MANAGEMENT OF THE EXTERNAL AUDITORY CANAL IN SKULL BASE SURGERY

Abstract—Transtemporal approaches to the skull base are being used with increasing frequency. When the external auditory canal is transected in the course of these operations, the risk of cerebrospinal fluid fistula is created. When hearing is to be sacrificed, we use a modification of the technique developed by Rambo for closure of the external auditory canal. This technique permits a cosmetically acceptable reliable watertight closure. When hearing is to be salvaged, we use a “conchal flap technique,” which prevents circumferential scarring and stenosis and permits a watertight suture closure.

The last 15 to 20 years have seen an increasing number of operative procedures described for the removal of lesions involving the skull base. For practical purposes, we define skull base lesions as those that involve the cranial base and whose operative removal presents the risk of:

1. Cranial nerve injury
2. Vascular injury
3. Cerebrospinal fluid (CSF) fistula

A large variety of lesions, both malignant and benign, will satisfy this definition. They may be vascular or neoplastic and may involve the anterior, middle, or posterior cranial fossae.

We have developed modifications of previously described techniques to minimize postoperative CSF otorrhea.

METHODS AND RESULTS

When hearing is to be sacrificed, we use a modification of the technique described by Rambo¹ for closure of

problem mastoid cavities. The operative procedure is begun by developing a flap of anterior canal wall skin (Fig. 1). The flap is based laterally. An incision is made medially at about the bony cartilagenous junction using the Lempert speculum. Sharp dissection is continued medially to laterally, elevating the flap off the underlying anterior canal wall. The flap is based on the posterior tragal skin. After the anterior canal wall skin flap has been developed, the skin overlying the conchal cartilage is removed (Fig. 2). Care is taken to leave the pericondrium intact over the underlying cartilage. This pericondrium will protect the cartilage from potential infection and also serve as a source of blood supply to the flap after wound closure. The flap is sutured over the denuded cartilage. Final closure can be done at the beginning of the operation when the flap is elevated or it can be a delayed to the end of the operation. It is crucial that all of the remaining canal skin and tympanic membrane be removed. Any retained residual epithelium could potentially form a postoperative cholesteatoma. The posterior bony canal wall is removed to maximally expose the eustachian tube, which is then packed with Proplast to obliterate it. Additional drilling is done in the area of the tympanic annulus in order to assure

Figure 1. The operation is begun by developing a flap of anterior canal wall skin.

Figure 3. Proplast can be used to obliterate the eustachian tube.

Figure 2. All residual epithelium must be removed prior to the end of the operation.

Figure 4. Watertight closure of the external auditory canal can be achieved at the beginning or deferred to the end of the procedure.

complete removal of epithelial tissue. A second layer of closure can be obtained by suturing together the subcutaneous tissue on the back of the flap (Fig. 3). This must be done from behind and can only be accomplished after elevation of the major flap. At the completion of the procedure, a watertight suture line has been achieved (Fig. 4). The rotated flap of anterior canal wall skin can receive nourishment from the underlying pericondrium and support from the underlying cartilage.

When hearing is to be salvaged but the postauricular flap must be elevated anterior to the tragus, we utilize a "conchal flap" technique. The traditional vascular strip incision is replaced by an incision well lateral in the ear. The incision begins in the posterior tragal skin and is carried around the external auditory meatus to include a larger portion of the skin overlying the conchal bowl (Fig. 5). The conchal cartilage and its attached pericondrium are left undisturbed. The major postauricular flap can then be elevated well beyond the external auditory canal without difficulty. The conchal flap is tucked into the bony external

Figure 5. The initial incision for the conchal flap technique is illustrated.

auditory meatus during the course of the procedure in order to protect it from inadvertent injury. At the end of the operative procedure, the major postauricular flap is returned to its anatomic position. The conchal skin that was left attached to the skin of the external auditory canal is then brought back out through the external auditory meatus and sutured back into exactly the same position from which it was initially excised (Fig. 6). The far lateral placement of this incision makes it accessible for water-tight closure. Postoperative scarring is not a problem, since these incisions are not circumferential. We have performed well over 50 closures of the external auditory canal using the modified Rambo technique. We have had one incidence in which there was some leakage through the superior portion of the Rambo suture line. We believe that this was due to a technical error. There have been no cases of necrosis or breakdown of the closure. The closure has achieved a uniformly excellent cosmetic result. We have used the conchal flap technique in six patients. Three of these patients had posterior fossa dural arteriovenous malformations and three had schwannomas of the jugular foramen. They all have useful postoperative hearing and adequate, problem-free external auditory canals. There were no postoperative conductive hearing losses. One patient required a drain for a CSF fistula that did not involve the meatal incision.

