



# MEDIAL GRAFT TYMPANOPLASTY: THE 'SWINGING DOOR' TECHNIQUE

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The "swinging door" tympanoplasty is a simplified and easy technique that can be taught to otolaryngology residents. This article describes and illustrates the essential features in this technique, in addition to several modifications.

Over the last 6 years, the author has instructed otolaryngology residents in the principles of tympanoplasty, emphasizing the "swinging door" technique.<sup>1</sup> The swinging door technique is a simplified grafting technique that enables otolaryngology residents to learn the basic principles of tympanoplasty and, more importantly, enables them to have early success in chronic ear surgery. In this technique, the tympanomeatal flap is divided and the annulus split to create two canal-drum skin flaps or "swinging doors." A fascia graft is then placed medial to the anterior tympanic remnant, attached to the malleus handle, and draped onto the posterior canal wall. The swinging door flaps are then rotated onto the fascia graft to secure its position and placement. The purpose of this article is to describe and illustrate this basic grafting technique, to introduce a new modification, and to discuss the benefits of using the swinging door technique in the instruction of otolaryngology residents. The swinging door technique is an easy, adaptable technique that can serve as a basic cornerstone for chronic ear surgery.

## SURGICAL TECHNIQUE

The technique of swinging door tympanoplasty was initially described by Palva et al<sup>2</sup> in 1969; many other medial graft techniques are actually variations on this technique. Palva et al used both the endaural and the postauricular approaches, depending on the location and size of the perforation. They also routinely placed the fascia graft lateral to the malleus handle. The techniques described here are further modifications of their basic technique.

The patient is brought to the operating room, and following the induction of general endotracheal anesthesia, facial nerve monitoring electrodes are placed, the patient is positioned, and the hair is trimmed for the procedure. With respect to the anesthetic technique used, Halothane (Ayerst, New York, NY), Ethrane (Anaquest, Madison, WI), and nitrous oxide are specifically avoided. The anesthesiologist is asked to limit the use of paralytic agents

so that at least two twitches can be appreciated using the "train of four twitch" monitor. With this approach, the facial nerve can be stimulated and responses recorded using the stimulating probe. The patient is positioned, with two considerations: the head should be placed close to the surgeon, because this minimizes arm extension and fatigue during the case; and the head should be turned and positioned so that the plane of the side of the head is as level or flat as possible. This position places the vertical segment of the facial nerve in a level plane, should a mastoidectomy with exposure of the facial nerve be necessary.

After positioning the patient, the postauricular region is injected before preparing and draping the field. Approximately 6 mL of 1:100,000 epinephrine in 1% lidocaine is used. While the nurse or resident is preparing the field using iodophor disinfectant, the surgeon scrubs his or her hands, meanwhile allowing the hemostatic effect of the epinephrine to occur. The surgeon sits and adjusts the height of the operating table and the chair to minimize back strain. The cartilaginous ear canal is progressively dilated until the largest ear speculum (Smith-Nephew-Richards, Memphis, TN) possible (6 to 7 mm) can be placed. The iodophor disinfectant is carefully suctioned from the ear canal, and the tympanic membrane is inspected. Additional injections of lidocaine with epinephrine are made in the ear canal. Ear canal injections should be made in the skin that bulges out when pushing in the speculum, ie, at the bony-cartilaginous junction. By carefully holding pressure with the speculum, the injection solution is forced to extravasate medially to the tympanic membrane. Usually, injections are made in the four quadrants of the ear canal, with the posterosuperior and posteroinferior quadrants being the most important. The tympanic membrane can be seen to blanch with the injections.

The author prefers to make canal incisions before making a postauricular incision, an approach that allows the incisions to be made under direct vision. The canal incisions are designed to create a laterally based canal skin flap that is actually a little larger than the standard vascular strip flap. The horizontal incision is made first using an angled 7200 Beaver blade (Rudolph Beaver, Waltham, MA) so that any bleeding that occurs does not necessarily block the surgeon's vision of the other incisions. The horizontal incision is started above the short process of the malleus, approximately 5 mm lateral to the annulus (Fig 1). The horizontal incision is cut from superior to inferior, cutting to the bone, and attempting to keep the incision 5 mm from the annulus. The incision is

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carried from the 12 o'clock position to the 7 o'clock (on a right ear) position. Vertical incisions are then made, cutting through the soft tissue to the bone, from medial to lateral. The superior vertical incision is cut, first using a straight Beaver blade and the incision extends out to, but not through, the introitus of the ear canal. The inferior vertical incision is cut next and should traverse from the 7-o'clock to the 6-o'clock position. Like the superior incision, the inferior vertical incision should not extend through the introitus of the ear canal. On completing the canal incisions, attention is turned to the postauricular region.

