



## Tool and Techniques

## The oblique occipital sinus - implications in posterior fossa approaches

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## ABSTRACT

The retrosigmoid craniotomy is the standard approach to resect pathologies in the cerebellopontine angle (CPA). Following the craniotomy, the dura mater is opened in the inferolateral direction and the basal cistern arachnoid is dissected in order to release pressure by the outflow of cerebrospinal fluid (CSF) from the foramen magnum, so that the CPA compartment can be approached with minimal retraction of the cerebellum. We report two patients, both with vestibular schwannoma, in whom preoperative magnetic resonance imaging (MRI) revealed unusual large oblique occipital sinus (OOS) draining laterally into the sigmoid sinus - jugular bulb junction. The sinuses were preserved intact while dura mater was opened for CSF release. Careful preoperative imaging is essential prior to posterior fossa lesions approaches in order to evaluate the persistency of an OOS, especially in a retrosigmoid approach. Inadvertent OOS damage might result in, not only significant bleeding during dural opening, but also air embolism or venous hypertension, if the contralateral sigmoid sinus is small or absent.

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## 1. Background and importance

Dural venous sinuses are venous channels located between the endosteal and the meningeal layer of the dura mater. One of the unpaired dural venous sinuses is the occipital sinus, which is the smallest and lies in the attached margin of the falx cerebelli [1]. Sometimes, instead of draining into the marginal sinus at the foramen magnum or the vertebral venous plexus [2], it can drain into the sigmoid sinus as it passes in the direction of the jugular foramen, which has been termed as oblique occipital sinus (OOS) [3]. The sigmoid sinus may be underdeveloped with the OOS replacing the venous sinus drainage on the ipsilateral side.

While dural incision is performed in a retrosigmoid approach, unawareness of the possibility of an OOS may result in serious complications as venous bleeding, air embolism or venous hypertension, if the contralateral transverse sinus is small or absent.

We present two patients operated for vestibular schwannomas with large OOSs, which were preoperatively identified and intraoperatively preserved.

## 2. Clinical presentation

A 21-year-old male, otherwise healthy, presented with headaches with a normal hearing and no facial palsy or other neurological deficit. Brain magnetic resonance imaging (MRI) demonstrated a 2.9 cc (17x19x18 mm) enhancing vestibular schwannoma, Koos grade III, without hydrocephalus (Fig. 1A). Besides, a left OOS was identified (Fig. 1B-D, Fig. 2, Fig. 3A) draining into a hypoplastic left sigmoid sinus (Type IIaA, according to Shin's classification) [4].

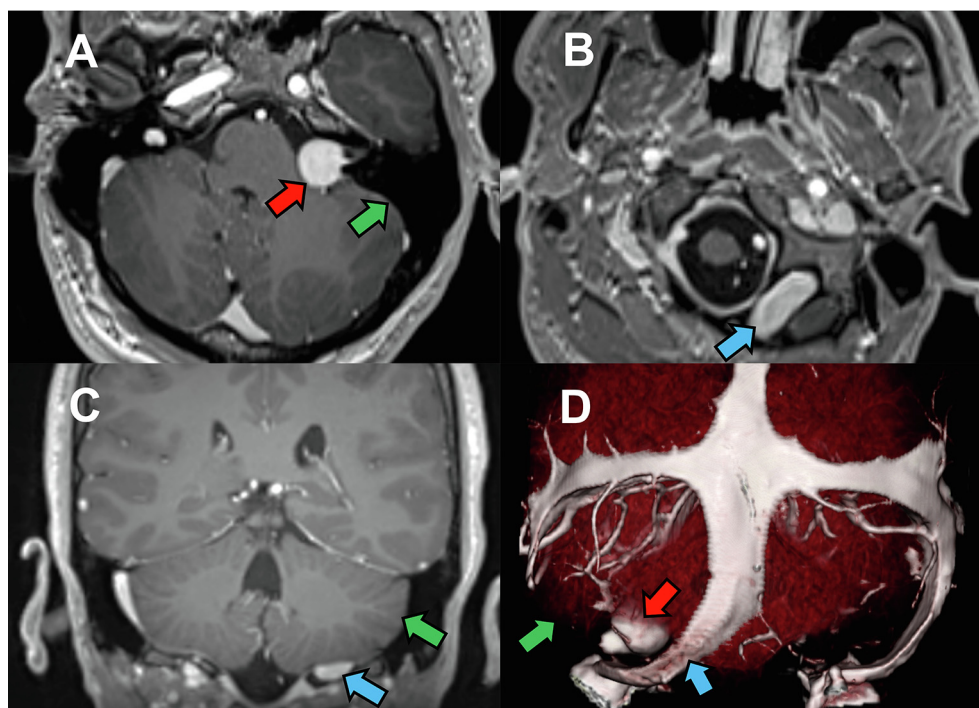
The second patient, a 62-year-old female, otherwise healthy, presented with one-year history of right severe sensorineural hearing loss, confirmed by audiometry and auditory brainstem response (ABR) (Gardner-Robertson III). Her neurological examination was otherwise unremarkable. Brain MRI demonstrated a large 8 cc (26x24x27 mm) enhancing extracranial vestibular schwannoma, compressing the brainstem, Koos grade IV, without significant hydrocephalus. A right OOS (Fig. 3B) was identified with bilateral patency of transverse-sigmoid sinuses (Shin type IB) [4].

