Transtentorial Approach to Parahippocampal Lesions

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General Considerations

Operative access to the posterior medial temporal lobe and parahippocampal regions is challenging because of the overlying vital cortices and unavailability of safe skull base corridors.

Subtemporal, transtemporal, transsylvian/transinsular/transcisternal, and potential interhemispheric parieto-occipital approaches have been considered reasonable trajectories to the region. The subtemporal approach requires excessive temporal lobe retraction with an associated risk to the vein of Labbé. The transtemporal approach transgresses the posterior temporal neocortex, a vital territory on the dominant side; it also leads to disruption of the optic radiations. The transsylvian-transcisternal alternative provides a deep and narrow working channel with unacceptably limited access to the posterior part of the medial temporal lobe region.

I prefer the *paramedian supracerebellar transtentorial approach* to the posterior mediobasal temporal lobe. This approach provides the necessary operative access for *intraparenchymal* lesions. The transection of the tentorium via the paramedian supracerebellar route offers a unique opportunity to reach the basal posteromedial temporal lobe while leaving the supratentorial structures unharmed. This exposure has a technically challenging long working distance, but favorable working angles. The exposure is also somewhat limited; therefore this route should be judiciously selected.

Anterior hippocampal and parahippocampal lesions (anterior to the cerebral peduncle and within the uncus) are approached via a limited anteromedial temporal lobe resection.

The nuances of technique of the *paramedian supracerebellar transtentorial approach* for resection of *extra-axial* lesions are described in the Paramedian Supracerebellar Craniotomy chapter and are also reviewed here.

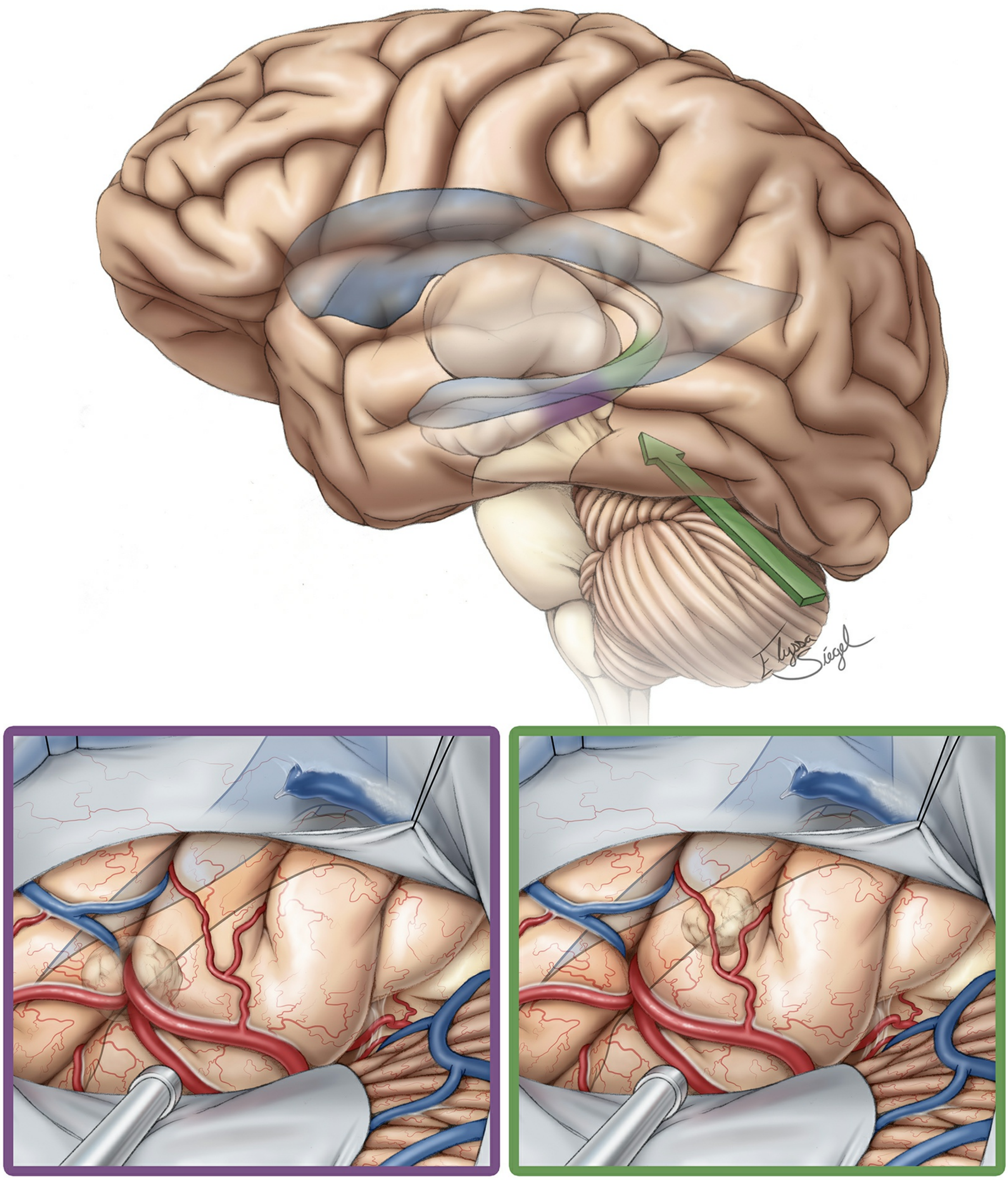

Figure 1: The supracerebellar transtentorial approach has numerous advantages over other alternative supratentorial operative corridors to reach the posterior basal temporal lobe: 1) a small paramedian craniotomy is minimally disruptive, and 2) only one cerebellar hemisphere is manipulated and the supratentorial cortices are left intact and not placed under retraction. The green arrow (upper

illustration) points to the roadmap trajectory for this operative corridor, and the green and purple colored sections of the hippocampus illustrate the reach of this approach (upper image). The lower images show the operative view of the typical locations of the lesion in relation to the hippocampus (yellow shading) and temporal horn (blue shading).

Indications for the Approach

The supracerebellar transtentorial approach can expose lesions in the posterior hippocampal and parahippocampal regions. These lesions are typically at or just posterior to the level of the cerebral peduncle or posterior to the uncus. Intraparenchymal tumors, arteriovenous/cavernous malformations, and more distal posterior cerebral artery aneurysms are reasonable candidates for this approach. This approach is also useful for exposing multicompartmental pineal region masses.

The exposure is deep and narrow; special expertise in microsurgical techniques is required for its use. Large lesions, extending superiorly and anteriorly, may not be suitable candidates.

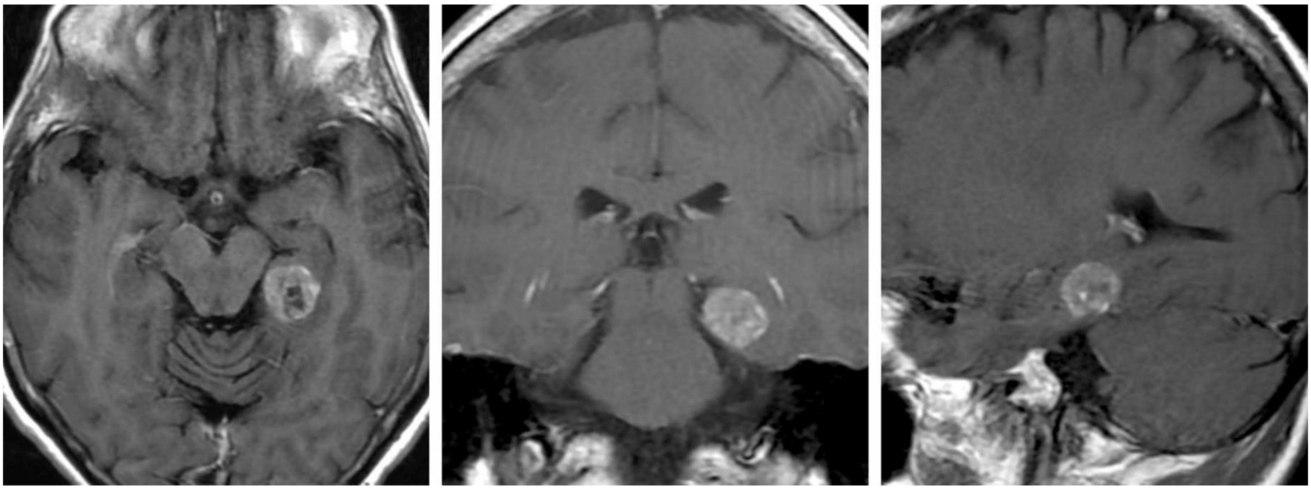

Figure 2: Posterior parahippocampal lesions, such as this metastatic adenocarcinoma, may be exposed through the supracerebellar transtentorial approach. The location of this tumor is at the most anterior reach of this approach.

Preoperative Considerations

A study of the surrounding arteries on T2-weighted images, including the posterior cerebral artery branches, is important. This artery is at risk and its route should be carefully studied.

