Section 13 – TYMPANIC MEMBRANE, MIDDLE EAR, AND MASTOID

Chapter 112 – Otitis Media, Myringotomy, and Tympanostomy Tubes

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The middle ear is an air-containing space in which the pressure is equalized to that of the outside atmosphere via the eustachian tube. Most of the pathology occurring in the middle ear and mastoid results from eustachian tube dysfunction. Some of the acute and chronic middle ear disorders can be reversed or prevented by temporary or permanent ventilation via myringotomy, with or without a tube.

Return of normal middle ear aeration is most frequently needed in the pediatric population. Children are predisposed to middle ear problems because of eustachian tube dysfunction with subsequent otitis media with effusion and recurrent acute otitis media. Indications for placement of tympanostomy tubes in children remain highly controversial. Some physicians advocate that pediatric patients with otitis media with effusion be managed with prophylactic or multiple courses of antibiotics or simple observation. Such management is controversial because of the threat of delayed language development during these formative years.

Over a decade ago, guidelines were proposed to provide a management algorithm for otitis media with effusion. Until recently, the indications for myringotomy with or without tube placement for otitis media with effusion were not critically defined. Clinical practice guidelines were developed by a subcommittee of experts from the American Academy of Pediatrics, American Academy of Family Physicians, and American Academy of Otolaryngology–Head and Neck Surgery. They stated that identification of serous otitis media does not require antibiotics or removal of the fluid. Effort needs to be made to distinguish children who are at risk for speech, language, or learning problems and provide appropriate intervention. Those who are not at risk can be observed for 3 months from the date of onset or diagnosis. If hearing loss, language delay, or learning problems are suspected, hearing testing should be conducted. If sequelae are not identified, the children can be re-examined at 3- to 6-month intervals. Once surgery becomes indicated, insertion of a tympanostomy tube is the preferred initial treatment. Adenoidectomy is reserved for patients who require repeat surgery. It was also concluded that antihistamines and decongestants are ineffective for otitis media with effusion. Furthermore, antimicrobials and corticosteroids do not have long-term efficacy and should not be used for routine management.[1]

LASER MYRINGOTOMY

The use of lasers in the practice of medicine has had direct application in otology. Laser myringotomy was proposed as a safe method to ventilate the middle ear. It is not clear whether laser myringotomy is an effective alternative to ventilation tubes. Koopman and associates conducted a randomized trial comparing laser my-ringotomy with ventilation tubes in children who had otitis media with effusion.[2] The mean time until closure of the laser perforation was 2.4 weeks, as opposed to a mean of 4 months with tubes. The success rate was 40% for the laser and 78% for tubes. We have not found laser myringotomy to be of clinical benefit in the treatment of eustachian tube dysfunction, and we have continued the use of myringotomy knives for opening the middle ear to provide ventilation.

Other clinical situations warrant removing fluid from the middle ear space or providing aeration. Factors that influence such treatment include the age of the patient, the nature of the pathology, the likelihood of persistent eustachian tube dysfunction, and the appearance of the tympanic membrane. Whether myringotomy alone or with tube placement is performed is also dictated by the clinical situation. In this chapter some of the more common indications for middle ear aeration or drainage are reviewed.

VACCINATION

The potential role of enhanced immunologic surveillance against the bacteria associated with otitis media raises the question of whether immunizations would decrease the need for myringotomy and tubes. Prevnar is a pneumococcal heptavalent conjugate vaccine that has been approved for use in children younger than 24 months. The prevalence of resistance to oral antibiotics emphasized the need to seek other methods of preventing acute otitis media. A study by Caspary and colleagues revealed that children vaccinated with Prevnar were two times

less likely to have non–*Streptococcus pneumoniae* isolated from the middle ear. Children who were vaccinated were three times as likely to be infected with *Haemophilus influenzae,* but these strains produced β-lactamase less often.[3]

The most common organisms isolated from effusions in the middle ear are *S. pneumoniae* and *Moraxella catarrhalis.* The yield for identification through routine culture techniques is approximately 25%. There is further evidence that otitis media with effusion is associated with persistent bacterial infection in the absence of positive culture.

The development of biofilms is hypothesized to be the reason that otitis media with effusion is recalcitrant to antibiotic treatment. Biofilms are described as a collection of bacteria coated by an extracellular matrix, which may effectively protect the bacteria from penetration by the antibiotic. A recent study investigated whether chronic otitis media is related to biofilms. Biopsy of ear mucosa was performed and fluid aspirated from 26 children undergoing placement of tympanostomy tubes. Using polymerase chain reaction–based diagnostics, at least one otitis media pathogen was positively identified in 24 of 24 effusions. Confocal laser scanning microscope images were obtained from middle ear mucosa biopsy specimens. By using organism-specific probes for the three most common bacteria, mucosal biofilms were visualized on 46 of 50 (92%) of the specimens. This information may change the philosophy on how best to medically manage chronic otitis media.[4]

PATIENT SELECTION

The indications for tympanocentesis, myringotomy, or myringotomy with tube placement are individualized for specific manifestations of eustachian tube dysfunction and middle ear pathology. The choice of procedure and the design of the myringotomy tube are based on the anticipated needs of the patient's middle ear problems. Hearing loss is the primary symptom for which ventilation of the middle ear is needed. Clinical situations can be characterized under the headings of otitis media with effusion (children and adults), acute otitis media, craniofacial abnormalities, barotrauma, otitis media and sepsis, and chronic eustachian tube dysfunction.

Otitis Media with Effusion

Children

Otitis media with effusion is probably the most common and most controversial pathologic condition for which tympanostomy tubes are placed. The immature development of the eustachian tube and the frequency at which children are exposed to pathologic organisms account for the higher incidence of middle ear effusion in this age group.

Parents may notice children pulling at their ear or, if old enough, complaining of ear discomfort. Audiometric and tympanometric screening tests performed in daycare centers and elementary schools have identified young children with hearing impairment and abnormal mobility of the tympanic membrane, respectively. Appropriate referral to a pediatrician or otolaryngologist will determine whether significant tympanic membrane, middle ear, or inner ear disease is present. Examination of the ear frequently reveals a dull, retracted tympanic membrane that is opaque or amber. Pneumatic otoscopy is often the most helpful technique for confirming lack of tympanic membrane mobility. A flat tympanogram also supports the diagnosis. However, we rely primarily on physical examination and rarely find this adjunctive diagnostic test to be necessary. An audiogram is obtained to determine the type and degree of hearing loss (conductive, sensorineural, or mixed).

Otitis media occurs in 40% to 70% of preschool children. However, otitis media with effusion frequently resolves within 3 months with or without the use of systemic antibiotics.[5] There are a few algorithms that are used in the management of otitis media with effusion. An option for medical therapy consists of three courses of antimicrobial therapy given for 10 days at a time, separated by one month. Another method of treatment is long-term, low-dose antibiotic prophylaxis. Children who have bilateral ear disease with significant hearing impairment and in whom medical treatment has failed are candidates for tympanostomy tubes. In a child younger than 6 months, it may be difficult to accurately assess hearing thresholds. Other methods for determining hearing loss include parents' observation of behavioral manifestations of hearing loss, such as sitting close to a television set, requesting higher listening volumes, poor school performance, inattentiveness, or failure to meet milestones for language development. If it is determined that one ear is involved and the contralateral ear is normal and if the hearing loss appears to be minimal, continued observation may be prudent in children younger than 3 years.

Adults

Otitis media with effusion occurs in adults as well as children. Adults with a history of recurrent childhood infections may have borderline eustachian tube dysfunction throughout their adult years. These people may have difficulty achieving middle ear aeration after an airplane flight or, more commonly, after an upper respiratory tract infection. Patients will complain of unilateral or bilateral ear "stuffiness," occasional popping sensations in the ear, and

hearing loss. Examination of the ear reveals a retracted tympanic membrane that may be dull or amber. Pneumatic otoscopy, especially when used with the operating microscope, facilitates identification of fluid in the middle ear. Tuning fork testing may confirm a conductive hearing loss. If a patient complains of new-onset hearing loss that appears to be conductive and one is uncertain whether the middle ear contains fluid, diagnostic myringotomy will provide a diagnosis.

