11 Translabyrinthine Approach

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Following its revival by Dr. William House, the translabyrinthine approach (TL) has become a workhorse technique, especially in patients with significant preoperative hearing loss. Dr. House collaborated with William E. Hitselberger and showcased the synergy that can be obtained with a multidisciplinary skull-base surgical team [1]. This model of collaboration between otologists and neurosurgeons has become commonplace and has arguably served as a model for anterior skull-base surgery teams.

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Preoperative Evaluation

The standard evaluation of a patient with an acoustic neuroma begins with a targeted history and physical examination. The most common presentation associated with acoustic neuroma is hearing loss, which is typically gradual but can occur suddenly [2]. Other common symptoms include high-pitched tinnitus, disequilibrium, headache, and facial numbness from compression of nerves adjacent to the tumor. Although disequilibrium, ataxia, headaches, nausea, and vomiting are rare at presentation, attention must be paid to these symptoms, which may be signs of hydrocephalus and brainstem compression [3, 4]. At presentation, most patients have a completely normal examination but harbor complaints of unilateral sensorineural hearing loss. The most common presenting signs associated with large tumors include an abnormal corneal reflex, nystagmus, facial hypesthesia, and imbalance. Facial palsy, abnormal eye movements, and papilledema are less common and mostly seen in patients with a large tumor associated with hydrocephalus.

When paralysis results from surgery, the House-Brackmann scale is usually used to grade recovery of facial nerve function [5]. However, the scale has been used preoperatively in an effort to quantify preexisting paralysis caused by a tumor. Most patients present with normal facial nerve function and minor hearing complaints. However, an increasing number of acoustic neuromas are now detected incidentally before patients become symptomatic due to improvements in imaging [6].

Because subjective hearing loss and tinnitus are the most common symptoms associated with an underlying acoustic neuroma, most patients go to an otolaryngologist for audiometric testing. Detection of a unilateral sensorineural hearing loss usually triggers imaging studies [6, 7]. The initial screening tool is usually a pure-tone audiogram, which typically establishes a pattern of asymmetric sensorineural hearing loss common in patients with an acoustic neuroma. A difference in hearing of 10–15 dB between ears at two different frequencies is considered significant asymmetry and may

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indicate underlying pathology [6, 8]. A speech discrimination test should be performed in conjunction with the pure-tone audiogram. Speech discrimination may be reduced disproportionately to the pure-tone loss. Therefore, a difference of 15–20% between ears should raise suspicion of a retrocochlear problem [6]. Silverstein and colleagues reported a combination of the two hearing tests, which was modified by Gardener and Robertson to classify hearing loss. Twelve percent of patients with acoustic neuromas lack hearing loss [9]. Neurodiagnostic auditory brainstem testing can also be used to diagnose acoustic neuromas, but this modality is less sensitive than magnetic resonance imaging (MRI), particularly for detecting small tumors [10].

The current gold standard for diagnostic imaging of acoustic neuromas is gadolinium-enhanced MRI, which has a sensitivity of 98% and a specificity of almost 100% [11]. Acoustic neuromas are often isodense to the brain and brightly enhancing. Furthermore, cystic degeneration or, rarely, hemorrhage may be detected [12].

Patient Selection

When surgical excision is indicated, the choice of surgical approach should be tailored to each patient. The most important factors in choosing a surgical approach are the patient's preoperative hearing function, tumor size, and tumor location. Simply put, the translabyrinthine approach should strongly be considered when patients do not have serviceable hearing or when an alternative approach is very unlikely to preserve hearing function. This decision becomes more complicated in patients with contralateral hearing loss or neurofibromatosis type 2 (NF2).

When considering hearing function, it is important to review the audiometric data for both ears. Serviceable hearing can be defined using the 50/50 rule or 70/30 rule. The 50/50 rule translates to a pure-tone average greater than 50 dB, a word recognition score greater than 50%, or both. The 50/50 rule is the more relaxed of the two criteria. The 70/30 rule should be reserved for considering patients with coexisting contralateral hearing loss of patients with NF2.

With consideration given to hearing preservation, tumor size and location can help guide the choice of surgical approach. When performed properly, the translabyrinthine approach allows for the resection of large tumors. However, as tumor size increases, brainstem compression becomes more likely and can be more difficult to address through a translabyrinthine approach. For extremely large tumors, the translabyrinthine approach can be combined with other approaches to increase the size of the exposure.

The patient's anatomy should be carefully studied to examine the size of the operative corridor when performing a translabyrinthine approach. The locations of the sigmoid sinus and jugular bulb should be assessed as these form the borders of the approach. An anteriorly located sigmoid sinus can narrow the size of the operative corridor. However, it is usually less limiting than a high-riding jugular bulb, which approaches the inferior aspect of the internal acoustic canal (IAC). A high-riding jugular bulb can prevent the goal of 270° exposure of the IAC and significantly narrow the operative corridor.

While techniques have been described to mobilize the dural venous sinuses, it is likely better to avoid this issue if an alternative surgical approach is viable. Of note, when a high-riding jugular bulb leads to selection of a retrosigmoid approach, its course should still be carefully noted. The jugular bulb can rarely rise above the level of the IAC, which likely increases the risk of injury when maximizing the anterior and inferior margins of a retrosigmoid craniotomy. The degree of temporal bone pneumatization should also be carefully reviewed as hyperpneumatization likely increases the risk of postoperative cerebrospinal (CSF) leak.

The translabyrinthine approach offers a number of benefits that explain its wide use among skull-base surgeons. The facial nerve is identified early in the approach and likely explains why this approach has the lowest incidence of postoperative facial nerve dysfunction [13–19]. There is less cerebellar retraction and often a lower duration of intradural dissection. Drilling is performed prior to dural opening, preventing bone dust from entering the cisternal spaces. The incision is more anterior, which reduces the amount of muscular dissection. These differences likely explain why patients undergoing a translabyrinthine exposure have the shortest hospital stay and lowest incidence of postoperative headache. Aside from loss of hearing, there is also likely a higher rate of postoperative CSF leak in translabyrinthine approaches.

Surgical Procedure

The TL approach is performed with the patient under general endotracheal anesthesia. Long-acting muscle relaxants are avoided because the facial nerve is monitored routinely in all cases. Pneumatic compression stockings are used before anesthesia is induced to avoid deep vein thrombosis of the lower extremities. Due to the length of the procedure and the possibility of administering mannitol, a urinary catheter is placed.

A C-shaped incision is placed 4–5 cm behind the postauricular sulcus, extending just above the auricle and just below the mastoid tip (Fig. 11.1a). The periosteum is incised in a T-shaped fashion, creating three musculoperiosteal flaps. The trifurcation is marked with colored sutures, which help the surgeon to replace the flaps during closure (Fig. 11.1b). When making the inferior periosteal cut, care should be taken to avoid injuring the facial nerve as it exits the stylomastoid foramen.

