4th EDITION

OTOLOGIC SURGERY

BRACKMANN • SHELTON • ARRIAGA

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Fourth Edition

OTOLOGIC SURGERY

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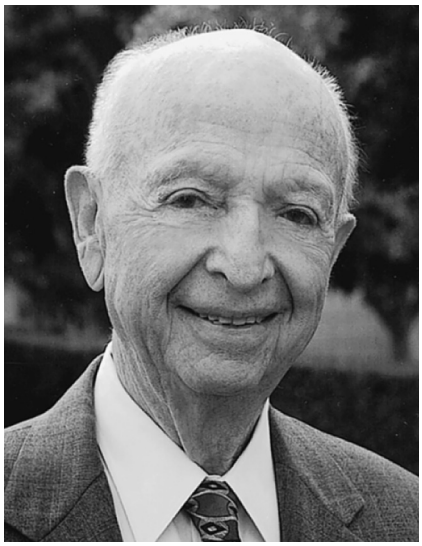
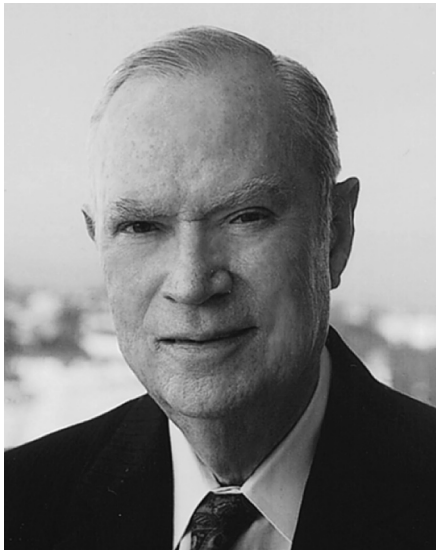
Dedication



This book is dedicated to our mentors and teachers, Drs. Howard P. House, William F. House, and James L. Sheehy. Each of these outstanding physicians had special talents and characteristics that, when melded together, resulted in an outstanding clinical, research, and educational facility, The House Clinic and Institute.

Howard House, the founder of our institution, was among the first to concentrate his activities in the field of otology. He devoted his career to the treatment of otosclerosis. In addition to his surgical genius, Howard was recognized as an outstanding statesman and fundraiser. Without him the House Clinic and Institute, which has provided so many opportunities for all of us, would not exist. He died in 2003 at the age of 95. At the time of his death, he was still coming to the office regularly and was active in development work for the Institute.



William F. House joined his brother in practice after completing his residency. A creative genius, Bill recognized that the future of otology lay in the diagnosis and treatment of diseases of the inner ear. He introduced the operating microscope and microsurgical techniques to the field of neurosurgery, and revolutionized the treatment of acoustic neuromas and other neurotologic problems. He is also recognized as instrumental in bringing the cochlear implant to the state of a practical clinical device as it is now widely applied.

Bill passed away in December 2012 after a lengthy illness. To the very end, he pursued a number of new innovations in otology and audiology. Bill's genius improved the quality of life for multitudes of patients. His legacy will live forever.

The final link in the chain that resulted in the success of the House Clinic and Institute was Dr. James L. Sheehy. His special interest was in the field of chronic otitis media. In addition to his outstanding surgical ability, Jim possessed exceptional talent in organizational ability and teaching. Jim was responsible for developing all the patient educational materials as well as serving as the editor for all of the many publications produced by members of the House Clinic. His course development, panel discussions, and slide preparation techniques became standards for our specialty. Jim had been a member of the House Clinic for 48 years and died in 2006.

It was our great privilege to be under the personal tutelage of each of these outstanding men. In addition to all the attributes enumerated above, each was first and foremost an outstanding physician. They practiced the art and science of surgery in the finest fashion, making it most appropriate that this book on surgical technique be dedicated to them.

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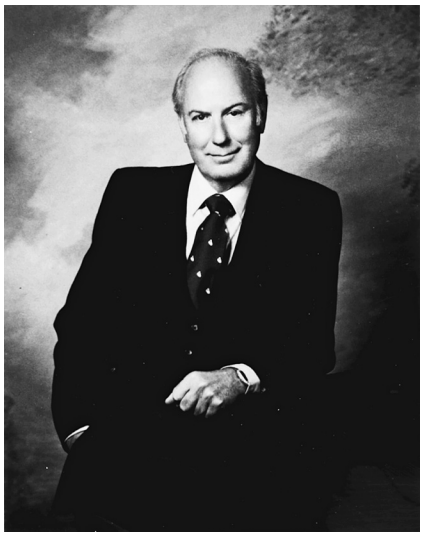
In Memoriam



On October 19, 1996, the field of otology lost one of its most influential leaders of modern times. Harold Frederick Schuknecht, MD, Professor Emeritus of the Department of Otology and Laryngology at the Harvard Medical School and Chief Emeritus of the Department of Otolaryngology at the Massachusetts Eye and Ear Infirmary, was a world-renowned clinical otologist, otopathologist, teacher, and scholar. His contribution to human otopathology is unparalleled. His book, *Pathology of the Ear,* which he solely authored, is without question the most complete and comprehensive thesis on the subject. His clinical approach and technical innovations were based on scientific principle, and he unabashedly held others to the same standard. His influence as a teacher and role model is evidenced by the unprecedented number of his students who have followed in his footsteps and have risen as leaders in our specialty. Through his life's work and through the lives of those he has touched, his influence lives on.

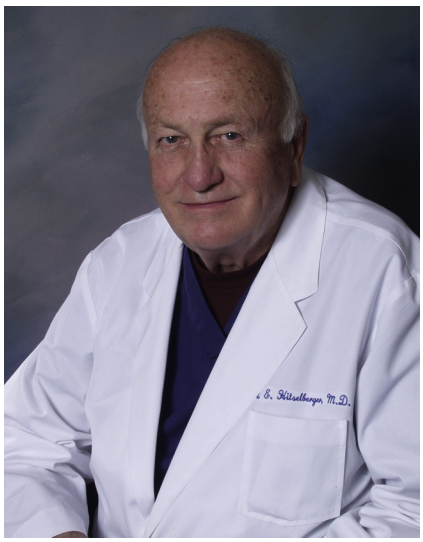
Mendell Robinson, MD, known for his eponymous stapes prosthesis, passed away on September 29, 2007. A sketch on a napkin during an air flight in 1960 led to the development of this popular and successful prosthesis. Dr. Robinson was an internationally renowned otosclerosis surgeon and had a successful otologic practice in Providence, Rhode Island, for almost 50 years. He was so appreciated that the mayor of Providence officially declared "Mendell Robinson Day" on two separate occasions. We have chosen to leave his chapter unchanged from the previous edition.

As the previous edition of *Otologic Surgery* was going to press, we were saddened by the sudden death of our dear colleague Antonio De la Cruz. He succumbed to a malignant lymphoma after a very brief illness.

Antonio was a member of the House Clinic and Institute for 34 years and director of the Institute's Department of Education. He directed hundreds of temporal bone dissection courses at the Institute and was responsible for teaching otologic surgery to thousands of physicians. His colleagues recognized him by election to the presidency of the American Academy of Otolaryngology–Head and Neck Surgery and the American Otologic Society.

Antonio participated in more national and international courses than any physician in the history of our specialty. All of us marveled at his tireless energy, which allowed him to travel at least on a monthly basis to courses around the world. In addition to his teaching activities, Antonio maintained an active otologic and neurotologic practice, benefiting many patients with his expertise. He contributed greatly in many areas, particularly in the surgical correction of congenital atresia of the external auditory canal.