## 3. Surgical procedure

Both surgeries were performed in a three-quarters prone position, with intraoperative monitoring of the facial nerve and

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**Fig. 1.** A) Axial T1-weighted gadolinium-enhanced MRI showing a Koos grade III, 2.9 cc left vestibular schwannoma [red arrows] in a 21-year-old male. B) Axial and C) coronal T1-weighted gadolinium-enhanced views showing a left side oblique occipital sinus (OOS) [blue arrows]. D) 3D reconstruction MRI showing the left side OOS draining into a hypoplastic/aplastic left sigmoid [green arrows] - jugular bulb sinus.

ABR in a case of a small tumor with useful hearing. After suboccipital retrosigmoid craniotomy, the dura was carefully opened in the latero-inferior part in order to approach basal cisterns to release cerebrospinal fluid (CSF). A developed OOS (Fig. 3A-B) was identified as noted in the preoperative MRI. The dura was incised until the posterior border of the OOS to preserve it and prevent bleeding. Then the cerebellum was elevated to approach

basal cisterns, releasing CSF and permitting minimal retraction to the cerebellum to proceed with the removal of the vestibular schwannoma. The surgeries were uneventful, without postoperative complications.

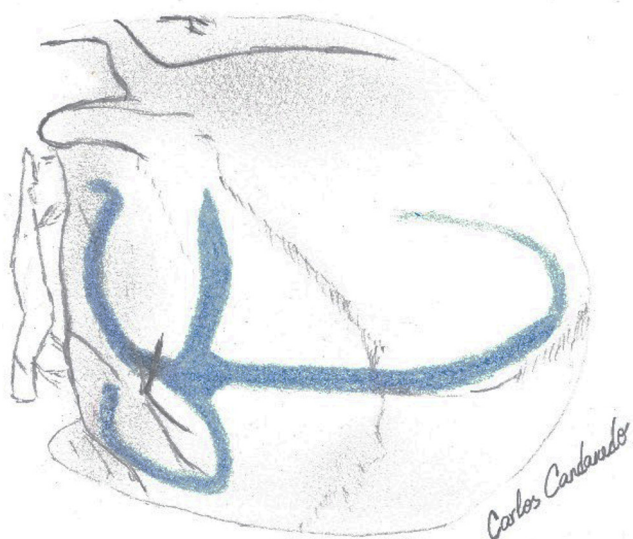
#### 4. Discussion

The OOS is reported very infrequently in the literature [3] and identified in 2.3% of patients on computed tomography venography (CTV) in the study of Shin [4], and in 4.7% according to Kobayashi [2]. However, the clinical and surgical implication, and the importance of its preoperative early recognition have not been clearly described, especially in adult patients. Dora and Zileli described clinical significance of anatomic variations of occipital sinus in patients with sinus thrombosis [5].

