# **Petroclival meningioma approach**

The combining trans-subtemporal and suboccipital retrosigmoid keyhole approach is simple, safe, and minimally invasive, and an ideal operation approach of petroclival meningioma. To master the operation skills and the intraoperative matters needing attention in the operation, is favorable to improve the resection rate and curative effect <sup>1)</sup>.

Early attempts to expose this region consisted primarily of an extended suboccipital craniectomy, with opening of the tentorium and ligation of the sigmoid sinus for additional exposure. During the 1960s, technological innovations including the surgical microscope and the pneumatic drill allowed surgeons to gain additional exposure by removing more bone from the base of the skull. This let surgeons define combined infra- and supratentorial approaches, which rely less on brain retraction to resect these difficult tumors successfully. These approaches rely on a combined posterior mastoid approach with an anterior petrosectomy <sup>2)</sup>.

These tumors are most often resected utilizing open transpetrosal approaches, but these operations, difficult even in the hands of dedicated skull base surgeons, are particularly challenging if the meningiomas are medially-situated and positioned mainly behind the clivus.

In an effort to reach lesions with caudal extensions into the posterior fossa, the subtemporaltranstentorial route was developed.

The combining trans-subtemporal and suboccipital retrosigmoid keyhole approach is simple, safe, and minimally invasive, and an ideal operation approach <sup>3)</sup>.

Transpetrosal approach: The combined transpetrosal approach has provided satisfactory functional improvements and excellent tumor control for patients with petroclival meningiomas.

Orbitozygomatic approach

Kawase approach

Retrosigmoid approach.

### Endoscopic transnasal transclival approach.

The endoscopic endonasal transclival approach has been widely described for its use to resect clivus chordomas, but there have only been isolated reports of its use for petroclival meningiomas. These tumors, are particularly challenging if the meningiomas are medially-situated and positioned mainly behind the clivus. For this subset of petroclival meningiomas, a transclival approach may be preferable.

Jean et al., report a meningioma resected via an endoscopic endonasal transclival technique. The patient was a 63-year-old man who presented originally for medical attention because of diplopia related to an abducens palsy on the left. A workup at that time revealed a meningioma contained entirely in the left cavernous sinus, and this was treated with stereotactic radiosurgery. His symptoms resolved and his meningioma was stable on MRI for several years after treatment. The patient was then lost to follow-up until 13 years after radiosurgery when he experienced intermittent diplopia again. At this point, workup revealed a large petroclival meningioma compressing the brainstem. He

underwent a successful endoscopic endonasal transclival resection of this tumor. A demonstration of the step-by-step surgical technique, discussion of the nuances of the operation, and a comparison with the open transpetrosal approaches are included in this report <sup>4)</sup>.

## **Approach indication**

The preoperative hearing and neurological function study will definitively influence the choice of the approach.

A scheme based on both anatomical location and tumor extent permits more rational decision making regarding the optimal surgical approach.

Tumors of the upper third involving the petrous apex and posterior cavernous sinus are best approached via an orbitozygomatic approach or Kawase approach.

Bambakidis et al over a study period, shwed that a diminishing proportion of patients with petroclival meningioma were treated using petrosal approaches. Utilization of the orbitozygomatic and retrosigmoid approaches alone or in combination provided a viable alternative to petrosal approaches for treatment of petroclival meningioma. Regardless of approach, progression-free survival rates were excellent over short-term follow-up period <sup>5)</sup>

Tumors of the middle clival level involving the caudal extent of the internal auditory meatus to the jugular foramen are best approached via a transpetrosal approach

A meticulous intrapetrous bone work skeletonizing the sigmoid sinus and preserving the inner ear structures, as well as the facial nerve intrapetrous segments, guarantees a wide exposure, minimizing the operative distance and cerebellar retraction <sup>6)</sup>

Tumors of the lower clivus down to the foramen magnum are best approached by the far lateral approach or combination approaches.

