# Transmastoid labyrinthectomy: Reliable surgical management of vertigo

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**Transmastoid labyrinthectomy has continued to be an important part of the surgical armamentarium for patients with vertigo and nonserviceable hearing loss. Continuing experience substantiates our earlier impression that the vestibular system usually accommodates rapidly to complete unilateral surgical ablation, regardless of age or degree of residual vestibular activity in the ear (as measured by preoperative bithermal caloric testing). Although the symptom of vertigo is reliably treated by transmastoid labyrinthectomy, a patient questionnaire has demonstrated a significant incidence of mild to moderate persisting postoperative dysequilibrium. Although this dysequilibrium is usually not debilitating, this questionnaire has demonstrated its existence more precisely than a retrospective review of the patients' clinical records. This study reviews 110 patients who underwent labyrinthectomy between 1978 and 1985. We remain impressed at the efficacy of the transmastoid labyrinthectomy in relieving the symptom of vertigo.** (OTOLARYNGOL HEAD NECK SURG 1989;101:5.)

Surgical intervention is considered when patients who have disabling vertigo fail to respond to appropriate medical therapy. Identification of the offending peripheral vestibular system generally can be accomplished by history, physical examination, and appropriate audiologic, vestibular, and radiologic tests. The decision to proceed with surgery and the choice of the surgical procedure are based on a combination of factors. These factors include the diagnosis, the hearing level in both ears, the vestibular function in both ears, and the experience of the surgeon. Although numerous surgical procedures, such as endolymphatic sac surgery, repair of perilymphatic fistula, neurovascular decompression, singular neurectomy, and others, are advocated to relieve vertigo of various causes, transmastoid labyrinthectomy remains one of the mainstays of physicians' surgical armamentarium for the definitive management of vertigo.

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Persistent labyrinthine symptoms may be manifested as unsteadiness, veering, or frank rotational vertigo. These symptoms are not unique to a single otologic disorder but may result from a wide variety of labyrinthine disorders, including Meniere's disease, inner ear barotrauma, labyrinthitis, congenital hearing loss, sudden hearing loss with vertigo, or complications of chronic otitis media, stapedectomy surgery, or trauma of the temporal bone.

This report reviews 110 consecutive patients who underwent transmastoid labyrinthectomy at the University of Michigan Medical Center between 1978 and 1985 for relief of intractable vertigo in the presence of a unilateral nonserviceable hearing loss.

## INDICATIONS AND PREOPERATIVE ASSESSMENT

Transmastoid labyrinthectomy may be considered when persistent or recurrent labyrinthine disability exists from any cause and when hearing is at a nonserviceable level. Although we have generally defined a pure-tone average of greater than 60 dB and a speech discrimination score of 50% or less as nonserviceable, the patient must concur with this assessment of the hearing loss. In addition to the objective audiometric assessment of the pure tone and speech discrimination ability of the ear, the patient should be questioned as to the subjective level of hearing in the ear. If the hearing level in the better hearing ear is compromised or at future risk, the patient may place considerable impor-

**Table 1.** Labyrinthectomy demographics ($n$ = 110)

| | n | % |
|---|---|---|
| Sex | | |
| Male | 48 | 44 |
| Female | 62 | 56 |
| Ear | | |
| Left | 58 | 53 |
| Right | 52 | 47 |
| Age (yr) | | |
| <20 | 1 | 1 |
| 20-39 | 18 | 16 |
| 40-59 | 43 | 39 |
| 60-79 | 46 | 42 |
| 80+ | 2 | 2 |

**Table 2.** Labyrinthectomy diagnoses ($n$ = 110)

| Diagnosis | No. | % |
|---|---|---|
| Meniere's disease | 64 | 58 |
| Sudden SNHL | 11 | 10 |
| SNHL, progressive | 8 | 7 |
| Chronic suppurative otitis media | 8 | 7 |
| Surgical trauma (staples 6, neuroma 1) | 7 | 6 |
| Head tauma | 5 | 5 |
| Labyrinthitis | 4 | 4 |
| Congenital SNHL | 2 | 2 |
| Glomus tumor/XRT | 1 | 1 |

*SNHL*, Sensorineural hearing loss; *XRT*, x-ray therapy.

tance on retaining the residual hearing in the involved ear. Sacrifice of hearing under these circumstances should be undertaken only after careful consideration by the patient and with full appreciation of the consequences of the hearing loss. Electronystagmography (ENG) is used routinely and may reveal a normal, significantly reduced, or absent vestibular response to caloric stimulation on the involved side. In this series, normal and symmetric vestibular responses were encountered in 17 patients. An absent caloric response, even to ice-water stimulation, in the involved ear does not necessarily indicate an absence of residual vestibular function, and this finding does not dissuade us from proceeding with labyrinthectomy. ENG is also of critical value in verifying active labyrinthine function in the contralateral ear. Should vestibular function in the opposite ear be absent or marginal, ablation of the offending ear must be reconsidered because of the significant disability that usually results from the complete loss of vestibular function.