The transverse and sigmoid sinuses may have slightly variable courses, and their preoperative study can enhance the safety of the craniotomy. Factors such as a steep tentorial angle and a very obese patient with a short neck, although not contraindications to the use of the supracerebellar route, can make the operation more challenging. In these rare situations, the patient's neck flexion may ameliorate the difficult working angles over the cerebellum, and it is recommended that the patient be placed in the sitting position.

Obstructive hydrocephalus requires preparation of the Keen's point or a preoperative frontal ventriculostomy. A paramedian linear incision (see below) can readily uncover the bony area corresponding to the burr hole for the Keen's point.

I use the modified park-bench position for patient positioning during this procedure. Cerebrospinal fluid drainage through the lumbar drain (in the absence of obstructive hydrocephalus) provides further decompression for mobilization of the cerebellum.

The preoperative studies should also evaluate the veins and venous sinuses of the tentorium. The venous phase on MR angiography or catheter angiography can guide the safety of tentorial transection or avoidance of this technique. If large veins are present within the tentorium, the tentorial incisions are tailored to avoid excessive bleeding or risk of venous infarction due to obstruction of deep veins (veins of Rosenthal) that rarely drain into the venous channels of the tentorium.

Operative Anatomy

A detailed familiarity with the regional anatomy of the tentorium is necessary to avoid complications.

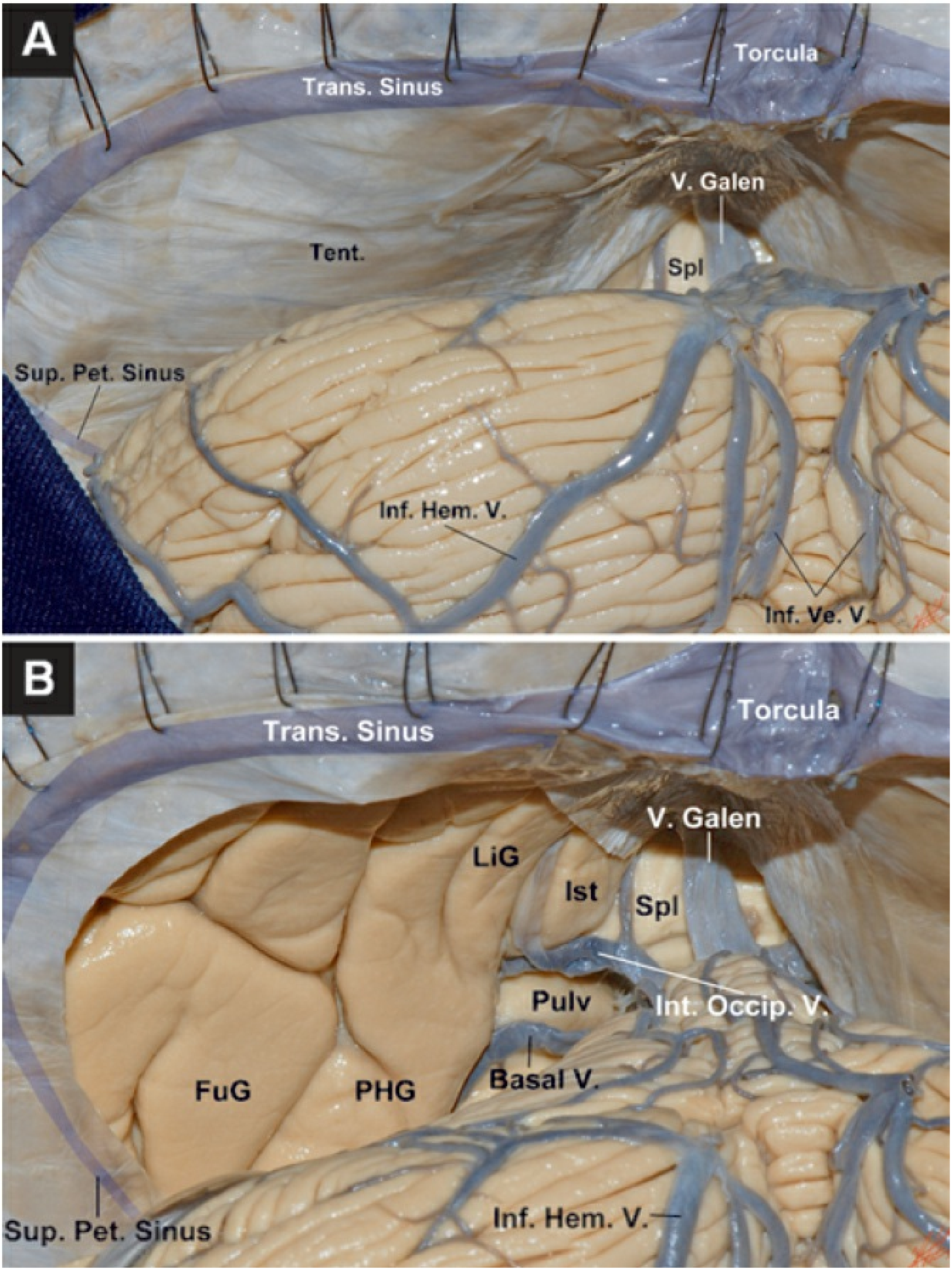

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Figure 3: The regional anatomy for approaching the

tentorium and its transection is shown. The window within the tentorium is tailored based on the location of the lesion and the extent of exposure necessary using navigation. A bilateral craniotomy is unnecessary. The mediobasal supratentorial regions become available after transection of the tentorium (A-upper image): Supracerebellar transtentorial approach on the left side after tentorial resection, demonstrating the operative corridor toward the basal surface of the temporal lobe (B-lower image). From de Oliveira JG, et al. Supracerebellar transtentorial approach-resection of the tentorium instead of an opening-to provide broad exposure of the mediobasal temporal lobe: Anatomical aspects and surgical applications. *J Neurosurg* 116: 764-772, 2012.

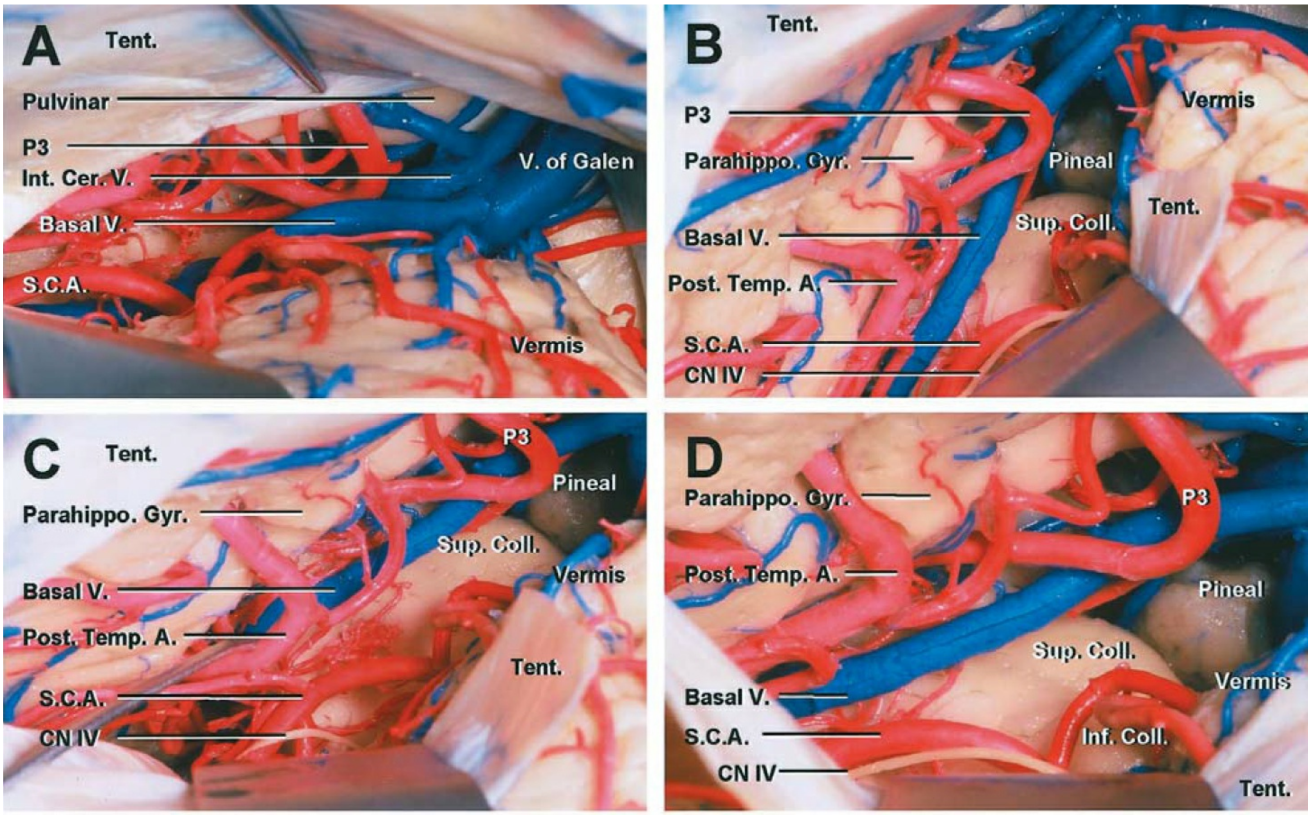

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Figure 4: Sectioning a window of the left tentorium through a paramedian supracerebellar craniotomy exposes the posterior ambient cisterns, basal temporal lobe, and the relevant arterial anatomy. Note the generous exposure of the posterior parahippocampus and distal posterior cerebral artery branches through this route (images courtesy of AL Rhoton, Jr).