A former House Fellow wrote the following: "I am saddened to hear of Antonio's passing. He had a unique ability to encourage others to perceive the skills of the expert to be achievable by them. His humble style, though, belied a high level of skill and savvy. His focused energy, his keen intellect, and his eagerness to teach all made him a great mentor and colleague, roles that touched so many of us over the last 30+ years. I am sure many, many will miss him but will forever cherish the perspective, skills, and tips he gave so freely. His contributions will live on."



William E. Hitselberger, a giant in the field of neurosurgery, passed away suddenly on February 13, 2014. Bill joined Dr. William F. House to form the first neurotologic/neurosurgical team, which revolutionized the treatment of acoustic neuromas and other skull base tumors. Bill was criticized by his colleagues for forming this association but persevered. He participated in the removal of more than 5000 acoustic neuromas, a record that is unlikely to ever be broken.

He was the first to place an electrode onto the cochlear nucleus to produce auditory sensations. This led to the development of the auditory brainstem implant.

Bill was proud that he participated in the training of more than 100 neurotologists, all of whom remember him fondly. Bill's legacy will be the multitude of patients whose lives he has improved.

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Derald E. Brackmann, MD

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Clough Shelton, MD

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Moisés A. Arriaga, MD, MBA

1 Otologic Instrumentation

Eric P. Wilkinson | Jose N. Fayad | J. Eric Lupo

Sophisticated micro-otosurgical techniques mandate that the otologic surgeon and surgical team have an in-depth understanding of the operating room (OR) layout and surgical instrumentation. This chapter describes in detail different surgical procedures and the necessary OR setup and instruments. Appendix 1-1 provides a comprehensive list of instruments and equipment.

OPERATING ROOM

The OR for otologic surgery requires features that differ from ORs used for nonotologic surgery. The following sections elaborate on the general environment of the OR designed for ear surgery. A word about the sterile field is in order. Respecting the sterile field is vital during routine otologic surgery and takes on special significance during neurotologic procedures. Maintaining the proper sterile environment means limiting traffic through the OR and keeping the number of visitors to a minimum. It is preferable for observers to be in a remote room watching the procedures on video. Individuals allowed in the OR should be experienced in sterile technique and should wear jackets over scrubs so that all skin surfaces are covered (Fig. 1-1).

Before entering the OR, the operative site is confirmed with the patient. The correct ear is marked with a marking pen. As many otologic procedures are performed on awake patients under local anesthesia, an OR environment conducive to their psychological well-being is imperative. Members of the surgical team and visitors must use discretion when making comments during surgery performed under local anesthesia.

The first piece of OR equipment to be discussed is the operating table. The surgeon must be comfortable while performing microsurgery. Adequate leg room under the table can be achieved with older OR tables by placing the patient 180 degrees opposite the usual position; in other words, the patient's head is where the feet would normally be (Fig. 1-2). Newer electric tables easily accommodate the patient and surgeon. Because most otologists spin the OR table 180 degrees after the induction of anesthesia, the new tables allow for spinning the table without unlocking it. Nonetheless, after the patient is properly positioned, the table must be firmly locked in place.

All ORs are equipped with wall suction. Standard suction devices are acceptable for otologic surgery. It is preferable, however, to use a multiple-canister suction setup, minimizing the number of times the bottles must be emptied (Fig. 1-3). Suction systems have several locations where the amount of suction can be varied, but the surgeon should also use a control clamp on the suction tubing on the sterile field (Fig. 1-4).

The tubing that is attached to the suction tips and suction-irrigators should be highly flexible. The readily available disposable suction tubing is not flexible enough for microsurgery and places awkward torque on the surgeon's hands. Suction setup problems are common in every OR. The prudent team troubleshoots the system in advance and has access to backup equipment.

Electrocautery equipment should be in a ready-to-use state on all procedures except perhaps stapes surgery. The patient must be properly grounded. It is advantageous to have monopolar and bipolar cautery on the field for all chronic ear and neurotologic procedures. To minimize risk to an implanted device such as a cochlear implant or auditory brainstem implant, monopolar cautery should be avoided after an implant has been placed. Nonadherent tips are available for most cautery devices and are desirable. Surgeons have at their disposal a wide array of safe cautery devices, but they must be thoroughly familiar with these electric instruments before use.

The surgical drill is another essential piece of equipment for otologic surgery. The vast array of available drills precludes an in-depth discussion of each system. In general, otologic drills fall into two categories: air driven and electric. There are advantages and disadvantages to each type, and most surgeons have a distinct preference based on training and experience. For surgeons using air-driven drills, it is preferable to use a central source of nitrogen to power the drill instead of tank-supplied gas within the OR. A central source eliminates the need for changing tanks during long procedures.

High-speed drills capable of doing most of the bone work in the temporal bone include the Fisch, Medtronic, and Anspach drill systems. These drills generally are unsuitable for work in the middle ear, especially around the stapes footplate. For the latter purposes, a microdrill, such as the Skeeter drill or Bien-Air, is suitable (Fig. 1-5). Whatever drill is used in the middle ear, it must have a variable speed control and a wide array of drill bits.

Most larger otologic drills are equipped with straight and angled handpieces. Most surgeons prefer straight handpieces for early gross removal of the mastoid cortex, switching to angled handpieces for working deeper in the temporal bone. The Anspach drill system has a handpiece that can be converted from straight to angled simply by rotating the connection. A full complement of cutting and diamond burrs is mandatory. Figure 1-6 shows the Anspach drill system. Most drill systems have attachments that vary in shape, diameter, and length. It is the surgeon's responsibility to be

Figure 1-1 Observer in jacket.

Figure 1-2 Operating table with patient's head at foot of bed.

Figure 1-3 Multiple-canister suction setup.

Figure 1-4 Suction tubing with control clamp.

Figure 1-5 Medtronic Skeeter microdrill for footplate work.

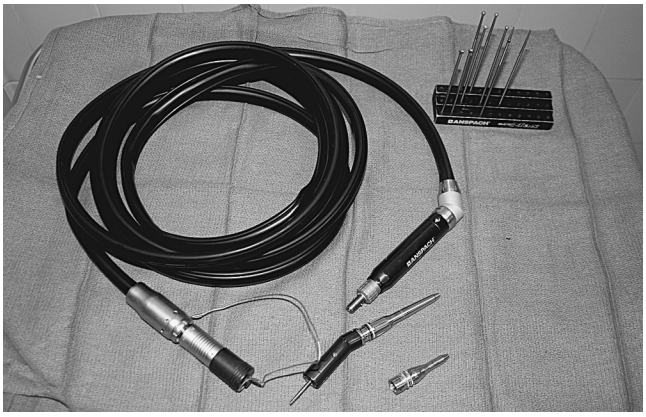

Figure 1-6 Anspach drill system.

intimately familiar with the drill system and to have all of the attachments and burrs that might be needed.

The otologic drill should be held in the hand like a pencil, with the hand resting comfortably on the sterile field. The side of the burr should be used to provide maximum contact between the bone and the flutes of the burr, affording safer and more efficient drilling (Fig. 1-7). The newer drills are remarkably reliable, but, similar to other tools, may malfunction. Drill systems require proper care and inspection before use. A backup system should be readily available.

The introduction of the operating microscope revolutionized otologic surgery. Most otolaryngologists are familiar with the microscope. Several brands of optically superior instruments are available; most are sufficiently similar to share the same general principles.

