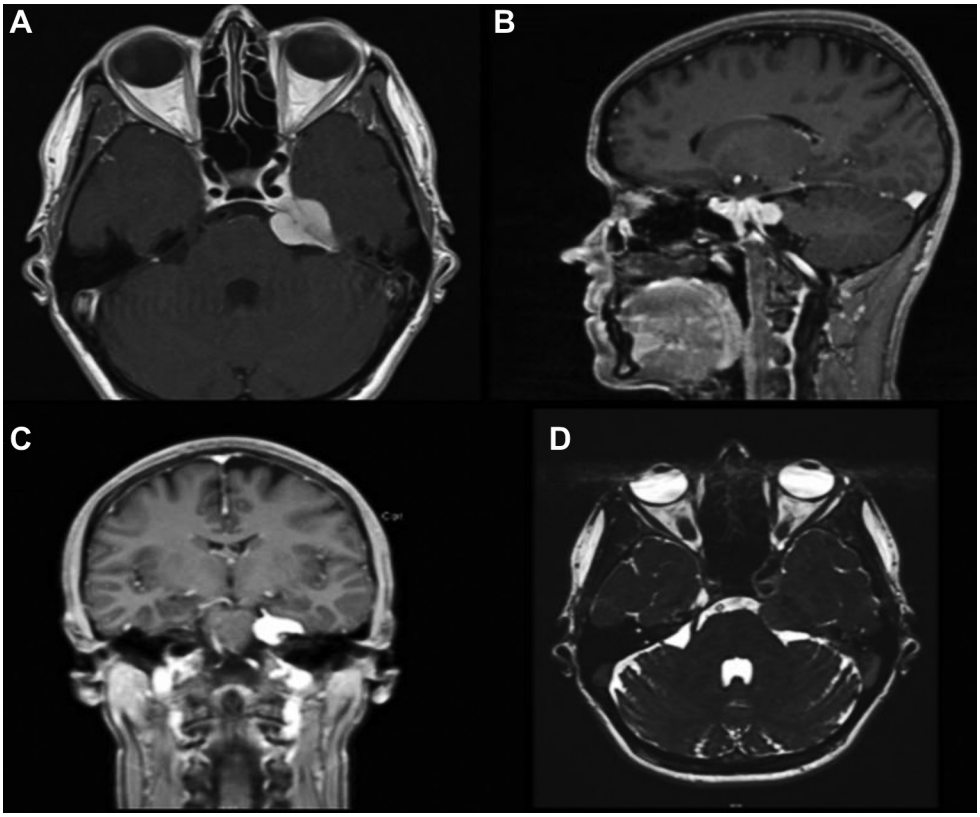

Figure 1. Cranial magnetic resonance imaging showing a homogeneous contrast-enhancing lesion with a dural tail in the petroclival region, with a major component in the posterior fossa–petrous apex area and minor supratentorial extension in the Meckel's cave region. Axial (**A**), sagittal (**B**), and coronal (**C**) T1-weighted contrast-enhanced images. Axial true fast imaging with steady-state precession sequence (**D**), displaying the relationship of the lesion with the nervous and vascular structures.