Patients with new-onset unilateral or bilateral serous effusions must undergo a complete examination of the head and neck. To provide comprehensive care, one must determine the cause of the effusion. New-onset unilateral or bilateral serous effusion of the middle ear may be a manifestation of eustachian tube dysfunction resulting from pathology in the nasopharynx. Marked adenoid hypertrophy or a neoplasm in the nasopharynx, such as nasopharyngeal carcinoma or lymphoma, can obstruct the eustachian tube orifice and cause serous effusion. Tumors of the infratemporal fossa and petrous apex may compress the eustachian tube. Fluid in the middle ear may also result from sinonasal allergic rhinitis. In particular, attention is directed to the nasopharynx. If examination with a mirror is inadequate, flexible fiberoptic or rigid nasopharyngoscopy is necessary.

If examination of the tympanic membrane reveals air bubbles within the middle ear space or air-fluid levels, aeration with a Valsalva maneuver or politzerization is attempted. These tests may also be facilitated by vasoconstriction of the nasal mucosa with topical oxymetazoline (Afrin). If the middle ear can readily be ventilated by either of these maneuvers, observation is warranted. Additional medical treatment with oral decongestants, short-term vasoconstrictive nasal sprays, or intranasal steroid sprays should be provided. However, if the patient is unable to ventilate the ear, myringotomy alone is performed. A tube is not necessary for patients seen for the first time with otitis media with effusion. Patients known to have a longstanding history of chronic eustachian tube dysfunction will probably require a tympanostomy tube.

Acute Otitis Media

Acute otitis media is also a disease most common to pediatric patients, although adolescent and adult patients may experience this painful infection as well. Symptoms of hearing loss, unilateral ear pain, and fever are typical of this acute infection. Systemic antibiotics are usually effective in reversing the infectious and inflammatory process. However, symptomatic relief may require 24 to 72 hours. Myringotomy alone provides immediate relief from distention of the tympanic membrane secondary to an abscess in the middle ear space. A tympanostomy tube is not necessary in this clinical situation.

Another manifestation of eustachian tube dysfunction in children is recurrent acute otitis media. This condition generally responds to oral antibiotics with clearing of the subsequent serous effusion. Prophylaxis with daily doses of antibiotics is an alternative strategy for medical management. Tympanostomy tube placement should be considered in patients who experience multiple recurrent infections despite appropriate medical therapy. In addition, if the infections become burdensome to the patient and parents or if the child's academic performance, school attendance, and physical health are repeatedly being compromised, tympanostomy tubes should be advocated.

Acute Otitis Media with Complications

Despite the relatively common occurrence of acute otitis media, complications associated with this infection are rare. Such complications include mastoiditis, meningitis, brain abscess, and facial paralysis. Along with systemic antibiotics, wide myringotomy with tube placement is warranted in this acute setting. This provides middle ear ventilation to facilitate decompression of the pressure and drainage of toxins affecting the facial nerve.

Craniofacial Abnormalities

The eustachian tube is rendered dysfunctional in numerous craniofacial abnormalities. A flattened cranium maintains the orientation of the eustachian tube in a horizontal plane, which may impede normal eustachian tube function. Patients with trisomy 21 abnormalities characteristically have poor tubal function and require myringotomy tubes. Similarly, patients with compromised soft palate function secondary to a cleft palate or tumor resection have a dysfunctional eustachian tube opening that predisposes them to middle ear fluid and disease. Patients with such abnormalities should be screened early in life for compromised eustachian tube function.

Barotrauma

Patients requiring hyperbaric oxygen therapy for disorders other than carbon monoxide intoxication may experience eustachian tube dysfunction. Consultation with an otologist may be requested for patients with pain or hearing loss during hyperbaric oxygen therapy. Typically, these patients have wound-healing problems that require 2 to 3 weeks of treatment. Medical management of their “middle ear squeeze” usually consists of oral and topical decongestants, along with slowing the rate of rise in pressure in the chamber. If pain or hearing loss still persists, tympanostomy tube placement is warranted.

Sepsis and Otitis Media

The ears and sinuses of hospitalized patients who are systemically ill with no obvious cause for their fever are often evaluated as a potential source. Consultation is frequently requested for patients with fluid signal from the middle ear as seen on magnetic resonance imaging (MRI) or computed tomography (CT) of the head and temporal bones. Should an effusion or obvious infection be identified, myringotomy with culture or tympanocentesis may be warranted.

Chronic Eustachian Tube Dysfunction

In patients with a longstanding history of eustachian tube dysfunction, an atrophic, retracted, flaccid tympanic membrane that is hypermobile may develop. Retraction may predispose to the formation of pockets extending posteriorly toward the sinus tympani or superiorly toward the epitympanum. The tympanic membrane may drape over the ossicular chain and create a natural type II or III tympanoplasty (Fig. 112-1).

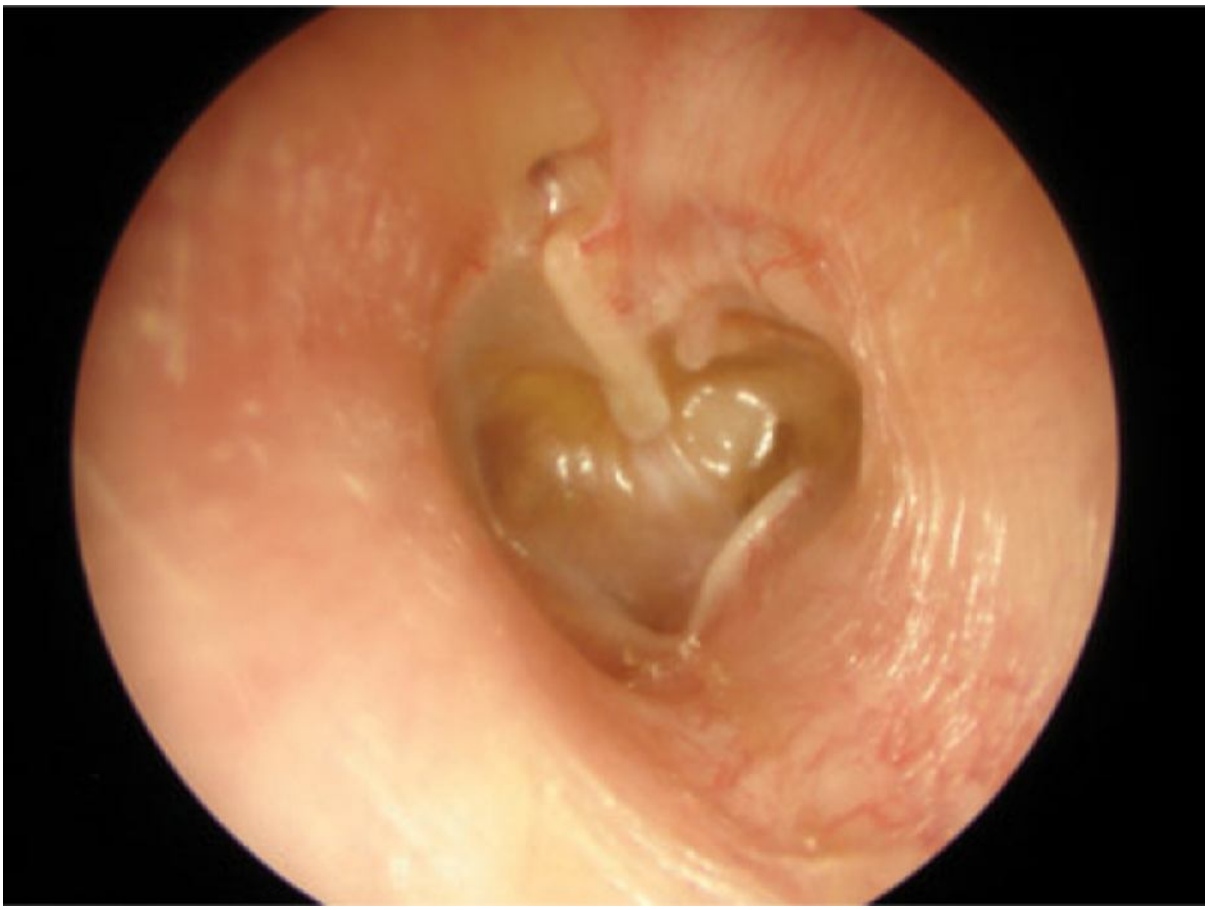

Figure 112-1 Severe atelectasis with a natural type II/III tympanoplasty. Ventilation of the middle ear aims to lateralize the tympanic membrane off the promontory and ossicles.