The otologic surgeon must be familiar with the adjustments on the microscope and must be prepared to troubleshoot the problems that may arise with the scope. The focal length of the objective lens is a matter of personal preference. Most otologists use a 200- or 250-mm objective. If a laser is attached to the microscope, one might consider a 300-mm objective. The objective lens should be selected, confirmed, and properly mounted before draping the microscope. Other adjustments, such as the most comfortable interpupillary distance, also should be performed before the scope is draped. Par focal vision should be established so that the surgeon can change magnification without having to change focus. This is accomplished by first setting the diopter setting of both eyepieces to zero. The 40× magnification (or highest available setting) is selected. The locked microscope is focused on a towel using the focus knob only. Without disturbing any of the settings, the magnification is now set at 6× (or the lowest available setting). The eyepieces are individually adjusted to obtain the sharpest possible image. The diopter readings are recorded for future use. The surgeon should have par focal vision when these appropriately adjusted eyepieces are used.

The microscope should move easily. All connections should be adjusted so that the microscope does not wander by itself, yet permit movement to any position with minimal effort. Wrestling with the microscope during microsurgery is an extreme distraction.

Proper posture at the operating table is crucial. To perform microsurgical procedures, the first rule is that the surgeon must be comfortable. The surgeon should be seated comfortably in a proper chair with the back support at the correct height. Both feet should be resting comfortably on the floor. Fatigue is avoided by assuming a restful position in the chair, rather than a rigid upright posture (Fig. 1-8).

The overall OR setup for routine otologic surgery is shown in Figure 1-9. For neurotologic surgery, more space must be available for additional equipment. Middle cranial fossa procedures require some modifications to the OR setup (Fig. 1-10). The essential modification entails the surgeon and the microscope trading places such that the surgeon is seated at the head of the table. Cooperation and careful orchestration among the surgeon, nursing personnel, and anesthesiologist are required for otologic surgery. The needs of the otologist are best served by having the anesthesiologist at the foot of the bed and the scrub nurse opposite the surgeon. Video feed of the procedure to the OR team members helps facilitate anticipation of surgical needs. Space for additional equipment, such as the facial nerve monitor and/or laser, and personnel necessary for their operation should be considered.

Figure 1-7 Proper holding of the drill.

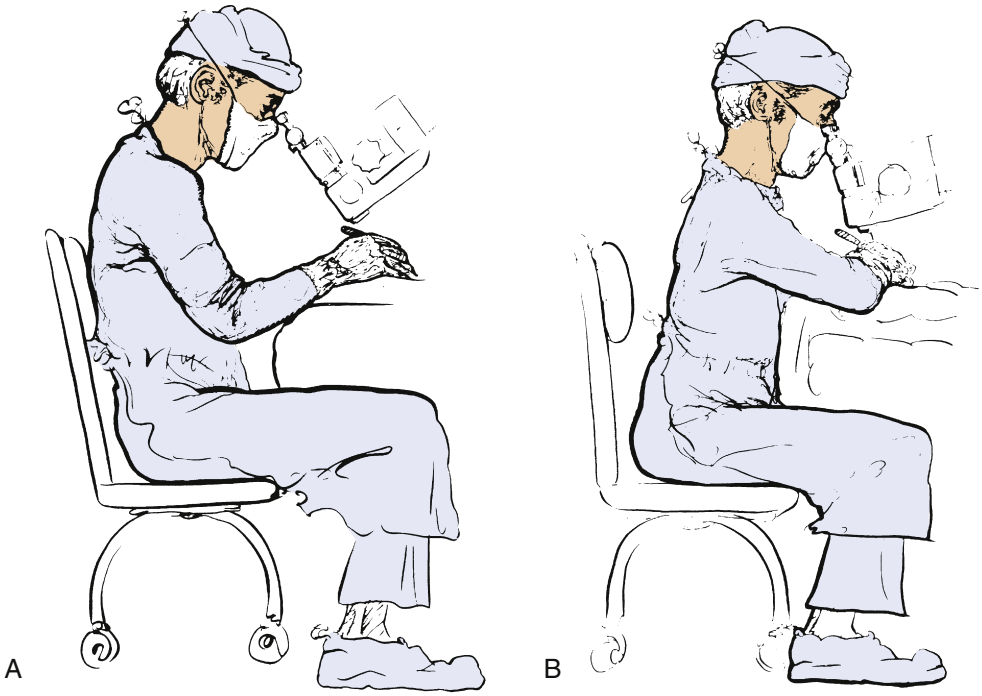

Figure 1-8 **A,** Proper posture for the surgeon. **B,** Wrong posture for the surgeon.

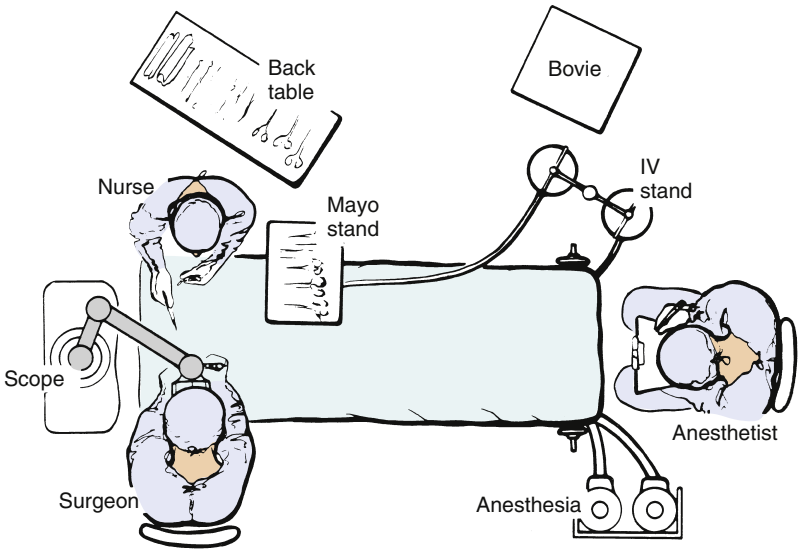

Figure 1-9 Usual otologic/neurotologic operating room setup.

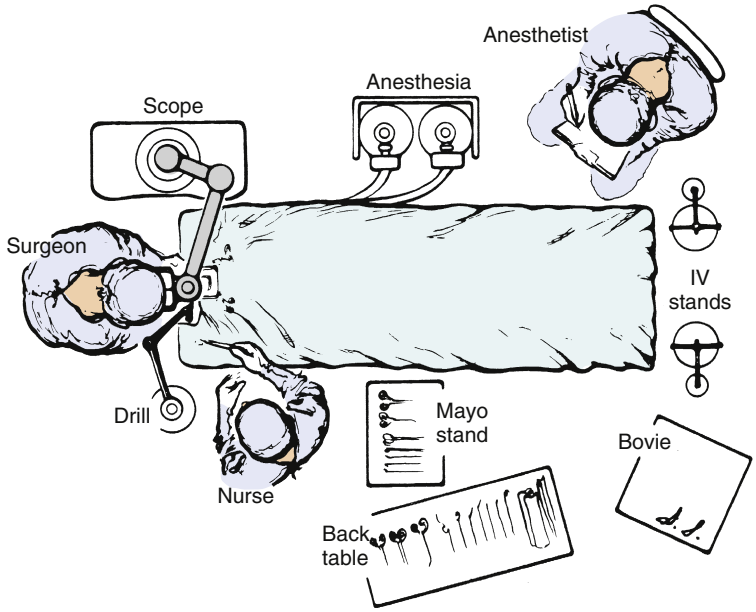

Figure 1-10 Operating room layout for middle fossa surgery.