The postauricular incision is made approximately 1 cm behind the postauricular crease, a location that simplifies closure (Fig 2). It is important for the postauricular incision to be cut perpendicular to the skin surface, and to be cut completely through the skin and subdermal layer. After completing the skin incision, the upper portion of the auricle is grasped and retracted laterally. This maneuver allows the surgeon to identify the avascular plane that is lateral to the temporalis fascia. If the surgeon plans to use the pre-areolar tissue that is lateral to the true fascia, it is important to dissect the avascular plane, leaving as much areolar tissue *down* on the temporalis as is possible. This plane of dissection is then carried inferiorly over the mastoid and around the ear canal, a maneuver that requires transection of the postauricular muscles. A self-retaining retractor is placed so as to provide optimal exposure of the temporalis region (Fig 3).

The advantages of obtaining a pre-areolar graft are twofold. Because the pre-areolar layer is avascular, this graft can be obtained rapidly, without the development of nuisance bleeding. Also, taking a pre-areolar graft leaves a readily available true fascia graft, should a revision be necessary. On the other hand, a true fascia graft is a little thicker and is easier for the resident surgeon to use and position. Before harvesting a fascia graft, the tissue plane is injected with the lidocaine-epinephrine solution. The inferior portion of the graft is first incised with the scalpel, and then the graft is dissected from the deep tissue plane using either the Freer elevator (Weck, Research Triangle Park, NC) or the blunt Metzbaum scissors (Codman Shurtless, Inc, Randolph, MA). A large graft is obtained and placed on a ceramic block under lights to dry. Any residual muscle should be carefully removed as the graft is spread out to its full extent.

Next, the periosteum is incised in a T-shaped fashion. The first incision is made superior to the ear canal and is carried horizontally from anterior to posterior below the temporalis muscle. A vessel located anteriorly, the superficial temporal artery, is often transected in this maneuver, and care should be taken to control and cauterize this vessel in this circumstance. A vertical incision is made from the midpoint of the horizontal incision to the tip of the mastoid. The periosteum is then elevated using a periosteal elevator, first posteriorly, then superiorly, and then anteriorly. On elevating the anterior periosteum overlying the mastoid into the ear canal, care is taken to avoid tearing the canal skin flap. Recently, the author has elevated this canal skin using a Freer elevator under microscopic vision. After elevating the skin flap of the ear canal, a self-retaining retractor is placed to retract the canal skin flap and the ear forward. A second retractor is placed to provide exposure in the superoinferior direction. Any blood in the ear canal is then suctioned and hemostasis is obtained.

Hemostasis is obtained using the bipolar cautery, and attention is turned to the ear canal. A tympanomeatal

flap is elevated using either a duckbill-shaped elevator or a round knife with a small-gauge (no. 3 French) Barron suction (Baxter Healthcare, Deerfield, IL). After elevating the canal skin and the fibrous annulus, the mesotympanum is entered. The tympanomeatal flap, the fibrous annulus, and the tympanic membrane are then cut in a vertical direction to create the swinging door flaps (Fig 4). The flaps are usually cut at the 9-o'clock position, through the tympanomeatal flap, and into the perforation. The location of this cut and the size of the two flaps can be modified depending on the pathology at hand. For instance, in the presence of a primary acquired cholesteatoma, the superior-based flap is interrupted by the defect in the superior canal wall. In this circumstance, the author prefers to make a large, inferior-based canal skin flap and to make a very small superior flap that is based anterior to the canal defect. Additional canal incisions are made so that the flaps can be rotated to the level of the anterior tympanic remnant. The flaps are elevated from the malleus hand as necessary (Fig 5).