Further progression of these retraction pockets may promote the formation of cholesteatoma. Placement of a tympanostomy tube will eliminate the negative middle ear pressure and minimize the likelihood of further progression.

PREOPERATIVE PLANNING

Otitis Media with Effusion

The parents of children who are candidates for placement of tympanostomy tubes should be given the chance to review the indications, operative procedure, and postoperative management of tube placement. Unless it is an older, mature child, the procedure is typically performed under general oral anesthesia. Ideally, an audiogram should be obtained before tube placement, but this may not be feasible in a very young child. Patients with recurrent acute otitis media requiring tube placement are managed similarly.

Patients with extremely small external auditory canals may require myringotomy tubes that are not normally stocked. Stenotic canals may permit only a straight tympanostomy tube with a very small inner flange. Should it be

anticipated that a smaller tube is necessary, a call to check on the operating room tube inventory is warranted. Placement of myringotomy tubes in adults is typically performed in the clinic under topical anesthesia. The instruments and technique are described later in this chapter.

Acute Otitis Media

Both pediatric and adult patients will benefit from my-ringotomy when they experience severe pain from acute otitis media. Topical anesthesia applied to an inflamed tympanic membrane may not be effective. An adult, however, is better able than a child to cope with myringotomy. Nursing assistance may be necessary to restrain or wrap the child in a sheet.

Myringotomy is also performed for diagnostic evaluation of otitis media. The predominant indications are a child with persistent acute otitis media in whom antibiotic therapy fails or any person who may be immunocompromised when identification of the organism is important for appropriate management. Myringotomy provides prompt relief of fullness, pressure, pain, and hearing loss in persons with acute otitis media unresponsive to antibiotics. When identification of the organism is critical, a Senturia trap is used for diagnostic tympanocentesis. In clinical situations in which the bacteriology of the middle ear effusion must be known, appropriate planning is necessary. Communication with the patient's physician and microbiology laboratory will expedite handling of the aspirated specimen.

Patients with acute otitis media who experience complications such as facial paralysis, mastoiditis, or meningitis require imaging to detect any other intracranial complications. Along with CT or MRI, neurosurgical consultation is warranted should an intracranial abscess be identified. Administration of intravenous antibiotics with close monitoring in a hospital is necessary. If coalescent mastoiditis is present, mastoidectomy along with a wide myringotomy and tube insertion should be performed.

Choice of Tubes

The tympanostomy tube is placed through an incision in the tympanic membrane to aerate the middle ear. Depending on the nature of the middle ear pathology, short- or long-term ventilation may be needed. Given the patient's findings and previous otologic history, along with the anticipated need, one may then decide how long ventilation will be necessary. The variety of tube designs and material available allows ventilation of the middle ear from a few weeks to indefinitely. Adult patients with new-onset otitis media with effusion who require ventilation should undergo placement of a tube that would remain in place from a few weeks to 3 months. Patients who meet this criterion are those who have persistent serous otitis media despite myringotomy drainage. In addition, patients who have recently undergone otologic surgery and are having problems with aeration may need short-term ventilation while the middle ear and eustachian tube recover. Such ventilation consists of a straight polyethylene tube for which the medial flange has been removed (Fig. 112-2). The tip of the tube is beveled to facilitate insertion.

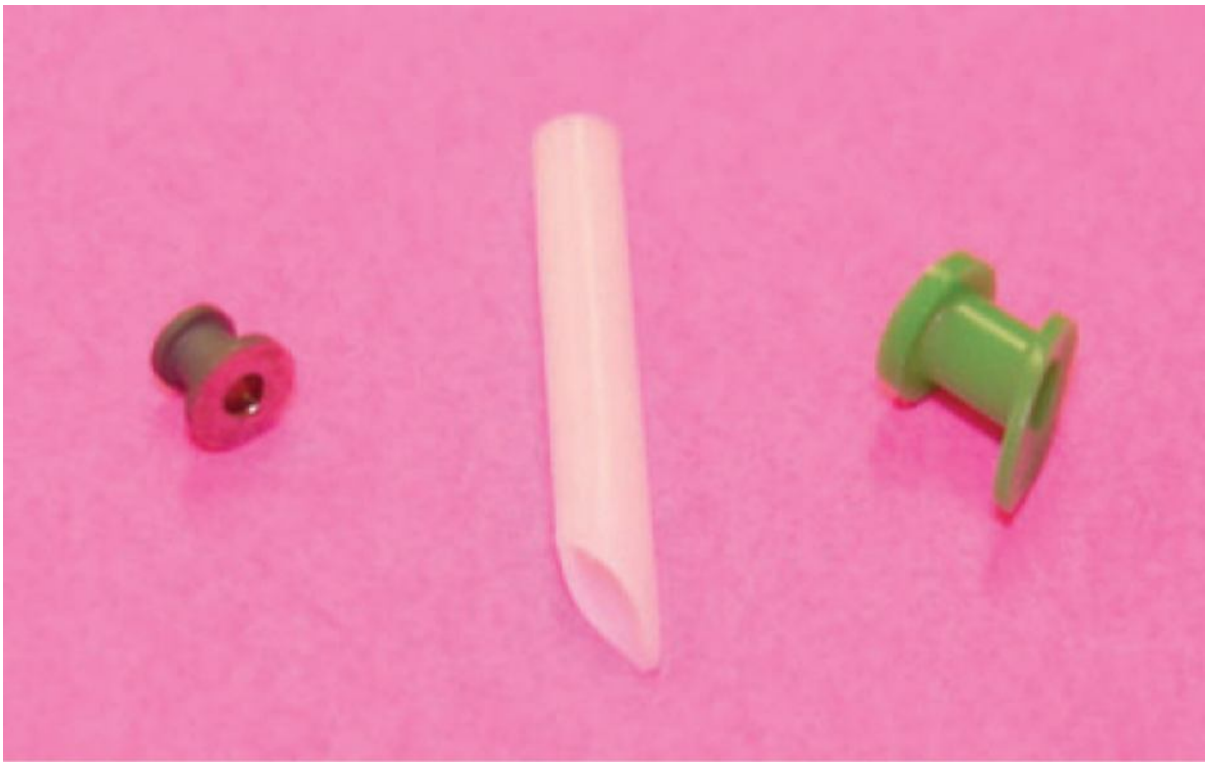

Figure 112-2 Tympanostomy tubes frequently used for middle ear ventilation: *left,* Tytan tube with a 0.76-mm inner diameter (ID) (Medtronics, Inc.); *center,* straight-shank tube (Micromedics); *right,* Armstrong modified beveled grommet, 1.14-mm ID (Medtronics, Inc.).

Tubes with an inner flange remain in the tympanic membrane and middle ear space for a longer time. A Tytan tube provides middle ear ventilation for 4 to 6 months. If more time is needed for additional ventilation, a grommet tube is used. The long-term results of using Armstrong beveled grommet tubes in children were reported by Lindstrom and coauthors. The median and mean times to extrusion were 16.5 and 15.5 months, respectively. The incidence of perforations that did not resolve was 1.32%. Tubes were retained longer than 2 years in 12.2% of the patients.[6] We prefer the design of the Armstrong beveled grommet tube (Fig. 112-2).

