Procedure 6 Extended Retrosigmoid Craniotomy

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INDICATIONS

- Lesions in the cerebellopontine angle and petroclival region can be surgically challenging to resect because of surrounding vascular and eloquent neural structures (i.e., brainstem) that have zero tolerance for retraction. Numerous surgical approaches, such as translabyrinthine, transcochlear, and presigmoid approaches, are part of the surgeon's armamentarium. Retrosigmoid craniotomy allows for easy and rapid access to the cerebellopontine angle.
- The extended version of the traditional retrosigmoid craniotomy is characterized by bony skeletonization of the sigmoid and transverse sinuses with an optional additional mastoidectomy. This modified version permits access to areas that are difficult to access with the classic approach—ventral to the brainstem and near the tentorium. This technique can often serve as a safe alternative to more radical cranial base approaches.
- This approach can be employed for extraaxial lesions in the cerebellopontine angle and intraaxial lesions arising along the petrosal surface of the cerebellum, cerebellar peduncles, or brainstem.

CONTRAINDICATIONS

- Patients must have patent contralateral transverse and sigmoid sinuses before manipulation of the sinuses ipsilateral to the approach.
- This approach is relatively contraindicated in older patients with poor-quality dura mater; in these patients, a craniectomy as opposed to a craniotomy should be performed.

PLANNING AND POSITIONING

- Preoperative planning includes assessment of the patient's cardiopulmonary status, evaluation of comorbidities, and basic laboratory tests, including a basic metabolic panel, complete blood count, coagulation profile, and type and screen. Baseline chest x-ray and electrocardiogram are also useful.
- In addition to standard magnetic resonance imaging (MRI) for intraoperative guidance, magnetic resonance venography is also obtained to ensure that the venous sinuses contralateral to the approach are patent before manipulation of the transverse and sigmoid sinuses ipsilaterally.
- Within 60 minutes of skin incision, perioperative antibiotics are administered.
- Brain relaxation can be achieved by administering mannitol, dexamethasone, and mild hyperventilation. For moderate-to-large lesions, a lumbar subarachnoid drain is also placed for intraoperative drainage; this drain is removed at case completion before extubation.
- After anesthesia induction, a multichannel central line and precordial Doppler is placed for early intraoperative detection and management of air embolism.
- Surgical navigation can be used as an adjunct depending on availability and complexity of the case. Surgical navigation can aid in the precise location of the transverse and sigmoid sinuses and in the placement of the burr holes before making the craniotomy flap.
- **Figure 6-1:** The patient is placed supine on the operating table with the ipsilateral shoulder elevated as needed to facilitate head rotation toward the contralateral side. The skull clamp is fixated with paired posterior pins at the equator in the occipital bone and single anterior pin at the equator in the contralateral frontal bone superior

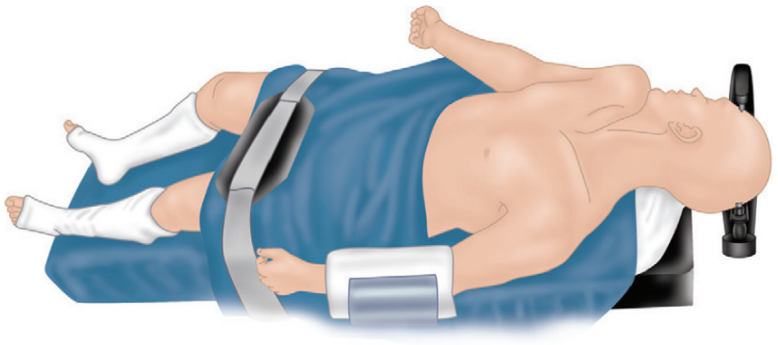

FIGURE 6-1

to the orbit. The head is positioned by first elevating the head above the heart in the "sniffing" position. Second, the head is rotated up to 60 degrees to the contralateral side depending on the intended operation. Third, the neck is extended so that the vertex is angled down 10 to 30 degrees, allowing for self-retraction of the frontal lobe off the anterior cranial fossa floor. When the head is ideally positioned, the malar eminence of the zygomatic bone should be the highest point in the operative field.