Although the presence of a unilateral hearing loss and reduced vestibular response reliably identifies the ear that is producing vertigo and dysequilibrium in the majority of patients, caution must be exercised in patients who have bilateral hearing loss, particularly when this hearing loss is accompanied by bilateral vestibular hypofunction.

Before a labyrinthectomy is undertaken, a radiologic examination of the temporal bones and full metabolic evaluation should be performed to rule out other causes of hearing loss and vestibular dysfunction, such as syphilis, hypothyroidism, diabetes, and acoustic tumor. The age and general medical condition of the patient must also be considered, because other conditions, such as visual impairment, arthritis, and neuromuscular disability, can certainly impact on and prolong convalescence. Although the patient should be free from rotatory vertigo, the effects of these other disabilities will persist and may contribute to postoperative dysequilibrium. Elderly individuals in particular should be counseled before surgery regarding the possible impact of these other factors on their eventual equilibrium and postural stability.

## SURGICAL TECHNIQUE

The patient is placed supine on the operating table. After induction of general anesthesia, the ear to be operated on is suitably prepared and the postauricular area injected subcutaneously with lidocaine (Xylocaine) 1% with adrenalin, 1:100,000. A postauricular incision is made 1 cm behind the postauricular crease, and the soft tissues are elevated off the mastoid cortex. A wide complete mastoidectomy is performed under magnification with the otologic drill and suction irrigation. Beveling of the bone over the sigmoid sinus, sinodural angle, and particularly the middle fossa plate is required to allow adequate visibility during the labyrinthectomy, especially when drilling medial to the facial nerve. Malleus, stapes, and tympanic membrane are left in place, and the incus may be removed at the surgeon's discretion.

The horizontal, posterior, and finally the superior semicircular canals are bivalved to allow positive identification of these structures. The surgical technique of bivalving the internal half of the semicircular canals allows one to stay within the otic capsule, thereby avoiding exposure of the facial nerve. Particular care should be used when approaching the ampullated end of the posterior semicircular canal that lies medial to the second genu of the facial nerve. The facial nerve

**Table 3.** Labyrinthectomy: duration of symptoms

| Years | No. of patients |
|---|---|
| <1 | 8 |
| 1-2 | 21 |
| 2-3 | 11 |
| 3-4 | 16 |
| 4-5 | 7 |
| 5-10 | 25 |
| 10-15 | 9 |
| 15-20 | 6 |
| >20 | 3 |
| NA | 4 |

is also extremely close to the inferior surface of the horizontal canal ampulla. At all times, one should drill only when there is an unobstructed view of the bur and the surgical site. All neuroepithelial elements should be positively identified and removed completely. With the wide access that this technique provides, the maculae of the utricle and saccule, as well as the ampullae of the three semicircular canals, may be positively identified and removed precisely.

The bone overlying the lateral end of the internal auditory canal is extremely thin, and care should be taken to avoid excess bone removal from the area of the ampullae of the superior and horizontal semicircular canals, because this may result in cerebrospinal fluid leak. If a drill is used to remove the membranous ampulla of the superior semicircular canal, a cerebrospinal fluid leak is more likely to occur. Therefore a blunt instrument (i.e., the back of a sickle knife) should be used to remove the neuroepithelium. Should cerebrospinal fluid leakage occur, the bone opening is enlarged in order to permit insertion of a piece of fascia or connective tissue to obstruct this opening. Once the labyrinth is fully exenterated, the postauricular wound is closed in layers with subcutaneous interrupted 3-0 chromic catgut sutures without drainage. A mastoid dressing is then applied. This procedure may be accomplished in 1 to 1½ hours.

## RESULTS

The present series of patients includes patients from our previously published series.[1-3] All but three of the patients have been available for postoperative assessment within the last 2 years. The following results are based on a retrospective review of the patient's chart and a questionnaire mailed to the patient's home.