Should ventilation of the middle ear be required indefinitely, other tubes are available. A Per-Lee tube has a soft Silastic shaft attached to a large flexible middle ear flange. When placed through the tympanic membrane, this tube will last for many years. The Goode T tube also provides long-term ventilation. Figure 112-3 demonstrates the Per-Lee and Goode T tubes. The physician and patient must be aware that extrusion of the tube may lead to a residual perforation in the tympanic membrane. In the first edition of this text we described the use of a tube composed of hydroxyapatite, which we no longer use.[7]

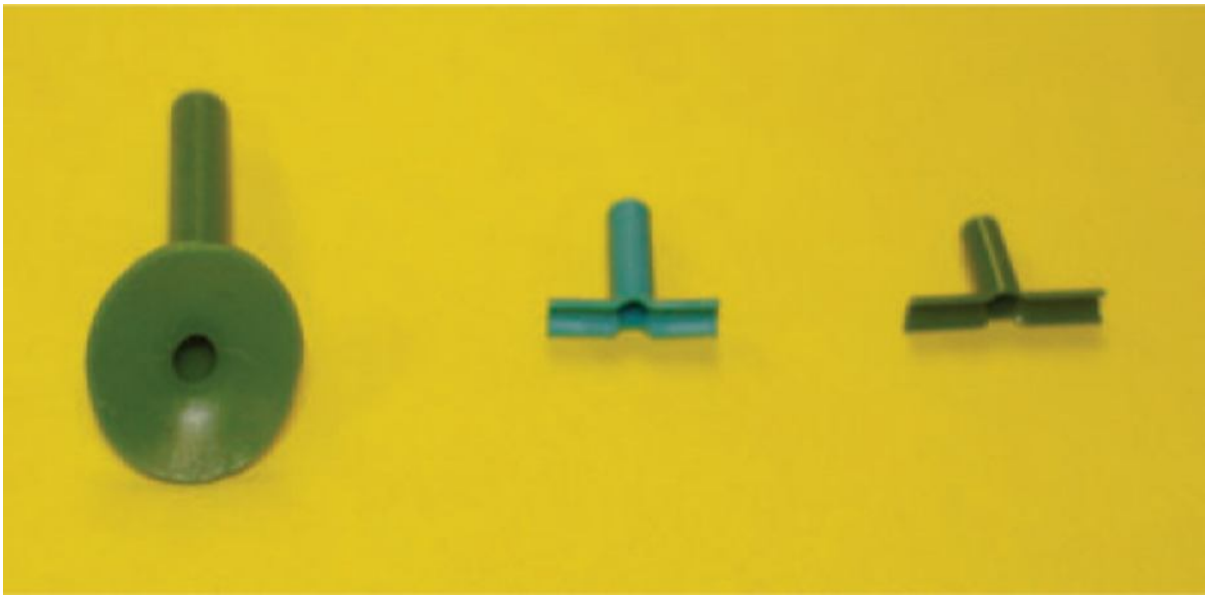

Figure 112-3 Long-term ventilation tubes: *left,* Per-Lee 600 flange angled vent tube, 1.5-mm inner diameter (ID) (Medtronics, Inc.); *center,* Goode T tube, 1.14-mm ID, 6-mm length; *right,* Goode T tube modified, 1.27-mm ID, 4.5-mm length (Medtronics, Inc.).

SURGICAL TECHNIQUE

Tympanocentesis

Tympanocentesis is performed when an infectious agent is believed to be the cause of otitis media. The external auditory meatus is carefully cleaned of cerumen or keratin debris. Concomitant otitis externa with a serous discharge requires further cleaning with a small suction device or a cotton-tipped applicator, or both. If bacterial or fungal colonization in the external meatus is suspected, the canal is flushed with 95% alcohol. Once the canal is suctioned free of this solution and it has dried, tympanocentesis is performed. In a cooperative adult, a small (2 to 3 mm) dot of phenol is applied to the tympanic membrane to provide local anesthesia. Either the posteroinferior or the anterior quadrants are readily accessible for this procedure (Fig. 112-4).

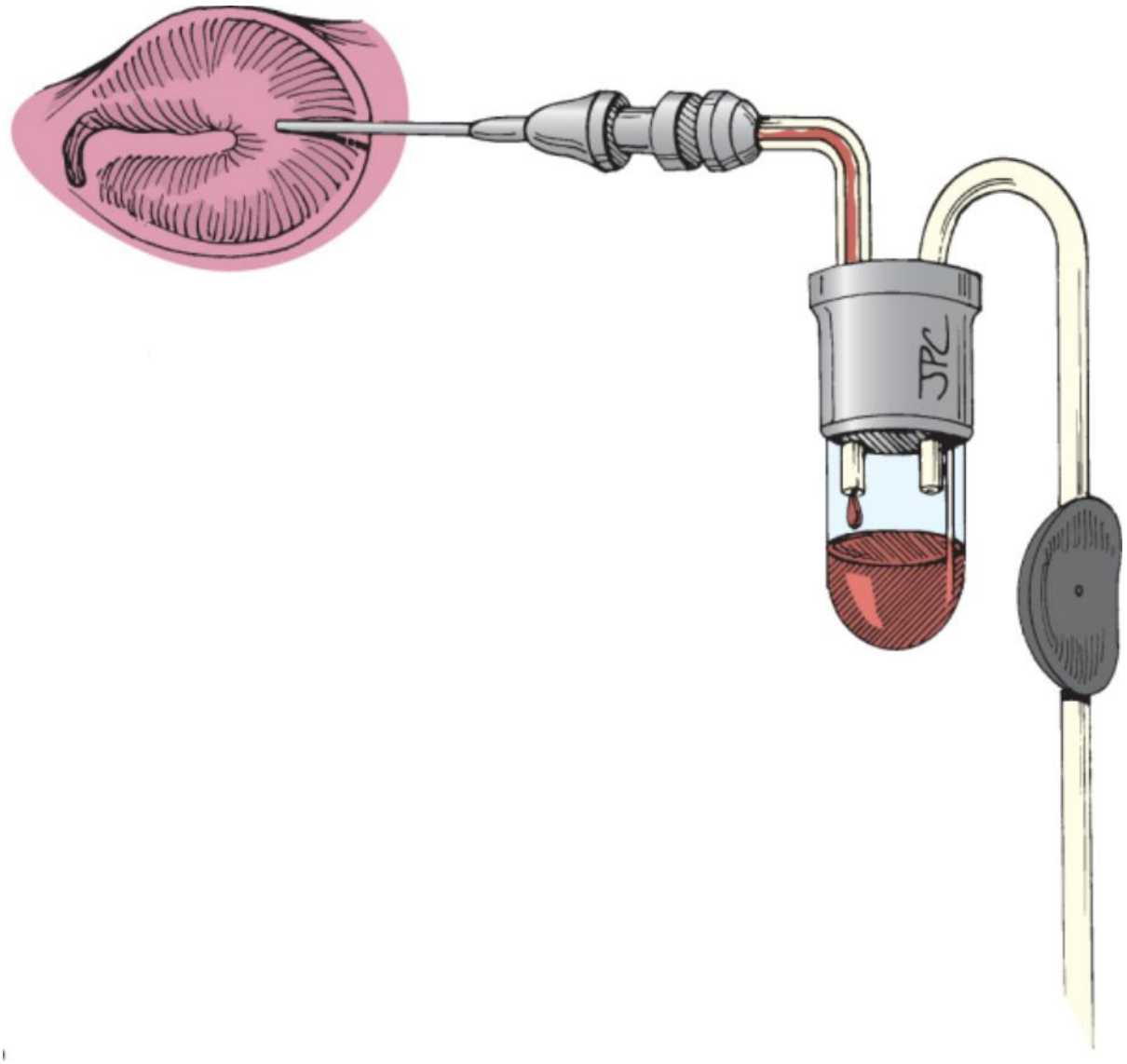

Figure 112-4 Tympanocentesis of the inferior tympanic membrane with a Senturia trap.
(From Bluestone CD: Otologic surgical procedures. In Bluestone CD, Stool SE [eds]: Atlas of Pediatric Otolaryngology. Philadelphia, WB Saunders, 1995, p 31.)