PROCEDURE

- **Figure 6-2:** C-shaped incision is made extending from 2 cm superior to the pinna and ending two fingerbreadths below the mastoid tip. A soft tissue dissection is performed so that bone is exposed from superior to the asterion down to the foramen magnum and from the mastoid process to several centimeters posterior to the sigmoid sinus. Osteotomies consist of two conceptual components:
- Retrosigmoid craniotomy with skeletonization of the venous sinuses
- Limited posterior mastoidectomy (if needed) for exposure of the jugular bulb
- **Figure 6-3:** Four burr holes are placed in the following order: inferiorly over the cerebellar hemisphere *(A)*, over the transverse sinus proximal to the transverse-sigmoid junction (placed slightly supratentorial so that the entire sinus can be exposed) *(B)*, over the sigmoid sinus as it enters the jugular foramen *(C)*, and over the transverse-sigmoid junction but slightly supratentorial *(D)*. With a Penfield No. 3, careful epidural dissection is performed to separate the dura and the venous sinuses. A craniotome is used to connect all the burr holes and create a free bone flap. The lumbar drain is optional; if placed right at this point, it is used to drain cerebrospinal fluid and to relax the brain slowly to facilitate the dissection of the epidural space.

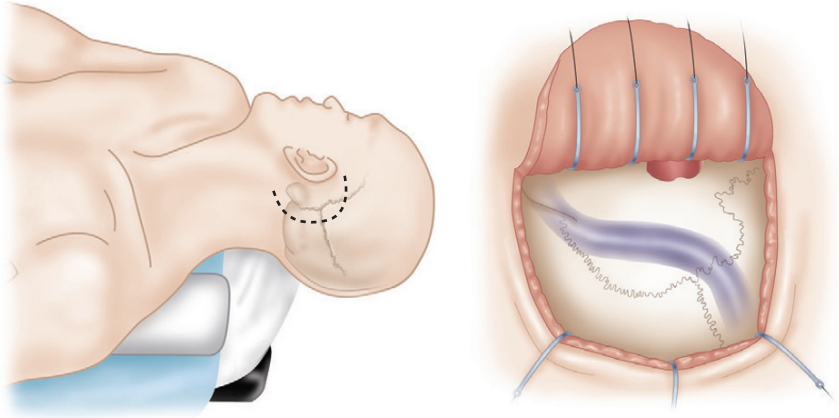

FIGURE 6-2

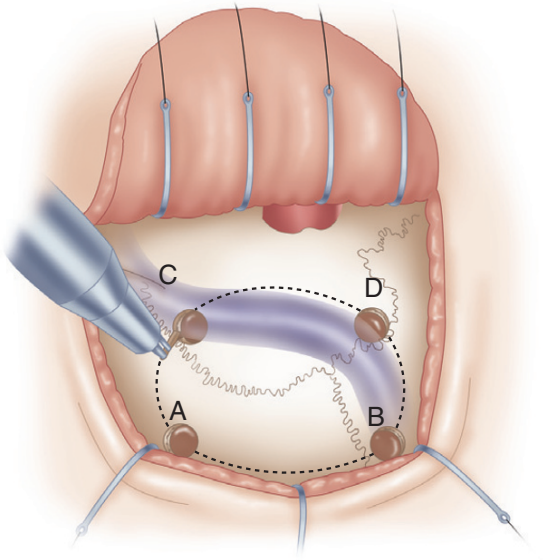

FIGURE 6-3

The bone overlying the sigmoid sinus transitions from compacted bone to a more trabeculated quality as the sinus enters the jugular foramen. Although the craniotomy can effectively unroof the compacted bone, a limited posterior mastoidectomy must be done to skeletonize the sinus as it drains into the jugular.

- **Figure 6-4:** Process of the limited posterior mastoidectomy begins with a cutting bur but then transitions to a diamond bur as the veil of blue to visualize through a thin eggshell rim of bone. In this process, the mastoid emissary vein may be encountered; hemostasis can be obtained here with cauterization.
- **Figure 6-5:** Cruciate dural opening is performed with pedicles based on the sigmoid and transverse sinuses. The flap based on the sigmoid sinus allows for the sinus to be reflected anteriorly and provide unobstructed access to the cistern lateralis and cerebellopontine angle. The flap pedicled on the transverse sinus allows for access between the cerebellum and tentorium.