DISCUSSION

CSF fistula has been and continues to be a specific problem in postoperative management of the skull base surgery patient.² The development of certain transtemporal surgical techniques has been hampered by development of postoperative CSF fistulas. Whereas cranial nerve injury and vascular accident may produce significant morbidity and some mortality, CSF fistula is the most common postoperative complication requiring reoperation.³ Because transtemporal approaches are more frequently utilized, CSF fistula arising from the external auditory canal (EAC) and eustachian tube have become more frequent.

Two questions that must always be addressed (and that bear on management of the EAC) are:

1. Can hearing be salvaged?
2. Must the facial nerve be mobilized and, if so, how much mobilization will be required?

The requirements for successful conservation of useful hearing are given in Table 1. Oftentimes the tumor will already have involved some of the structures listed and it will be clear that successful tumor extirpation will require sacrifice of hearing. In other instances it may be necessary to sacrifice one or all of these structures as part of the approach to the neoplasm.

Most operations on the temporal bone require consideration of the facial nerve. In some cases it may be avoided entirely, but frequently it will need to be sacrificed, transected, or rerouted. This is especially common when access to the jugular foramen or petrous portions of the carotid artery is required. The facial nerve is directly lateral to these structures and it is difficult or impossible to expose them fully without moving the facial nerve out of the way. If the requirement for mobilization is extensive, then removal of the posterior bony external auditory canal is mandatory and hearing will usually have to be sacrificed. In such cases closure of the lateral end of the external auditory canal is often necessary and usually prudent. It will, however, from time to time be possible to access the jugular foramen and inferior portions of the petrous carotid artery with minimum mobilization of the nerve. We have been able to approach lesions in this area by mobilizing only the descending portion of the nerve along with its parotid ramifications without removing the posterior bony canal wall. In such cases it was necessary to elevate the postauricular flap anterior to the external auditory canal in order to access the extracranial facial nerve and parotid gland. Simple transection of the external auditory canal will result in postoperative circumferential scarring and stenosis. The traditional means of avoiding this complication is the classic "vascular strip" incision, which is relatively resistant to circumferential stenosis. This solution, however, is impractical in cases in

Figure 6. Elevation of the major postauricular flap is shown.

Table 1. Requirements for Successful Hearing Conservation

1.	Preservation of the auditory portion of the VIIIth nerve
2.	Preservation of the membranous labyrinthine
3.	Uncompromised blood supply to the auditory portion of the VIIIth nerve and the membranous labyrinthine
4.	Functioning ossicles
5.	A patent eustachian tube to provide an aerated middle ear space
6.	An intact tympanic membrane
7.	A patent external auditory canal

Figure 7. Illustrates our strategy for management of the external auditory canal in skull base surgery. When hearing is to be sacrificed and the wound is likely to be connected to the subarachnoid space, a modified Rambo closure is frequently utilized. When hearing is to be preserved but the flap must be advanced in order to include the external auditory canal (EAC) and require its transection, the conchal flap technique is used to preserve a functioning external auditory canal.

which the subarachnoid space is entered. CSF filling the postoperative defect may dissect down the posterior EAC from lateral to medial and escape around the margins of the vascular strip incision. The lateral portions of this incision are close enough to the actual external auditory meatus to make packing as a means of avoiding fluid leak

unsuccessful. If hearing can be preserved but flap design requires transection of the EAC, we believe the conchal flap technique is a more reliable method (Fig. 7).

When hearing is to be sacrificed, the EAC should be closed. Previously utilized techniques for closing the EAC have depended on simple eversion of transected canal skin. This technique has produced a uniformly poor cosmetic result. The bunched up, everted tissue is obvious postoperatively. A number of patients complained about having a "belly button" in their ear. We also had several cases of wound breakdown related to poor blood supply and lack of support. In cases that require the elimination of the posterior bony canal wall and tympanic membrane, the modified Rambo technique provides a more cosmetic and reliable method of closing the auditory canal. We find it superior to previous methods in which the lateral canal is closed from behind by everting the soft tissue outward. That technique provided a less reliable closure and one that was certainly less cosmetic. We have also used this technique for operations that traditionally leave the EAC and tympanic membrane intact even though hearing was sacrificed.

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