PARAMEDIAN SUPRACEREBELLAR TRANSTENTORIAL APPROACH FOR INTRA-AXIAL PARAHIPPOCAMPAL LESIONS

I routinely use the lateral or park-bench patient position for this route. The initial stages of the exposure are the same as the ones for the pineal lesions. For further details, please see Paramedian Supracerebellar Craniotomy.

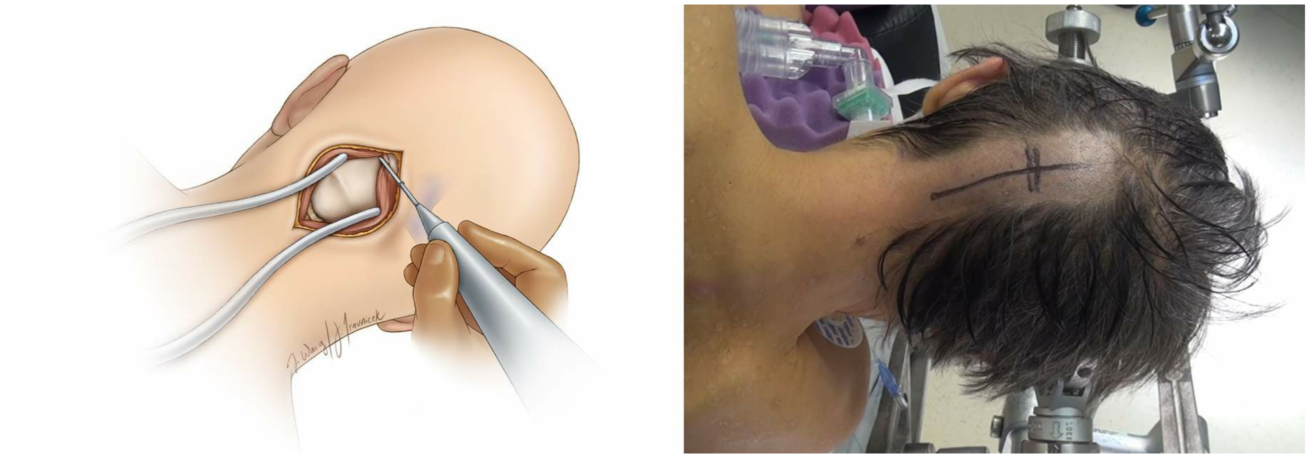


Figure 5: A left-sided suboccipital supracerebellar craniotomy is perfomed to expose the left tentorium. A skull clamp is used with the patient's neck flexed and head turned slightly (15-20 degrees) toward the floor. The patient's ipsilateral shoulder is allowed to fall forward and is taped away from the surgeon's working zone. Intraoperative

neuronavigation identifies the location of the midline, as well as the transverse and sigmoid sinuses. A paramedian vertical linear incision is made halfway between the inion and mastoid groove. This incision extends one-third above and two-thirds below the transverse sinus and is about 7–8 cm in length. Note that the Keen’s point is underneath the upper edge of the incision. The location of the transverse sinus is marked with the short horizontal line (left image).

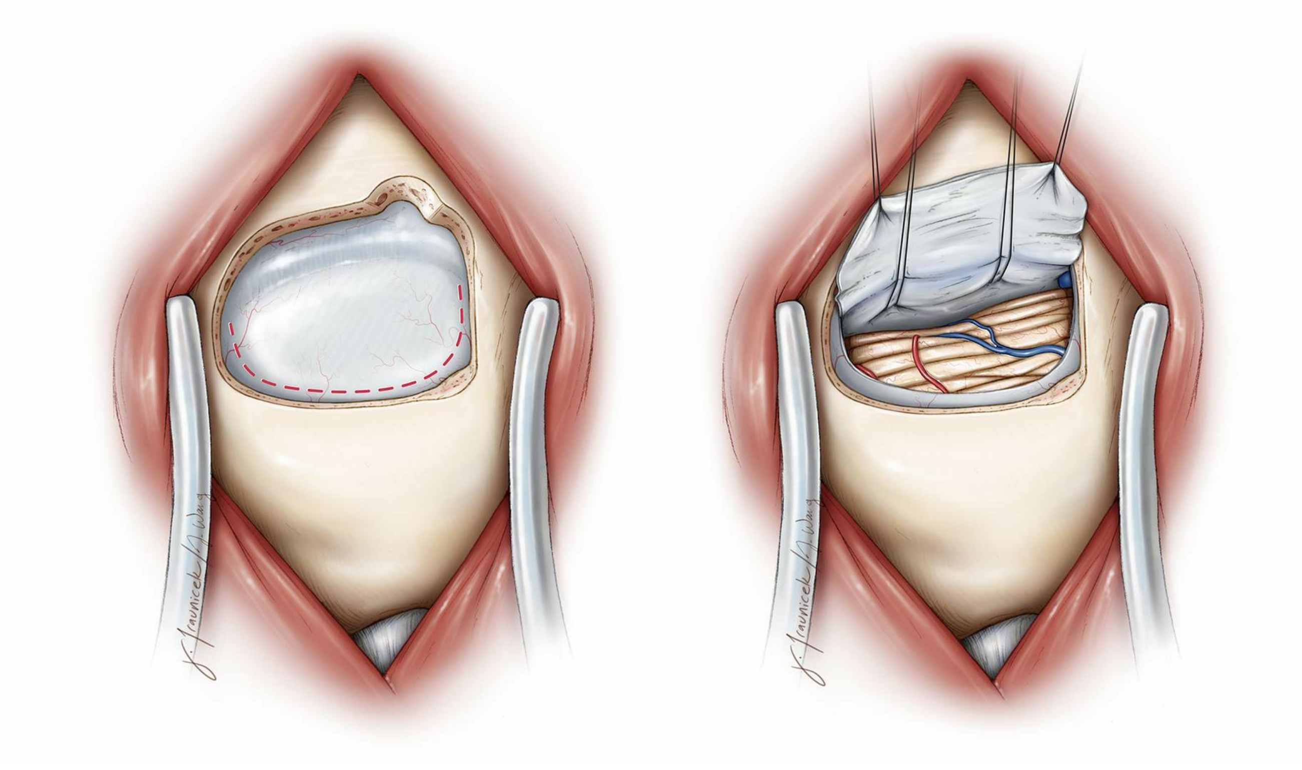


Figure 6: A single burr hole is made at the inferior edge of the transverse sinus, approximately 2 cm lateral to the midline and torcula. A small bone flap is elevated while the entire width of the transverse sinus is exposed to allow room for later rostral mobilization of this sinus (left upper image). The dura is opened as a single curved flap based on the sinus. Two retraction sutures may be placed along the posterior aspect of the tentorium to mobilize and gently rotate the transverse sinus superiorly to expand the operative space

through the supracerebellar corridor (right upper image).