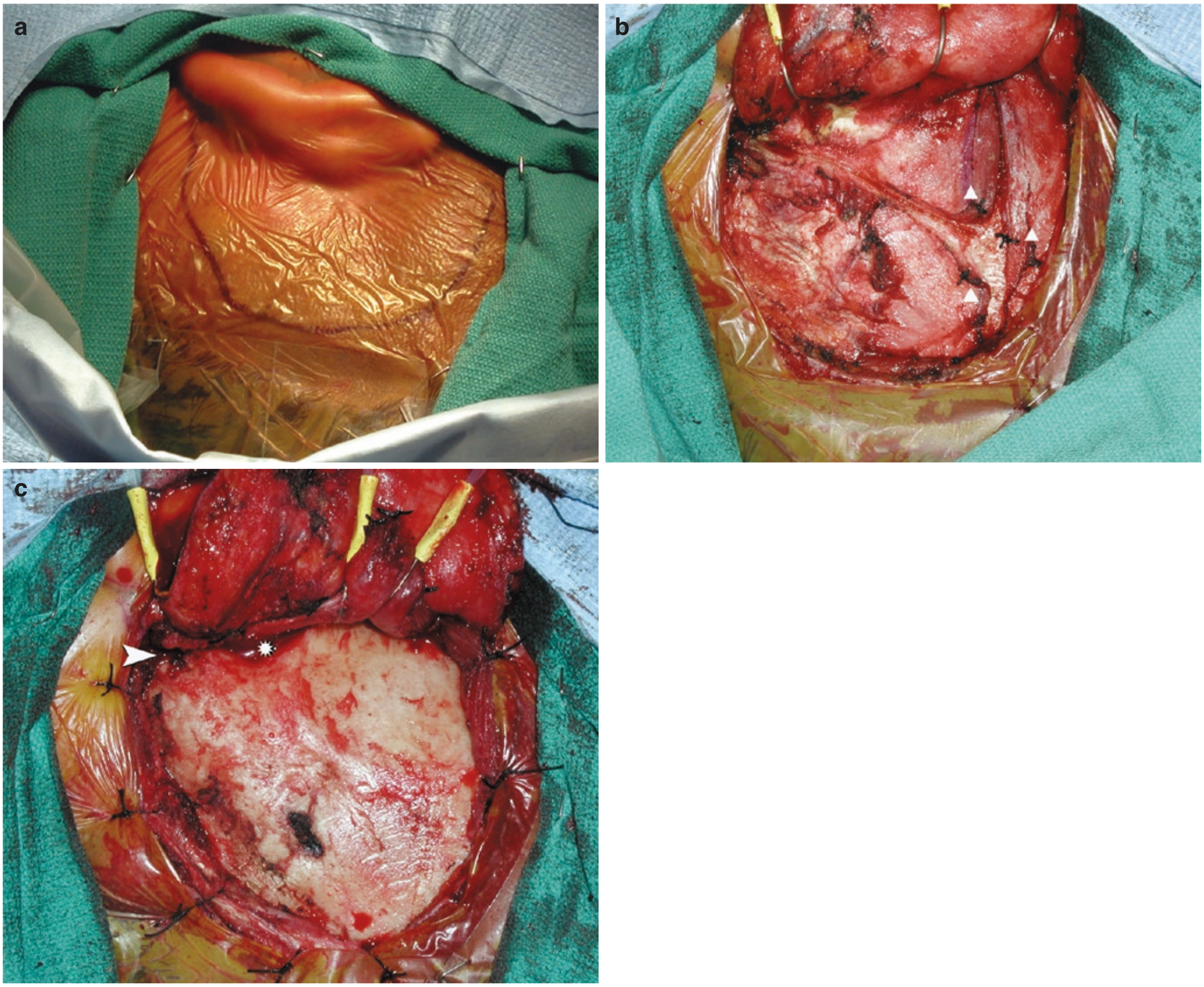

Fig. 11.1 (**a**) A right-sided surgical incision is outlined. (**b**) The skin flap is reflected forward. The musculoperiosteal layer is incised in a "T." The trifurcation is marked by three black stitches (white triangles). (**c**) The musculoperiosteal layers have been elevated and sutured to skin edges. The anterior flap is sutured to the skin flap and reflected forward. The arrow points to the mastoid tip and the asterisk indicates the external auditory canal

Bleeding from the mastoid emissary vein should be anticipated while elevating the periosteum and controlled with bone wax. While this brisk bleeding is often concerning to the early surgical trainee, its occurrence is welcome to provide a landmark for the transverse-sigmoid sinus junction. The anterior flap is sutured to the C-shaped skin flap, and both are retracted anteriorly with skin hooks (Fig. 11.1c). This maneuver provides an excellent exposure without the need for self-retaining retractors and avoids increasing the depth of the surgical field unnecessarily [20].

Cortical landmarks should be identified to orient the surgeon. The floor of the middle fossa can be estimated by the temporal line, which provides a superior boundary for the petrous bone. The posterior aspect of cortical bone forming the external acoustic canal can be estimated by the spine of Henle, which provides an anterior boundary. The sigmoid sinus is the posterior boundary in the mastoidectomy, but it lacks a consistent surface landmark. Its location is represented by a line drawn between the spine of Henle and the temporal line. These three lines mark the suprameatal triangle (also known as Macewen's triangle).

Troughs are drilled along the three lines of the suprameatal triangle. As the anatomy is appreciated during drilling, these lines should be saucerized and maximally widened to prevent narrowing of the surgical corridor. First, the superior trough is extended superiorly above the temporal line to identify the dense cortical bone of the mastoid tegmen. This cortical bone can be followed inferiorly and medially to expose the mastoid tegmen.

Attention is then turned to the anterior boundary of the suprameatal triangle. The anterior mastoid is drilled until the external auditory canal (EAC) becomes eggshell thin. The boundary of the EAC and mastoid tegmen are connected anteriorly toward the root of the zygoma. The posterior border is defined by exposing the sigmoid sinus, which allows for the identification and deepening of the sino-dural angle. It is important to expose the dura of the posterior fossa at least 1–2 cm past the sigmoid sinus, which allows for retraction of the sigmoid sinus if necessary.

As the bone over the sino-dural angle is deepened, Koerner's septum is opened as the antrum is entered. The opening in the antrum is widened until it connects with the cortex of the EAC. The surface of the lateral semicircular canal should be seen as this bone is thinned. The digastric ridge is then identified by further opening the mastoid tip. This important landmark points anteriorly to the stylomastoid foramen, where the mastoid segment of the facial nerve can be identified (Fig. 11.2a).

The labyrinthectomy can usually be completed before the sigmoid sinus, and the dura of the middle and posterior fossae is decompressed. The labyrinthectomy is begun by blue-lining the superior aspect of the horizontal semicircular canal. A cup is then developed within the otic capsule bone superior to the bisected horizontal semicircular canal. At this point, the inferior half of the horizontal semicircular canal is kept intact to protect the tympanic segment of the facial nerve, which lies immediately inferior to it (Fig. 11.2b).