### Retrosigmoid approach

Retrosigmoid transtentorial (RTT) and retrosigmoid intradural suprameatal (RISA) approaches have been used.

The RTT approach is an excellent approach to ventrolateral brainstem and petroclival region. It provides greater superoventral exposure of the ventrolateral brainstem than RISA and provides similar petroclival exposure <sup>7</sup>.

see Anterior transpetrosal approach.

Combined transpetrosal approach.

Although multiple surgical approaches have been developed, the retrosigmoid route tends to be used to address tumors that are predominantly located in the posterior fossa.

A modification of the lateral suboccipital retrosigmoid approach with the placement of a tentorial incision yields good visualization of the supratentorial part of the tumor around the midbrain.

Yamahata et al. treated four patients, one with primary and three with recurrent petroclival

meningioma, by a modified approach. After lateral suboccipital craniotomy, the infratentorial part of the tumor was removed after detaching it from the tentorial surface. The cerebellar tentorium was then carefully incised from the supracerebellar angle, taking care not to damage the superior cerebellar artery and trochlear nerve. The operative field surrounding the midbrain was widened by this procedure, and safe dissection of the tumor from the brainstem and other neurovascular structures was performed with direct observation of the interface. This approach is a useful modification of the retrosigmoid approach to petroclival meningiomas. It facilitates the safe resection of the supratentorial part of the tumor in the ambient cistern behind the tentorium <sup>8)</sup>.

For petroclival tumors, first the posterior fossa cisterns are opened to drain the cerebrospinal fluid and relax the brain. The tentorium is divided posterior to the trochlear nerve, and the anterior part is excised.

The Meckel's cave is opened widely to relax the trigeminal root. Tumor resection is then performed with bipolar cautery, micro-scissors, and the ultrasonic aspirator, working toward the base of the tumor, and working from below upward, to identify and avoid injury to the abducens nerve. The posterior cavernous sinus can be opened if the tumor extends into it. If the tumor is well above the tentorial notch, a transsylvian approach is performed at the same sitting <sup>9)</sup>.

Most of the petroclival meningiomas arising medial to the trigeminal nerve (clival-type meningiomas) exhibit invasion into Meckel cave, with a high incidence (65%) of adherence to the entry zone of the trigeminal nerve and around basilar perforators.

Modified temporal-occipital transtentorial transpetrosal-ridge approach and transpetrosal presigmoid approach <sup>10</sup>.

A pretemporal trans-Meckel's cave transtentorial approach offers large surgical exposure and multiple trajectories to the suprasellar, interpeduncular, prepontine, and upper-half clival regions without overt traction, which is mandatory to remove large PCMs. To unlock Meckel's cave where a large PCM lies abutting the cave, pretemporal transcavernous and anterior transpetrosal approaches are prerequisites to create adequate exposure for the final trans-Meckel's cave step <sup>11</sup>.

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As first step, they perform a retrosigmoid suprameatal approach in order to resect the posterior part of the tumor and obtain brainstem decompression. In the second step, carried out after patient's recovery from the first surgery, they remove the supratentorial portion of the lesion using a frontotemporal craniotomy to achieve the decompression of the optic nerve, oculomotor nerve, and carotid artery. The retrosigmoid suprameatal approach allows for adequate brainstem decompression: the tumor itself creates a surgical channel increasing the accessibility to the lower and upper petroclival surface. Moreover, this route allows for early visualization of cranial nerves in the posterior fossa and safe tumor removal under direct visual control, reducing the risk of postoperative deficits. Via the simple and safe frontotemporal craniotomy, the supratentorial part of the lesion can be removed thus avoiding the need of invasive approaches. We propose a two-stage surgery for treatment of petroclival meningiomas combining two simple routes such as retrosigmoid suprameatal and frontotemporal craniotomy. This approach reflects the philosophy to use simple and less invasive approaches in order to preserve neurological function and a good quality of life of the patient <sup>12</sup>. 1)

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