



Surgery for Small Vestibular Schwannoma

Last Updated: July 4, 2021

General Considerations

There is probably not a more controversial topic in all of neurosurgery or neurotology than the optimal treatment for small- to medium-sized acoustic neuromas.

Acoustic neuromas usually arise from the superior vestibular nerve at the transition point between myelin production from oligodendrocytes (central myelin) and myelin production from Schwann cells (peripheral myelin). This transition point, the Obersteiner–Redlich zone, is usually within the internal auditory canal (IAC) near the transverse crest.

Therefore, acoustic neurinomas tend to originate within the IAC and grow through the porus acusticus into the cerebellopontine angle. In general, about 14% of acoustic neuromas are intracanalicular.

Small vestibular schwannomas are defined generally as Koos grade I or IIa, either purely intracanalicular or protruding from the IAC no more than 10 mm, respectively.

Patients usually present with tinnitus, vertigo, and unilateral sensorineural hearing loss. Surgical approaches include the middle fossa and retrosigmoid approaches and are selected on the basis of tumor size and location and the possibility of hearing preservation. My preferred surgical approach to small acoustic neurinomas in patients with useful hearing is the retrosigmoid craniotomy.

The increased adoption of magnetic resonance imaging (MRI) has resulted in an increased incidence in the diagnosis of small vestibular schwannomas, particularly within the elderly population. However, the management of small asymptomatic to minimally symptomatic vestibular

schwannomas presents a challenge within the spectrum of care for patients diagnosed with a vestibular schwannoma. Surgeons must avoid increasing the patient's symptoms with the proposed plan of care.

Therefore, this management topic is quite controversial within the neurosurgical literature and is subject to frequent debate. The perspective presented in this chapter is mine.

Treatment Recommendations

Three management options should be considered for small vestibular schwannomas:

1. Conservative observation and serial radiographic follow-up
2. Stereotactic radiosurgery
3. Microsurgical resection

These options are described in detail as applied to small acoustic neuromas. In general, conservative observation is pursued after the initial diagnosis.

Conservative Observation

Determining the optimal course of action for these small lesions should include consideration of the natural course of growth and symptomatic capabilities of the lesion versus the risk of intervention. This philosophy provides a baseline for justifying the recommendation of more permanent treatment options.

Some authors and our otolaryngology colleagues have advocated for immediate microsurgery or radiosurgery. However, variables such as tumor size and patient age, hearing status, and treatment preference heavily impact those recommendations. The average growth rate is generally 1 to 2 mm/year; however, these lesions can be prone to rapid expansion, so the initial observation intervals should be conservative. Many authors recommend an initial 6-month interval for follow-up imaging.

A lack of obvious tumor growth on imaging should not be assumed to indicate a lack of symptomatic progression, given that even stable lesions can result in gradual hearing deterioration. Therefore, audiometric testing for speech discrimination and decibel loss is appropriate.

Conservative observation is recommended by many for small vestibular schwannomas that are asymptomatic or mildly symptomatic. The obvious argument against this recommendation is the possibility for sensorineural hearing loss, even in the absence of tumor progression. The possibility of sensorineural hearing loss and early progression should be weighed against the risks associated with microsurgical resection or stereotactic radiosurgery. The surgeon must take the patient's unique anatomical and clinical factors into consideration when making this determination.

A large series by Tveiten et al. (1) of patients with an average of 8 years of follow-up and serviceable hearing at diagnosis revealed a 68% chance of maintaining functional hearing via conservative management compared to 40% via Gamma Knife radiosurgery and 14% via microsurgical resection. This study carried an innate bias given that the treated tumors were more likely to have undergone progressive growth, but nonetheless, the results of this study highlight the value of conservative measures.

Stereotactic Radiosurgery

Multiple study authors have recommended stereotactic radiosurgery for small vestibular schwannomas, which secures serviceable hearing in 40% to 75% of patients 3 to 7 years after diagnosis. However, a randomized controlled study comparing observation to radiosurgery has not been performed. Therefore, recommendations for this surgery are typically conservative.

It is important to note that the cochlear radiation dose should be less than 4.2 Gy (2). Initiating Gamma Knife radiosurgery before the onset of subjective hearing loss is preferable (3).

Microsurgical Resection

Surgery for small vestibular schwannomas must result in the preservation of not only facial nerve function but also hearing. Resection can be performed via either a [retrosigmoid](#) or [middle fossa](#) approach.

The initial hearing-preservation rate after these approaches ranges from 50% to 100%, but the possibility of delayed decline in functional hearing persists. The vast range in success rates of resection depends on patient selection and the surgeon's skill. Therefore, these considerations must be a factor when recommending this treatment to patients.

Surgery may offer an opportunity for saving the hearing of patients with serviceable hearing. This depends highly on the surgeon's hands and the patient's baseline hearing, tumor size, and extent of tumor extending toward the fundus of the IAC. Patients who have excellent hearing before surgery, a small tumor, and a good fundal cap of cerebrospinal fluid (CSF) are the best candidates for hearing preservation surgery. Similarly, these are also the patients who fare best with observation or radiosurgery.

MICROSURGICAL RESECTION OF SMALL ACOUSTIC NEUROMAS

The techniques for resecting small acoustic neuromas follow those for the resection of larger ones. The following series of illustrations demonstrates nuances of the technique for resection.