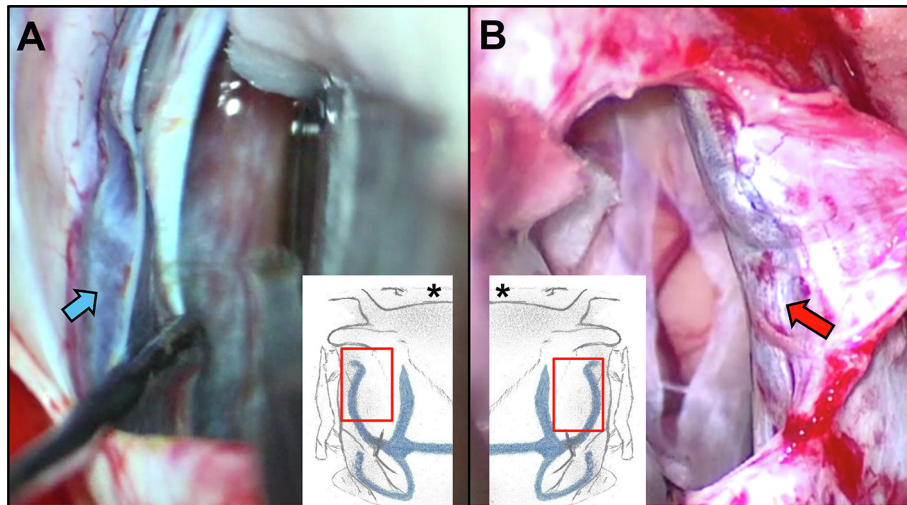
The surgeon should be aware of possibilities of venous sinuses anomalies in the posterior fossa. Practically, as the oblique occipital sinus lies on the way of dural incision in the retrosigmoid or far lateral approach, it may be accidentally damaged resulting in significant hemorrhage, air embolism and even venous hypertension (in cases when the opposite sigmoid sinus is underdeveloped). Ideally, these cases should be evaluated with CTV or magnetic resonance venography (MRV), but careful examination of regular MRI contrast studies may be sufficient if the surgeon is looking actively for the possibility of this venous anomaly.

#### 5. Conclusion

While preparing to a posterior fossa surgery, the surgeon should be aware of the possibility of anomalous OOS, in order to avoid inadvertent injury to the venous sinus and related complications.



**Fig. 2.** A schematic diagram illustrating the concept of the oblique occipital sinus (OOS), where a patent occipital sinus drains into an hypoplastic/aplastic sigmoid sinus as it passes in the direction of the jugular foramen.



**Fig. 3.** Intraoperative images of the A) left oblique occipital sinus (OOS) (blue arrow) in a left suboccipital retrosigmoid approach, and a B) right OOS (red arrow) in a right suboccipital retrosigmoid approach. \* The mirrored schematic diagram does not describe the patency of the ipsilateral sigmoid sinus, but only guides the reader's anatomical orientation in the intraoperative surgical images.

## References

- [1] Lang Jr J, Samii A. Retrosigmoidal approach to the posterior cranial fossa. An anatomical study. *Acta Neurochir (Wien)* 1991;111:147–53.
- [2] Kobayashi K, Suzuki M, Ueda F, Matsui O. Anatomical study of the occipital sinus using contrast-enhanced magnetic resonance venography. *Neuroradiology* 2006;48:373–9.
- [3] Tubbs RS, Bosmia AN, Shoja MM, Loukas M, Cure JK, Cohen-Gadol AA. The oblique occipital sinus: a review of anatomy and imaging characteristics. *Surg Radiol Anat.* 2011;33:747–9.
- [4] Shin HS, Choi DS, Baek HJ, Choi HC, Choi HY, Park MJ, et al. The oblique occipital sinus: anatomical study using bone subtraction 3D CT venography. *Surg Radiol Anat* 2017;39:619–28.
- [5] Dora F, Zileli T. Common variations of the lateral and occipital sinuses at the confluens sinuum. *Neuroradiology* 1980;20:23–7.