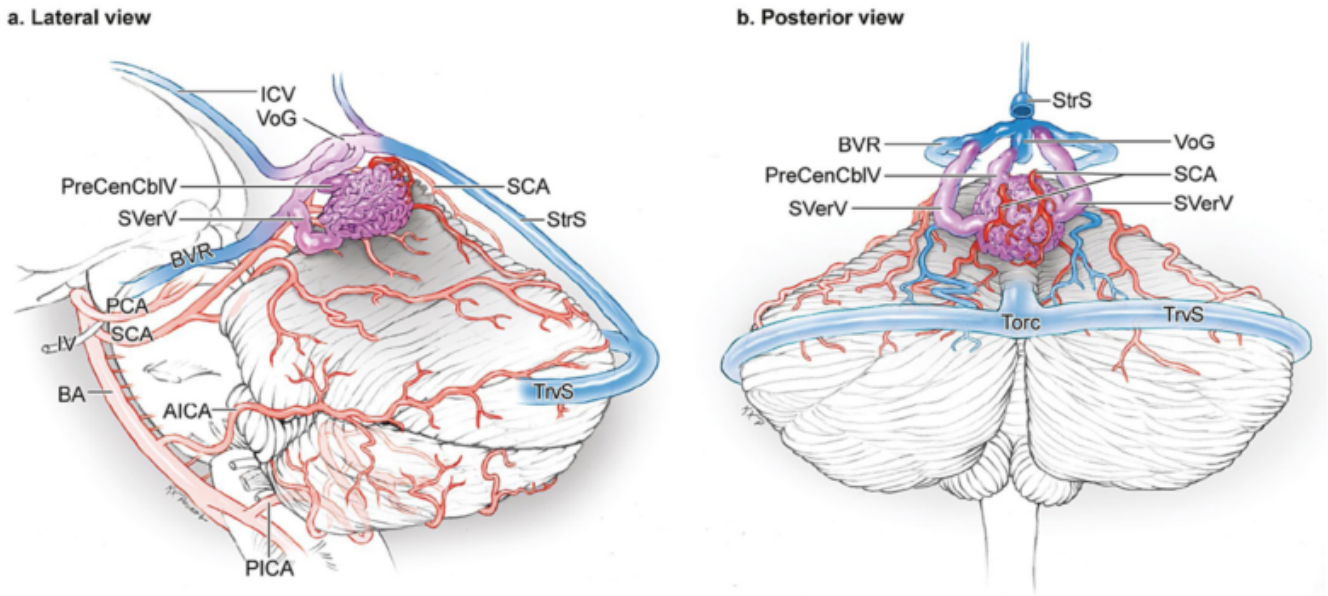
# Superior vermian arteriovenous malformation

Superior vermian arteriovenous malformation are much more common than inferior vermian AVMs (90% and 10%, respectively).

## Treatment

Surgical exposure is perpendicular to inferior vermian AVMs but tangential with superior vermian AVMs, requiring some transgression of the posterior vermis to access the inferior margins. The SCA feeders are identified by incising the posterior arachnoid of the quadrigeminal cistern on both sides of the vermian apex and opening the cerebellomesencephalic fissure where the cortical branches (s4 segments) emerge. Feeders are traced to the AVM margin and coagulated, carefully preserving arteries to the tectum and posterior midbrain. PICA feeders originate beyond its cranial loop along the distal telovelotonsillar (p4) and cortical (p5) segments. Venous drainage is through superior vermian veins, which drain to the Galenic complex (unlike inferior vermian veins). Vermian AVMs are not considered eloquent unless they extend to the cerebellar nuclei, and can be near but not associated with the trochlear nerve [1), 2)].




This AVM is based in the midline either on the superior vermis (tentorial surface, as shown) or on the inferior vermis (suboccipital surface, not shown). This AVM is supplied bilaterally by the SCA in the superior vermis and by the PICA in the inferior vermis. Superior vermian AVMs drain deeply to the VoG via SVerV and inferior vermian AVMs drain superficially to the torcula via IVerV.

## Approaches

Besides the occipital transtentorial approach the posterior subtemporal approach and supracerebellar infratentorial approach could be options as surgical routes to the superior vermis [3)].

The posterior subtemporal approach offers a relatively short distance to the posterior cerebral artery or the SCA from the brain surface. However, the operative view is limited to the proximal portion of these vessels and the surgical trajectory is lateral, making it difficult to expose the midline and the contralateral side of the lesion. Furthermore, there is a potential risk of venous congestion due to the retraction of the temporal lobe.

The supracerebellar infratentorial approach is useful for posterior infratentorial lesions. This approach provides operative views ranging from the splenium of the corpus callosum to the cerebellomesencephalic fissure including the quadrigeminal cistern [4].