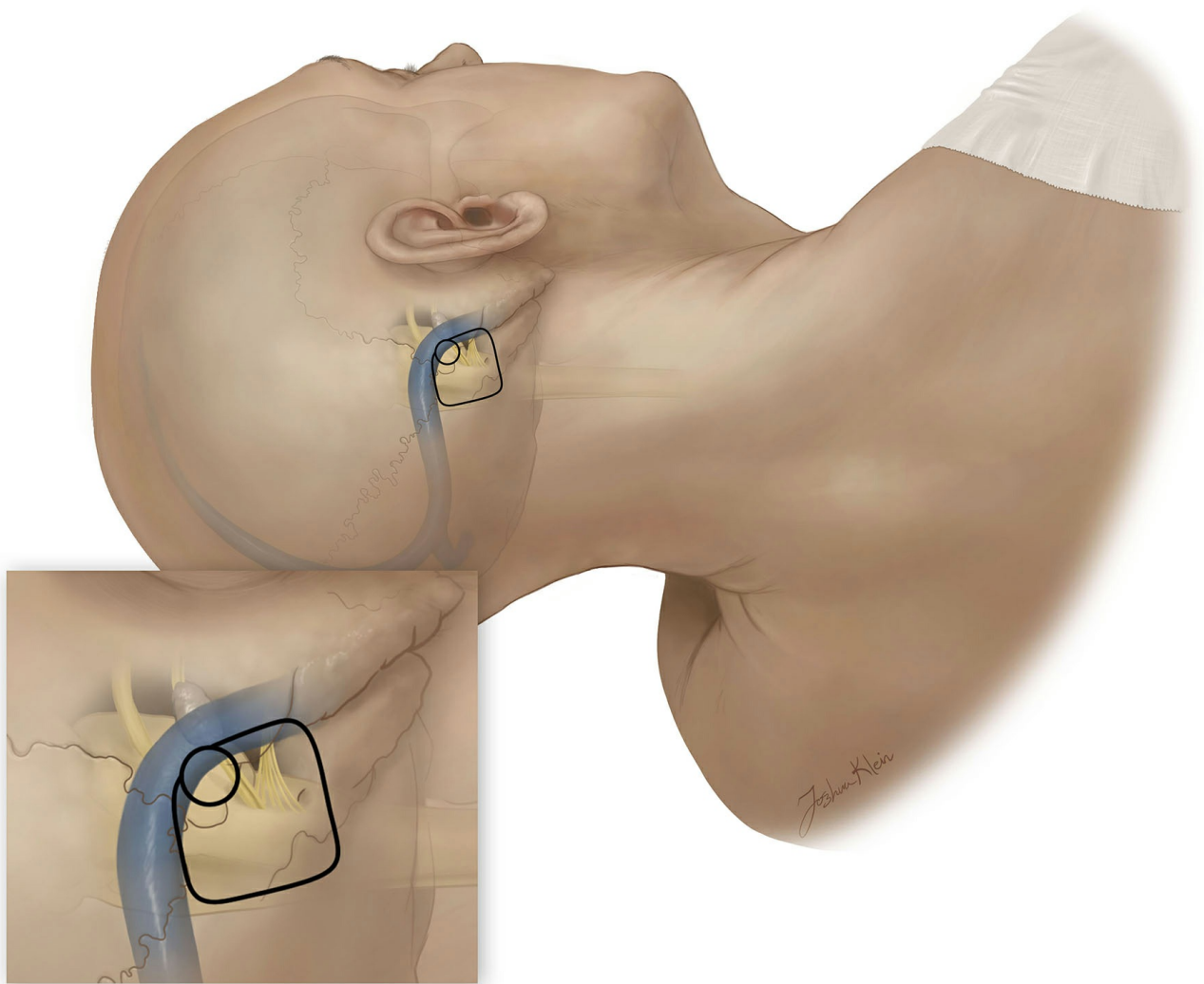


Figure 1: The patient should be positioned according to the location of the lesion within the cerebellopontine angle. I place the sagittal sinus parallel to the floor and mobilize the patient's shoulder away from the operative field using tape. The lateral position maintains the neck in the most physiological position and minimizes the risk of intractable postoperative neck pain associated with the supine position, which demands significant rotation of the neck. Therefore, the head is in a neutral position with the neck flexed and thorax elevated 15 degrees.

Baseline evoked-potential monitoring electrodes are placed on the head and face; audiometric data are obtained.

A lumbar puncture is performed before drapes are placed, and ~30 to 40 μ l of CSF is removed. This maneuver relieves posterior fossa tension and allows smooth entry around the cerebellum toward the cerebellopontine angle. The craniotomy is the standard limited [retromastoid osteotomy](#) with exposure of the edge of the sigmoid sinus. The location of the tumor in relation to the exposure is ghosted.