The labyrinthectomy continues by widening the cup to involve the superior and posterior semicircular canals. The crus commune is identified, and the posterior semicircular canal is followed to the ampullated end. The canal and surrounding bone must be visualized at all times because the ampullated end of the posterior canal lies medial to the vertical segment of the facial nerve. The medial aspect of the facial nerve can be injured with the drill if care is not taken during this step. If the facial nerve has not already been identified and skeletonized, care must be taken to avoid drilling under the

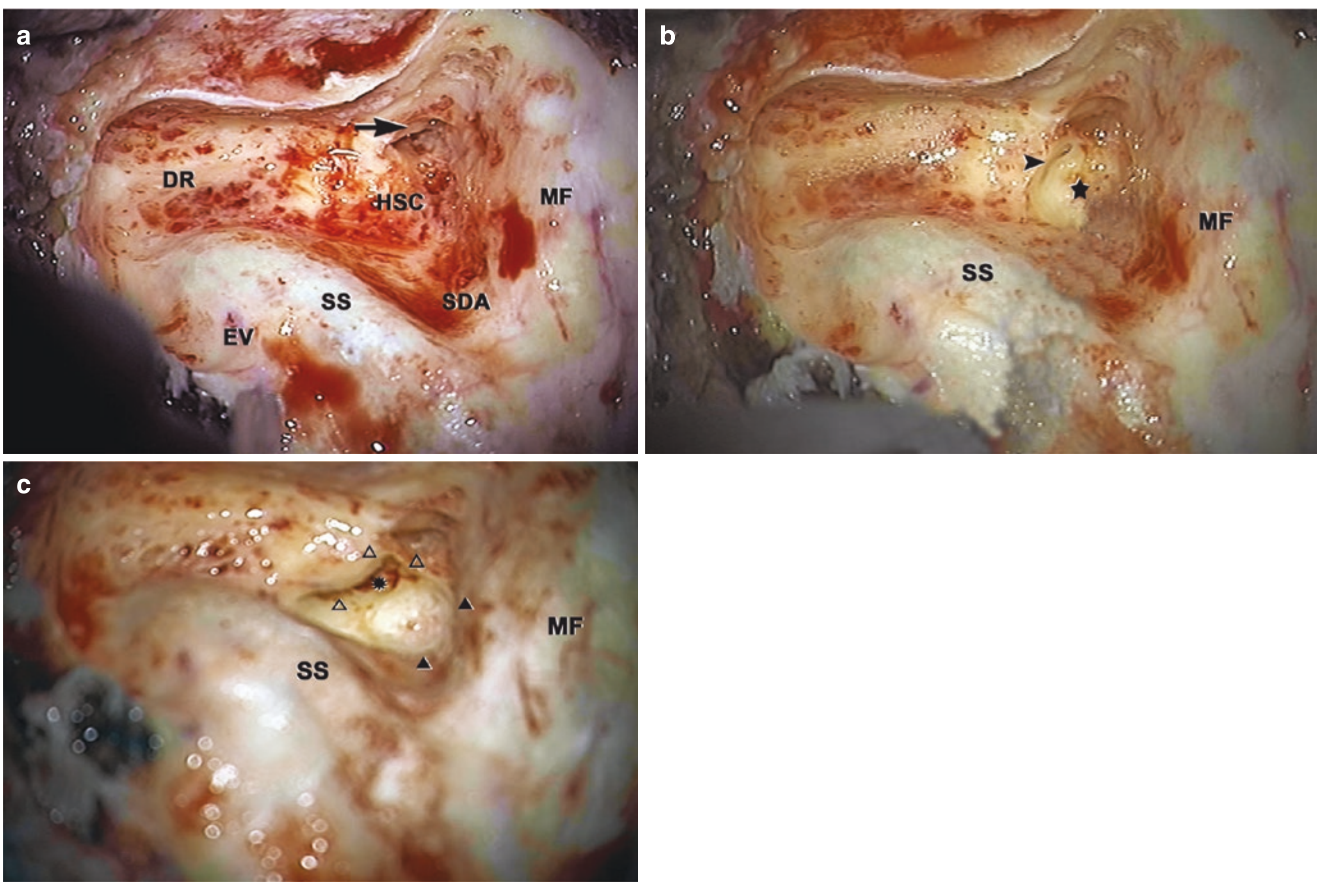

Fig. 11.2 (**a**) A complete mastoidectomy has been performed. The middle fossa (MF) and sigmoid sinus (SS) are identified. The sinodural angle (SDA) is widely open. The mastoid emissary vein (EV) is outlined. The digastric ridge (DR) and the horizontal semicircular canal (HSC) are identified. The incus is also identified (arrow). (**b**) The labyrinthectomy is started. The horizontal semicircular canal is bisected, and the superior half has been removed. The black arrowhead points to the bisected horizontal semicircular canal. A cup within the otic capsule bone is developed superior to the horizontal semicircular canal (black star). (**c**) The labyrinthectomy is completed. The vestibule is opened (black asterisk). The ampullated end of the three semicircular canals is opened (open triangles). The outline of the superior semicircular canal is marked by black triangles

bony shelf that usually develops as the posterior canal is followed inferiorly. This bony shelf should be removed gently by drilling parallel to the facial nerve. This strategy provides clear visualization of the entire drill bit at all times.

The three ampullated ends of the semicircular canals and the bone covering the vestibule are opened, and the neuroepithelial tissue is removed (Fig. 11.2c). The ampullated end of the superior semicircular canal should be preserved as a landmark for the superior vestibular nerve. The sigmoid sinus is decompressed as is the dura of the middle and posterior fossae, both medially and laterally to the sigmoid sinus, and all bone is removed. This step can usually be achieved by thinning the bone with a diamond drill. A dural elevator is used to dissect the dura from the bone, and a pair of rongeurs is used to remove the separated bone. As bone removal over the posterior fossa dura continues medially, the vestibular aqueduct and the beginning of the endolymphatic sac are encountered and divided.

Further medial dissection identifies the porus of the IAC. It is important to remember that the axis of the IAC is almost the same as that of the external auditory canal. Laterally, the fundus of the IAC is near the medial wall of the vestibule. Medially, however, considerable bone needs to be removed to expose the IAC at the porus appropriately and to identify both its superior and inferior borders.

Once the porus is identified, two troughs are created, one superior and the other inferior to the IAC (Fig. 11.3a). The inferior limit of the IAC is identified by drilling the retrofacial air cells between the presumed location of the IAC superiorly and the jugular bulb, which marks the inferior limit of the dissection. As the drilling continues medially and anteriorly, the cochlear aqueduct is identified. This important landmark usually marks the medial limit of dissection to avoid injuring the lower cranial nerves. During resection of small and medium-sized tumors, opening the cochlear aqueduct usually causes leakage of CSF. The aqueduct may be obstructed by large tumors. The superior trough is created by removing bone between the dura of the middle fossa and the superior border of the IAC.