Children

Children warranting ventilation with tubes routinely require general anesthesia for insertion of the tube. Once general oral anesthesia has been induced, the operating microscope is positioned and the ear examined. With an ear loop, small cotton-tipped applicator, suction device, or alligator forceps, the ear is cleaned of cerumen. We prefer to place the myringotomy tube in the anterior or anterosuperior quadrant (Fig. 112-5). These areas retain a tube longer because of the migration pattern of the epithelium of the tympanic membrane. After the myringotomy, a 5F suction device is used to evacuate fluid from the middle ear. Thicker secretions may require suctioning with a 7F suction device. If fluid removal proves difficult, a second my-ringotomy is performed in the posteroinferior quadrant to better ventilate the ear. Once the fluid is evacuated, the size of the myringotomy is noted. If the myringotomy site is inadequate, it can be enlarged with the myringotomy knife. Alligator forceps may also be opened in the myringotomy site to dilate the incision. A grommet tube is typically inserted in children requiring such ventilation (Fig. 112-6). Once a grommet tube is placed, its proper location and orientation are verified. One should avoid placing the myringotomy tube right at the annulus or immediately adjacent to themalleus. The former may result in marginal perforation and the latter in pulsatile tinnitus.

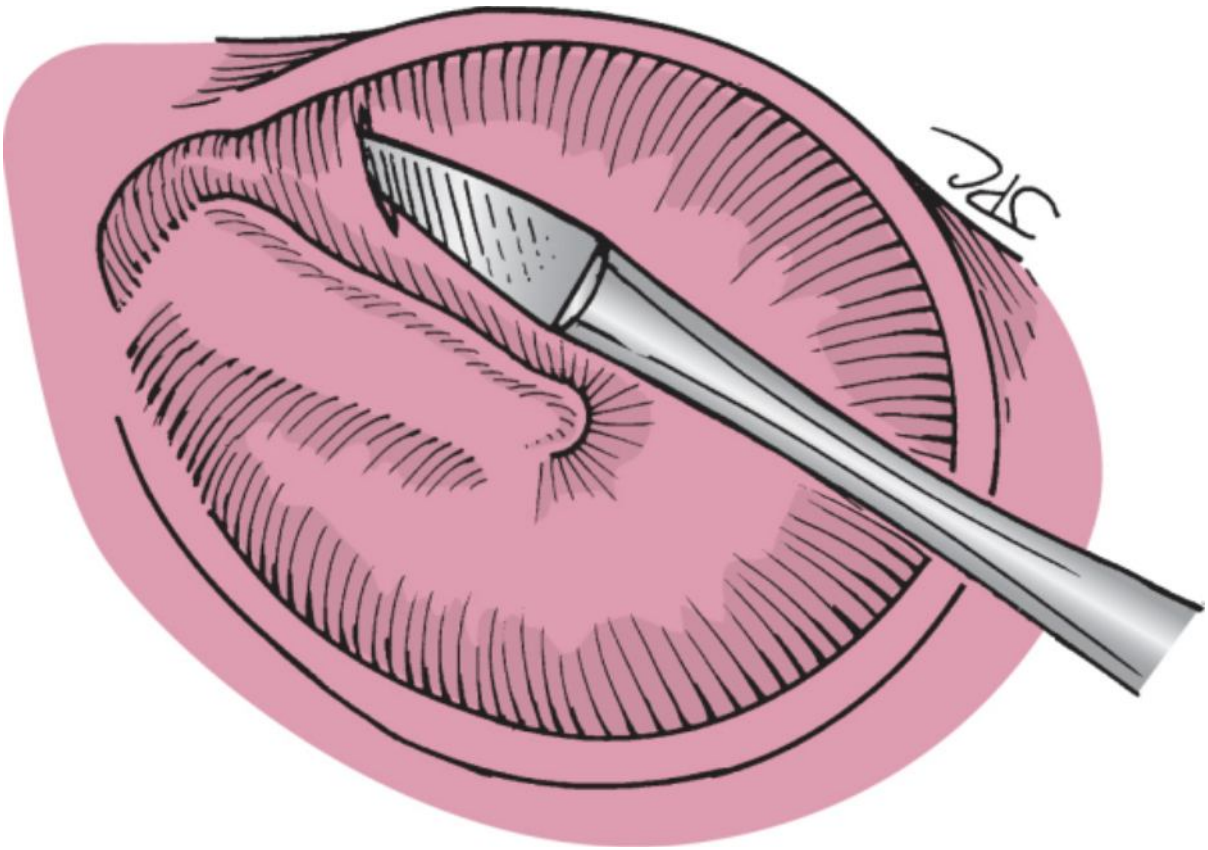

Figure 112-5 Myringotomy is performed in the anterosuperior quadrant.
(From Bluestone CD: Otologic surgical procedures. In Bluestone CD, Stool SE [eds]: Atlas of Pediatric Otolaryngology. Philadelphia, WB Saunders, 1995, p 33.)

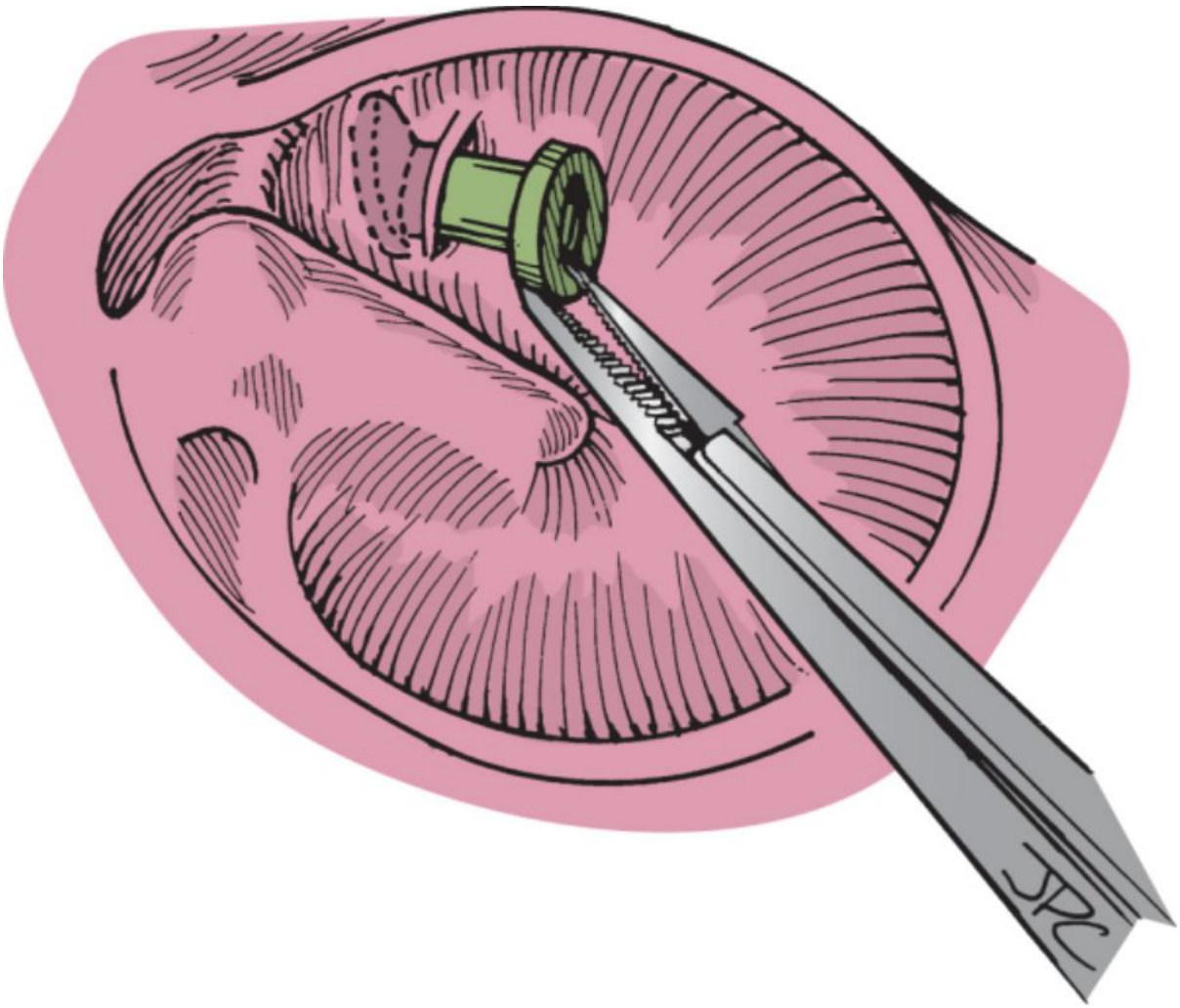

Figure 112-6 An Armstrong beveled grommet tube is placed after aspiration of fluid in the middle ear.
(From Bluestone CD: Otologic surgical procedures. In Bluestone CD, Stool SE [eds]: Atlas of Pediatric Otolaryngology. Philadelphia, WB Saunders, 1995, p 35.)