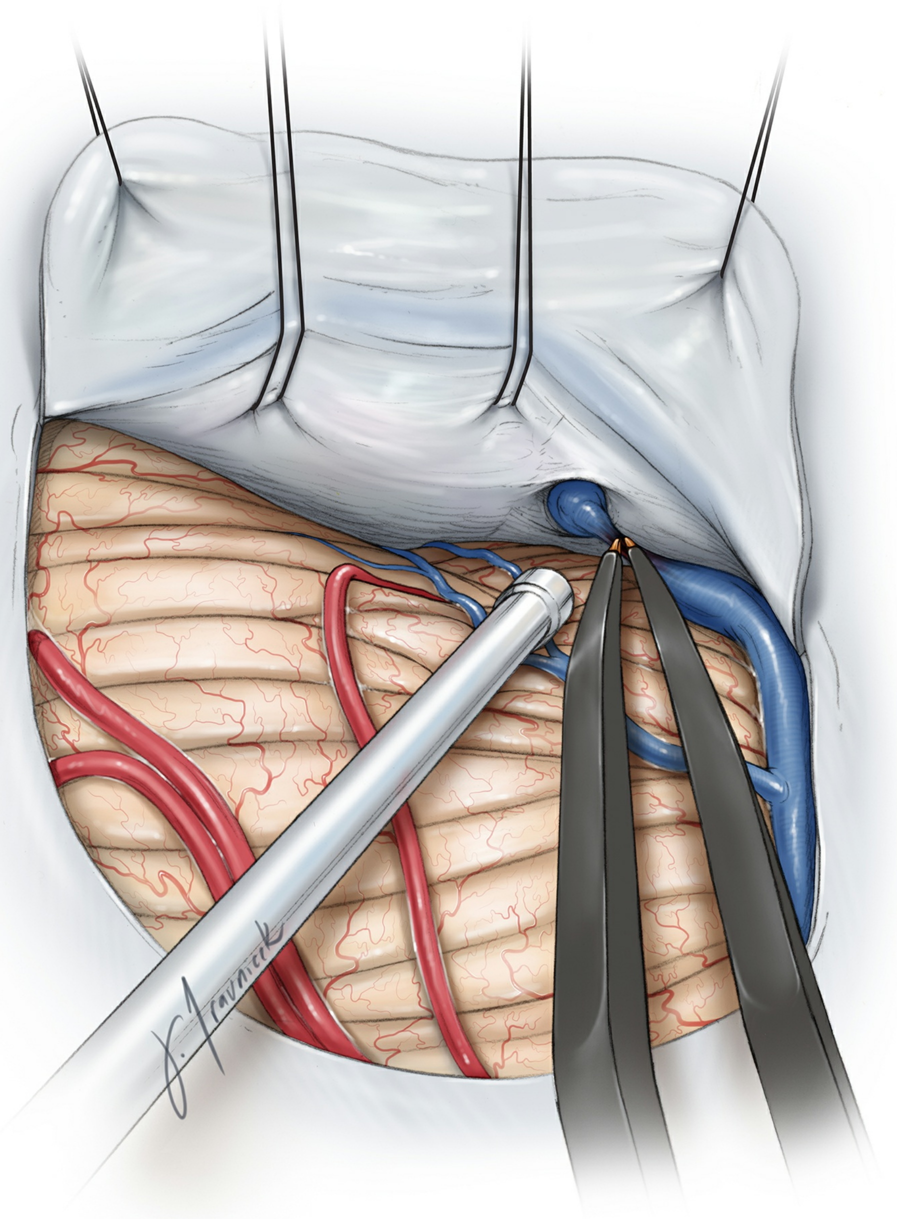


Figure 7: One or two paramedian bridging veins may have to be sacrificed. Large midline bridging veins are left intact. Note the retraction sutures placed through the posterior tentorium. These sutures gently rotate and mobilize the transverse sinuses superiorly. Microdoppler ultrasonography can confirm the patency of the sinus and gauge the safe degree of retraction on the sinus.

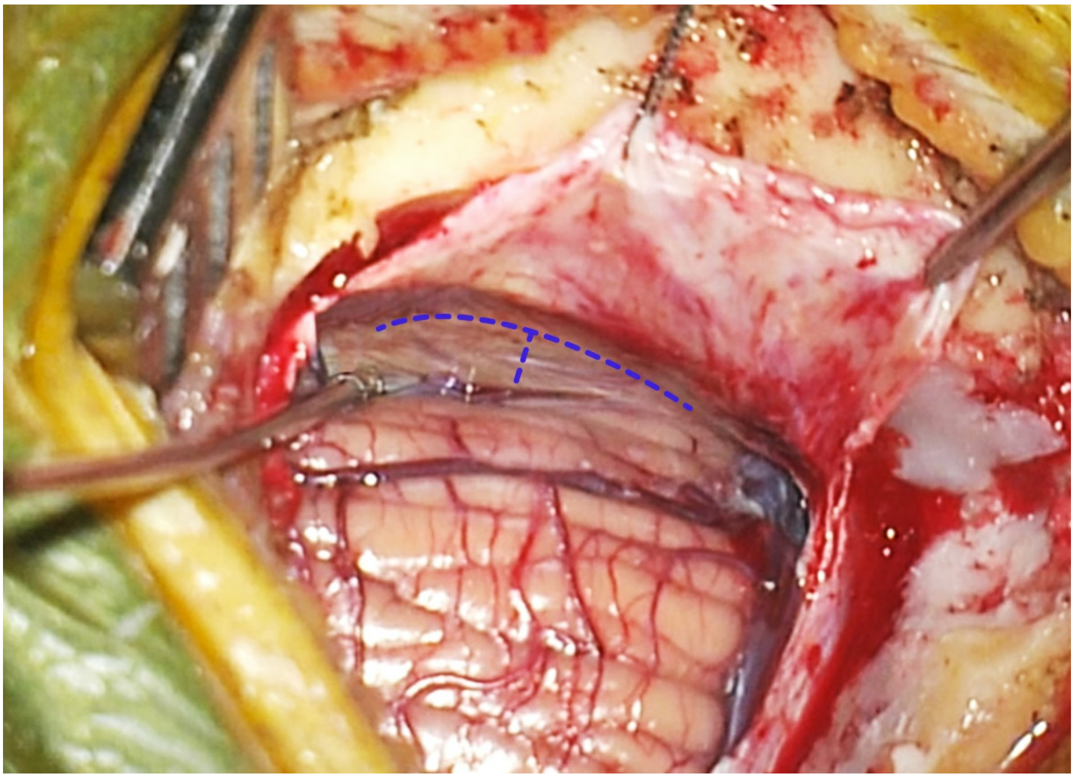


Figure 8: Gradual release of cerebrospinal fluid through the lumbar drain or a ventriculostomy catheter allows gentle caudal mobilization of the lateral cerebellar hemisphere. The dura may be incised in a “T”-shaped pattern (hashed line) for smaller lesions or a “U”-shaped fashion (see Figure 10) for larger lesions. Intraoperative navigation guides the location of the tentorial incisions.

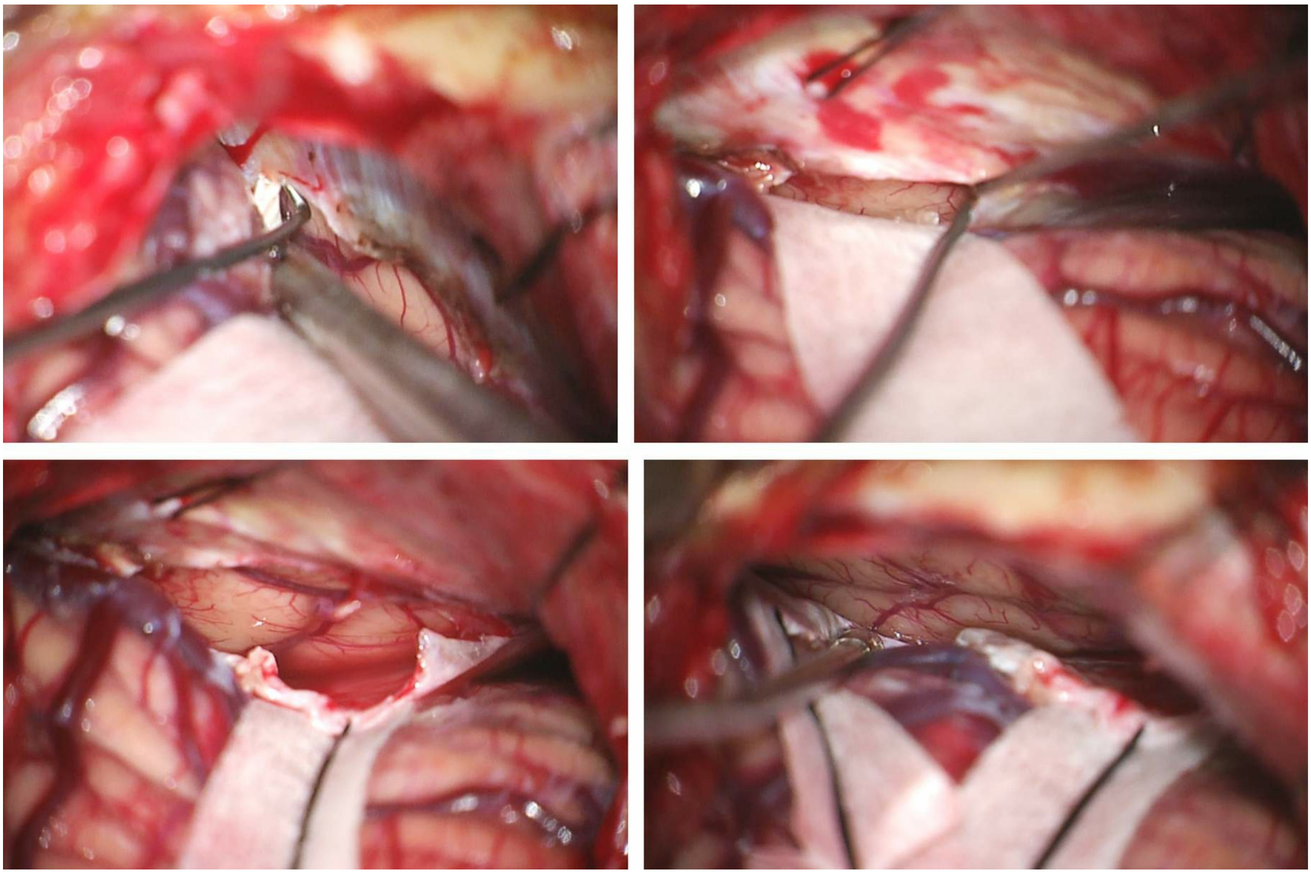


Figure 9: The steps in completing the tentorial incisions ("T"-shaped opening) for the tumor in Figure 2. The edge of the tentorium is elevated with a fine right-angled dissector, and microscissors are used to continue the transection process (left upper image). A small curved knife can facilitate cutting toward the operator (right upper image). The lower images demonstrate placement of one of the retraction sutures within the tentorium (left lower image) and the final extent of the operative corridor using retention sutures over cottonoid patties to protect the surface of the hemisphere (right lower image).