The ampulla of the superior semicircular canal serves as a landmark for the superior vestibular nerve and the superior border of the most lateral extent of the IAC. As dissection continues anteriorly and laterally, care is taken to avoid injuring the facial nerve, which can be identified in its labyrinthine segment at this location. The bone overlying the porus and IAC is thinned and removed completely (Fig. 11.3b). When the troughs are created correctly, more than 270 degrees of the circumference of the IAC are exposed. It is important for the bone to be removed to the anterior border of the superior portion of the porus, particularly in larger tumors. Doing so optimizes exposure and facilitates dissection of the facial nerve in this area.

Finally, the inferior and superior vestibular nerves are identified at the fundus of the IAC with the transverse crest between the two nerves. The facial nerve is separated from the superior vestibular nerve at the fundus of the IAC by a vertical bony crest (Bill's bar).

Before the dura is opened, all air cell tracts should be sealed with bone wax to avoid postoperative leakage of CSF. Furthermore, the aditus ad antrum is sealed with periosteal tissue both lateral and medial to the incus, and then bone wax is applied (Fig. 11.3b).

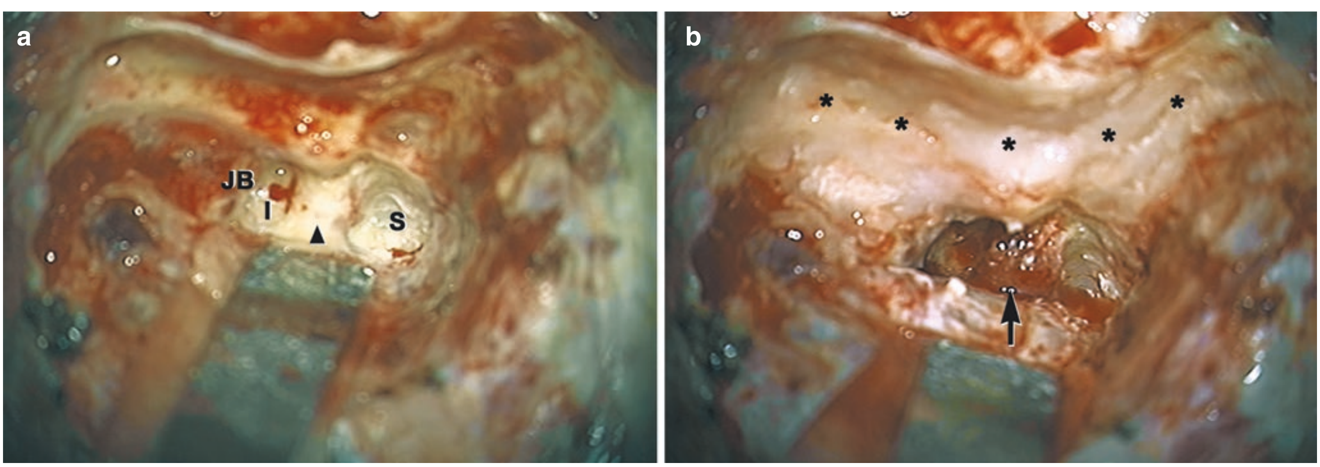

Fig. 11.3 (**a**) The dura of the middle and posterior fossae is decompressed. The jugular bulb (JB), which serves as the inferior limit of the dissection, is identified. An inferior trough (I) and a superior trough (S) are created to outline the internal auditory canal (black triangle). (**b**) The inferior and superior troughs are well developed, and all bone is removed from the posterior fossa, middle fossa, and internal auditory canal. All air cells within the external auditory canal and in the retrofacial tract and zygomatic root are sealed with bone wax (black asterisks). Periosteal tissue is used to plug the aditus, and bone wax is used to seal that area. The internal auditory canal is decompressed (black arrow)

Tumor Dissection

Once drilling of the temporal bone is complete, microsurgical dissection of the tumor from the seventh and eighth nerve complex can begin. Typically, the eggshell-thin bony covering over dura of the middle and posterior cranial fossae has been removed as has the bone covering the entire posterior two-thirds of the IAC from Bill's bar to the porus acusticus [21].

During any surgery involving the cerebellopontine angle (CPA), continuous intraoperative monitoring of the facial nerve is crucial. Multiple studies have shown that intraoperative monitoring of the facial nerve improves outcomes [4, 22–28]. We find that frequent testing of the areas where tumor is attached is essential for safe resection. The signal from the facial nerve may change during tumor dissection or manipulation, brain retraction, or irrigation of the tumor bed.

After the dura is opened (Fig. 11.4a), the diagnosis of a facial nerve schwannoma/neuroma is excluded via facial nerve stimulation and clear visualization of a normal facial nerve anterior and superior to the tumor mass and superior vestibular nerve complex. If the presumed vestibular schwannoma is actually a facial nerve schwannoma, it is our opinion that resection should not be attempted unless the preoperative facial function is abnormal. We have found that the decompression associated with the surgical approach itself provides extra room for future schwannoma growth and often preserves normal facial function for many years.

Bill's bar and intraoperative facial nerve stimulation are used to identify the facial nerve at the distal IAC, which is then carefully separated from the superior vestibular nerve (Fig. 11.4b–d). One advantage of the TL approach is that access to the CPA is shifted anteriorly compared with the suboccipital approach. Therefore, less retraction of the cerebellum is necessary [7]. The extent of the tumor and the involvement of neural structures are assessed (Fig. 11.5a). Depending on the size and extent of the adhesions to the facial nerve, the tumor may need to be debulked before