An antibiotic-steroid drop is instilled into the ear if the middle ear had mucoid fluid, excessive serous fluid, or a purulent collection. In addition, unwarranted bleeding merits the use of drops to minimize the likelihood of tubal obstruction.

Adults

Most teenagers and adults tolerate myringotomy and tube placement under local anesthesia in an office setting. The patient is informed about the indications for tube placement, and the potential risks of inserting and having a myringotomy tube in place are discussed. Operative consent is obtained. The instruments needed for the procedure are prepared. Instruments that should be available include an applicator wrapped with a wisp of cotton, topical phenol, a myringotomy knife, a suction tip, alligator forceps, and a fine micropick to facilitate myringotomy tube positioning should it be necessary (Fig. 112-7).

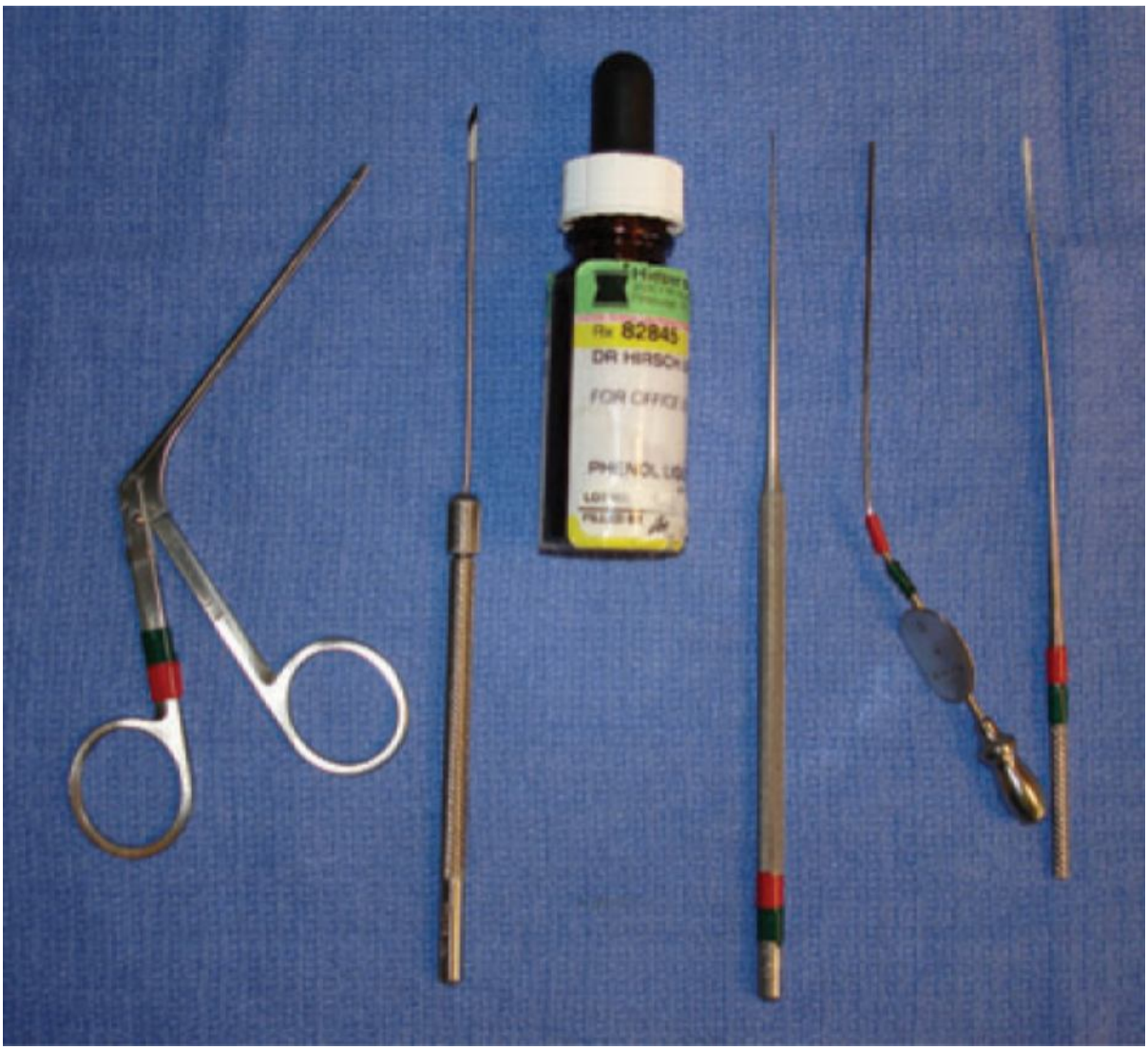

Figure 112-7 Instruments needed for placement of a myringotomy tube in the office
(from left to right): fine alligator forceps, myringotomy knife, phenol, fine micropick, suction tip, and applicator wound with a wisp of cotton.

The ear canal is cleaned under the operating microscope. Ideally, the tube is placed in the anterior aspect of the tympanic membrane. On occasion, because of the prominent convexity of the anterior bony canal wall, access to the anterior tympanic membrane is limited. In this situation a myringotomy tube is placed in the posteroinferior quadrant. Topical anesthetic (phenol applied to a fine cotton-tipped applicator) is placed on the lateral surface of the tympanic membrane. A myringotomy is performed, and fluid is aspirated from the middle ear. The ventilation tube is inserted and optimally positioned.

Topical anesthesia is occasionally insufficient, possibly because of the patient's intolerance to manipulation of the ear or narrowness of the ear canal. After informing the patient, a local anesthetic consisting of 1% lidocaine (Xylocaine) with 1:100,000 epinephrine is infiltrated into the external canal. Topical phenol is also placed to cauterize the drum and minimize bleeding. Patients are advised that the tongue may feel temporarily numb on the side of the injection.

Patients requiring ventilation for an indefinite period are usually taken to the operating room for tube placement under the operating microscope. Our first choice is a T tube, given its relative ease of insertion and lower incidence of tympanic membrane perforation after extrusion. The Per-Lee tube provides indefinite middle ear ventilation. The large flange of a Per-Lee tube is trimmed. Myringotomy is performed in the anterior aspect of the tympanic membrane. The flanges of the Per-Lee tube are folded on themselves with alligator forceps, and the tube is advanced into the middle ear (Fig. 112-8). It is often necessary to use middle ear hooks or picks to facilitate tucking the flanges of the tube medial to the tympanic membrane. In the first edition of this text we mentioned using the Jahn hydroxyapatite tube for long-term ventilation. This tube requires a lengthier procedure for proper placement. It was necessary to elevate an inferior tympanomeatal flap to drill a trough in the bony tympanic ring for placement of the tube in the middle ear. Problems encountered with this tube included the development of

organized occlusion of the lumen of the tube that defied achieving patent communication from the ear canal to the middle ear. In addition, the shaft of the tube became incorporated into the bony tympanic ring, and a surgical drill was required to remove the tube.