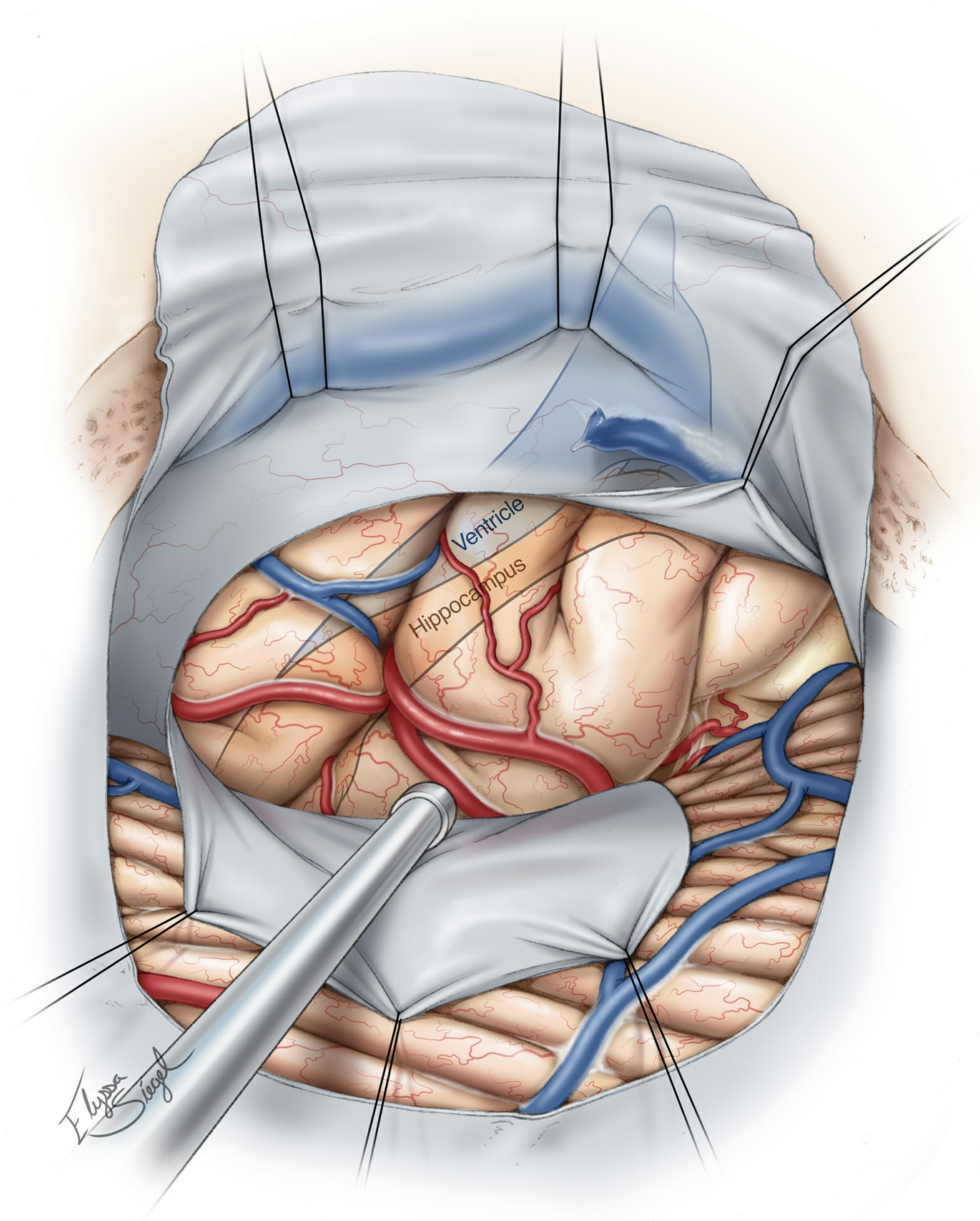


Figure 10: The dura may be incised in a "U"-shaped configuration for exposing wider regions of the mediobasal surface and resection of larger lesions. Retraction sutures also mobilize the incised section of the tentorium along with the cerebellum inferiorly. Note the location of the underlying temporal horn (blue) and hippocampus (yellow). Dissection of the arachnoid membranes over the medial dorsolateral mesencephalon will mobilize the cerebellum inferiorly and expand the operative corridor. The trochlear nerve is protected along the edges of tentorium.

When incising the lateral tentorium, the surgeon should follow the border of the petrosal sinus or petrous ridge until the trochlear nerve is exposed entering the free border of the dura. The tentorium should then be cut before this entry point while the nerve can be seen directly. The posterior petrosal vein and other bridging veins are protected during tentorial sectioning.

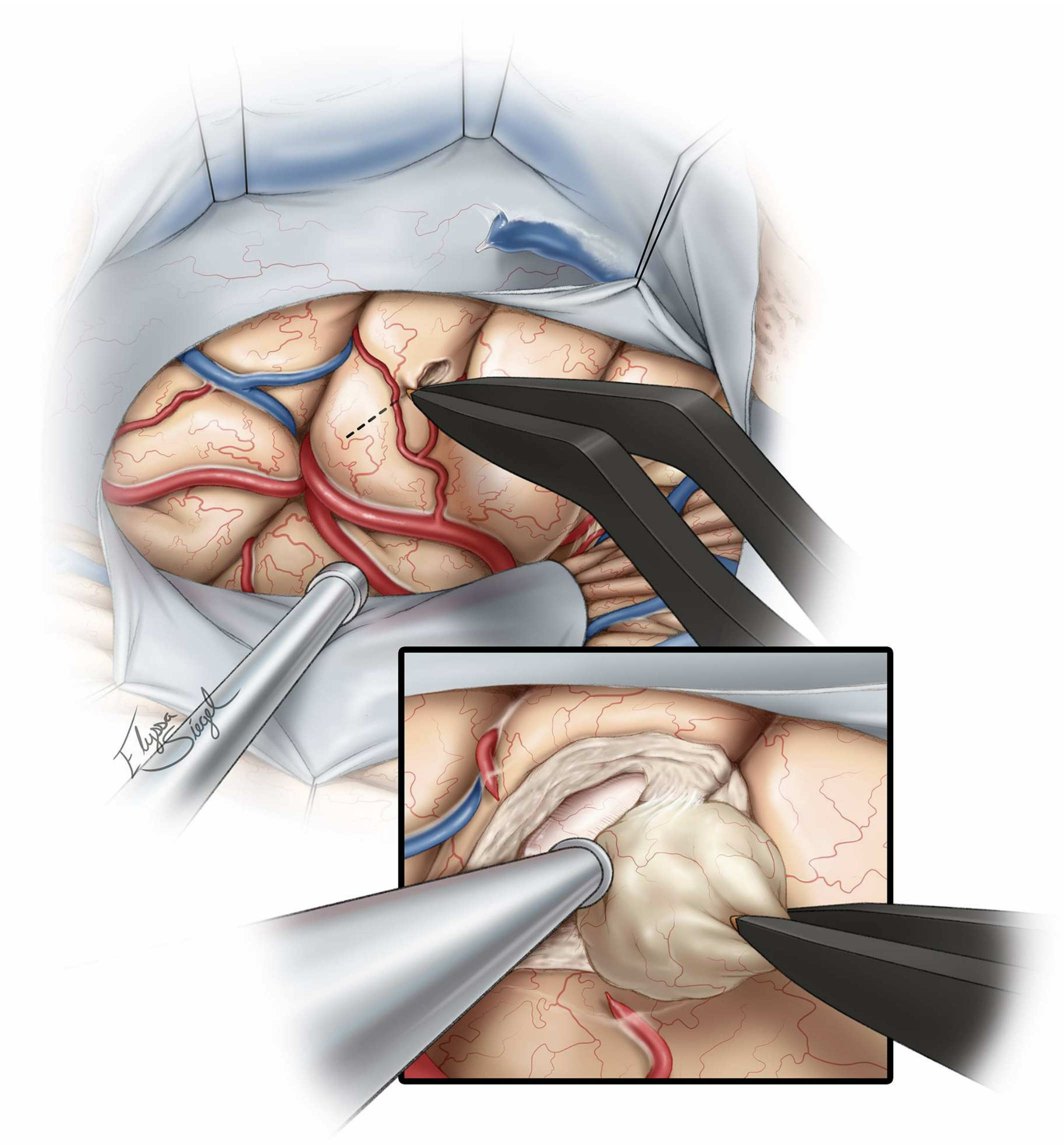


Figure 11: Intraoperative navigation guides the borders of tentorial sectioning based on the exact location of the lesion. Because of unfamiliar operative angles, the surgeon can easily misinterpret or be disoriented regarding the location

of the lesion in relation to the surface of the tentorium. After adequate surface of the posterior basal temporal lobe is exposed, navigation can guide the location of the corticotomy if the lesion is not apparent on the pial surface. Distal posterior cerebral artery *en passage* branches are numerous in this region and should be meticulously preserved. The thalamoperforating arteries can be injured during tumor manipulation. In addition, indiscriminate coagulation leads to undesirable thalamic and occipital lobe ischemia. Small cortical arteries overlying the lesion may have to be sacrificed.