STAPES SURGERY

The following description of the instrumentation and operative setup for stapes surgery also provides information useful for other middle ear procedures. Under most circumstances, it is preferable to perform stapes surgery under local anesthesia, and surgeons who do so usually use some type of preoperative sedation. Numerous regimens are available, and their description is beyond the scope of this text. If sedation is administered by the surgeon or nursing personnel without the assistance of an anesthetist or anesthesiologist, the agents used should be short acting and reversible.

It is far safer for the patient to be psychologically prepared for the procedure than to be oversedated. Monitored anesthesia care may also be performed. This approach requires the presence of anesthesia personnel in the OR to sedate the patient as is required for the operation, and to monitor vital functions. The surgeon is relieved from this duty, allowing total concentration on the microsurgery.

About 30 minutes before the operation, the patient is brought to the preoperative holding area. If the surgeon routinely harvests a postauricular graft, this area is now shaved. A plastic aperture drape is applied to the operative site and trimmed so as not to cover the patient's face (Fig. 1-11). An intravenous line is started, and the patient is now ready to go to the OR. When the patient is on the OR table, the monitors are placed on the patient by the nursing or anesthesia staff. Minimal monitoring includes pulse oximetry, automatic blood pressure cuff, and electrocardiogram electrodes. The ear and plastic drape are scrubbed with an iodine-containing solution, unless the patient is allergic to iodine. A head drape is applied, and the ear is draped with sterile towels so as not to cover the patient's face; this can

Figure 1-11 Plastic drape applied for stapes surgery.

Figure 1-12 Patient draped in the operating room for stapes surgery. Note opening for the patient's face opposite the surgeon.

be facilitated by supporting the drapes with a metal bar attached to the OR table, or by fixing the drapes to the scrub nurse's Mayo stand (Fig. 1-12).

The patient's head is now gently rotated as far away from the ipsilateral shoulder as possible, and the table is placed in slight Trendelenburg and is rotated toward the surgeon. These maneuvers increase the surgeon's working room and obtain a straight view of the posterior superior aspect of the external auditory canal (EAC). The EAC is irrigated gently with saline heated to body temperature. Vigorous cleaning of the canal is avoided until the ear is anesthetized. The local anesthesia is administered with a plastic Luer-Lok syringe. A 1.5-inch, 27-gauge needle is firmly attached to the syringe. If the ear is injected slowly and strategically, excellent anesthesia and hemostasis can be achieved with a solution of 1% lidocaine with 1:100,000 epinephrine. When using stronger concentrations of epinephrine (e.g., 1:40,000), the patient's blood pressure and cardiac status must be considered, in addition to the possibility of mixing errors.

The canal is injected slowly in four quadrants starting lateral to the bony-cartilaginous junction. The final injection is in the vascular strip. If one routinely harvests fascia or tragal perichondrium, these areas are now injected.

Before describing stapes surgical instruments, a few general comments are in order. All microsurgical instruments should be inspected periodically to ensure sharp points and cutting surfaces. The instruments for delicate work should have malleable shanks, enabling the surgeon to bend the instruments to meet the demands of the situation.

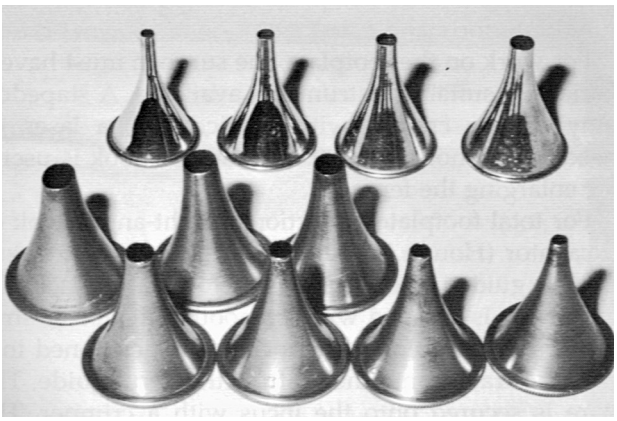

Figure 1-13 Speculum array.

If the surgeon prefers a total stapedectomy to the small fenestra technique, an oval window seal must be selected. If fascia is used, the tissue is harvested before exposing the middle ear. The tissue is placed on a Teflon block or fascia press to dry. If perichondrium is preferred, this may be harvested immediately before footplate removal. For the small fenestra technique, a small sample of venous blood is obtained when the intravenous line is started. This blood sample is passed to the scrub nurse and placed in a vial on the sterile field.

Various ear specula should be available in oval and round configurations. Sizes typically range from 4.5 to 6.5 mm (Fig. 1-13). It is desirable always to work through the largest speculum that the meatus permits without lacerating canal skin. Some surgeons prefer to use a speculum holder for stapes and other middle ear procedures. The tympanomeatal flap is started with incisions made at the 6 and 12 o'clock positions with the No. 1, or sickle, knife. These incisions are united with the No. 2, or lancet, knife. This instrument actually undermines the vascular strip instead of cutting it. The strip is cut with the Bellucci scissors. The defined flap is elevated to the tympanic annulus with the large round knife, known as the large "weapon." When properly identified, the annulus is elevated superiorly with the Rosen needle and inferiorly with the annulus elevator, or gimmick. Figure 1-14 shows a typical set of stapes instruments, including suction tips.

Adequate exposure usually requires removal of the bony ledge in the posterosuperior quadrant. This can be initiated with the Skeeter microdrill and completed with a stapes curette (Fig. 1-15).

From this point on, the steps differ depending on the technique preferred by the surgeon. The diagnosis of otosclerosis should be confirmed on entering the middle ear and a measurement should be taken from the long process of the incus to the stapes footplate with a measuring stick. The next step is to make a control hole in the footplate with a sharp pick-needle (Barbara needle) or the laser. The incudostapedial joint is separated with the joint knife or small right angle hook, the tendon is cut with scissors or laser, and the superstructure is fractured inferiorly and extracted.

For work on the footplate, the surgeon must have a variety of suitable instruments available. A stapedotomy can be created with a microdrill, laser, or needles and hooks. The