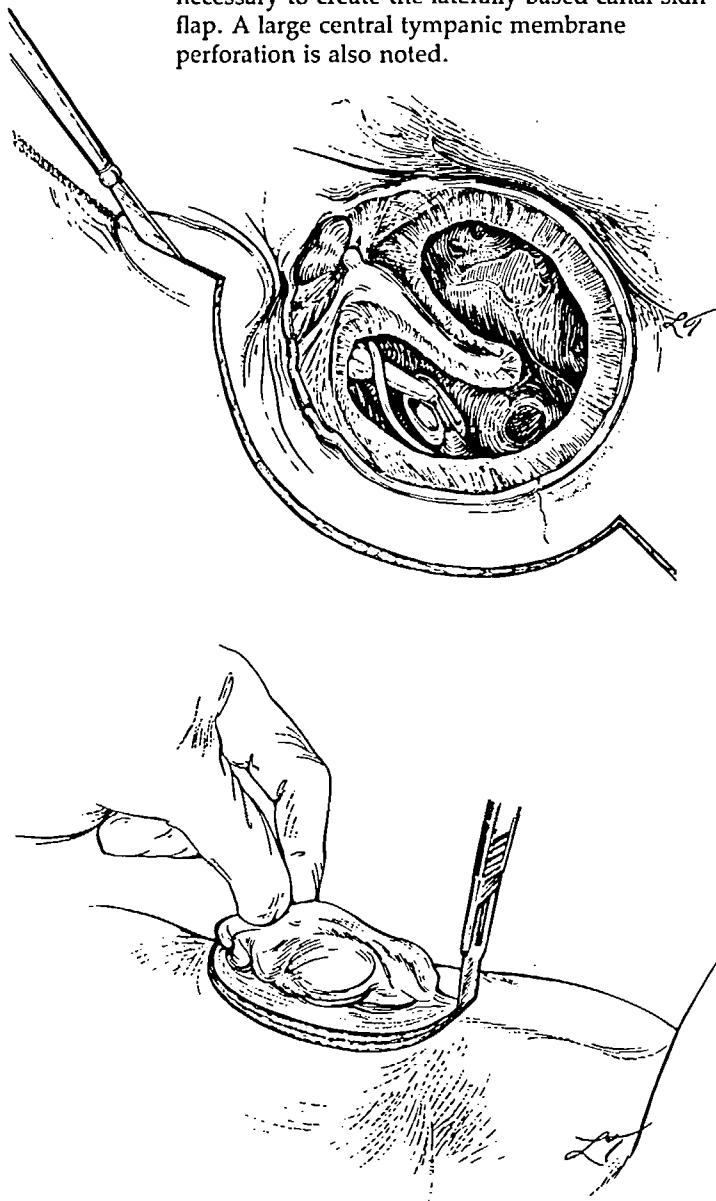
After both flaps have been elevated, attention is turned to the margin of the perforation. Because the squamous epithelium tends to grow medially over the edge of the perforation, the margin of the perforation needs to be resected. This resection is performed with the spring-handled ear microscissors (Storz, St. Louis, MO). The undersurface of the tympanic membrane is then inspected to be certain that there has been no extension of the squamous epithelium. The undersurface of the anterior tympanic remnant is gently abraded using a blunt instrument.

The middle ear is inspected and any pathosis is handled. The middle ear is gently irrigated with cool saline to remove debris and to encourage hemostasis. The eustachian tube and middle ear are then packed with Gelfoam (Upjohn Co, Kalamazoo, MI) (lightly coated with epinephrine). The middle ear is packed so that the lateral surface of the malleus handle is clearly visible. The eustachian tube is tightly packed to support the placement of the fascia graft against the anterior tympanic remnant. After placement of the Gelfoam, any excess blood or fluid can be removed using small 3F Barron suction and a small wisp of cotton held by a microcup forceps. When the bleeding has *stopped*, the tympanic membrane is grafted.

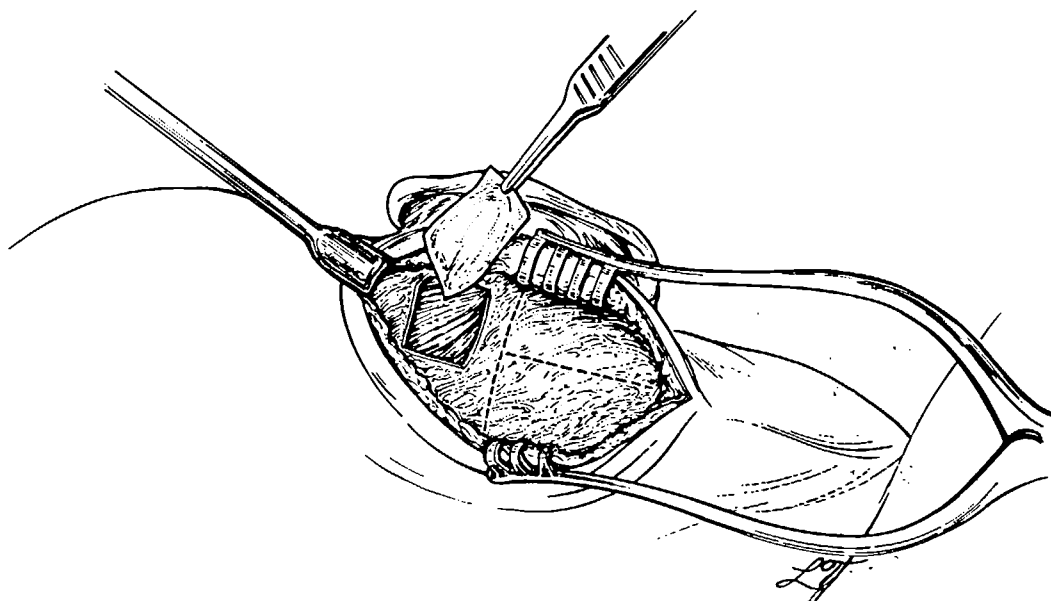
The fascia graft is cut so that frayed edges are removed, and shaped so that the anterior aspect can be securely placed under the anterior tympanic remnant. This shape is often referred to as a wedge or bullet shape. The narrow (anterior) aspect of the graft is grasped with a microcup forceps and is rehydrated for 1 to 2 seconds, depending on the thickness of the graft. The anterior aspect of the graft is then placed as close to the anterior tympanic remnant as is possible. A blunt instrument (House annulus dissector, Storz, St. Louis, MO) holds the graft in place as the cups release the graft. Using the House annulus dissector and a small (22-gauge) microsuction, the graft is carefully unfurled and placed under the anterior tympanic remnant (Fig 6). The fascia graft is draped onto the lateral surface of the malleus handle and then onto the posterior canal wall. Specific attention is given to the spot where the graft transitions from being an underlay graft to an overlay graft. The graft is then carefully spread out over the posterior canal wall.