Next, the surgeon can begin microsurgical removal of the tumor. This inferior-to-superior trajectory is beneficial for removing tumors that extend to the level of the temporal horn and Calcar avis.

Dynamic retraction of the cerebellum using the suction device allows exposure and resection of the tumor without the use of fixed retractors. The suction apparatus allows a more controlled, expanded view of the working zone at the exact location of the dissection. In contrast, if retractors are used, the retractor's wide blade may in fact compromise the deep exposure because of its less flexible vector of retraction.

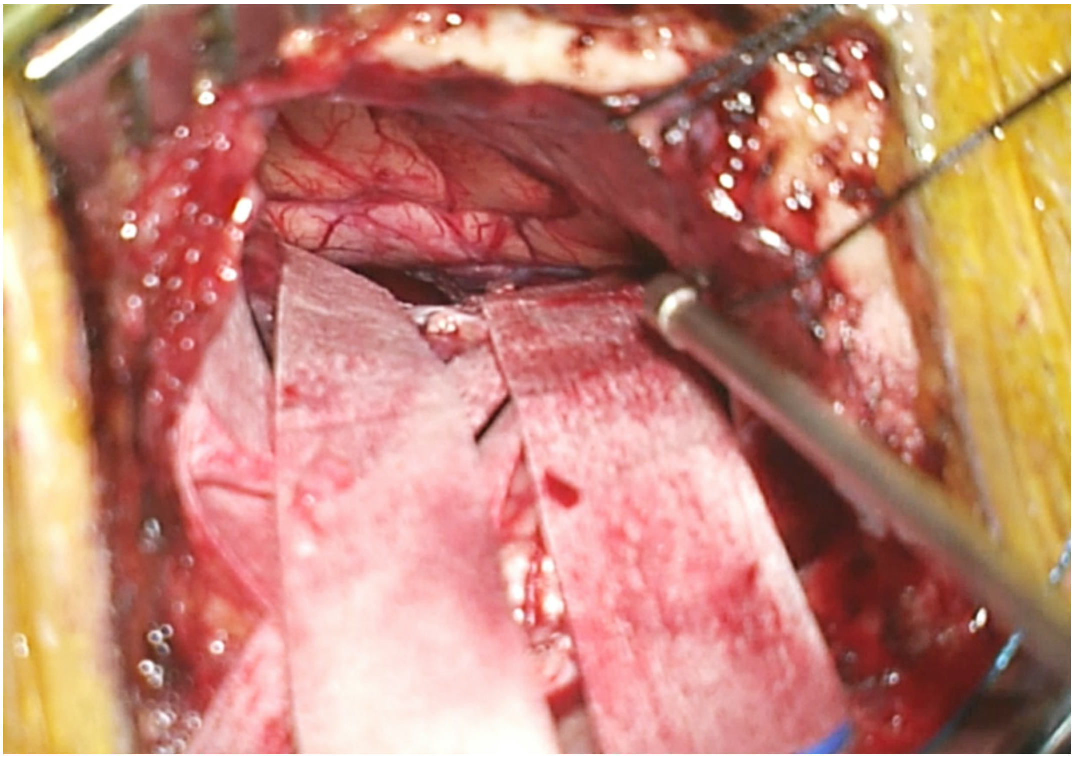
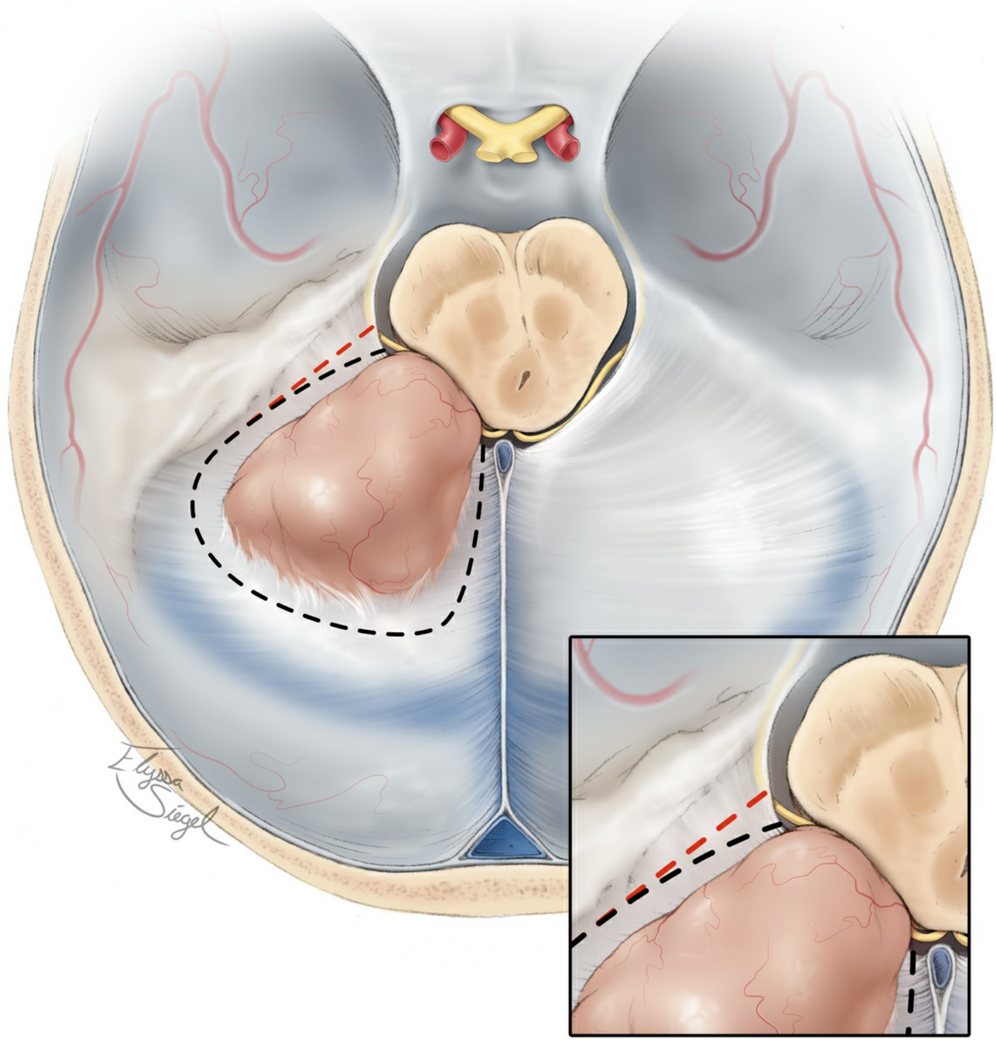


Figure 12: The final appearance of the operative space after resection of the tumor.

SUPRACEREBELLAR TRANSTENTORIAL APPROACH FOR EXTRA-AXIAL LESIONS

This modification of the supracerebellar approach can also be performed with the patient in the park-bench position.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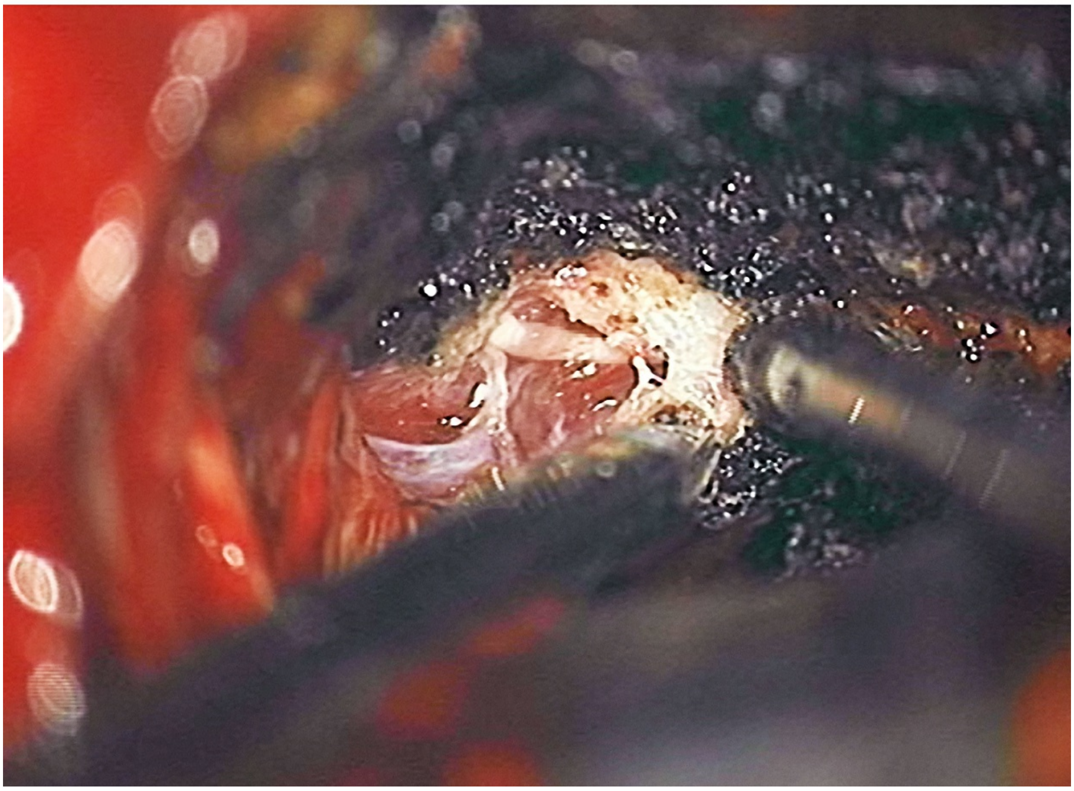

Figure 13: Note the role of this route for resection of medial tentorial extra-axial tumors and, more specifically, meningiomas. The trochlear nerve must be protected along the lateral edge of the incisura during tentorial transection (upper inset image). Incision along the red hashed line will sacrifice the nerve—incision along the black hashed line is appropriate. Alternatively, a “T”-shaped incision may be made within the tentorium for intraparenchymal lesions within the posterior basal temporal lobe (see the above section). An intraoperative photograph during resection of a left-sided petrous apex meningioma demonstrates the location of the nerve as it enters the dura at the anterior edge of the coagulated tumor and tentorium (lower image).