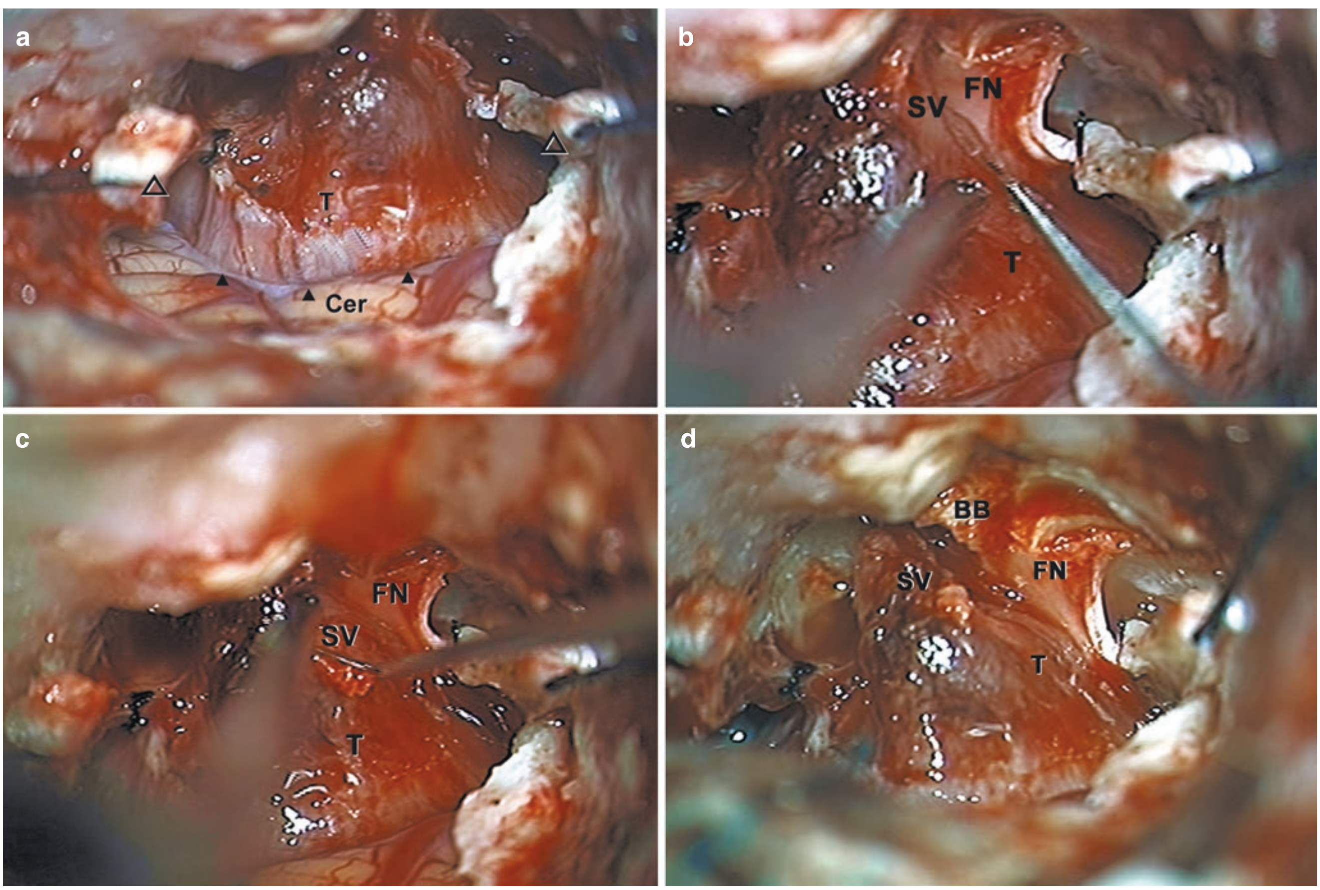

Fig. 11.4 (**a**) The dura is opened, and dural flaps are retained with dural stitches (open triangles). The tumor (T) is exposed. The cerebellum (CER) can be seen. The solid black triangles point to the interface between the tumor and cerebellum. (**b**) The facial nerve (FN) is identified. The edge of the facial nerve is confirmed using facial nerve stimulation. The plane between the facial nerve and the superior vestibular nerve (SV) is developed using sharp dissection. (**c**) The superior vestibular nerve is avulsed from its attachment away from the facial nerve using a right-angled instrument. (**d**) The superior vestibular nerve and the facial nerve are separated by Bill's bar (BB). The plane between the facial nerve and superior vestibular nerve is well developed in the lateral part of the internal auditory canal

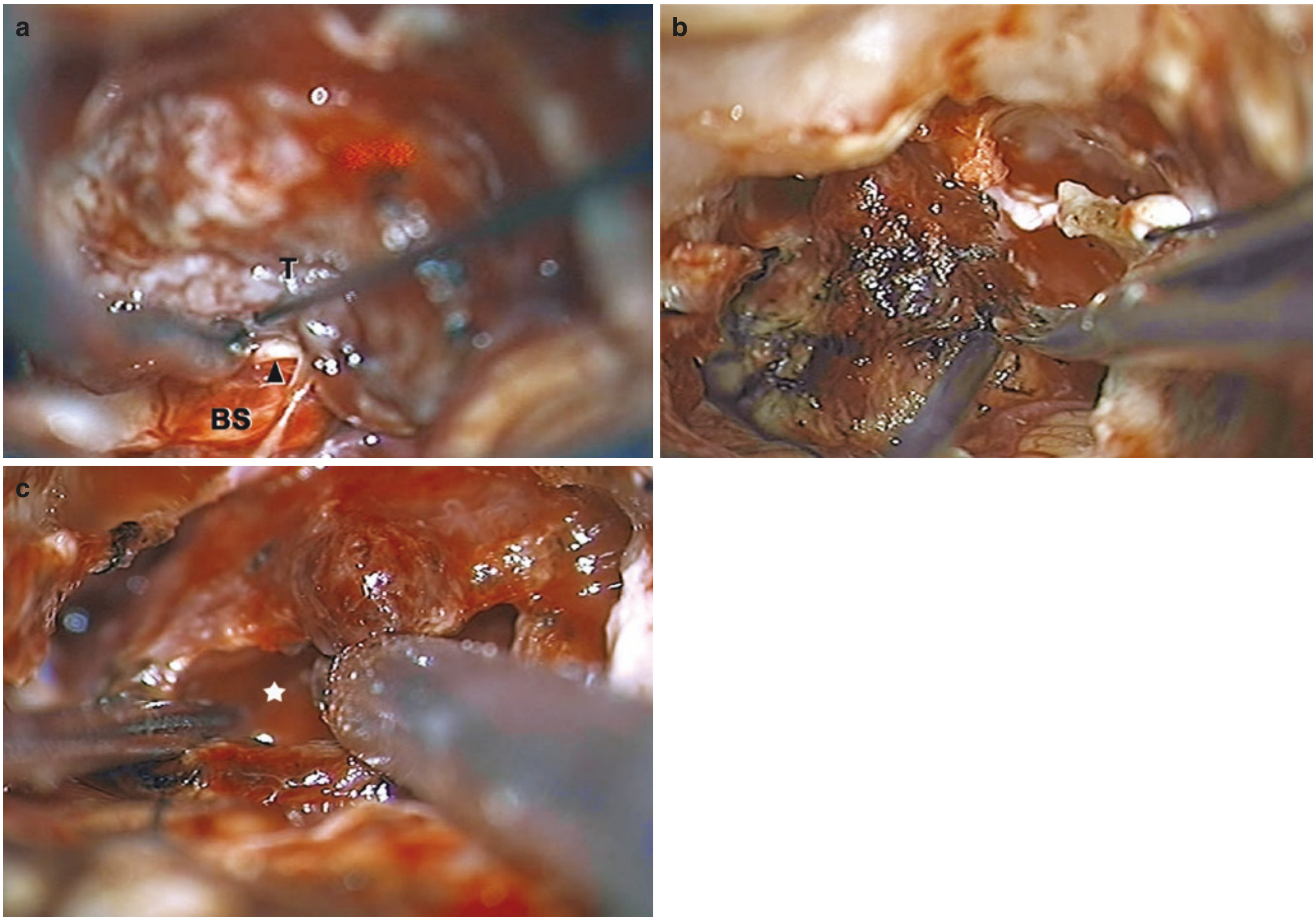

Fig. 11.5 (**a**) The inferior and medial poles of the tumor (T) are dissected. The facial nerve (black arrowhead) is identified, if possible, at the root entry zone at the brainstem (BS). (**b**) After the facial nerve is identified both laterally and medially, the tumor debulking is started. The posterior surface of the tumor is cauterized, and a piece of the tumor is removed and sent for biopsy. (**c**) Tumor debulking continues. A Cavitron ultrasonic surgical aspirator (CUSA) is used to evacuate the contents of the tumor. The remaining tumor cavity is visible (white star)