In a previous report,<sup>1</sup> the author described the use of multiple grafts in tympanoplasty. In some cases, the surgeon might be satisfied with the placement of the graft except for a single small area. The author, in these circumstances, places a small piece of fascia over the defi-

**FIGURE 1.** Illustration shows the incisions necessary to create the laterally based canal skin flap. A large central tympanic membrane perforation is also noted.



**FIGURE 2.** The postauricular incision is made 1 cm behind the crease.

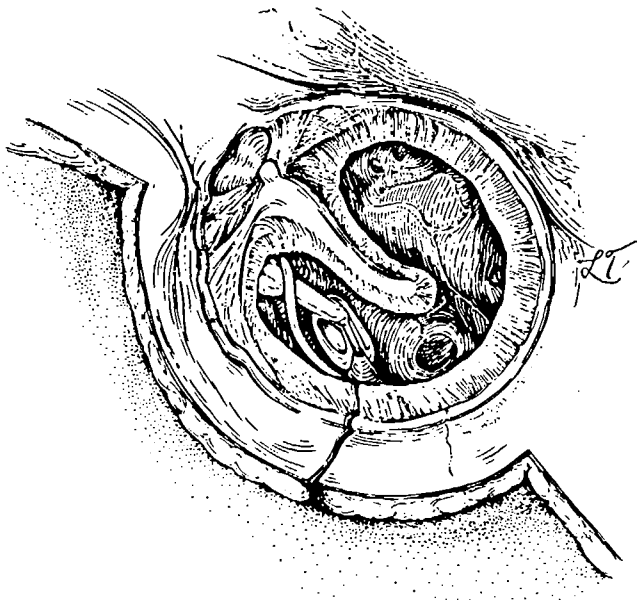


**FIGURE 3.** After retracting the auricle anteriorly, a large fascia graft is obtained. Note the location of the periosteal incisions.

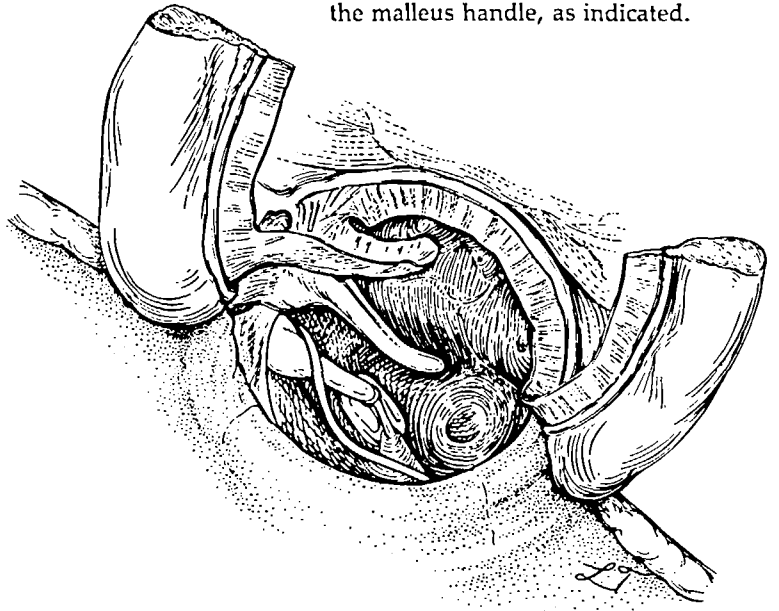
cient area, ie, a second graft (Fig 7). In total perforations, the author routinely uses multiple grafts. In this case, a small fascia graft is first placed anteriorly and is tucked under the bony annulus (Fig 8). This maneuver creates, in effect, a new anterior tympanic remnant or annulus. A second graft is then positioned in the fashion described in the previous paragraph. This modification converts a difficult grafting situation into a more manageable one.

After placement of the graft, the swinging door flaps are rotated over the graft (Fig 9). The swinging door flaps should cover the area where the graft transitions from being an underlay to an overlay graft. In addition, the swinging door flaps can be advanced anteriorly, allowing coverage of an area where the fascia graft may be deficient. Anterior advancement of the swinging door flaps, in essence, covers the middle ear with a fascia layer and a skin flap layer. After placement of the swinging door flaps, it is important to inspect them carefully to be certain that the squamous layer has not become inverted or rolled inward. The flaps and the newly grafted tissue are then covered with Gelfoam coated with Cortisporin suspension (Burroughs Wellcome, Research Triangle Park, NC). The ear canal is filled with the Gelfoam, leaving a space posteriorly for the replacement of the laterally based canal skin flap.