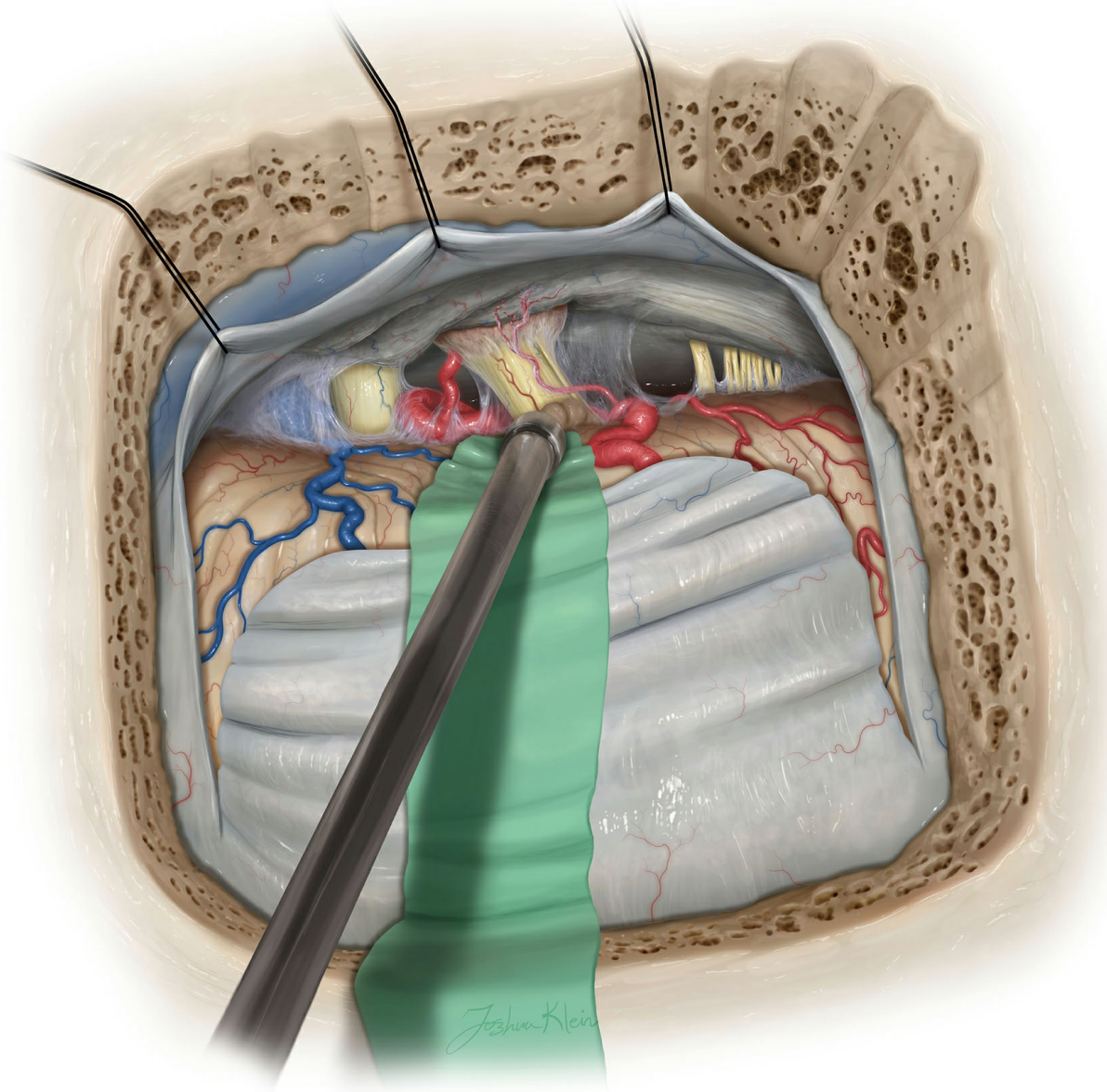


Figure 2: The arachnoid layers of the cerebellopontine angle are dissected, and the small portion of the tumor herniating into the cistern is identified. Careful dissection of the tethering arachnoid bands between the flocculus and vestibular nerves allows easy mobilization of the cerebellum without the use of fixed retraction. I often use a piece of surgical glove cut in the shape of a patty to slide around the cerebellum atraumatically.

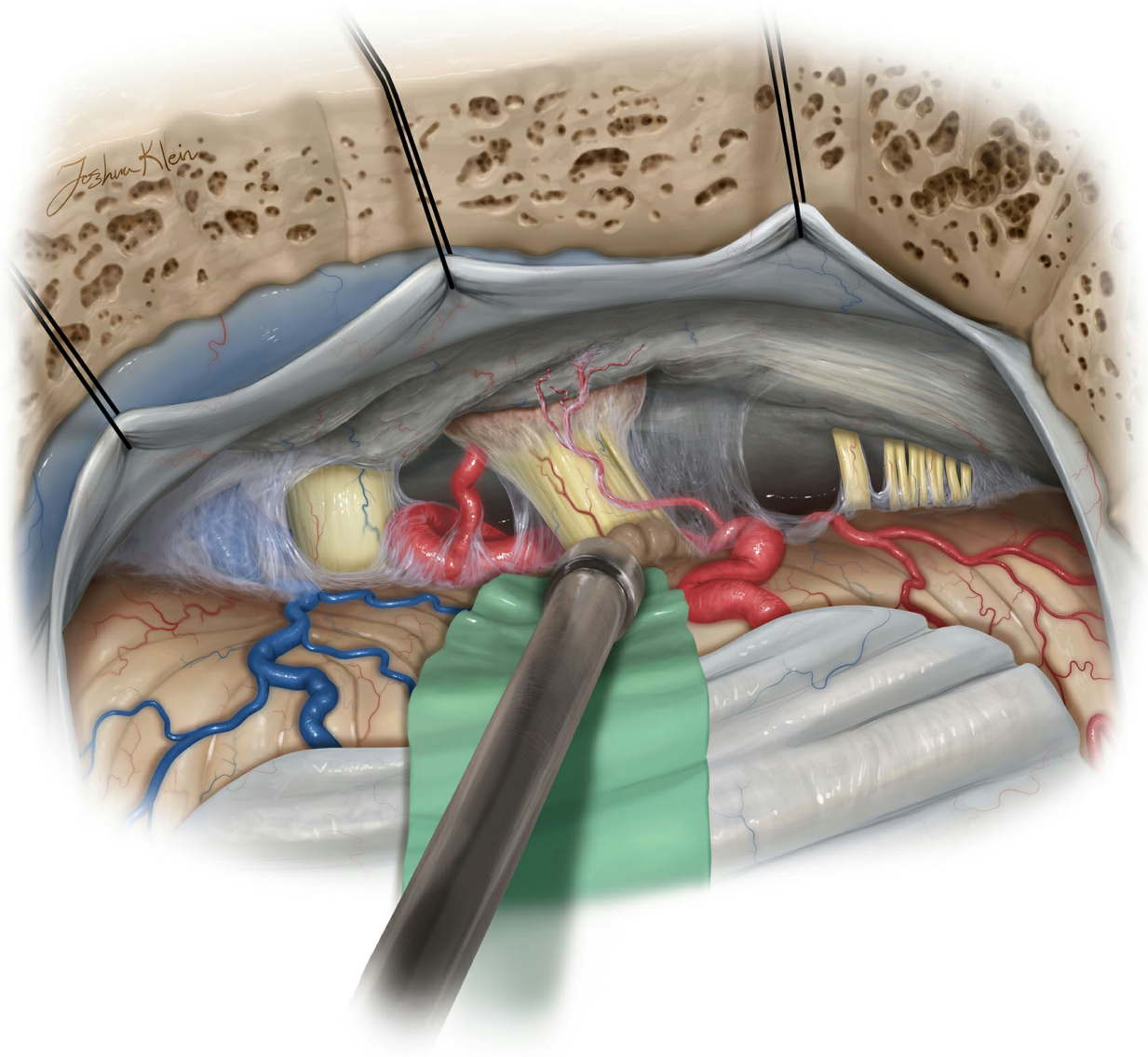


Figure 3: Often, 1 to 2 meningeal dural arterial branches to the petrous dura around the IAC (subarcuate arteries) can be safely sacrificed, and the IAC can then be exposed. These small arteries are clearly feeding the petrous dura and are not entering the IAC. They should not be confused with the labyrinthine artery that enters into the IAC.