microdissection proceeds (Fig. 11.5b). When debulking is indicated, we prefer ultrasonic aspiration and typically have this tool available for every case (Fig. 11.5c). After the tumor capsule is opened and debulked or when the tumor is less than 2 cm and debulking is unnecessary, the mass is separated from the facial nerve (Fig. 11.6a–c).

We prefer sharp medial-to-lateral dissection of the tumor to minimize trauma to the nerves and brainstem. Use of electrocautery should be minimized by the use of thrombin-soaked Gelfoam®. When necessary, bipolar cautery should be used on a very low setting. The labyrinthine artery almost invariably runs between the seventh and eighth cranial nerves, and care must be exerted to avoid injuring the vessel inadvertently.

Complete tumor resection is always attempted. However, especially in patients with prior radiation, a portion of the tumor capsule can be very adherent to the facial nerve. We prefer to leave a patient with a small part of a benign tumor capsule than with facial palsy. This decision can be difficult to make intraoperatively and relies on the surgeon's judgment and experience. When considering leaving tumor behind, it should be remembered that when only a small portion of the tumor capsule remains, the risk of tumor recurrence is minimal [29].

After the tumor is removed, the surgical field is gently irrigated and meticulous hemostasis is maintained. A large piece of temporalis fascia is harvested and draped over the posterior aspect of the external auditory canal and aditus to provide an additional layer of protection against CSF leakage. The dura is approximated using a 4–10 Nurolon® suture (Fig. 11.7a). Subcutaneous fat is harvested through an incision in the left lower abdominal quadrant. This step is usually performed after the tumor has been dissected to minimize the time between harvesting the fat and using it to fill the defect.

The fat is cut into strips and kept in an antibiotic solution until it is used. The first fat strip is placed to cover the defect in the dura. It is tied in place using the tail of the suture used to approximate the dural flaps (Fig. 11.7b). This maneuver helps seal the dural defect and prevents the fat from being

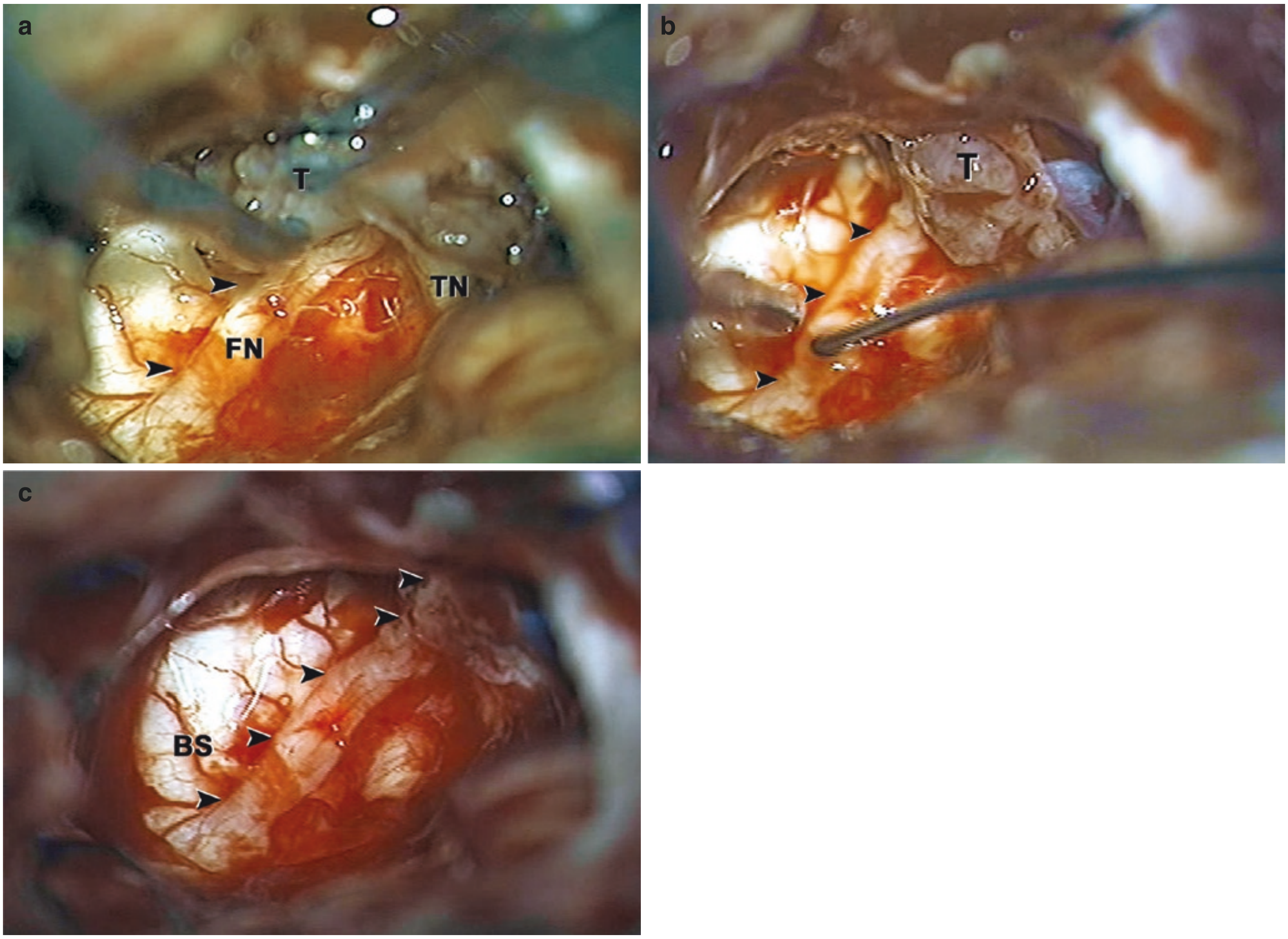

Fig. 11.6 (**a**) As tumor removal continues, the facial nerve (FN) becomes more apparent. The black arrowheads point to the course of the facial nerve from the root entry zone passing laterally. The trigeminal nerve (TN) can be seen at the superior pole of the tumor (T). (**b**) Intermittently, the responsiveness of the facial nerve (black arrowheads) to stimulation is confirmed during dissection. A small tumor remnant (T) is still visible. (**c**) Tumor removal is complete. The entire course of the facial nerve from the brainstem (BS) is visible (black arrowheads)