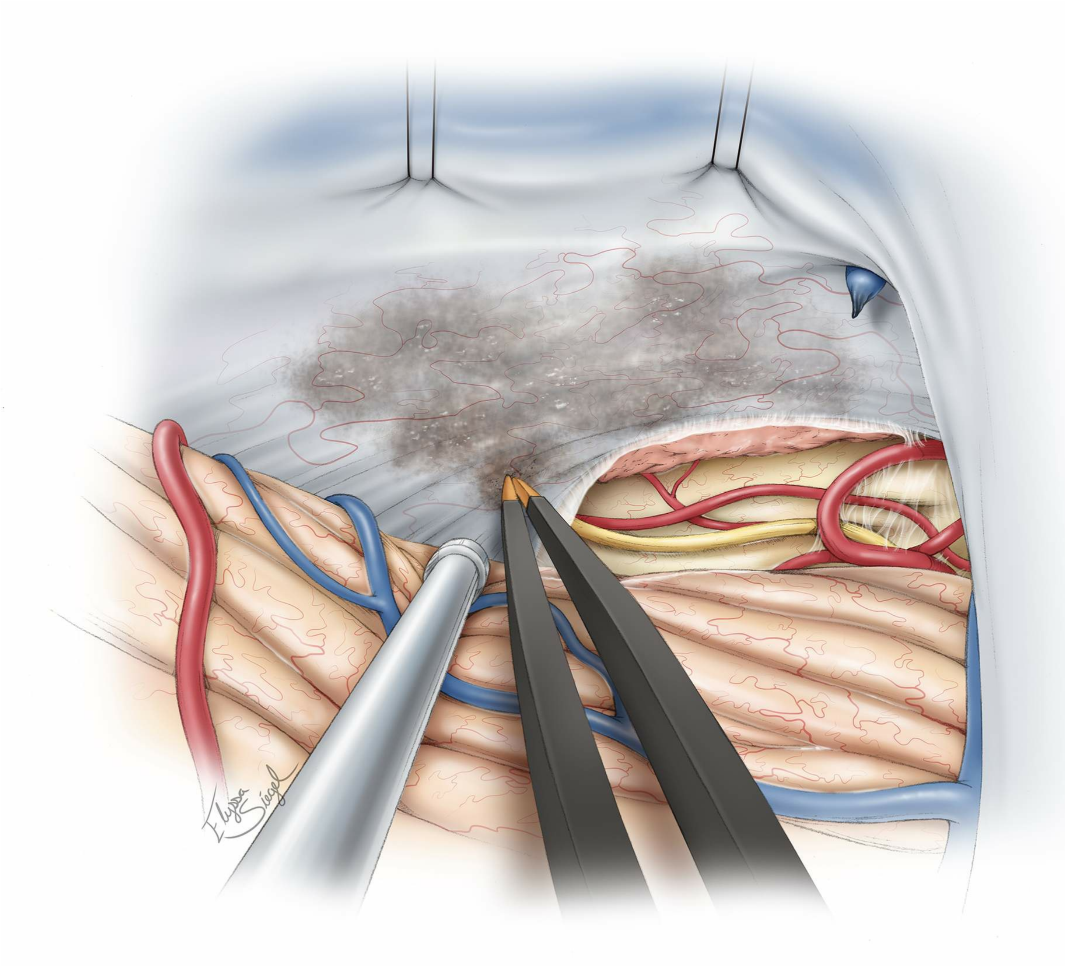

Figure 14: Early exposure of the dorsolateral brainstem and

surrounding neurovascular structures at the tentorial incisura allows for their protection by microdissection away from the tumor before significant tumor debulking is undertaken and the surgical field is obscured by bleeding. Extra-axial tumors can be devascularized early in surgery through cauterization of the undersurface of the tentorium.

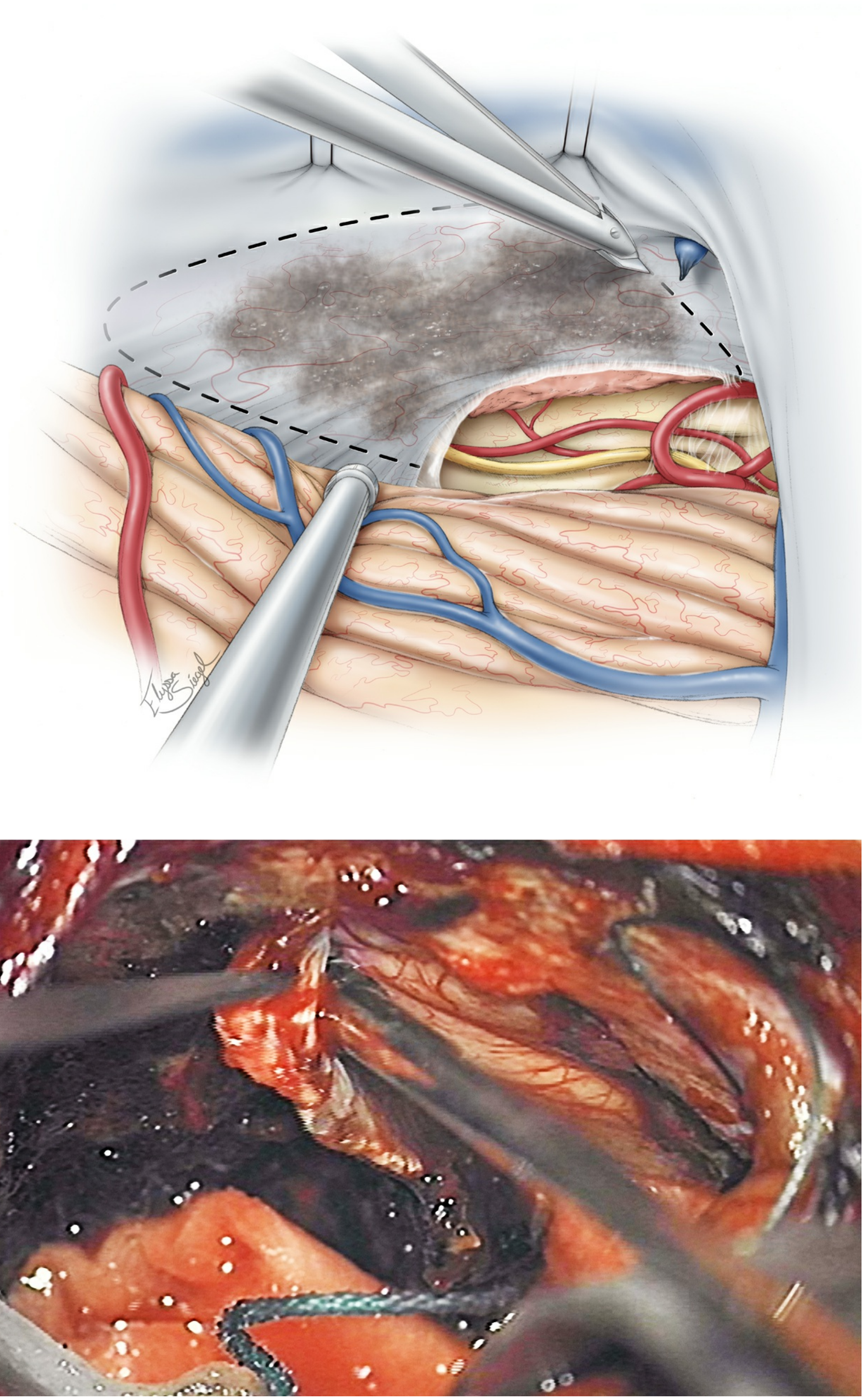

Figure 15: A generous portion of the tentorium is then incised from the petrous ridge to the midline while the operator identifies and preserves the trochlear nerve along the entire anterior edge of the tentorium. Occasional

bridging veins draining the occipital lobe and entering the superior aspect of the tentorium may be sacrificed. The medial tentorial cut should preserve the straight sinus and its tributaries. Venous lakes may be present, and venous bleeding through the leaflets of the tentorium should be controlled using thrombin-soaked gelfoam packing. Bipolar cauterization will exacerbate the bleeding by shrinking and tearing the tentorial edges.