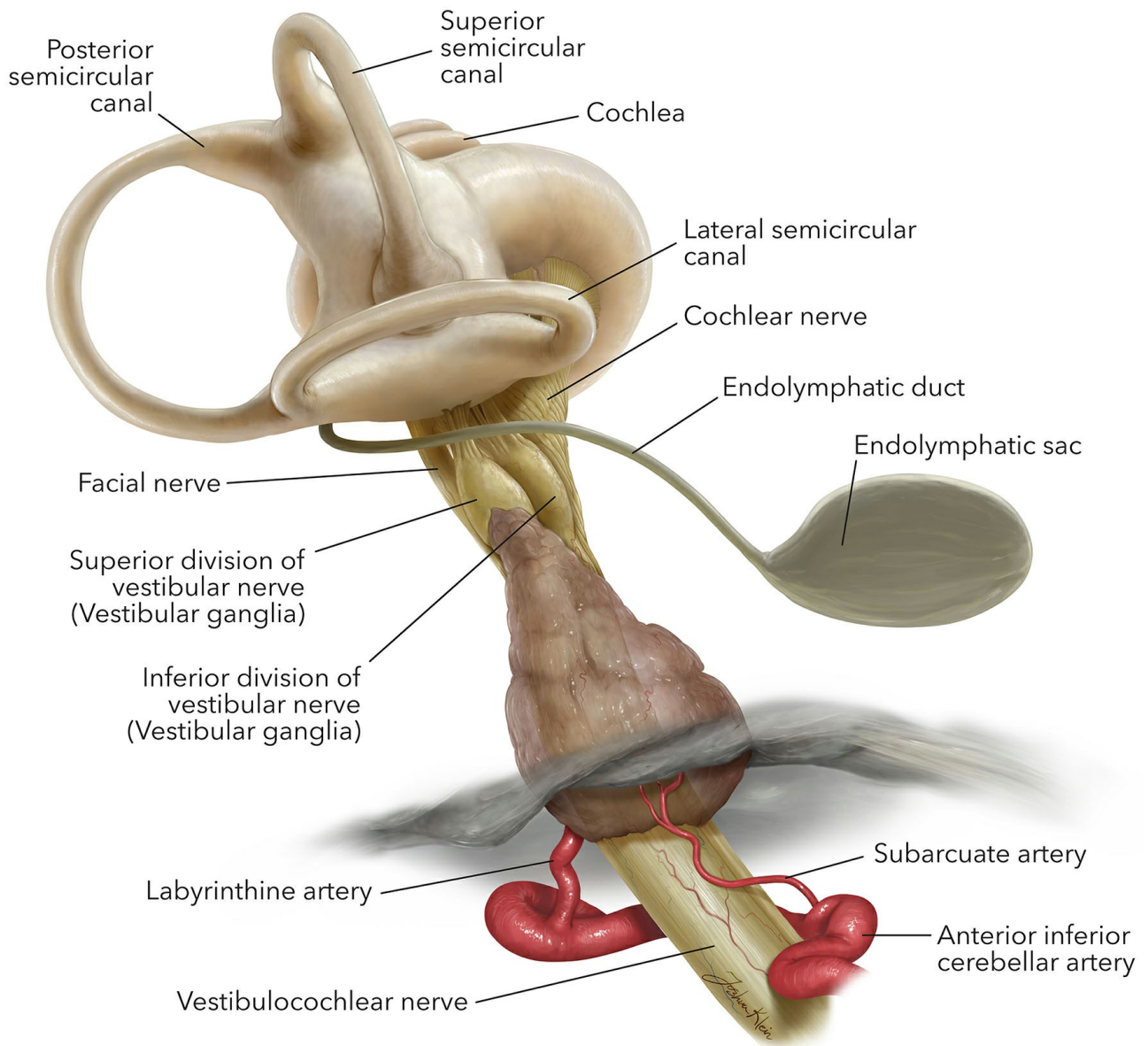


Figure 4: Anatomy of the labyrinth and endolymphatic sac to the IAC. Note the most common origin of the tumor from the superior vestibular nerve.