Of the 110 patients, 48 (44%) were men and 62 (56%) were women. In 58 patients (53%) the left ear was operated on and in 52 (47%) the right ear was operated on. The age distribution is noted in Table 1. The majority of patients were 40 to 79 years of age.

**Table 4.** Labyrinthectomy: audiologic/vestibular findings ($n$ = 110)

| Result | No. |
|---|---|
| SRT (dB) | |
| 0-39 | 0 |
| 40-49 | 1 |
| 50-59 | 7 |
| 60-69 | 28 |
| 70-79 | 20 |
| 80 or more | 28 |
| No response | 24 |
| NA | 2 |
| Discrimation (%) | |
| 50 | 20 |
| 40-49 | 11 |
| 30-39 | 10 |
| 20-29 | 9 |
| 20 | 50 |
| NA | 20 |
| ENG/calorics | |
| Normal | 17 |
| Ipsilateral RVR | 64 |
| Bilateral RVR | 6 |
| NA | 23 |

*SRT*, Speech reception threshold; *RVR*, reduced vestibular response.

Table 2 demonstrates the diagnoses of the patients undergoing surgery. The predominant diagnosis was Meniere's disease, but sudden hearing loss, progressive sensorineural hearing loss with vertigo, chronic suppurative otitis media, trauma, labyrinthitis, and congenital sensorineural hearing loss were additional diagnoses. The duration of symptoms is noted in Table 3, with approximately half of these individuals having symptoms for longer than 4 years. Audiologic findings are demonstrated in Table 4. In only one case was a patient's speech reception threshold better than 50 dB. This was an 80-year-old man in whose case labyrinthectomy was selected rather than a potentially more morbid vestibular nerve section. Speech discrimination scores were greater than 50% in 20 patients; however, in most of these patients speech reception thresholds were above 60 dB.

Vestibular evaluation, specifically the bithermal caloric examination, was normal in 17 individuals, whereas 64 demonstrated an ipsilateral reduced vestibular response and six bilateral reduced vestibular response. In 23 individuals specific results were unavailable.

**Table 5.** Labyrinthectomy: postoperative results ($n$ = 110)

| Result | Vertigo No. (%) |
|---|---|
| Complete relief | 97 (88) |
| Marked relief | 10 (9) |
| Slight relief | 0 (0) |
| No difference | 0 (0) |
| Worse | 0 (0) |
| NA | 3 (3) |

**Table 6.** Labyrinthectomy: postoperative results ($n$ = 110)

| Result | Dysequilibrium No. (%) |
|---|---|
| Normal | 69 (63) |
| Mild | 17 (15) |
| Troublesome | 10 (9) |
| Disabling | 3 (3) |
| No response | 11 (10) |

Postoperative results for vertigo and dysequilibrium are demonstrated in Tables 5 and 6. Ninety-seven patients (88%) noted complete absence of vertigo after surgery. Ten patients (9%) noted marked relief and three patients (3%) were unavailable for followup. After surgery, 69 patients (63%) stated that they were free of dysequilibrium, and 17 patients (15%) noted mild dysequilibrium. Ten patients (9%) noted troublesome dysequilibrium and three patients (3%) disabling dysequilibrium. In 11 patients this information was not available.

Operative complications included two individuals among the first 15 patients reported previously who had cerebrospinal fluid leaks after surgery.[1] There have been no subsequent cerebrospinal fluid leaks. There were three instances of facial nerve paresis or paralysis. Only one patient had lasting sequelae, in which case the horizontal portion of the facial nerve was lacerated by a cutting bur as the horizontal canal was being exenterated. Decompression of the horizontal and mastoid segments of the facial nerve was performed and 8 years after surgery the patient has a House II/VI recovery. The second patient had a transient paresis with complete recovery after exposure of the medial surface of the second genu of the facial nerve. In the other case a transient delayed facial paresis was noted 9 days after surgery; this later resolved completely. In two instances there were wound infections that required outpatient drainage and antibiotic treatment. The only additional complication was a case of presumed anesthetic-related hepatitis that had been detected 2 weeks after surgery. There were no instances of meningitis or dural or vascular tears.

## DISCUSSION

Various techniques of labyrinthectomy have been performed for many years. In 1895 Jansen[4] described the technique of labyrinthine ablation for suppurative disease in which the lateral semicircular canal was opened after radical mastoidectomy and the vestibular contents removed. In the early 1900s Lake,[5,6] Milligan,[7] Neumann,[8] and Richards[9] described several procedures for removing the entire membranous horizontal semicircular canal.