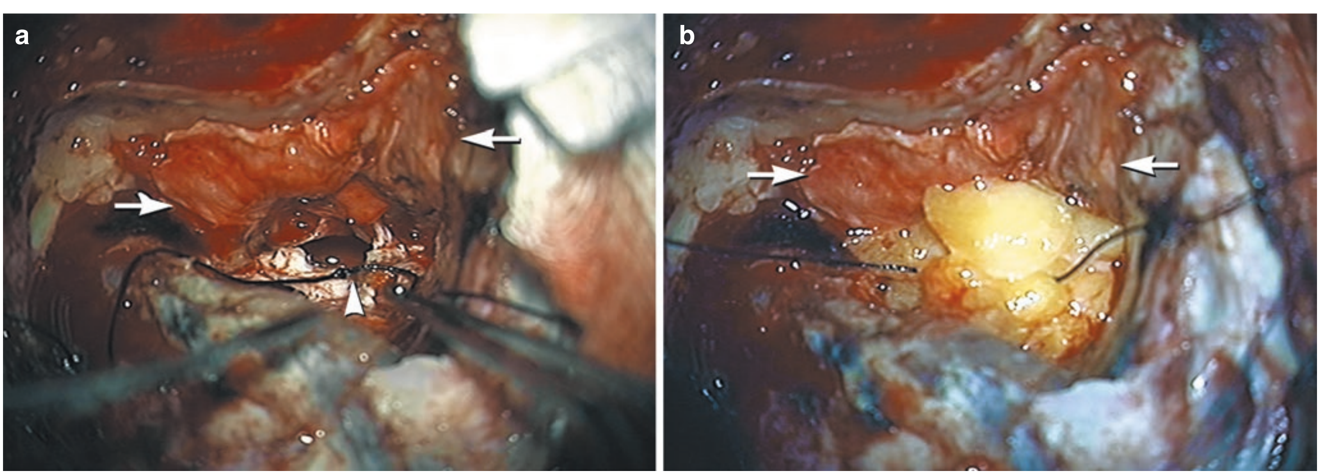

Fig. 11.7 (**a**) During closure, the dural flaps are approximated using 4-0 dural sutures (white triangle). A large piece of temporalis fascia is harvested and draped over the posterior external auditory canal wall and the mastoid antrum (white arrows) as an additional layer of protection against CSF leakage. (**b**) A strip of abdominal fat is placed within the dural defect, and the dural stitch is tied over the fat strip to fix it in place. The temporalis fascia (white arrows) is draped over the posterior canal wall and mastoid antrum

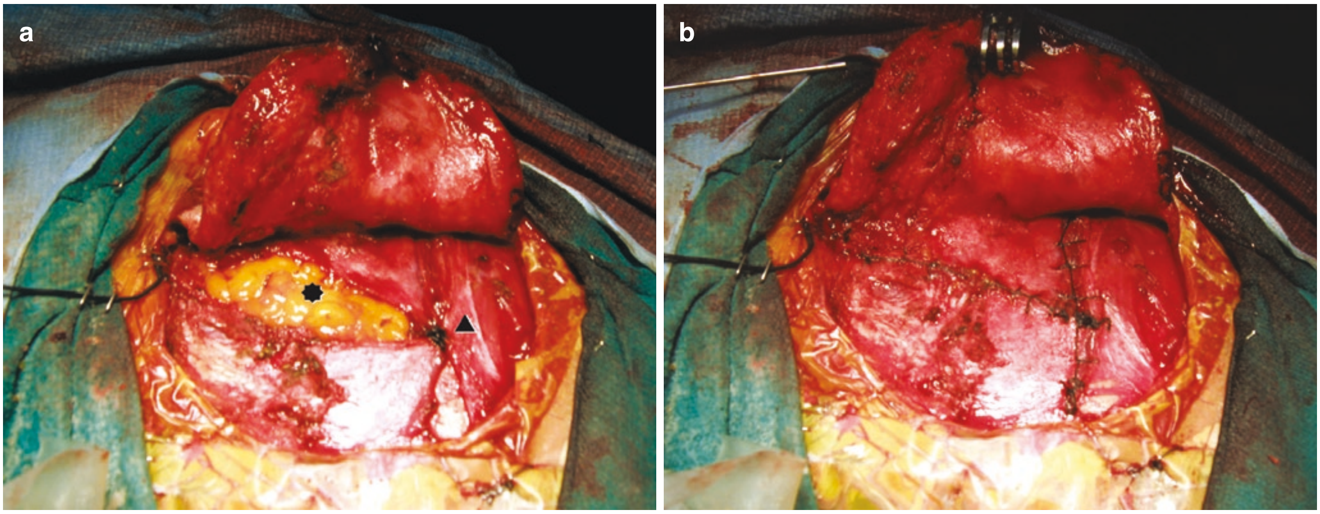

Fig. 11.8 (**a**) The musculoperiosteal layer is closed. The trifurcation, marked by the sutures, is reapposed (black triangle). Fat (black asterisk) is visible within the mastoid cavity and craniectomy defect. (**b**) The musculoperiosteal layer is closed completely in a watertight fashion

dislodged laterally or into the CPA. Several fat strips are used to fill the defect in the bone completely to the level of the periosteum. Tissue glue can also be applied to supplement the closure if suspicion of a potential leak is high. Other authors have advocated the use of hydroxyapatite bone cement in addition to adipose tissue to reconstruct the bony defect and to prevent CSF leakage [7]. Careful attention to occluding the mastoid air cells with bone wax also decreases the likelihood of the patient developing a CSF leak.

The musculoperiosteal layer is closed using 3-0 Vicryl sutures (Fig. 11.8a). If the flaps are elevated appropriately at the beginning of the procedure and kept well hydrated throughout the case, this layer often can be closed in a watertight fashion (Fig. 11.8b). Several 3-0 Vicryl® sutures are used to obliterate the dead space between the skin flap and the musculoperiosteal layer. A watertight closure of the skin incision follows. Finally, a light mastoid pressure dressing is applied.

Complications

The most dreaded complication of any CPA tumor surgery is injury to the surrounding vasculature, especially injury to the anterior inferior cerebellar artery or brainstem, which can cause a stroke. Fortunately, this risk, which is minimized by a good exposure, meticulous technique, and the experience of the skull-base team, is rare.

