Lateral Suboccipital Retrosigmoid Approach with Tentorial Incision for Petroclival Meningiomas: Technical Note

Hitoshi Yamahata¹ Hiroshi Tokimura¹ Kazuho Hirahara² Takeshi Ishii² Masanao Mori¹
 Ryosuke Hanaya¹ Kazunori Arita¹

¹ Department of Neurosurgery, Kagoshima University, Kagoshima, Japan

² Department of Neurosurgery, Kagoshima City Hospital, Kagoshima, Japan

Address for correspondence Hitoshi Yamahata, MD, Department of Neurosurgery, Graduate School of Medical and Dental Sciences, Kagoshima University, 8-35-1 Sakuragaoka, Kagoshima, Kagoshima 890-8520, Japan (e-mail: yamahata-nsu@umin.net).

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Abstract

Introduction The resection of petroclival meningiomas presents great neurosurgical challenges. 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. Our 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.

Methods We treated four patients, one with primary and three with recurrent petroclival meningioma, by our 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 supra-cerebellar angle, taking care not to damage the superior cerebellar artery and trochlear nerve.

Results 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.

Conclusions Our 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.

Keywords

- ▶ lateral suboccipital approach
- ▶ petroclival meningioma
- ▶ skull base
- ▶ cerebellar tentorium

Introduction

Petroclival meningiomas are technically challenging. Although multiple surgical approaches including the combined petrosal approach that requires extensive bone drilling have been used to treat these tumors, the lateral suboccipital retrosigmoid approach may be applicable in tumors whose main part is located in the posterior fossa.^{1,2} We describe a simple modification of the lateral suboccipital retrosigmoid approach that involves placing a tentorial incision; it yields

good visualization of the supratentorial part of the tumor adjacent to the midbrain.

Materials and Methods

We subjected four patients, one with a primary and three with recurrent petroclival meningiomas, to the lateral suboccipital approach with tentorial incision. The mean diameter of the tumors was 4.95 cm (range: 4.0–5.8 cm). The average

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Fig. 1 Intraoperative photographs. (A) The cerebellar tentorium seen from the supracerebellar angle. (B) The cerebellar tentorium was carefully incised using a monopolar coagulator. (C) After tentorial incision the operative field was widened and the trochlear nerve and cerebellar artery were visualized. (D) After sufficient removal of the tumor, the basilar artery is seen along its course from its union with the vertebral artery to the posterior cerebral artery.

age of the patients was 56.75 years (range: 39–69 years); three of the four patients were women. Because the three recurrent tumors were highly invasive and largely extended into the cavernous sinus, the goal of our surgical treatment was limited to sufficient decompression of the brainstem.

Operative Procedure

With the patient in the lateral position, lateral suboccipital craniotomy was performed. Then the infratentorial portion of the tumor was resected after detaching it from the tentorial surface (►Fig. 1A). The cerebellar tentorium was incised from the supracerebellar angle in the direction of the midbrain, taking care not to damage the superior cerebellar artery and trochlear nerve (►Fig. 1B). A sufficient view of the surrounding midbrain was obtained by reflecting the edge of the incised tentorium. The supratentorial part of the tumor was internally decompressed by ultrasonic aspiration, and then it was separated from the midbrain, the superior cerebellar and posterior cerebral arteries, and the trochlear and oculomotor nerves. After sufficient removal of the tumor, the full length of the vertebrobasilar system from the vertebral to the posterior cerebral artery could be visualized (►Fig. 1D).

Results

Subtotal resection was achieved in the patient with the primary petroclival meningioma. In the three patients with recurrent tumors, encasement of the cranial nerves and strong adhesion to the brainstem did not permit subtotal removal. There was no operative mortality; however, one patient with tumor recurrence died 1 month after the operation of disseminated intravascular coagulation that resulted in cholecystitis. The average removal rate was 74%; the removal rate of the tumor portion around the midbrain was 89%.