Alcohol injections into the oval window and lateral semicircular canal for the purpose of destroying the cristae and maculae were proposed in the late 1930s by Peacock,[10] Mollison,[11] and Wright.[12] Day[13] and Cawthorne[14] described fenestration of the horizontal semicircular canal followed by destruction of the membranous labyrinth. Lempert[15] popularized the endaural incision followed by removal of the stapes and aspiration of the contents of the vestibule. Schuknecht[16] (in 1956) and Cawthorne[17] (in 1957) independently described the transcanal oval window labyrinthectomy with a tympanomeatal flap. Armstrong[18] advocated removal of the neuroepithelium in an effort to reduce the failure rate. In 1969 Pulec[19] described the translabyrinthine section of the eighth cranial nerve. This procedure entails sectioning the nerve in the internal auditory canal proximal to Scarpa's ganglion after completion of the transmastoid labyrinthectomy. In 1969 Pulec[20,21] described the postauricular labyrinthectomy, a procedure synonymous with transmastoid labyrinthectomy. Each of these procedures sought more complete ablation of the vestibular end organ.

For labyrinthine ablation to be effective, it must be complete. Graham and Colton,[1] Graham,[2] and Graham and Kemink[3] elaborated in detail their experience with transmastoid labyrinthectomy. Our further experience with the transmastoid labyrinthectomy procedure has suggested that this procedure is effective, although some individuals have residual dysequilibrium. Glasscock et al.[22] and Schuknecht[23] report similar results. Although this procedure is extremely effective for a person with episodic vertigo, there is an incidence (15%

to 25%) of continuing postoperative dysequilibrium. Although some patients are troubled by this dysequilibrium, most are gratified by the lack of episodic vertigo and associated vegetative symptoms and consider themselves much improved. We noted that the elderly had an increased incidence of postoperative dysequilibrium, as might be expected.

We have not found the addition of translabyrinthine vestibular nerve section to be of additional benefit for the control of vertigo or dysequilibrium if the initial labyrinthectomy was complete. Six patients were referred who experienced dysequilibrium after a previous labyrinthectomy. Two of these patients with a residual complaint of episodic vertigo were subsequently found to have undergone an incomplete labyrinthectomy. They were relieved of vertigo by a completion of the labyrinthectomy and vestibular nerve section. The other four patients had previously undergone complete labyrinthectomies and did not benefit from translabyrinthine nerve section. These results are supported by Schuknecht's studies[23] evaluating the sectioning of the vestibular nerve after a complete labyrinthectomy. He believed vestibular nerve section adds nothing to a complete labyrinthectomy. Jung et al.[24] found that three patients (15% of individuals in their labyrinthectomy series) had persistent vertigo after labyrinthectomy and benefitted from translabyrinthine cochleovestibular nerve section. To date it has not been shown clearly that transmastoid labyrinthectomy with section of the vestibular nerve improves results.[22] However, Linthicum et al.[25] and Ylikoski and Belal[26] have noted neuroma formation in the labyrinthectomy defect in autopsy specimens. The latter authors recommend excision of Scarpa's ganglion to prevent peripheral vestibular axonal regeneration. Our belief is that the additional potential morbidity of translabyrinthine vestibular nerve section is not justified and we continue to recommend to patients a transmastoid labyrinthectomy when episodic vertigo and nonserviceable hearing coexist. Although 10% of our patients who undergo labyrinthectomy either had Meniere's disease or subsequently developed Meniere's disease in the opposite ear, in no instance has hearing in the opposite ear become nonserviceable.

Although the follow-up time is short (3 to 10 years), it is our impression that the risk of eventual hearing loss in the opposite ear rarely justifies the increased morbidity of a hearing-preservation procedure such as retrolabyrinthine vestibular nerve section when the hearing in the involved ear is poor, particularly in older patients. This is supported by a recent article by Palaskas et al.[28] documenting the progression of hearing loss in bilateral Meniere's disease. In their review of 85 patients with bilateral Meniere's disease, nine patients (10%) had a decline in hearing in the opposite ear to a level exceeding that of the original ear. In only one case, however, was a patient considered a candidate for labyrinthectomy. At this time our experience substantiates this report and we believe that the preservation of a nonserviceable hearing ear (or theoretically the preservation of a cochlea for subsequent cochlear implantation) is unnecessarily conservative.

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