The most routinely feared complication of the translabyrinthine approach is injury to the facial nerve. Patients and nursing staff should be educated about delayed facial weakness, which can follow normal immediate postoperative facial function, which is usually attributed to nerve edema. When facial nerve integrity has been confirmed by nerve stimulation with good parameters, most patients recovered normal or near-normal facial function [30, 31]. We typically give patients three doses of dexamethasone in the first 24 h after surgery; we then discontinue it unless a delayed facial nerve palsy occurs. There has been continued publication of data that quantifies the high risk of poor wound healing and infection when postoperative glucocorticoids are used.

Other complications include aseptic or bacterial meningitis, CSF leakage, hematomas, transient or permanent neurologic deficits, and standard postoperative risks such as deep venous thrombosis, pneumonia, and cardiac complications. Reported rates of meningitis range from 1.6% to 4% [32–36], and reported rates of CSF leakage range from 1.4% to 8% [13, 16, 33, 34, 37]. With large tumors, the risk of CSF leakage is closer to 15% [32, 35]. When leaks do occur, CSF diversion with lumbar drainage for 3 or 4 days is our initial treatment. In our experience, CSF leaks requiring permanent CSF diversion are usually due to elevated intracranial pressure.

Outcomes

For tumors removed through the TL approach, the most current otolaryngological and neurosurgical texts cite the rate of operative mortality at less than 1% and perhaps as low as 0.1–0.2%, even with large tumors [12]. There was only 1 death in an Italian series of 175 patients with tumors at least 3 cm [16].

Recurrence rates after TL operations are low. Shelton reported five recurrences in a series of 1668 TL resections of acoustic neuromas [38]. Thedinger and colleagues reported a recurrence rate of 0.5% in 999 patients with acoustic or glomus jugulare tumors [39]. After a mean follow-up of

11 years, Schmerber and colleagues reported no cases of recurrences in 91 patients with acoustic tumors [40]. Despite the past criticism that the TL approach is inappropriate for most large tumors, other authors have concluded that total tumor removal is possible in most patients, regardless of the size of their tumor [32]. However, as expected, the risk of complications increases as the size of the tumor increases.

The main outcome measures of the TL approach are the extent of tumor resection and postoperative facial nerve function.

Comparison of outcomes between different surgical approaches in vestibular schwannoma surgery is complicated by multiple biases. Significant selection bias is present as certain tumor characteristics favor one surgical approach over another. For example, small, intracanalicular tumors are much more likely to be removed via the middle fossa approach. Surgeons also frequently have an intrinsic preference for one approach over another due to training and experience.

When reviewing the literature, a “good” facial nerve function outcome is a House-Brackmann grade I or II. Good facial nerve outcomes occur in 97–100% of patients with isolated intracanalicular tumors, in 92.5–95% of those with tumors smaller than 2 cm, and in 63% of those with tumors larger than 2 cm [21, 41–44]. Briggs and colleagues reported that 90% of their patients with tumors smaller than 2 cm had grade 1 or 2 function [13]. Mass and colleagues found that 76% of 258 patients undergoing the TL approach had grade I or II facial function 1 year after follow-up [33]. However, this study included 29 patients with tumors larger than 35 mm. Delayed facial nerve palsy appearing more than 72 h after surgery had been reported [45]. Its incidence is estimated at 5%, but most patients regain their immediate postoperative baseline within a few months. In our experience, delayed facial palsy that persists longer than expected is attributable to postoperative edema.

An important consideration before any surgical intervention is the patient’s perception of outcome compared with standard rates of improvement reported in the literature. Ryzenman and colleagues analyzed the self-reports of 1595 patients who underwent acoustic neuroma surgery via any surgical approach [46]. Postoperatively, 45% of the patients reported worsened facial weakness after surgery. However, 70% were “quite a bit” or “very much” content with their quality of life. Similarly, Martin and colleagues analyzed the self-reports of 76 patients who underwent TL resection of acoustic tumors performed by the same surgical team [47]. The quality of life subjectively reported by the patients was reduced compared with their objective results. We believe that the key to matching patients’ expectations to any objective outcomes starts with consistent preoperative counseling in a multidisciplinary (neurosurgery and otolaryngology) skull-base clinic.

Postoperative Care

Similar to the other phases of treatment, postoperative care is performed jointly by the neurosurgery and otology services. Patients are admitted to the neurosurgical intensive care unit overnight for the performance of frequent neurologic exams. Patients spend the first night on the neurosurgical service and are then transferred to the otology service. If there are new neurologic deficits or other concerns, an immediate postoperative computed tomography (CT) scan is performed. Otherwise, the patient is closely monitored clinically until the postoperative MRI is obtained. Unless a new deficit is present, minimal steroids are used and rapidly tapered. Patients appear to have less postoperative nausea than in the retrosigmoid approach, likely due to complete obliteration of the labyrinthine structures. Unless there is a concern for venous compromise, intravenous fluids are only continued until patients tolerate appropriate oral fluid intake.

The other phases of care are similar to the modern postoperative care of patients following craniotomy. Mobilization is performed as soon as it is tolerated, preferably starting as soon as the patient is recovered from anesthesia. Aside from the multiple known benefits of mobilization, this also encourages early discontinuation of urinary catheters. The patient’s diet is similarly advanced as soon as he or she is recovered from anesthesia. Prevention of deep vein thrombosis begins with sequential compression devices, which are placed before induction in the operating room. Chemoprophylaxis is added on the morning of postoperative day 2 and continued until discharge. A mastoid dressing is placed in the operating room and removed on postoperative day 2. When available, patients benefit from specialized nursing staff that frequently cares for patients following skull-base surgery. At our institution, this tailored care allows for patients with lumbar subarachnoid drains to leave the intensive care unit and still be cared for by nurses with experience in managing CSF drains.

Patients are usually discharged on the morning of postoperative day 3 and are seen in clinic at 2 weeks for suture removal. They are seen again at 6 weeks and—provided there are no concerns—at 1 year with repeat MRI to evaluate for recurrence. In patients with known residual tumor following surgery, a 2-year MRI is used to confirm a lack of progression, followed by a 5-year MRI to confirm stability [40].

The management of postoperative facial weakness deserves special attention. Patients should be counseled regarding the possibility for immediate and delayed facial weakness. Corneal protection is important for any patient with incomplete eye closure (lagophthalmos). Patients with concomitant V1 dysfunction should be counseled to be extra vigilant. Common methods of corneal protection include hourly administration of lubricating drops with nightly lubricating ointment. Lubricating drops should be preservative-free as frequent administration of preservatives can disrupt the tear film and promote inflammation. Methods of temporary eye closure include eyelid taping, patch placement, and temporary tarsorrhaphy. For long-term lagophthalmos, gold weight implantation is frequently used.

Conclusions

The TL approach is a versatile surgical tool for the removal of acoustic tumors. Close cooperation is needed between members of the neurosurgical and neuro-otological team to achieve good results.

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