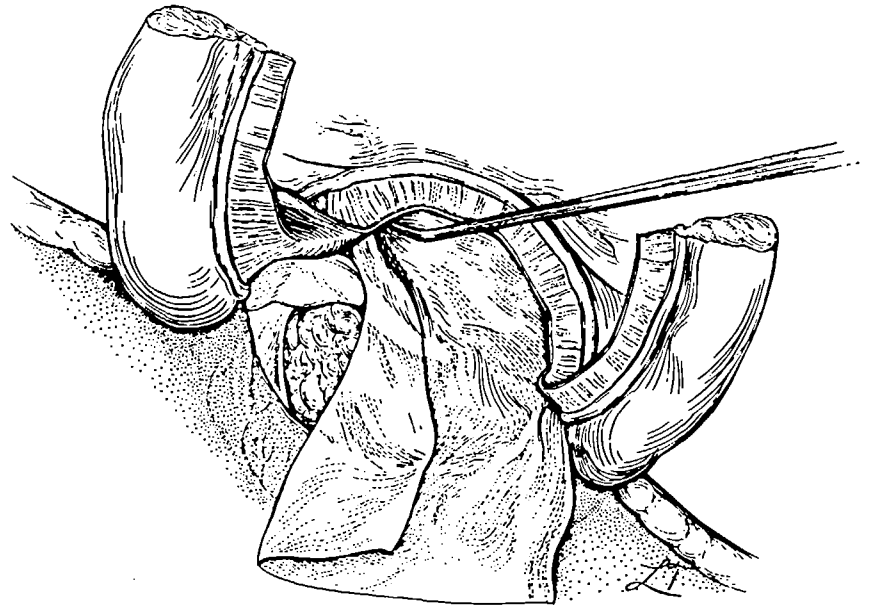
The laterally based canal skin flap is extended and replaced into the ear canal using the microcup forceps (Fig 10). It is important to verify that this flap has been correctly placed in the ear canal, and if a question arises, the location of the flap can be verified by inspecting it through the ear canal. The surgeon should avoid suctioning any blood in the ear canal, lest the graft be inadvertently suctioned also. After placement of the canal skin flap, the periosteal layer should be sutured into its proper location using an absorbable suture such as 3-0 Vicryl (Ethicon, Somerville, NJ). The periosteal closure does not have to be watertight, but it should provide hemostasis. The skin layer is closed in a single layer using a running absorbable suture to closely approximate the subcutaneous layer. Skin sutures are not used in this technique. The remainder of the ear canal is filled with additional Gelfoam. A cotton ball is placed in the ear canal, and a Glasscock dressing (Oto-Med, Inc, Lake Havasu, AZ) is applied after removing the facial nerve monitoring electrodes.



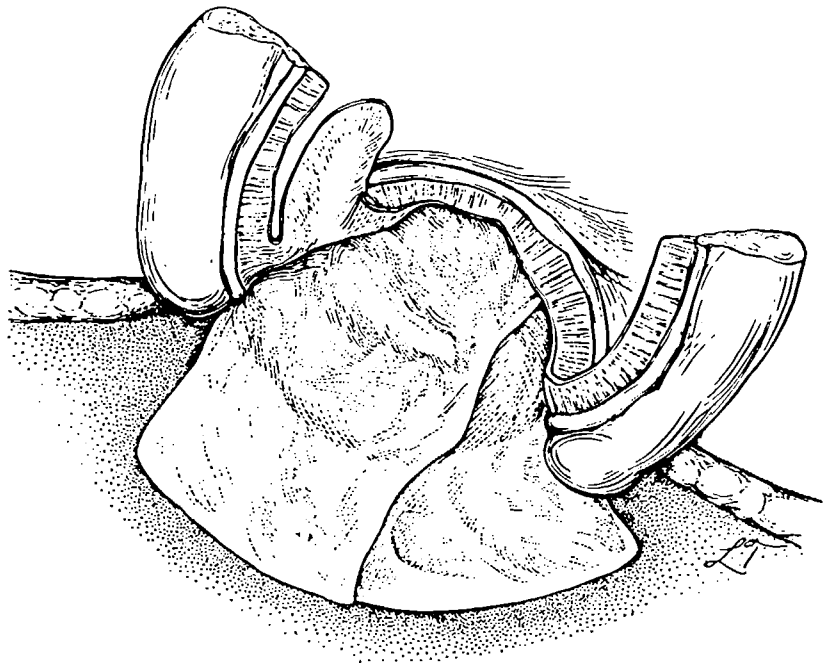
**FIGURE 4.** After elevating the tympanomeatal flap, the skin, annulus, and drum are divided using the microscissors.