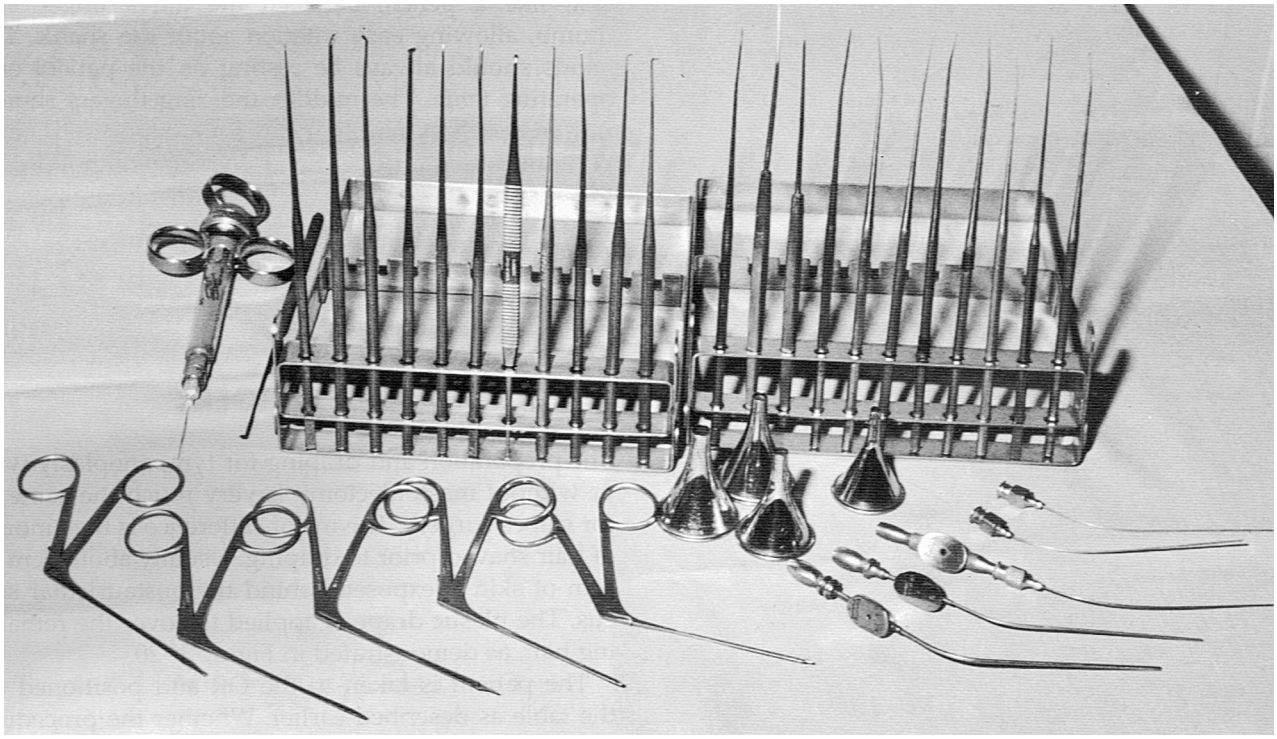

Figure 1-14 Stapes instruments

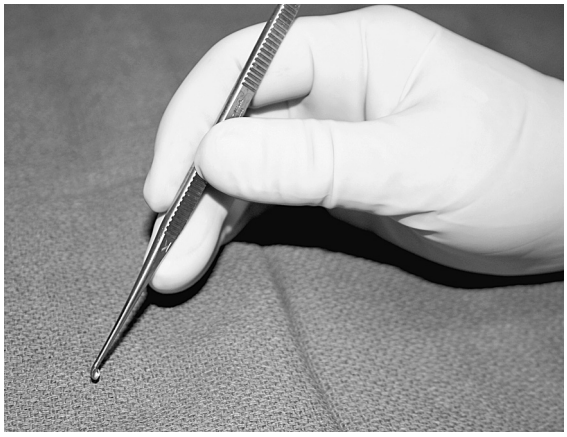

Figure 1-15 Stapes curette.

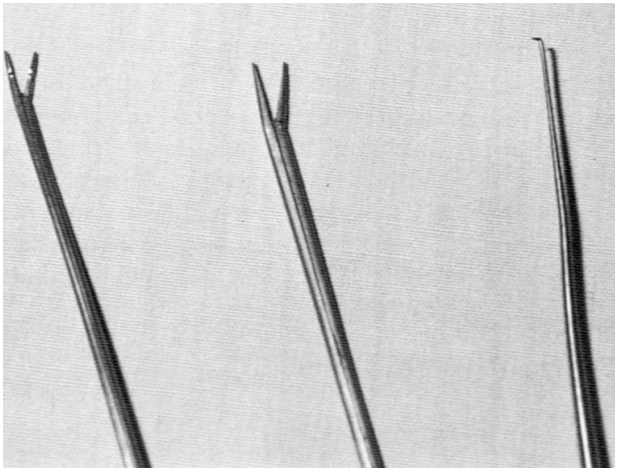

Figure 1-16 Crimpers and footplate hook.

0.3-mm obtuse hook is useful for enlarging the fenestra. For total footplate extraction, a right-angle hook or excavator (Hough hoe) is used. If a graft is to be placed over the oval window, it is guided into place with a footplate chisel.

The prosthesis is grasped with a smooth alligator or strut forceps and placed on the incus. It is positioned on the graft or into the fenestra with a strut guide. A small right-angle hook may be necessary to fine-tune the position of the prosthesis (Fig. 1-16). The wire is secured onto the incus with a crimper or wire-closing forceps. The McGee crimper is useful, especially if followed by a fine alligator forceps for the last gentle squeeze. Nitinol is a metal alloy of nickel and titanium used in stapes prostheses because of its unique ability to secure itself to the incus upon heating. Once the wire is maneuvered into position on the incus, a pulse of laser energy or a brief pulse of heat from a microheating electrode applied to the wire causes the wire to close around

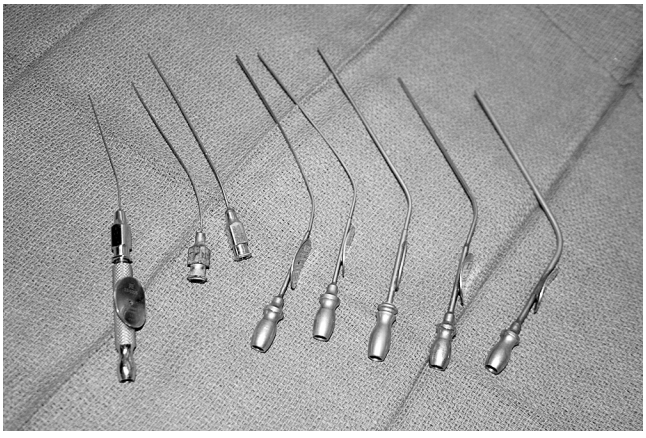

Figure 1-17 Rosen suction tubes with House adapter; Baron tubes.

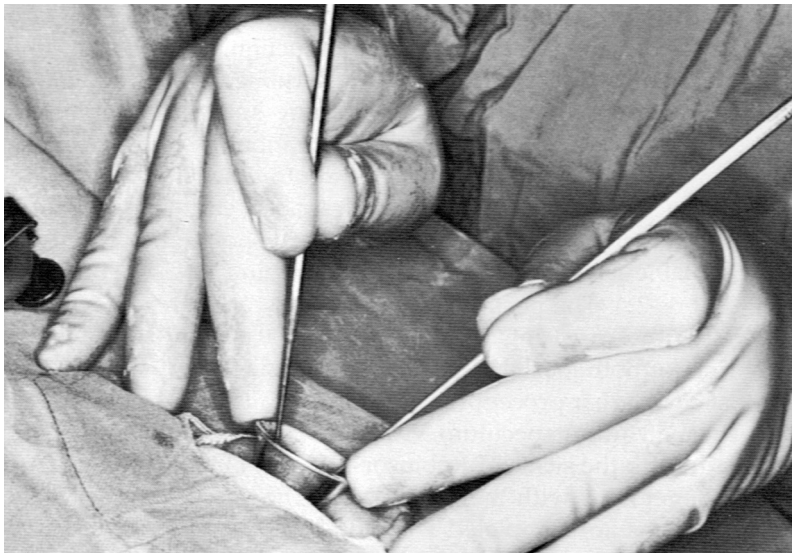

Figure 1-18 Proper holding of instruments as shown by Dr. William House.

the incus. Nitinol is found in prostheses such as the SMart piston (Olympus) or the Eclipse piston (Grace Medical).

Suction tubes for stapes surgery include Nos. 3 to 7 Fr Baron suctions plus Rosen needle suction tips (18 to 24 gauge) with the House adapter (Fig. 1-17). The Rosen tips are useful when working near the oval window with the surgeon's thumb off the thumb port.

Excessive ear packing material after stapes surgery is not necessary. Absorbable gelatin sponge may be placed across the flap incisions to secure the flap in place. Antibiotic ointment may also be placed to hold the flap in place. A piece of cotton suffices as a dressing, unless a postauricular or endaural incision has been made, in which case a mastoid dressing is applied.