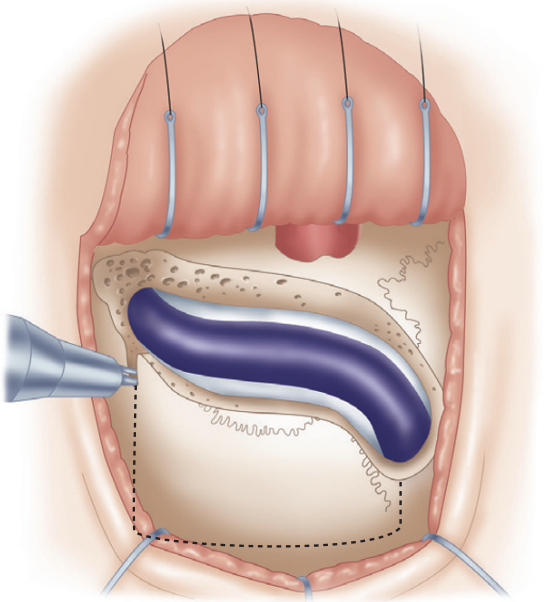

FIGURE 6-4

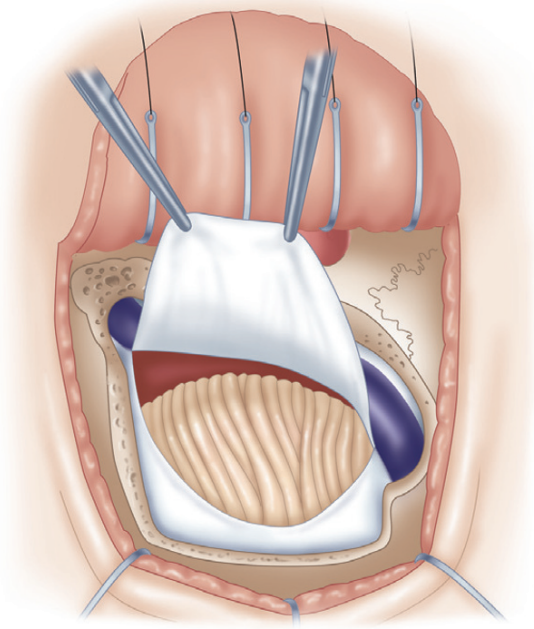

FIGURE 6-5

- At this point, intradural dissection proceeds per the target lesions. A lumbar drain can be used to facilitate cerebellum relaxation for larger tumors.
- The dura is primarily closed with interrupted sutures. Of key importance, in light of performing a mastoidectomy, the mastoid air cells must be thoroughly waxed to circumvent a potential route of cerebrospinal fluid egress.
- **Figure 6-6:** Bone flap is secured with titanium plates and screws.

TIPS FROM THE MASTERS

- This approach is a safe and effective alternative to more radical cranial base approaches to the cerebellopontine angle and to the petroclival region. Skeletonization of the venous sinuses provides the advantage of increased working angle—especially providing a line of sight parallel to the petrous surface of the cerebellum.
- A lumbar subarachnoid drain should be considered in cases in which early access to cerebrospinal fluid cisterns may be challenging.

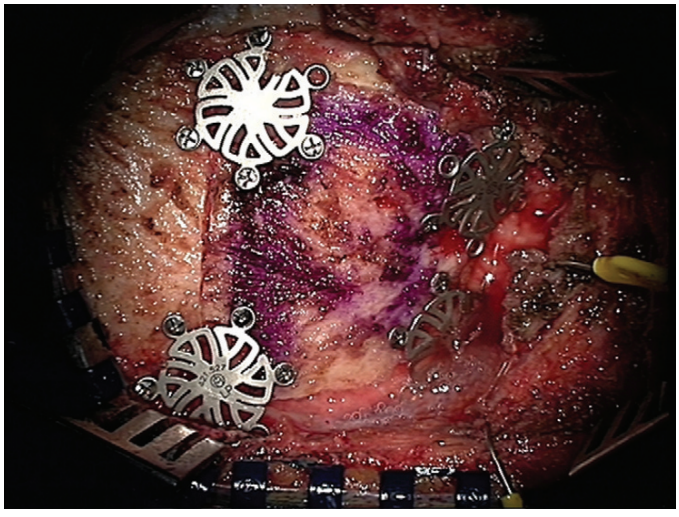

FIGURE 6-6

PITFALLS

The primary limitation or risk of this approach is the potential for venous injury. This potential highlights the importance of confirming that the patient has patent contralateral venous drainage in case intraoperative sinus injury occurs and sacrifice becomes necessary.

BAILOUT OPTIONS

- For older patients with poor-quality dura (which can be assessed after initial burr hole placement) and to prevent inadvertent sinus injury, a craniotome should not be used for skeletonization. In these patients, a standard retrosigmoid craniotomy or craniectomy should be performed. The sinuses can be subsequently unroofed with a series of cutting and diamond drill bits.
- The management of venous sinus injury depends on the extent of the defect and the presence of contralateral drainage. Small injuries can often be managed by packing. In situations of larger injury in which contralateral flow is not patent on preoperative imaging, a patch (muscle or dural substitute) can be sutured to repair the defect.

SUGGESTED READINGS

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Figures 6-1 through 6-6 adapted from Quiñones-Hinojosa A, Chang EF, Lawton MT. The extended retrosigmoid approach: an alternative to radical cranial base approaches to lesions in the posterior fossa. Neurosurgery 2006;58:ONS208–14.