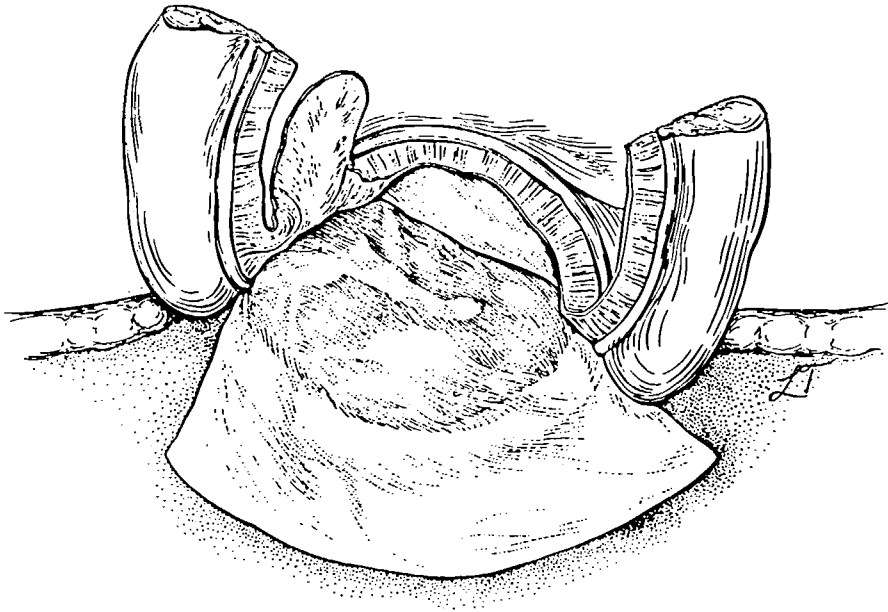
**FIGURE 5.** The swinging door flaps are elevated and the drum is elevated from the malleus handle, as indicated.



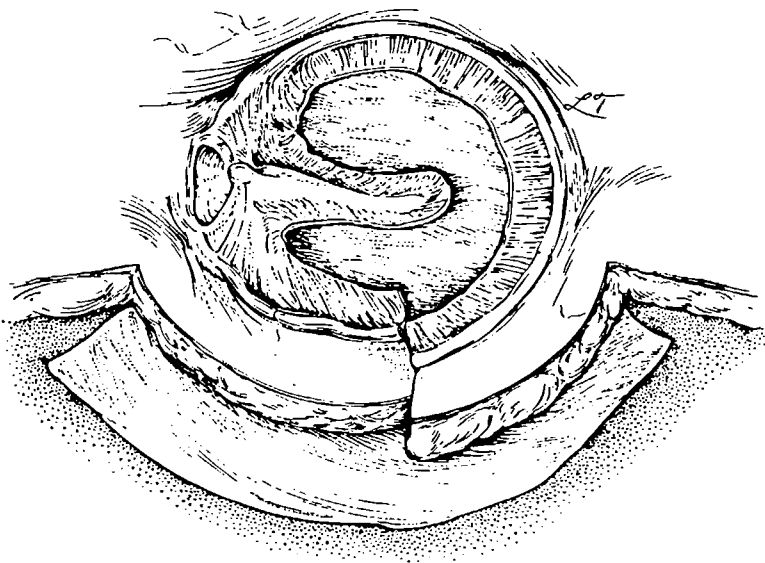
**FIGURE 6.** The fascia graft is placed medial to the anterior tympanic remnant. It is unfurled using a blunt instrument. Note the graft is placed lateral to the malleus handle and onto the posterior canal wall.



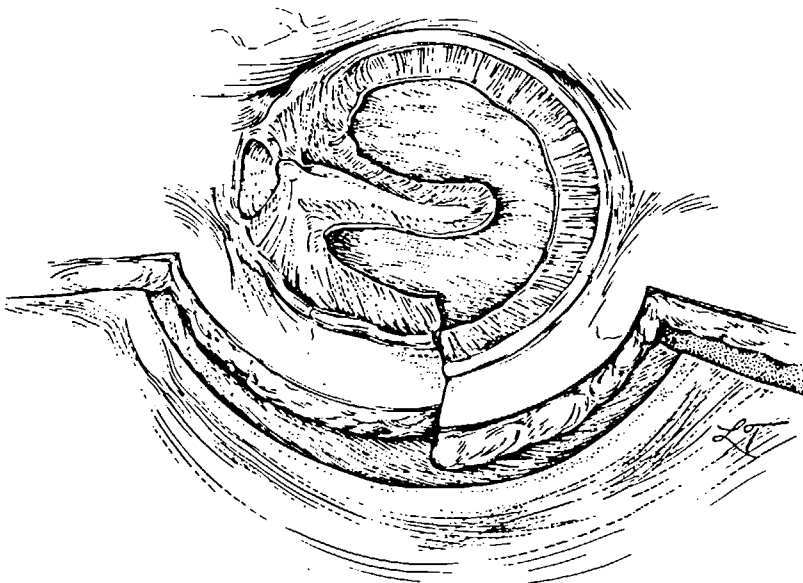
**FIGURE 7.** This figure depicts multiple graft placements to cover the middle ear.