For all middle ear procedures, the surgeon should hold the instruments properly. The instrument should rest, like a pencil, between the index finger and thumb, allowing easy rotation around the shank. The fingers and hands should always be anchored on the patient or the OR table. The middle and ring fingers should rest on the speculum so that the hand moves as a unit with the patient. Proper hand position and holding of instruments should afford the surgeon an unimpeded view (Fig. 1-18).

TYMPANOPLASTY WITH MASTOIDECTOMY

The preparation and draping for tympanoplasty with or without mastoidectomy are much the same as for stapes surgery. The major difference is the amount of hair shaved before draping. Usually, enough hair is shaved to expose about 3 to 4 cm of skin behind the postauricular sulcus. The plastic drape is applied to cover the remaining hair (Fig. 1-11).

The patient is positioned on the OR table as described earlier. Whether the procedure is performed under local or general anesthesia depends on the extent of the surgery, the surgeon's preference, and the desire of the patient. After appropriate sedation or induction of the anesthesia, the ear and plastic drape are scrubbed with the proper solution or soap. Some surgeons place a cotton ball in the meatus if a

Figure 1-19 Chronic ear surgery draping for general anesthesia.

perforation exists, preferring not to allow the preparation solution to enter the middle ear. The field is draped as described earlier, the head is rotated toward the contralateral shoulder, and the table is placed in slight Trendelenburg position (Fig. 1-19). The postauricular area, canal, and tragus (if necessary) are injected with 1% lidocaine with 1:100,000 epinephrine for local and general anesthesia cases.

Most chronic ear procedures begin in a similar fashion. Through an ear speculum, vascular strip incisions are made with the sickle or Robinson knife and united along the annulus with the lancet knife. The vascular strip incisions are completed with a No. 64 or 67 Beaver blade. This same blade can be used to transect the anterior canal skin just medial to the bony-cartilaginous junction. The postauricular incision is made with a No. 15 Bard-Parker blade behind the sulcus. The level of the temporalis fascia is identified, and a small self-retaining (Weitlaner) retractor is inserted. The fascia is cleared of areolar tissue and incised. A generous area of fascia is undermined and removed with Metzenbaum scissors. The scrub nurse can assist by using a Senn retractor to elevate skin and soft tissues away from the fascia. The fascia is thinned on the Teflon block and dehydrated by placing it under an incandescent bulb, carefully monitoring

its progress. The fascia may also be dehydrated by placing it on a large piece of Gelfoam and compressing this complex in a fascia press. Figure 1-20 shows the instruments used in the initial stages of chronic ear surgery.

Continued postauricular exposure is obtained by incising along the linea temporalis with a knife or with the electrocautery. A perpendicular incision is made down to the mastoid tip. Soft tissues and periosteum are elevated with a Lempert elevator (Fig. 1-21), the vascular strip is identified, and a large self-retaining retractor is inserted. A very large retractor, such as an Adson cerebellar retractor with sharp prongs, is preferred.

Next, under the microscope, the remaining anterior and inferior canal skin is removed down to the level of the annulus with the large weapon. The plane between the fibrous layer of the drum remnant and the epithelium is developed with a sickle knife, and the skin is pulled free with a cup forceps. The canal skin is placed in saline for later use as a free graft. The ear canal is enlarged with the drill and suction-irrigators. An angled handpiece and medium to

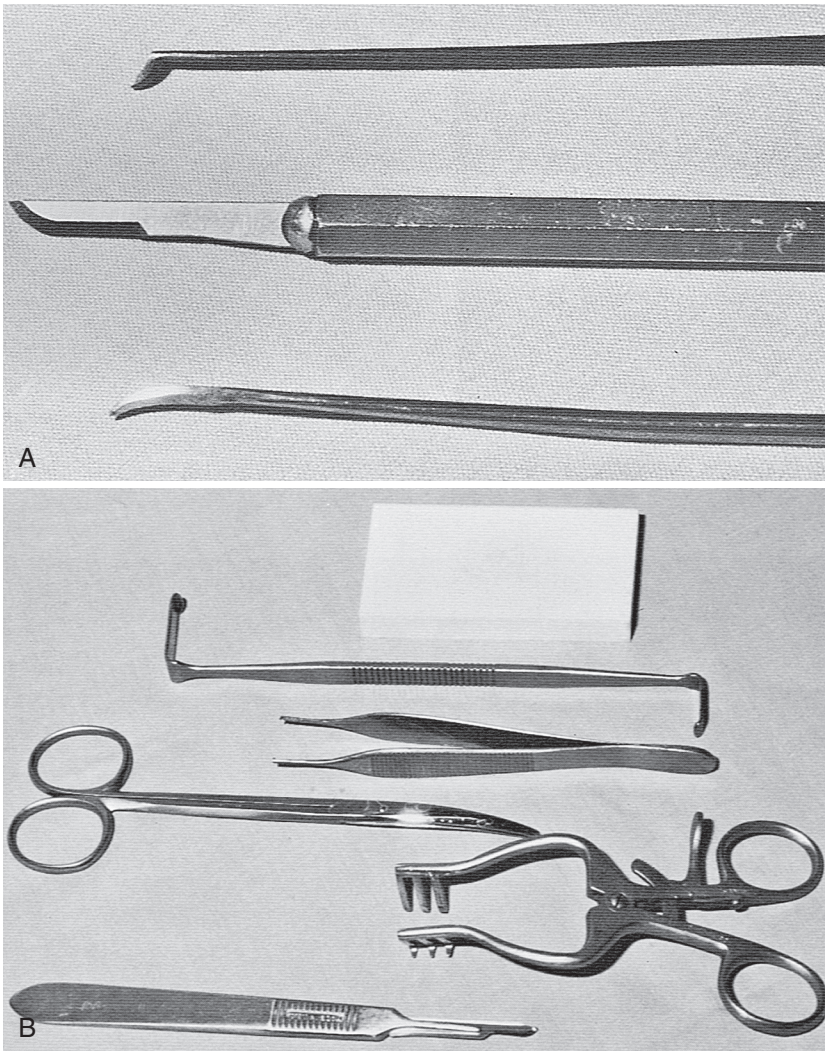

Figure 1-20 **A,** Instruments for making a canal incision. **B,** Instruments for handling fascia.

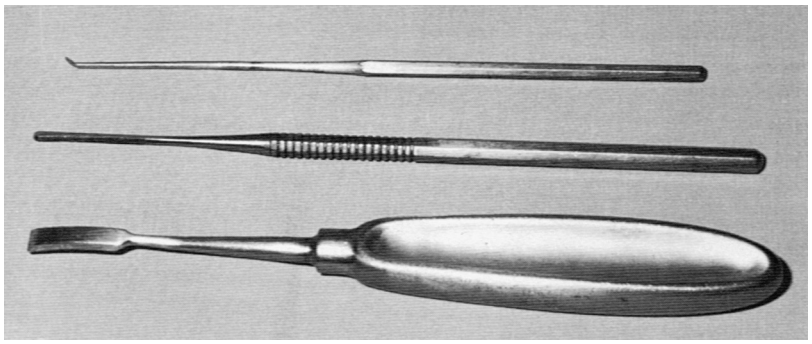

Figure 1-21 Periosteal elevators.

small cutting burr are used. Irrigation through the suction-irrigators is done with a physiologic solution such as Tis-U-Sol, lactated Ringer, or saline. Two large (3000 mL) bags of irrigant are hung and connected by way of a three-way stopcock to the delivery system (Fig. 1-22).