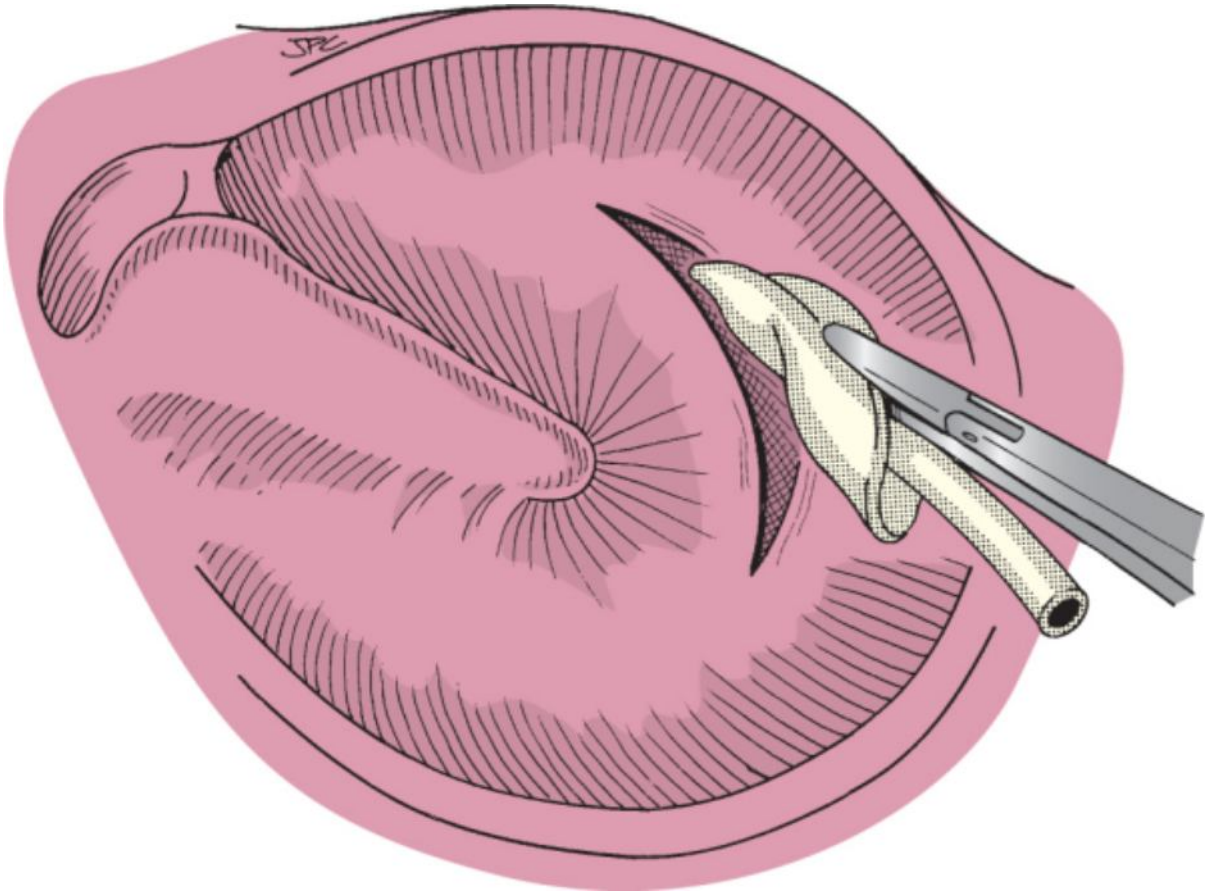

Figure 112-8 The flange of a Per-Lee tube has been trimmed, folded on itself, and grasped with alligator forceps in preparation for insertion. A wide myringotomy has been incised to fit the larger tube.

POSTOPERATIVE MANAGEMENT

Myringotomy and placement of tympanostomy tubes are usually done in the office in adults with serous otitis media. Patients are advised that some drainage may occur. A cotton ball is placed in the external meatus. Once drainage has ceased, patients are instructed to leave the ear open to air.

All patients, including children and adults, are instructed to keep their ears dry. Patients are particularly advised to minimize water exposure while showering or swimming. During showering, a cotton ball with petrolatum (Vaseline) placed on its medial surface is recommended for water protection. We permit swimming with tympanostomy tubes in place. Again, however, precautions are still given to minimize water exposure. We advocate the use of ear plugs for swimming (e.g., silicone putty, a molded ear plug, Doc's Proplugs). The latter has been most effective for protecting the ear during showering and swimming.

Patients undergoing myringotomy tube placement for purulent otitis media, mucoid effusion, or blood coming through the tube from the middle ear are instructed to use topical antibiotic eardrops to minimize the likelihood of tube obstruction from inspissated secretions or dried blood. Parents or patients are advised to use 4 to 5 drops of a quinolone ear preparation twice a day. Children receiving myringotomy tubes are usually checked within a few weeks of placement. The position and patency of the tube are verified. Patients are seen every 4 to 6 months, depending on the ear pathology.

Postoperative tympanostomy tube otorrhea occurs in approximately 20% of untreated children. In a study comparing topical ciprofloxacin/hydrocortisone and neomycin/polymyxin B/hydrocortisone with no treatment, it was noted that there was less otorrhea in the treated ears than in the untreated ears. Given the prophylactic efficacy of drops, it was recommended that the quinolone preparation be used because of its lack of ototoxicity.[8] As a result of the broad spectrum of coverage provided by quinolones, they are the medication of choice when tube otorrhea develops. Other factors that may contribute to otitis media and otorrhea include exposure to other children in daycare and to second-hand smoke.

Persistent drainage despite the use of topical eardrops warrants microscopic evaluation of the ear. Purulent material draining through the myringotomy tube should be cultured for identification of the organism and antibiotic sensitivity. The presence of polypoid tissue implies a foreign body reaction to the tube or keratin debris in or around the tube. Ototopical drops containing steroids are often effective in reversing the pathology, but persistent granulation tissue or polyp formation will probably necessitate biopsy and removal of the tube. CT may be appropriate to evaluate the middle ear for cholesteatoma.

On occasion, granulation tissue may develop around the outer flange of a myringotomy tube and manifest as aural bleeding and localized infection. Management consists of removing the polyp with either a suction device or cup forceps. Liquid silver nitrate is applied with a fine cotton-tipped applicator to cauterize the granulation tissue base. Topical eardrops are prescribed for 1 week.

COMPLICATIONS

Myringotomy or placement of a myringotomy tube is usually straightforward and without complications. However, as with any surgical procedure, problems can occur. One must determine that the observed pathology merits myringotomy or a tube, or both. The indications mentioned include ventilation for retraction pockets, middle ear effusion, aeration for barotrauma, and conductive hearing loss in which the status of the middle ear space is in question. If the tympanic membrane is opaque or does not readily move, diagnostic myringotomy is performed. However, caution must be exercised to not confuse congenital or aberrant blood vessels in the middle ear space with fluid. In particular, a dehiscent high-riding jugular bulb or aberrant carotid artery may look like a blue or salmon effusion. Careful inspection of the tympanic membrane should allow recognition of these unusual findings. Similarly, a glomus tumor may also be confused with acute otitis media with effusion.

During myringotomy and tube insertion, caution must be taken to not traumatize the canal wall. In particular, the anterior bony canal is covered with thin skin that bleeds easily when abraded or lacerated. Should this occur, a cotton wick impregnated with adrenaline is placed in the ear canal for 5 minutes, and topical eardrops are provided for 5 days.

Creating too large a myringotomy may also be a problem. A tube placed in a large perforation may readily fall into the middle ear. If the tube can be removed through the myringotomy site, this effort should be undertaken. Identifying a tube in the middle ear behind an intact tympanic membrane does notmandate removal of the tube (Fig. 112-9). Occasionally, the tube may fall into the hypotympanum and make access difficult unless a large tympanomeatal flap is elevated. If the tube drops out of sight, it is best to not blindly try to retrieve it. The patient or family should be told of the complication and apprised of the rare but potential problems, including chronic otitis media or a sense of the object shifting with head movement. This is unusual and surgical intervention is warranted if patients are symptomatic. Preoperative imaging may be useful in planning the procedure.