**FIGURE 8.** This figure depicts the use of multiple grafts to repair a total tympanic membrane perforation.



**FIGURE 9.** The swinging door flaps are rotated to cover the fascia graft. The flaps can be advanced as necessary to cover deficient areas.



**FIGURE 10.** The laterally based canal skin flap is returned to its normal position. (Ordinarily, Gelfoam would cover the middle ear and swinging door flaps, but these are left out for visual reference.)

## POSTOPERATIVE CARE

The patient is taken to the recovery room and is observed until awake and alert. In most cases, tympanoplasty without mastoidectomy is performed as an outpatient procedure. It is very important for the surgeon or the outpatient surgical nurse to review the postoperative instruction, which, at the author's institution, are pre-printed. These instructions include the removal of the dressing the next morning, the coverage of the incision with Band-Aids, and the placement of a cottonball in the ear canal. The patient is instructed to avoid blowing the nose and to keep the ear dry. In addition, Cortisporin suspension is instilled into the ear each time the cotton is changed. Prophylactic antibiotics, ear drops, and analgesics are routinely prescribed in tympanoplasty cases.

The patient is evaluated, the incision inspected, and the ear canal gently cleaned after 2 weeks. The gelatin is removed if it is liquefied and easy to suction. Otherwise, the patient is instructed to continue instilling drops for 2 to 3 more weeks. Showering and water sports can usually be safely resumed after 3 to 4 weeks in small- to medium-sized perforations. In near-total or total perforations, a longer period might be needed to be certain that the epithelial layer of the new tympanic membrane has regrown. In either case, the author prefers to inspect the ear to be certain that it is reepithelialized before releasing the patient to resume these activities. An audiogram is usually obtained at this time also.

## A NEW MODIFICATION

In a prior report,<sup>1</sup> the author described several modifications of the basic swinging door technique, including multiple grafts, anterior advancement of the swinging door flaps, cartilage grafting, and techniques for attaching the graft to the malleus handle. This new technical modification specifically deals with the problem of absent canal wall skin on the anterior canal wall (Fig 11). This circumstance occurs in two situations: during revision cases for a blunted lateral graft, and following the removal of extensive myringitis granulosa, or medial third external otitis. During revision surgery of a lateralized graft, the author prefers to use the blunted drum to reline the anterior canal wall. Despite this maneuver, the anterior bony canal lateral to the bony annulus still remains denuded. The same thing occurs following resection of myringitis on the anterior canal.

To deal with this problem, the author prefers to first enlarge the bony canal using a drill and both cutting and diamond burs. To prevent injury to a flap, the metallic foil of a suture pack is cut and fashioned into a retractor. After enlarging the canal, the middle ear and eustachian tube are packed with Gelfoam as described earlier. A fascia graft is first tucked under the bony annulus and draped out over the middle ear (Fig 12). A second, smaller fascia graft is placed over the anterior canal bone, and the anterior canal flap is draped down over it (Fig 13). This second graft can extend down onto the medially placed fascia graft. The remainder of the middle ear and the posterior canal wall are then grafted with an additional piece of fascia. At this point, before placement of the Gelfoam in the ear canal, the newly grafted tympanic membrane is first covered with a small piece of thin medical-grade Silastic sheeting (Dow-Corning, Midland, MI) (Fig 14). The Silastic sheeting should be cut so that the

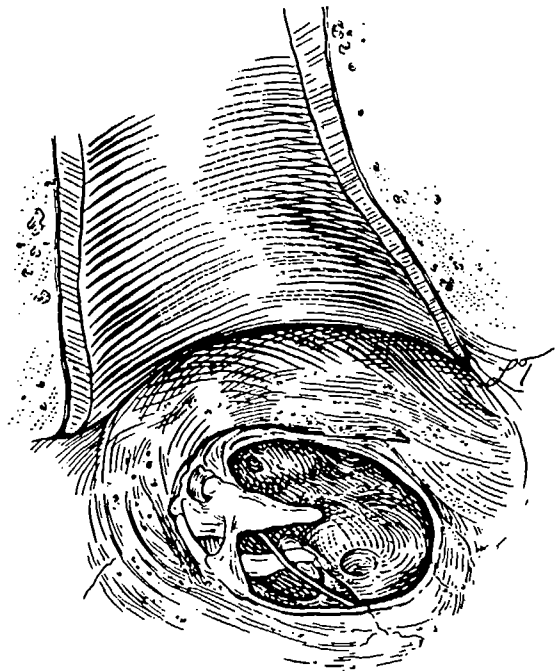


FIGURE 11. The illustration shows that the anterior canal wall is denuded of its skin layer.



FIGURE 12. A fascia graft is placed medial to the bony annulus.

anterior edge is gently curved and it can be placed into the anterior sulcus of the canal. The Silastic sheeting serves as a space maintainer to prevent adhesions and blunting of the anterior sulcus. The remainder of the ear canal is then packed with Gelfoam, as described earlier.