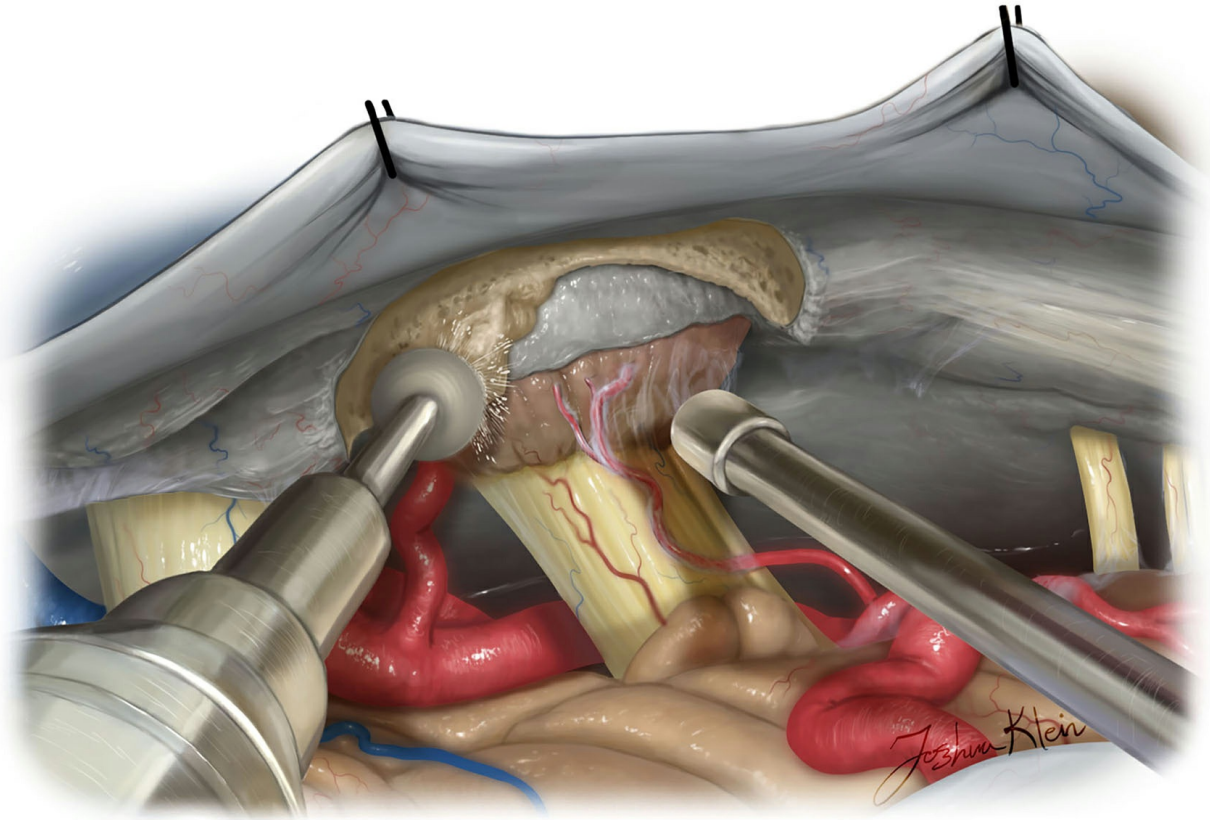


Figure 5: As the internal auditory canal is opened with a high-speed drill, care is taken to not enter the posterior semicircular canal. Maintaining a 1- to 2-mm distance from the transverse crest aids in protecting the posterior semicircular canal.

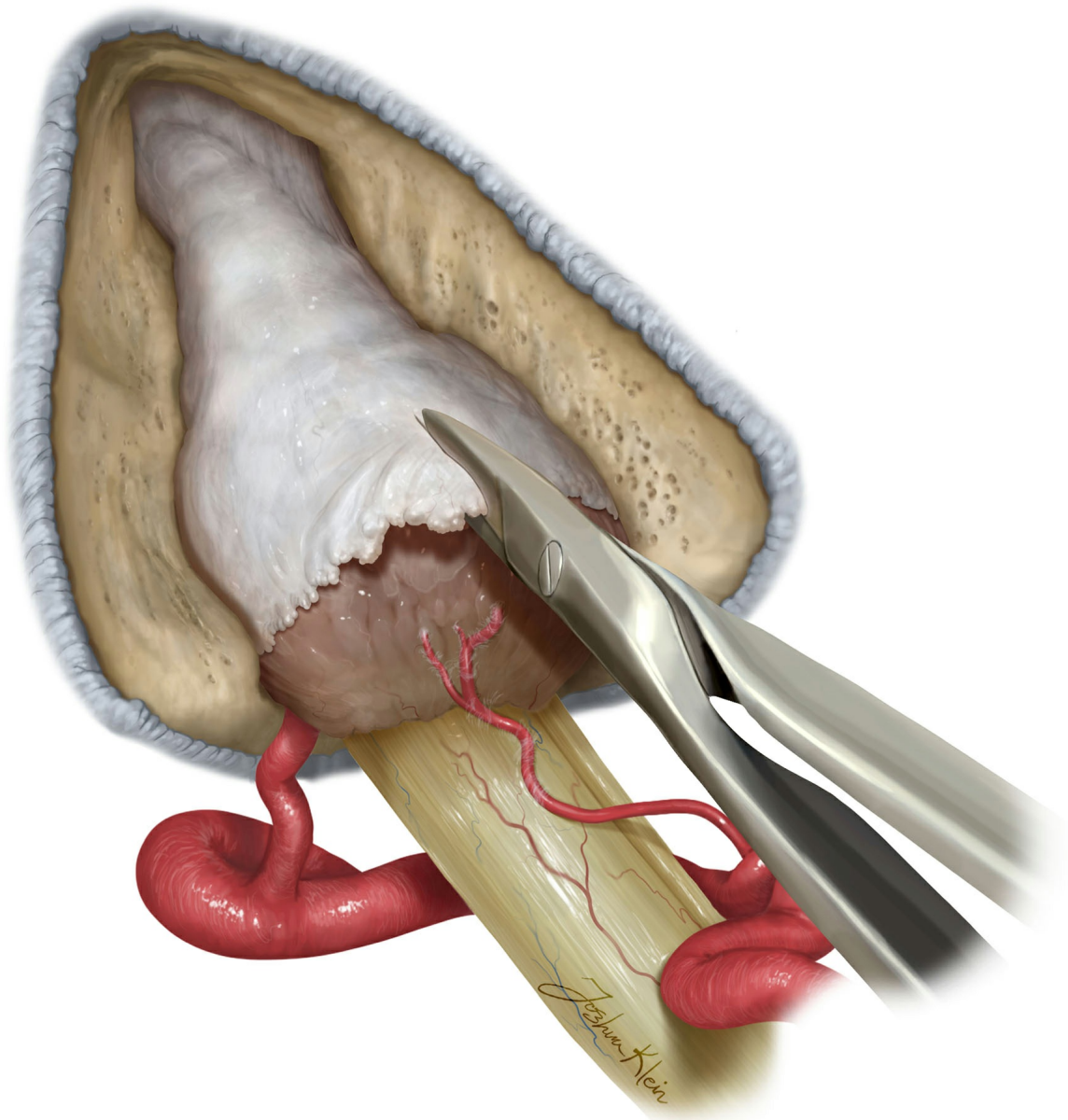


Figure 6: The dura of the internal auditory canal is opened via sharp dissection.