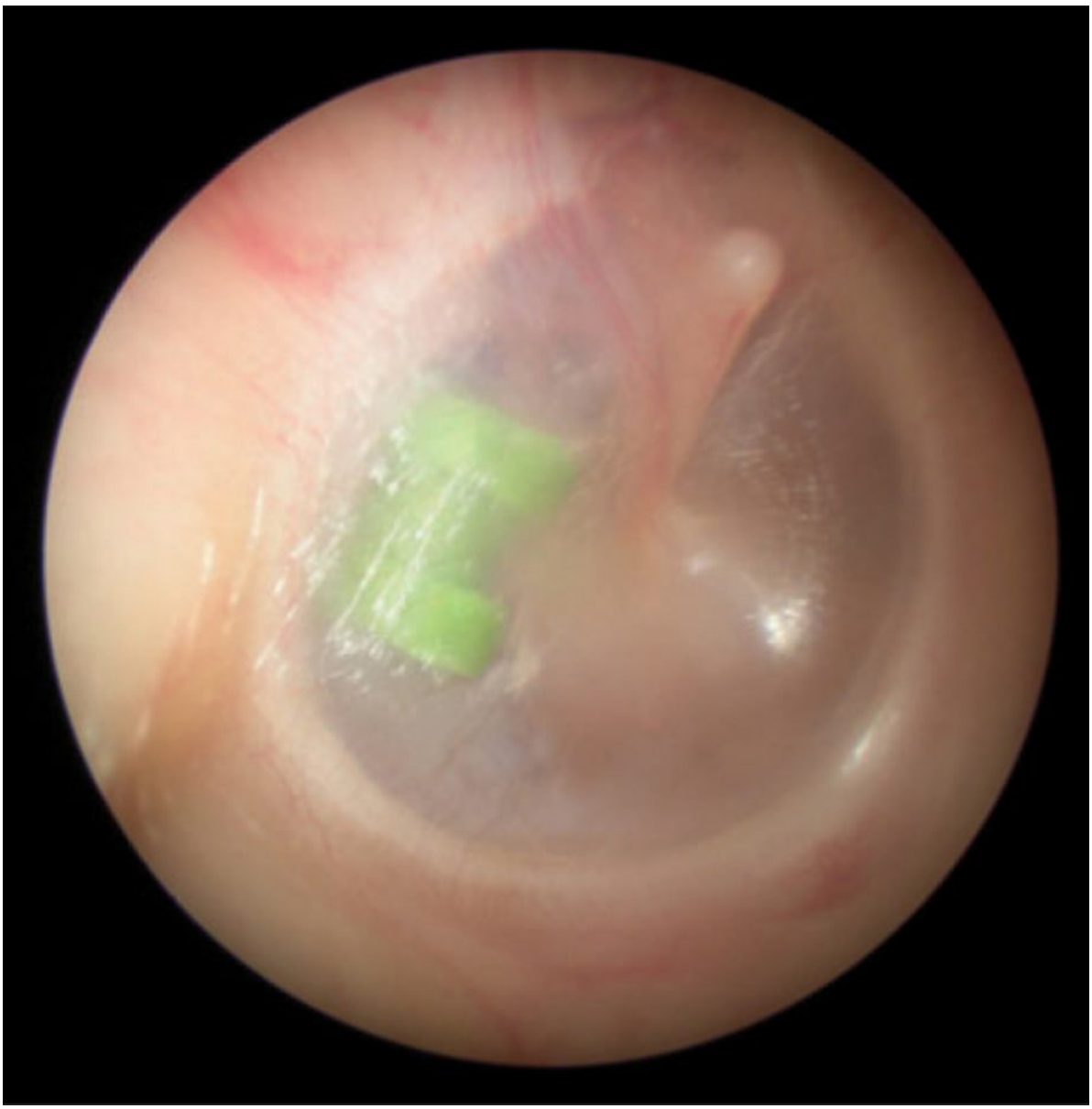

Figure 112-9 Right ear demonstrating a retained myringotomy tube in the middle ear.

A large tympanic membrane defect may also occur when a large suction device for aspiration is applied to a severely atrophic tympanic membrane. There are two options for management. One is to place Gelfoam medial to the perforation and paper-patch the defect. A second myringotomy and tube are then placed in the posterior or posteroinferior quadrant. Another method is to place the tube at a margin of the large perforation and apply a paper patch to the remaining portion of the defect.

In some patients the ear canal is exceedingly small. This often occurs in children with trisomy 21 abnormalities. If the stenotic canal is small, a smaller tube is often necessary. If a beveled grommet tube is preferred, one is available in a smaller size. This smaller tube is preferentially used in children younger than 3 months or, again, in patients with very small ear canals. On rare occasion the canal is so stenotic that only a straight tube can be placed.

Myringotomy tubes should not be placed in the posterosuperior quadrant. Concern for the ossicular chain in this area demands that this quadrant not be violated. A tube with short depth, such as a Tytan tube, may be placed carefully if the ear canal is so narrow that this is the only quadrant visible.

Myringotomy tubes can become plugged. Diligent care is required for patients who are prone to this problem. In particular, patients with hydroxyapatite tubes require meticulous attention. It is for this reason that we no longer use this type of tube design. The diameter of a 3F suction device is sufficiently comparable with that of the tube lumen to permit placement within its lumen. A desiccated mucous plug may often be removed in this fashion. Otherwise, a straight or curved pick can be used to mobilize the plug to facilitate suctioning and extraction. On occasion, the plug can also be pushed into the middle ear space. Patients with mucoid effusions are susceptible to

plugging the lumen of their tube, which may be prevented with the use of topical eardrops containing steroids.

Patients with poor eustachian tube function and a retracted tympanic membrane may undergo myringotomy tube placement to improve ventilation. Sometimes, there is a fibrous union between the incus and stapes. Before myringotomy tube placement, a natural type III tympanoplasty may exist (see Chapter 114), which describes a tympanic membrane directly adherent to the stapes. After placement of the tube, the tympanic membrane may lateralize, thereby causing partial ossicular disarticulation and increasing the air-bone gap. Careful inspection of the incudostapedial area may identify this potential problem. Although rare, patients are advised that hearing may actually deteriorate after tube placement.

Despite the presence of fluid in the middle ear and mild conductive hearing loss, patients may not acknowledge improved hearing after tube placement. Immediately after tube placement, patients may complain of a hollow sound or describe their hearing as though they “are in a barrel.” They are reassured that this is a short-lived problem and that hearing will sound more normal by the next day.

After myringotomy tube extrusion, a perforation in the tympanic membrane may persist. If additional time for middle ear ventilation is necessary, the perforation functions like a myringotomy tube. However, a persistent perforation may need to be repaired with either a paper patch or formal tympanoplasty (see Chapter 113).

Post-tympanostomy tube otorrhea (PTTO) occurring within 2 weeks of placement is considered an early complication. Its reported incidence is between 5% and 49%. Late PTTO occurs greater than 2 weeks postoperatively and is caused by the same mechanism as for acute otitis media and by external contamination. It has been noted to develop in 26% of patients. Chronic PTTO refers to otorrhea lasting longer than 8 weeks and has an incidence of 4%.[1] Some of the factors that may predispose to PTTO include children in an urban setting, lower socioeconomic status, repeated exposure to unrelated children (daycare), and the presence of mucoid or purulent effusions at the time of placement of the tympanostomy tubes. In children older than 3 years, the bacteriology of the drainage mirrors the organisms of acute otitis media: *S. pneumoniae, H. influenza, M. catarrhalis,* and *Streptococcus pyogenes.* The incidence of *Pseudomonas aeruginosa* and *Staphylococcus aureus* is higher in children older than 3 years, and it occurs with even greater frequency in the summer months.[9]

PEARLS

- Myringotomy without a tube may be more appropriate if the compromise in middle ear aeration is only short lived.
- Do not place a myringotomy tube in the posterior superior quadrant to avoid the possibility of injury to the ossicular chain.
- Use a wider-diameter tube and topical steroid eardrops if mucoid fluid is encountered in the middle ear.
- When placing a myringotomy tube in the office setting, have a fine 1-mm right-angled pick available to facilitate positioning of the tube.
- Persistent otorrhea, especially when granulation tissue is present around the tube, may require removal of the myringotomy tube.

PITFALLS

- Application of phenol or placement of a myringotomy tube in an atrophic flaccid portion of the tympanic membrane is more likely to result in residual tympanic membrane perforation.
- Placing a myringotomy tube at the annulus or juxtaposed to the malleus handle may lead to marginal perforation or pulsatile tinnitus, respectively.
- Aggressive aspiration of an atrophic tympanic membrane through the myringotomy site with a large-diameter suction device may result in perforation at another area of the tympanic membrane.
- Re-establishing aeration in an ear with severe retraction, possible erosion of the incus, and a natural type III tympanoplasty may cause greater conductive hearing loss if the tympanic membrane lateralizes away from the stapes.
- Hitting the promontory while placing a myringotomy tube in a severely retracted tympanic membrane can be avoided by placement in the anterior superior quadrant, over the air space of the eustachian tube opening.