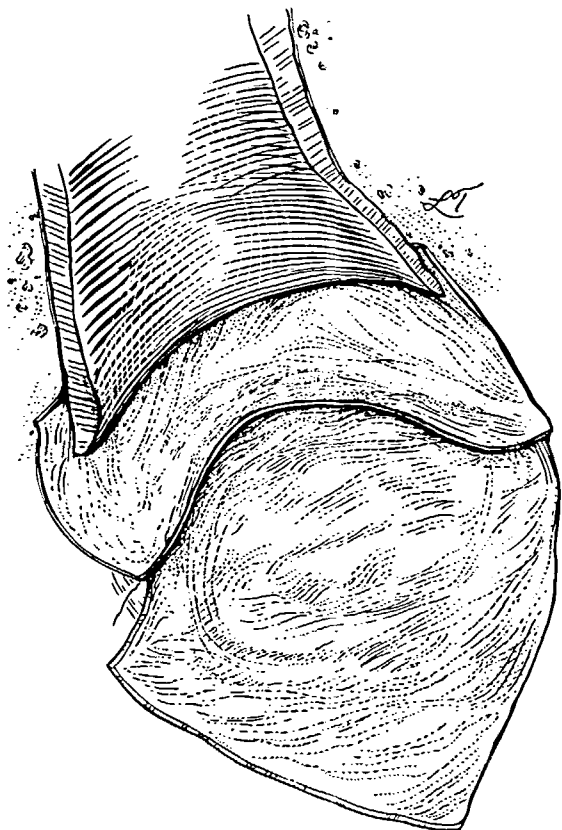


FIGURE 13. A second fascia graft covers the anterior canal wall. Note the graft drapes down onto the first graft.

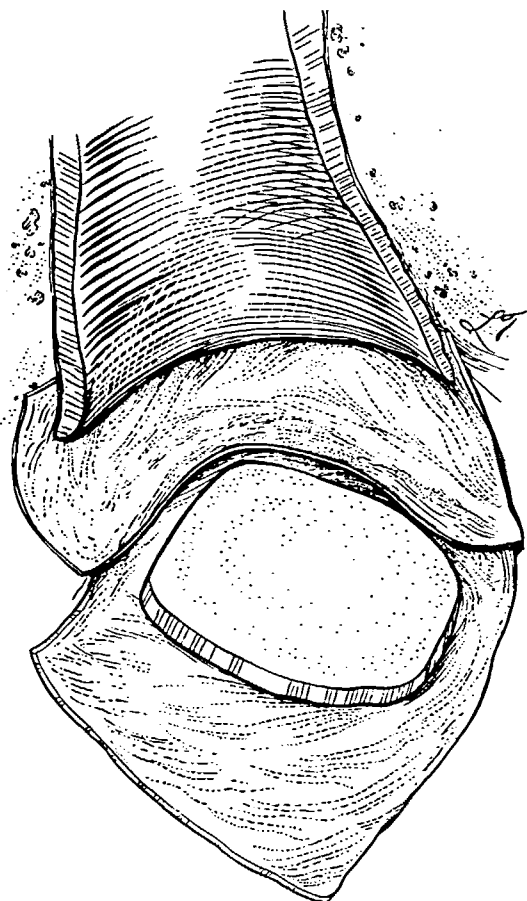


FIGURE 14. A small piece of Silastic sheeting is used to prevent blunting of the anterior sulcus.

## RESULTS

In the initial article<sup>1</sup> concerning this technique, the author observed a 3-month successful take rate of 95%. Graft failures were attributed to infection in three cases and retraction of the anterior graft in two cases. Since that initial report, later failures (after 6 months) have been observed in a few cases. Some of these late failures were due to recurrent otitis media. However, in some cases the recurrent perforation appeared to be spontaneous and without explanation. It is presumed, not proved, that these late spontaneous perforations are due to a loss of graft vascularity.

## DISCUSSION

In order to achieve speed and proficiency, the young otologic surgeon should develop a series of procedures that can be performed repetitively and can be adapted to the

pathology at hand. These procedures include the standard preparation, injection, incisions, graft harvest, opening of the ear, and wound closure. A simple, easy graft technique should also be part of this series of procedures. The author has taught this graft technique to residents over the last 6 years, and most have developed the skills to perform it within the first 1½ years of otolaryngology residency. The refinements and further simplification in this report are due to this teaching experience. It is the author's impression that despite resident participation in tympanoplasty, the success rate remains very high.

## REFERENCES

1. Schwaber MK: Postauricular undersurface tympanic membrane grafting: Some modifications of the "swinging door" technique. *Otolaryngol Head Neck Surg* 95:182-187, 1986
2. Palva T, Palva A, Karja J: Myringoplasty. *Ann Otol Rhinol Laryngol* 78:1074-1080, 1969