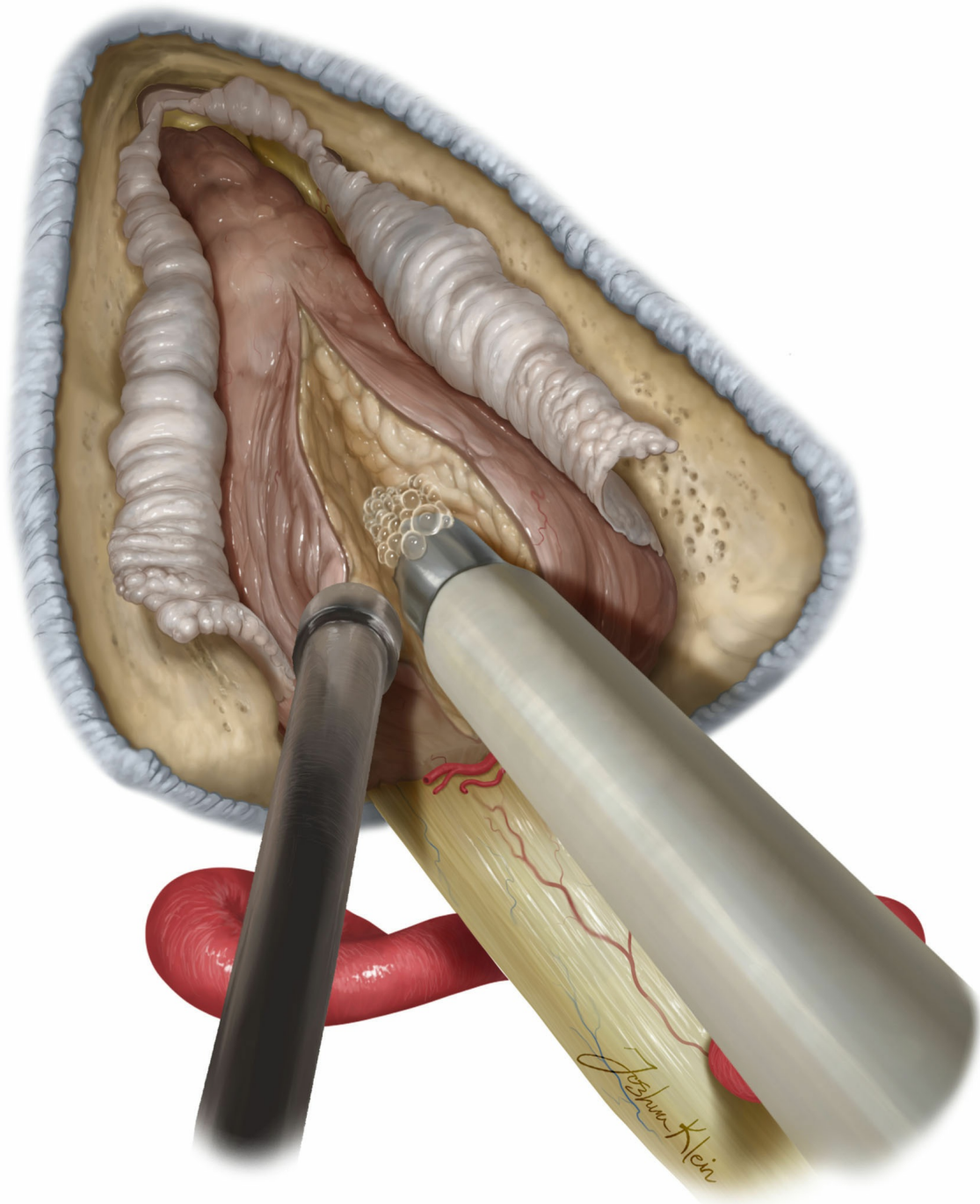


Figure 7: The arachnoid layer containing the blood supply to the vestibulocochlear nerve is dissected from the tumor capsule to ensure preservation of hearing. The tumor is then debulked.