For mastoidectomy surgery, the surgeon must have a full array of cutting and diamond burrs, and a complete set of suction-irrigators. It is advisable to have bone wax and absorbable knitted fabric (Surgicel) readily available. Cholesteatoma removal can be accomplished with middle ear instruments such as the gimmick, weapon, and fine scissors.

Although the setup for closing and packing after chronic ear surgery varies with the specifics of the situation, a few generalities should cover most situations encountered by the otologist. To maintain the middle ear space, silicone elastomer (Silastic) sheeting works well and is readily available. This sheeting comes in various thicknesses, with and without reinforcement. For middle ear packing, absorbable gelatin sponge (Surgifoam) is the usual choice, soaked in saline or an antibiotic otic preparation. Surgifoam is also used to pack the EAC, although some surgeons prefer an antibiotic ointment, as described in the section on stapes surgery. For meatoplasty packing, 1-inch nonadhesive Curity packing strip or nasal packing gauze is saturated with an antibiotic ointment and rolled around the tip of a bayonet forceps; this creates a plug that conforms to the new meatus and is easily removed (Fig. 1-23).

Wound closure is accomplished by closing the periosteal layer and placing deep dermal interrupted absorbable sutures. The skin does not typically require a separate suture closure as Steri-Strips provide adequate approximation for healing. The wound is finally covered with a standard mastoid dressing.

Some additional instruments that prove to be handy in many chronic ear procedures include an ossicles holder, Crabtree dissectors, Zini mirror, right-angle hooks, and the House-Dieter malleus nipper. It is impossible to describe instruments for every conceivable situation, but the foregoing should cover most of the needs of the otologist.

Figure 1-22 Suction irrigation setup.

ENDOSCOPIC MIDDLE EAR SURGERY

Endoscopic tympanoplasty is a novel technique for surgically addressing tympanic membrane perforations, cholesteatomas, and other middle ear issues. The transcanal endoscopic

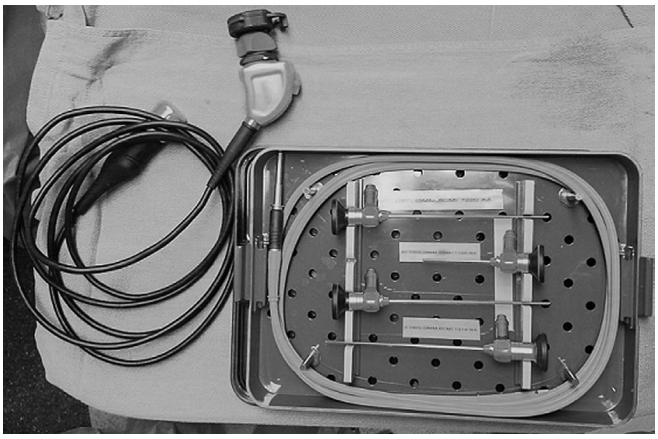

Figure 1-24 Assorted endoscopes for endoscopic-assisted surgery.

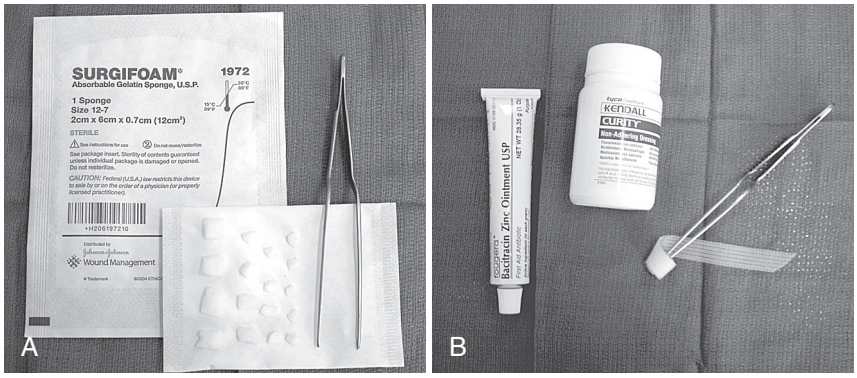

Figure 1-23 **A,** Surgifoam packing. **B,** Meatoplasty packing.

view may afford a wide view of the middle ear, encompassing areas that are not possible to visualize with the traditional operating microscope. Specialized endoscopes (Fig. 1-24) and instrumentation have been developed for the purpose of endoscopic middle ear surgery. Many of the same instruments used in standard otologic tympanoplasty may be used; however, instruments with single and double curvature and microtips have been found to be useful. An endoscopic tower with monitor, camera input, and light source is positioned across the operating table from the surgeon for ergonomic viewing by the surgical team. Apart from these aspects, the patient is positioned in the room as in traditional otologic surgery and is prepared and draped in a similar fashion.

ENDOLYMPHATIC SAC SURGERY

There are many well-described procedures on the endolymphatic sac. The purpose of this chapter is not to outline the surgical options, but rather to discuss the methodology for performing sac surgery. The preparation and draping of the patient for endolymphatic sac surgery are essentially the same as for tympanoplasty with mastoidectomy surgery. In the preoperative holding area, the postauricular area is shaved, exposing at least 4 cm of skin behind the sulcus. Plastic adhesive drapes are applied, and the patient is transported to the OR.

Endolymphatic sac surgery is performed with the patient under general anesthesia. The field is scrubbed in the usual manner, and the patient is positioned as described for chronic ear surgery.

This is a good time to mention briefly the use of intraoperative facial nerve monitoring and other forms of physiologic monitoring, including eighth cranial nerve and cochlear potentials. Many surgeons use facial nerve monitoring whenever the facial nerve might be in jeopardy. Electrodes for facial nerve monitoring or other forms of monitoring should be positioned before the preparation.

After the preparation for endolymphatic sac surgery, the planned incision is injected with 1% lidocaine with 1:100,000 epinephrine. The incision is made 2 to 3 cm behind the sulcus. Periosteal incisions are made sharply or with the electrocautery. A Lempert elevator elevates soft tissues and periosteum up to the level of the spine of Henle. A House narrow (canal) elevator is used to delineate the EAC, and a large self-retaining retractor is inserted. With drill and suction-irrigator, a complete mastoidectomy is performed. The antrum is *not* widely opened, but is instead blocked with a large piece of absorbable gelatin sponge (Gelfoam) to prevent bone debris from entering the middle ear.

Bone over the sigmoid sinus and posterior fossa dura is thinned with diamond burrs. The retrofacial air tract is opened widely to locate the endolymphatic sac. The sac is decompressed with a diamond burr. A stapes curette can be used to remove bone over the proximal sac. The occasional bleeding that occurs over the surface of the sac or surrounding dura is best controlled with bipolar cautery. Alternatively, monopolar cautery at a very low setting can be used. The cautery tip is touched to an insulated Rosen or gimmick that is in contact with the offending vessel (Fig. 1-25). Another method used to control small areas of bleeding in endolymphatic sac and chronic ear surgery is to cover the area with pledgets of Gelfoam that have been soaked in topical thrombin.

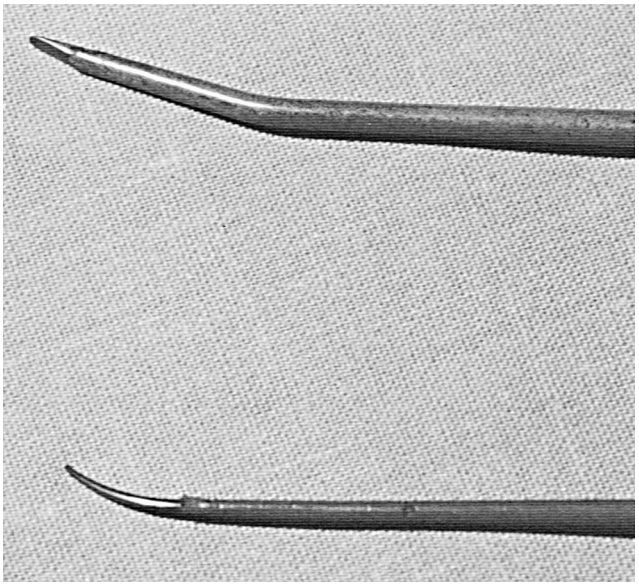

Figure 1-25 Insulated gimmick (*top*) and Rosen (*bottom*).