Illustrative Clinical Case

This 65-year-old woman presented with a 10-year history of decreased hearing on the left side. Magnetic resonance imaging (MRI) revealed a homogeneously gadolinium-enhanced mass on the left cerebellopontine angle with brainstem compression (►Fig. 2A). At surgery she was placed in the right recumbent position. Retrosigmoid craniotomy was performed, and a vascularized tumor behind the petrosal veins was exposed in the cerebellopontine angle (►Fig. 2B). After

Fig. 2 Illustrative case. (A) Preoperative T1-weighted gadolinium-enhanced magnetic resonance image (MRI) showing a left petroclival meningioma impinging on the cerebral peduncle. (B) Intraoperative photograph showing the tumor behind the petrosal veins. (C) Intraoperative photograph showing the widened operative field after incision of the cerebellar tentorium. The midbrain can be seen behind the tumor. (D) Postoperative MRI showing subtotal removal of the tumor.

detachment from the tentorial surface and the dura mater on the petrosal bone, we performed internal decompression. The cerebellar tentorium was incised to enlarge the operative field, especially in the direction of the midbrain, to facilitate the safe removal of the tumor (► **Fig. 2C**). She had an uneventful recovery and developed no additional neurologic deficits. Postoperative MRI confirmed the subtotal removal of the tumor (► **Fig. 2D**) that was pathologically identified as a meningotheliomatous meningioma.

Discussion

Petroclival meningiomas arise from the upper two thirds of the clivus at the petroclival junction and medial to the trigeminal nerve.¹ A variety of approaches including transpetrous and middle fossa approaches have been used successfully for their surgical resection.^{1–7} The surgical strategy depends on the location of the tumor and the direction of tumor expansion.¹ Tumors located predominantly in the posterior fossa are addressed via the retrosigmoid approach.⁷

The retrosigmoid route to the petroclival region may offer advantages over approaches that involve large petrosectomies. General neurosurgeons are familiar with this approach, and it is less invasive, the surgical time is shorter, the risk for

facial paresis and hearing loss is lower, and the development of cerebrospinal fistulae is rare.⁵ Cadaver studies showed that the working area provided by the retrosigmoid and combined petrosal approaches to the petroclival surface is similar.⁸

The retrosigmoid approach is suitable when the main part of the tumor is located infratentorially. However, when this approach is used, it is difficult to address the supratentorial part, especially in tumors with extensive growth and/or recurrence because they tend to adhere strongly to surrounding neurovascular structures. In such cases, tentorial incision yields additional supratentorial exposure. Dissection of the tentorium increases operative exposure during the subtemporal and combined petrosal approach.⁹ The significance of tentorial incision in the course of the lateral suboccipital approach has not been widely discussed.^{4,9} In cadaver studies,¹⁰ infratentorial supracerebellar approaches with division of the tentorium yielded good visualization of part of the parahippocampal gyrus, oculomotor nerve, and posterior cerebral artery. Compared with the standard retrosigmoid approach, the additional tentorial incision widened the vertical angle toward the supratentorial portion. In our cases, the tentorial incision provided good visualization of the structures around midbrain such as posterior cerebral artery and oculomotor nerve, which were not usually obtained through the retrosigmoid route per se.

In spite of the usefulness of the approach just described, there are some disadvantages. Because the area obtained by the tentorial incision is relatively deep and narrow, this approach may be inappropriate for the patients of posterior fossa tumors with large extension into the middle fossa. The handling of venous bleeding from the cavernous sinus and proximal or local control of the feeding arteries may be difficult in this approach. Therefore, the tumors invading into cavernous sinus or internal carotid artery are not suitable for this approach. Careful patient selection is needed to exploit the merit of this approach.

When the retrosigmoid approach was applied, additional drilling of the suprameatal tubercle improved exposure of the petroclival region with or without tentorial incision.¹¹ Tumors extending into Meckel cave and the posterior cavernous sinus can be removed by this maneuver.^{11–13} Drilling is necessary in attempts to totally remove, via the retrosigmoid route, petroclival meningiomas invading Meckel cavity. Of our four patients, three presented with recurrence that involved extensive growth that could not be surgically eradicated even with drilling; these patients required postoperative treatment with radiosurgery.

Conclusion

The approach described here is a useful modification of the lateral suboccipital retrosigmoid approach; it is less invasive and allows resection of the supratentorial part of petroclival tumors without requiring supratentorial craniotomy.

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