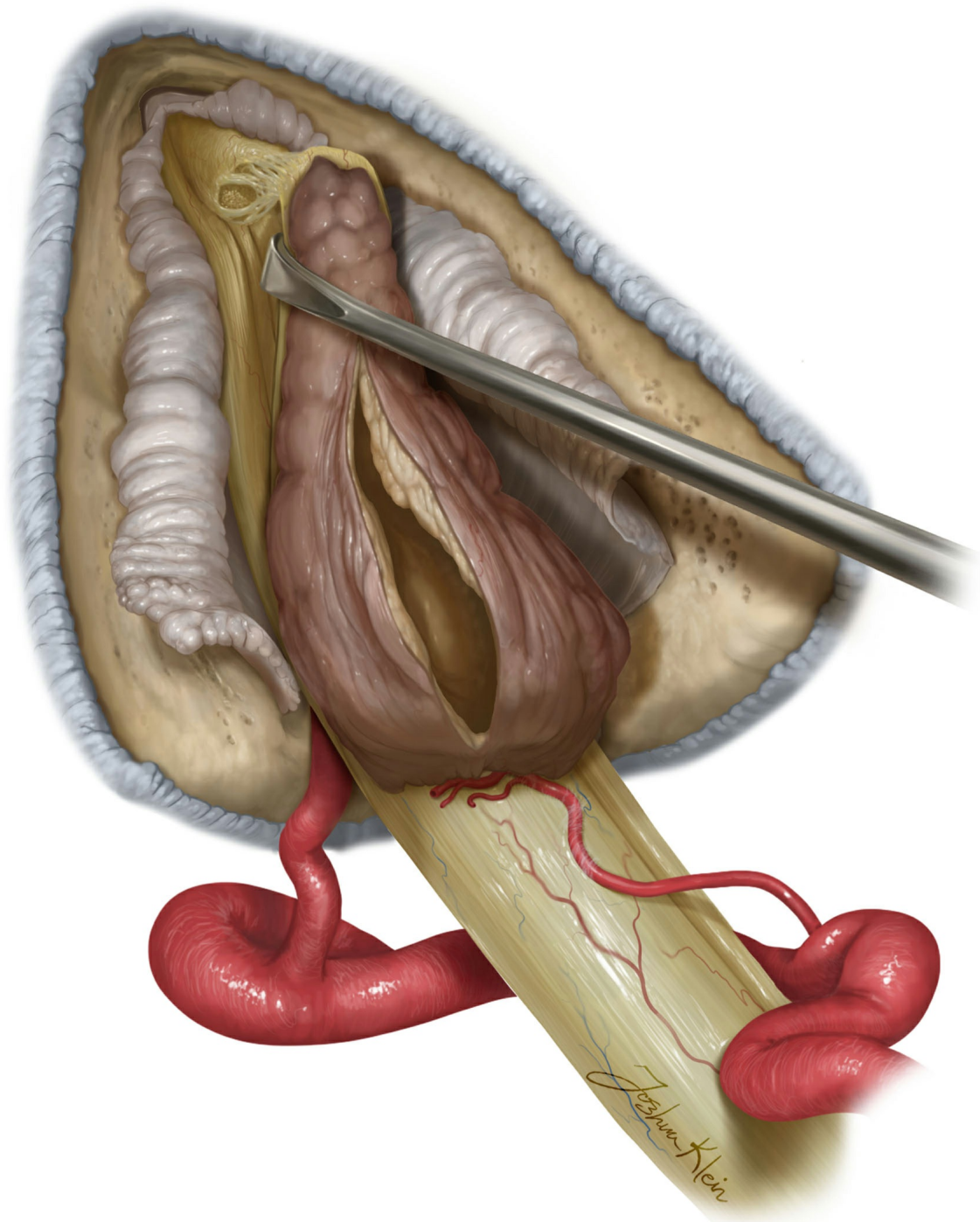


Figure 8: The superior vestibular nerve from which the tumor typically arises is sectioned/avulsed lateral to the tumor to ensure that residual tumor is not left behind.

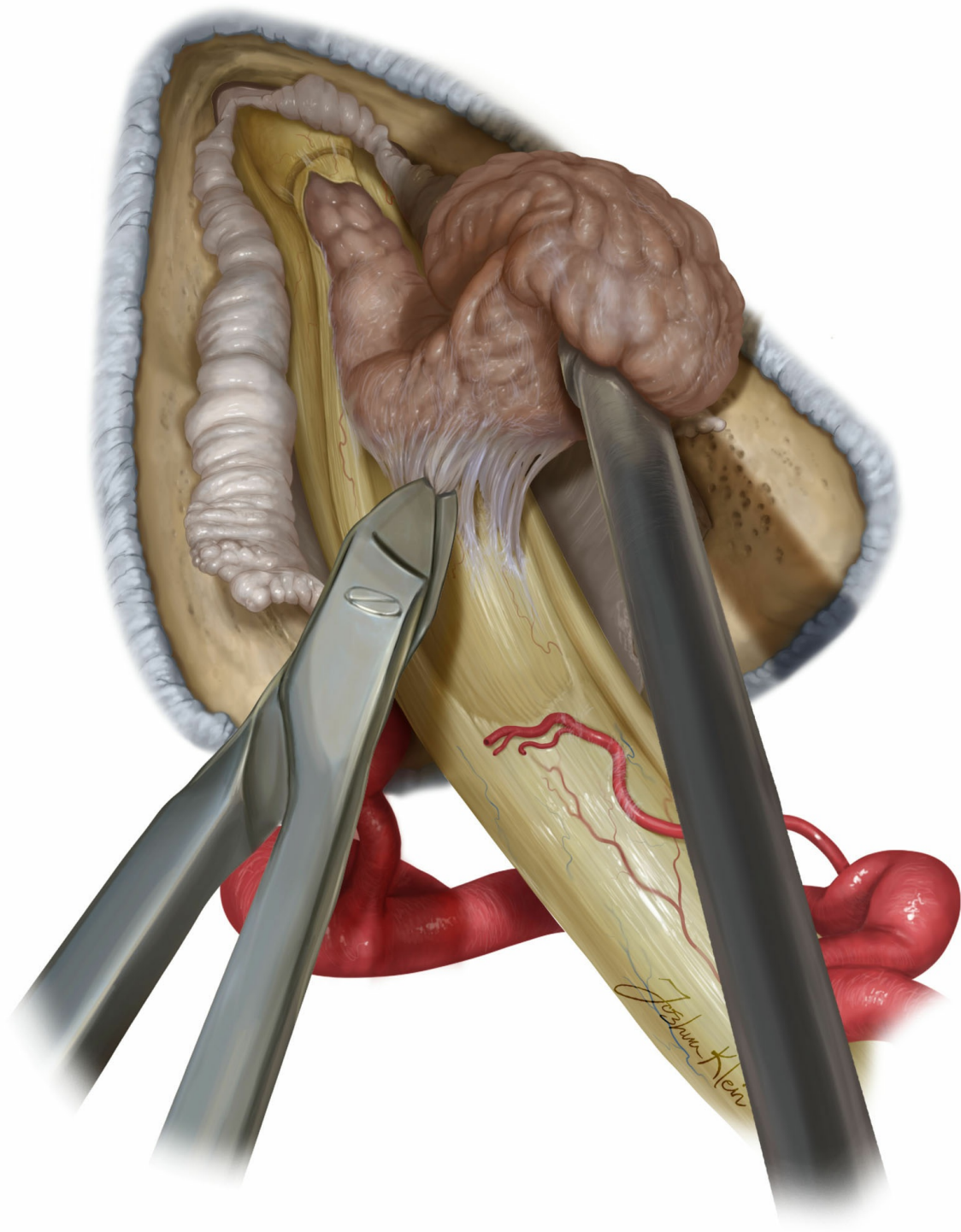


Figure 9: The tumor is peeled from the inferior vestibular-cochlear nerve complex, starting at the medial pole of the tumor. Care is taken to preserve the arterial supply to the nerves that are left intact. Papaverine-soaked gelfoam is used to minimize vasospasm.