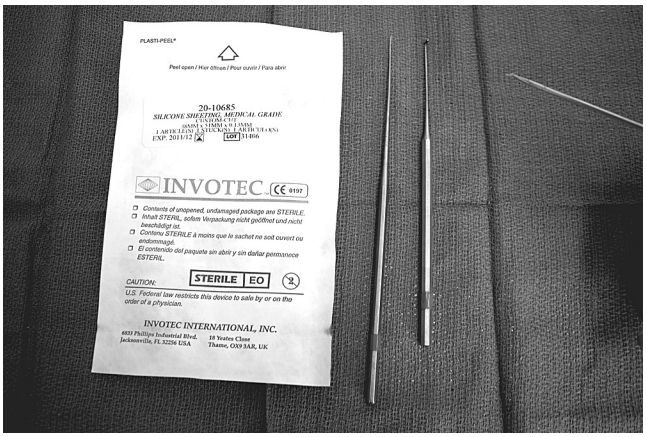

Figure 1-26 Endolymphatic sac instruments and materials.

Before opening the sac, the wound is irrigated copiously with saline or bacitracin solution. Fresh towels are placed around the field. The sac is opened with a disposable Beaver ophthalmic blade (No. 59S, 5910, or 5920). The lumen is probed with a blunt hook or gimmick. The shunt tube preferred by the surgeon is now inserted. Thin Silastic sheeting (0.005 inch) can be used to fashion a shunt. Figure 1-26 shows the materials for the latter steps of endolymphatic sac surgery. As with chronic ear procedures, the wound is closed in layers, usually beginning with 2-0 chromic and finishing with 4-0 Vicryl or Dexon. A standard mastoid dressing is applied. This dressing either is prepared in the OR or is obtained as a prepackaged dressing (e.g., Glasscock dressing).

NEUROTOLOGIC PROCEDURES

This section describes the OR layout for neurotologic procedures, the only exception being middle fossa surgery, which is discussed separately. For procedures involving intracranial structures, extraordinarily meticulous attention to detail is mandatory. The preparation for neurotologic surgery may

Figure 1-27 Drapes (3M 1000) applied for neurotologic surgery.

begin the evening before surgery by having the patient wash his or her hair and scalp with an antiseptic shampoo. The day of surgery, the surgeon sees the patient in the holding area so that the ear to be operated on is positively identified. The surgical site is shaved so that at least 6 cm of postauricular scalp is exposed. An adhesive is applied to the area and the plastic drapes are applied (Fig. 1-27). At the same time, the abdomen is shaved from below the umbilicus to the inguinal ligaments in preparation for harvesting a fat graft from the left lower quadrant. The fat donor site is prepped and surrounded by drapes and covered with a plastic adhesive drape.

After anesthetic induction, a urinary catheter is inserted and arterial and central venous lines are placed when indicated. Electrodes for monitoring CN VII and VIII (and possibly other nerves) are positioned. The patient's head is supported on towels or a "donut" as needed and rotated toward the contralateral shoulder. The surgical sites are scrubbed and then blotted dry with a sterile towel. The areas are draped off with towels and then covered with plastic adhesive drapes (e.g., Steri-Drape, Ioban, Cranial-Incise). Some surgeons prefer to include another layer of towels around the cranial site, followed by either sheets or a disposable split sheet. It is important to have several layers of draping to prevent saturation of the drapes with fluids down to the level of the patient (Fig. 1-28).

Because the scrub nurse must handle numerous items attached to tubes and cords, it is helpful to have a plastic pouch fastened to the field into which the drill, suction, and cautery tips can be placed (Fig. 1-29). Two Mayo stands are kept near the field: one for the neurotologic instruments and the other for the fat-harvesting tools (Fig. 1-30).

The postauricular area is injected with the usual local anesthetic, and the plastic drape is cut away with scissors to expose the mastoid and lateral subocciput. As with other procedures, a skin incision is made, hemostasis is obtained, soft tissues and periosteum are elevated, and a large self-retaining retractor is inserted. Bone removal is accomplished using a drill and suction-irrigation. For neurotologic cases, bone removal is more extensive, exposing the sigmoid sinus and a considerable amount of posterior fossa dura behind the sigmoid. It is imperative that the surgeon has immediate access to bone wax and Surgicel. Many surgeons also insist on having immediate access to hemoclips and thrombin-soaked Gelfoam.

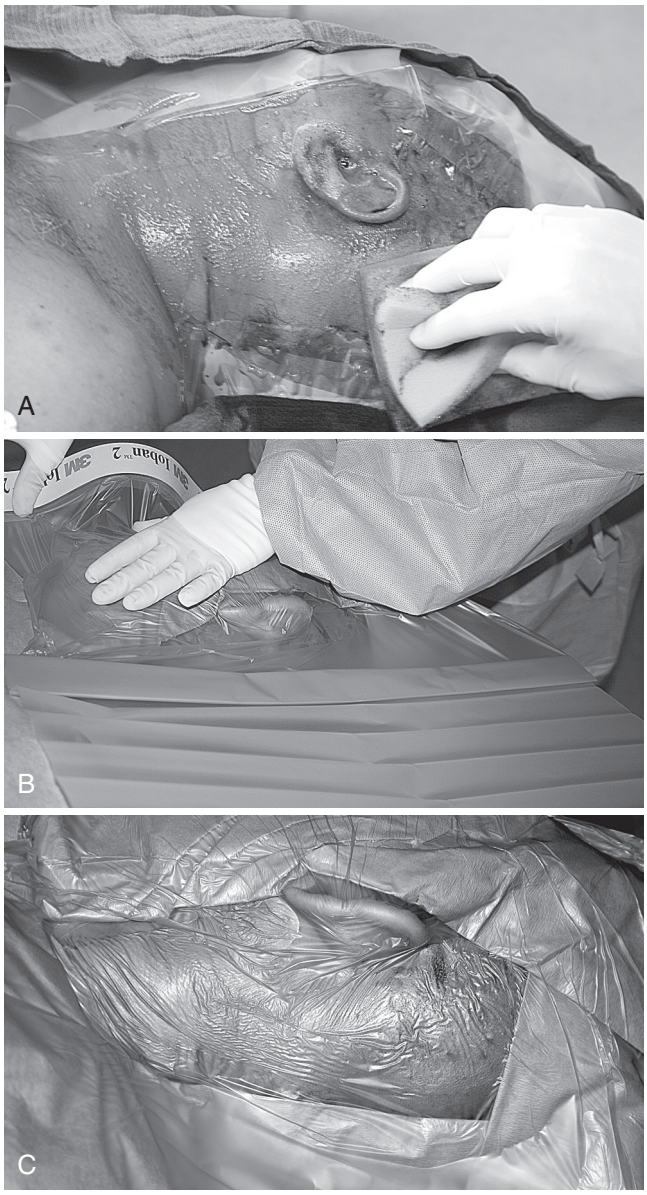

Figure 1-28 **A** to **C,** Draping sequence for neurotologic surgery.

Figure 1-29 SK-100 Surgi-kit for holding instruments.