Sectioning of the tentorium as described above will further devascularize the tumor and furnish a relatively bloodless field to debulk the tumor and microsurgically mobilize it from the surrounding cortex.

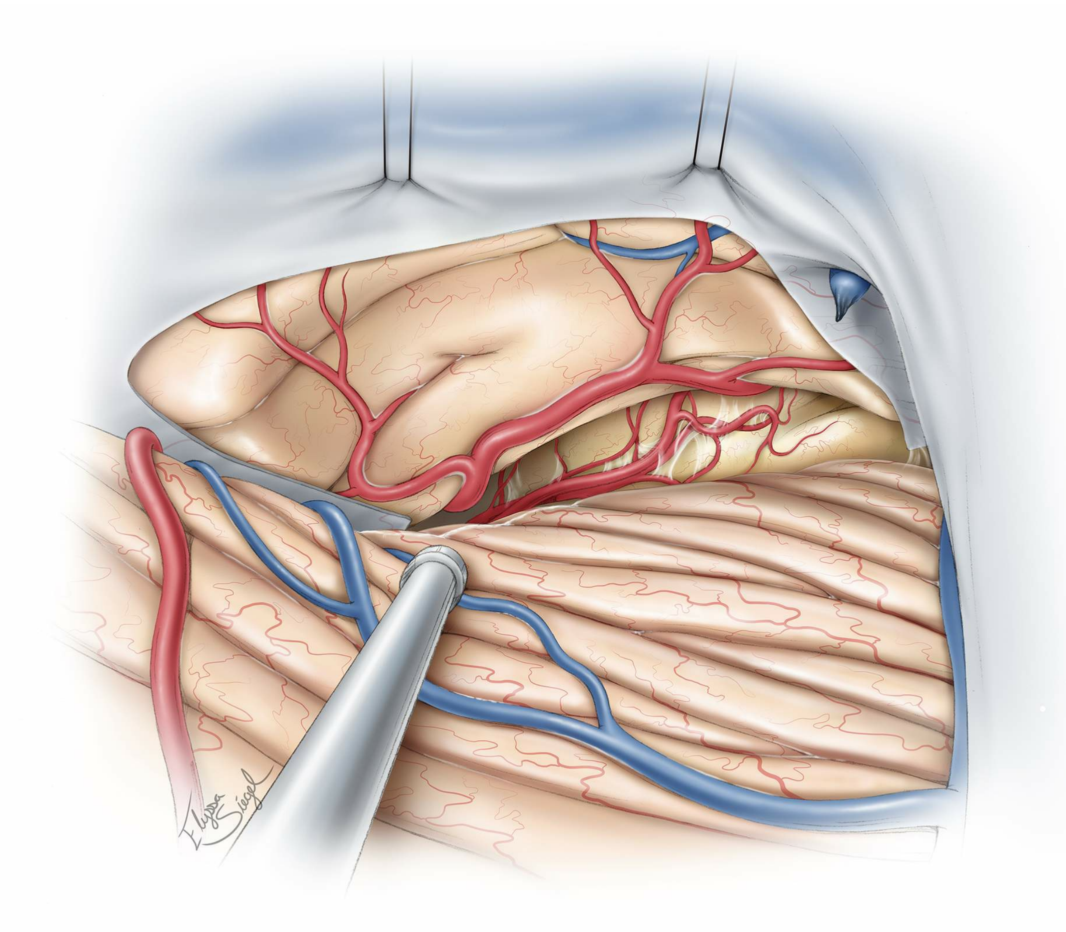

Figure 16: This tentorial resection creates a wide corridor to the basal occipital and posteromedial temporal regions. An

intra-axial tumor in this region can be similarly resected.

Closure

The tentorium is gently reflected back in its original position and not sutured. The dura must be closed in a watertight fashion because the occurrence of postoperative cerebrospinal fluid fistulae is a significant risk after tumor operations within the posterior fossa. I prefer to avoid the use of an allograft to reconstruct the dural defect and instead use a piece of pericranial autograft.

The bone may be replaced using cranial plates. I minimize the strangulation of the suboccipital muscles by deep sutures to avoid muscle necrosis and uncontrolled postoperative pain. The neck muscles are gently approximated. The fascia is closed in a watertight fashion.

Postoperative Considerations

The patient is observed in the intensive care unit for a day or two after surgery and then transferred to the ward. Steroids are administered prophylactically to minimize the risk of aseptic meningitis. If preoperative hydrocephalus was present and a ventricular catheter was implanted intraoperatively, this catheter should be left in place during surgery and removed during the postoperative recovery period.

Aggressive retraction of the cerebellum can lead to retraction edema. This can be seen on postoperative imaging and can occasionally cause symptomatic posterior fossa tension and a need for decompression. Therefore, caution should be exercised during dural closure and bone flap replacement. If the brain appears swollen, the dural closure should not cause more tension and the bone flap should not be replaced. This brain swelling can be potentially compounded by partial transverse sinus thrombosis and paravermian vein sacrifice.

Pearls and Pitfalls

- Compared with other more commonly used approaches, the supracerebellar transtentorial corridor provides numerous advantages, but is associated with long and narrow working distances.
- Aggressive cerebellar retraction should be avoided and *en passage* vessels along the mediobasal surface of the temporal lobe, including the thalamoperforating arteries, should be protected.

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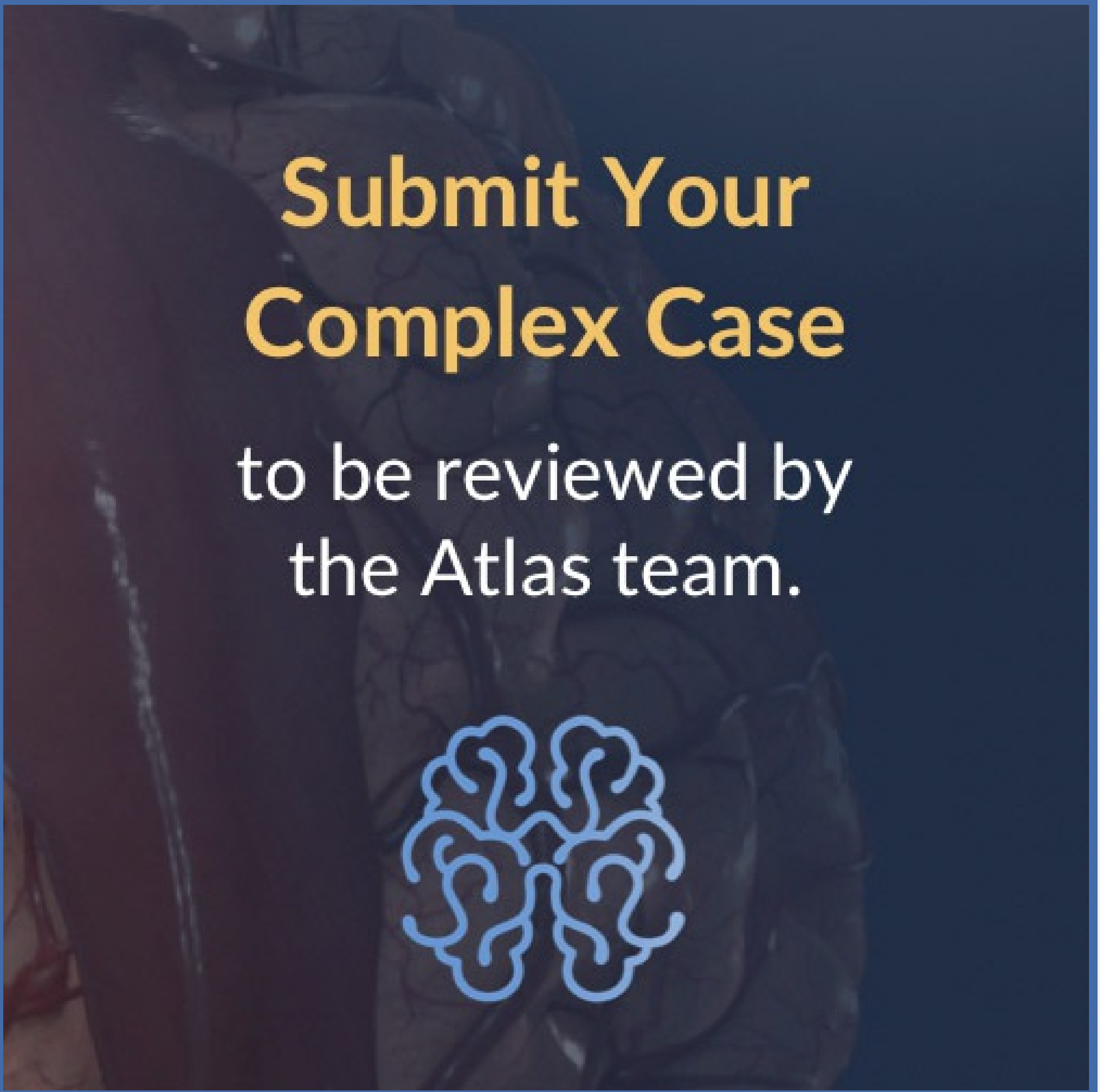
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