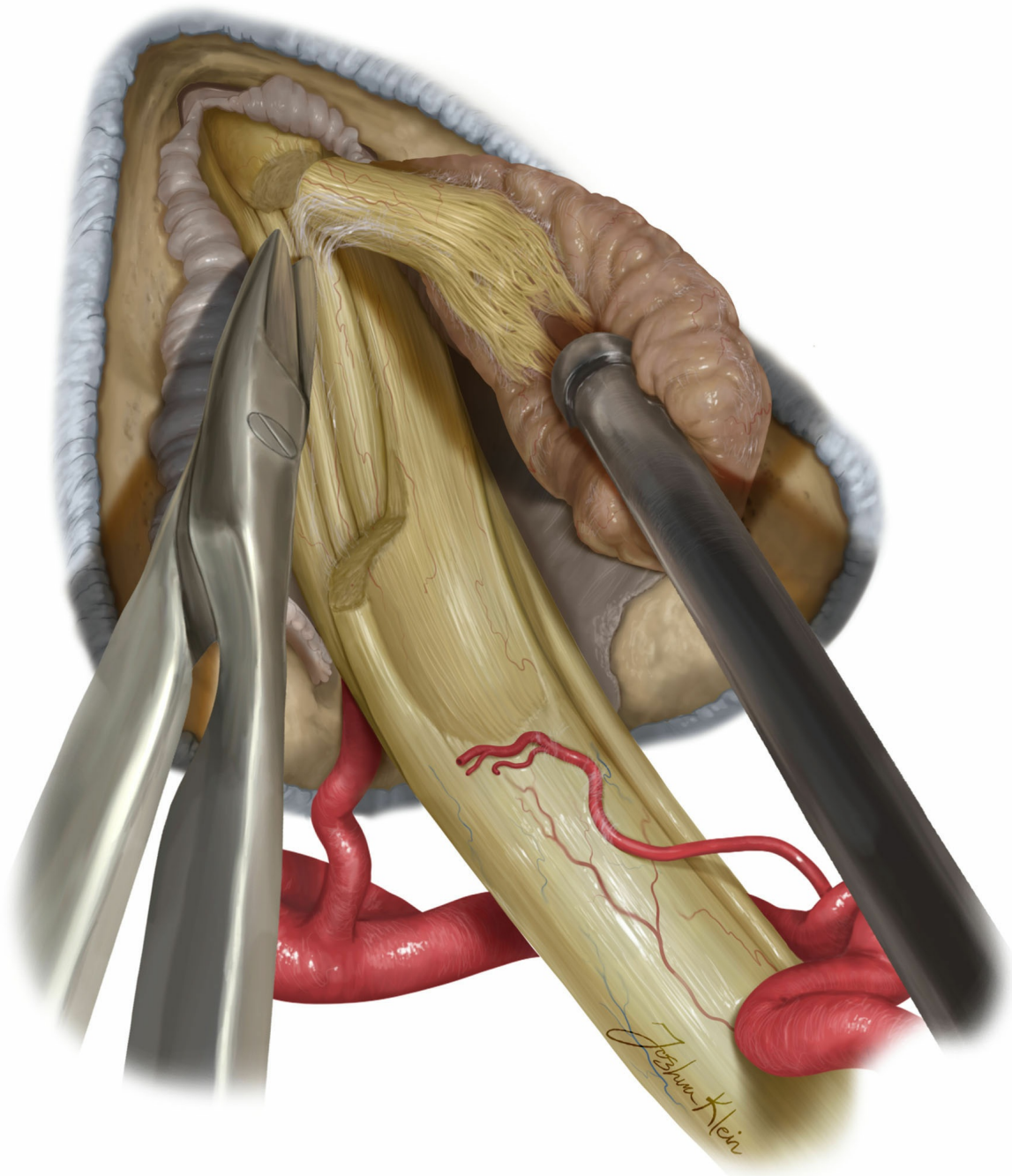


Figure 10: Final attachments are dissected from the facial and inferior vestibular nerves. Physiologic preservation of the facial nerve is assessed by direct stimulation of the nerve.

Closure

The opened IAC air cells are sealed with bone wax to prevent CSF leakage through peritubular air cells. The closure is performed in standard fashion.

Further Considerations

If the 3-month MRI confirms gross-total resection, I order MRI at 2 years

to look for early recurrence and again 5 years after that (7 years postoperatively) to investigate for later recurrence. If the 7-year scan is negative for tumor recurrence, I plan to order MRI in 7 to 10 years to look for very late recurrence.

REFERENCES

1. Tveiten OV, Carlson ML, Goplen F, et al. Long-term auditory symptoms in patients with sporadic vestibular schwannoma: an international cross-sectional study. *Neurosurgery* 2015;77:218–227, discussion 227.
2. Kondziolka D, Mousavi SH, Kano H, et al. The newly diagnosed vestibular schwannoma: radiosurgery, resection, or observation? *Neurosurg Focus*. 2012;33:E8.
3. Mousavi SH, Niranjana A, Akpınar B, et al. Hearing subclassification may predict long-term auditory outcomes after radiosurgery for vestibular schwannoma patients with good hearing. *J Neurosurg*. 2016;125:845–852.
4. Myrseth E, Lund-Johansen M, Tveiten OV. Management of small vestibular schwannoma in patients with minimal symptoms. In: Carlson ML, Link MJ, Driscoll CLW, et al, eds. *Comprehensive Management of Vestibular Schwannoma*. Thieme Medical Publishers; 2019.
5. Link MJ, Driscoll CL What is the best treatment for small- to medium-sized vestibular schwannoma? In: Carlson ML, Link MJ, Driscoll CLW, et al, eds. *Comprehensive Management of Vestibular Schwannoma*. Thieme Medical Publishers; 2019.