However, when it is applied to AVMs, it is difficult to expose arteries feeding the anterior part of the nidus. Moreover, a nidus or dilated drainer will also become an obstacle owing to the surgical trajectory from the posterior side. In addition, when the cerebellar hemispheres and the vermis are retracted downward, veins between the cerebellum and the tentorium may need to be sacrificed. Sacrificing those veins before controlling the feeding arteries may cause brain edema or hemorrhagic complications.

The OTA can eliminate the above-mentioned disadvantages of the other approaches. One of the main advantages of this approach is a broad perpendicular view of the supracerebellar space including the quadrigeminal cistern, which makes it easier to obtain anatomical orientations and to expose feeding arteries when applied to AVMs. In addition, the SCAs, which often are the feeders of superior vermian AVMs, can be controlled in the early stage of the procedure.

Nowadays OTA is performed in the prone, lateral, semilateral, or park bench position, depending on the surgeon's preference [5] [6].

These positions allow the occipital lobe to fall owing to the effect of gravity and minimize the need for occipital lobe retraction. Drainage of cerebrospinal fluid through lumbar puncture, ventricle puncture, or opening the arachnoid of the quadrigeminal cistern can further minimize such a requirement. Recently, favorable outcomes of the OTA with preoperative partial embolization, as in the present case, were also reported [7] [8].

Several potential limitations of the OTA should be noted. First, there is a risk of hemianopsia due to occipital lobe injuries caused by its retraction [9]. However, this can be avoided by minimizing occipital lobe retraction, as mentioned above. Visual evoked potential monitoring is also useful option to reduce the risk. Second, if the tentorial sinus is prominent as in the present case, it can limit the transtentorial approach [10].

Intraoperative Doppler sonography or indocyanine green videoangiography may help to detect it although preoperative angiography did not detect it in the present case. It would be possible to cut tentorial sinus by careful coagulation or suturing in most cases. However, when the tentorium incision cannot be performed, the incision of the contralateral tentorium or other surgical approach such as supracerebellar infratentorial approach should be considered. Third, the operative view of the contralateral side is generally limited in the OTA. In such a case, a bi-tentorial incision provided greater contralateral exposure of the posterior incisural space. Other surgical approaches can also be used in combination when the lesions are extending far laterally or caudally.

# Outcome

From fifteen cerebellar vermian arteriovenous malformations that were surgically treated over a 7-year period, three instances of unsuspected residual malformation were documented and required reexploration. The total operative mortality was 7%, and the neurological morbidity was 21% [11].

# Case series

Motiei-Langroudi et al. presented his experience with 10 superior vermian AVMs and 3 dAVFs with retrograde transverse sinus or torcular drainage, each resected through a supracerebellar infratentorial approach in the park bench position with modification of the neck and head position (vertex tilt-up instead of down).

All 13 patients were treated surgically, with 4 receiving adjunctive endovascular embolization. Postoperative digital subtraction angiography confirmed complete resection of lesion in all. One patient experienced superficial wound infection treated by oral antibiotics, and another presented with a cerebrospinal fluid collection due to delayed hydrocephalus requiring insertion of a ventriculoperitoneal shunt. The median modified Rankin Scale score at last follow-up was 1. There were no surgical complications at the time of last follow-up.

This series shows that for superior vermian AVMs or dAVFs with retrograde transverse sinus or torcula venous drainage, the supracerebellar infratentorial approach in a modified vertex tilt-up park bench position is a safe and effective surgical approach [12].

# Case reports

Uchino et al. reported the case of a 73-year-old man with a hemorrhagic superior vermian AVM that was treated with surgical resection through the occipital transtentorial approach (OTA). This approach, with a direct perpendicular view of the whole lesion, enabled them to control the feeding arteries safely and to finally accomplish a total resection.

The OTA is an elegant approach for the resection of superior vermian AVMs. Detailed assessment of angiographic features is mandatory in selecting an effective and safe surgical approach for posterior fossa AVMs depending on their location. [13].

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Mabuchi et al. reported a case of two distal aneurysms of the cerebellar arteries, one arising from the vermian branch of the posterior inferior cerebellar artery, the other arising from the hemispheric branch of the superior cerebellar artery, and both feeding an associated arteriovenous malformation (AVM). The aneurysm of the distal posterior inferior cerebellar artery was considered the source of a cerebellar hemorrhage because of the location of a hematoma in the cerebellar vermis. The life-threatening hematoma was evacuated in an emergency operation 6 hours after the acute onset of symptoms. The cerebellar aneurysms and the AVM were clipped or extirpated successfully after the patient's condition improved. The association of two rare types of aneurysms with an AVM strongly supports the theory that increased hemodynamic stress derived from the AVM plays an important role

in aneurysm formation. The authors think that one should operate on the symptomatic lesion first or both the aneurysm and the AVM in the same operative procedure [14].

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