

4 Cartilage Palisades in Underlay Tympanoplasty Techniques

Definition

Cartilage underlay palisade technique is the oldest and the most popular technique in cartilage tympanoplasty. As shown in Chapter 1, during the 1960s and 1970s Heermann gradually developed the method as used today: parallel placement of 0.5–3 mm wide full-thickness cartilage strips in the inferosuperior direction of the tympanic cavity. Palisades are usually cut from pieces of tragal or conchal cartilage covered on the concave side with the perichondrium. Although the palisades are placed side by side and close to each other there will be some distance between the palisades. The edges of the perichondrium on the outer side of the palisade are supposed to stick to each other and close the gaps, facilitating the epithelialization of the eardrum.

Cartilage palisades have most often been used as underlay grafts (Heermann and Heermann 1967; Heermann et al. 1970; Heermann 1977, 1978, 1991, 1992; Wiegand 1978; Milewski 1989, 1991, 1993; Amedee et al. 1989; Péré 1989; Helms 1991, 1995; Hildmann et al. 1996; Velepik et al. 2001; Andersen et al. 2002, 2004; Neumann et al. 2003; Neumann and Jahnke 2005).

The superior ends of the palisades are often supported by the “architrave,” a piece of cartilage placed onto the eminence of the tensor tympani muscle (Heermann and Heermann, 1967; Heermann et al. 1970; Heermann 1992). In the posterior part of the tympanic cavity the superior ends of the palisade are supported by the chorda tympani, incudostapedial joint, stapes head, and interposition prosthesis.

The inferior end of the first palisade, the *simmering*, placed under the bony annulus is sometimes supported by a piece of cartilage placed in the anterior part of the hypotympanum. Heermann places the inferior ends of the remaining palisades onto the bony annulus with no need for inferior support by Gelfoam. I often prefer to place the inferior ends at the level of and close to the bony annulus, not onto and not under the bony annulus, and often support the palisades with Gelfoam.

Superiorly, the support by Gelfoam is sometimes needed. In my opinion the “architrave” can often be replaced by Gelfoam. I regularly support the short palisade connecting the undersurface of the umbo with Gelfoam. Some groups and some surgeons never apply Gelfoam within the middle ear, claiming that it causes formation

of adhesions in the middle ear. Some other groups and surgeons use always Gelfoam to support the eardrum grafts or interposed ossicles. I frequently use Gelfoam to support the underlay grafts and have not found adhesions caused by Gelfoam.

Indications for Surgery

Heermann considered wide indications for palisade technique and used cartilage palisades in nearly all cases with chronic otitis media and its sequelae.

Since 1995 I have always used underlay techniques in posterior perforation and in total perforation after removal of retractions, in sinus cholesteatoma, after tensa retraction cholesteatoma, and in adhesive otitis media. Primary and late results after surgery of sinus cholesteatoma and tensa retraction cholesteatoma in children have been published. The hearing results and stability of reconstructed eardrum were surprisingly good (Andersen et al. 2002, 2004; Uzun et al. 2003; 2004).

Palisade techniques can be used in endaural approaches, as used by Heermann, or in retroauricular approaches, as used by Milewski, Helms and Hildmann, or—as I prefer—in transcanal approaches with fixed ear speculum.

Generally retractions, atelectasis, adhesive otitis and recurrent surgery cases with poor tubal function or poor tubal patency, expressed in negative preoperative Valsalva test, will be absolute candidates for cartilage palisade technique.

Harvesting and Shaping of Palisades

Harvesting and shaping of palisades is easy (Chapter 3). A piece of conchal or tragal cartilage is removed with the perichondrium attached on both sides. The size for a total perforation is 10 mm × 8 mm. The convex side of the palisade is turned toward the tympanic cavity and should not be covered with perichondrium; the perichondrium is therefore removed from the anterior side of the tragal cartilage, or from the posterior side of the conchal cartilage.

The palisades are cut as 0.5–3 mm wide strips. Even when they are placed close to one another there will al-

ways be a small separation between the palisades, but this gap will soon be filled with tissue fluid. The perichondrium on the outer side sticks to the overlying remnant of the eardrum or/and the fibrous annulus. Tissue fluid connects the neighboring strips of perichondrium as well, allowing epithelialization of the new eardrum without any ingrowth of the epithelium around the edges of the palisades into the inner side of the eardrum.

Surgical Techniques

The surgical techniques are adapted to location and size of the perforation as well as the extension of the active disease. The ossicular pathology will also decide the choice of surgical technique.

Posterior Perforation

In posterior perforation the tympanomeatal flap, including the fibrous annulus and the remnants of the eardrum have to be elevated. The tympanomeatal flap may be cut at the 9-o'clock position, resulting in swing-door technique with excellent view of the tympanic sinuses. The technique involving raising a large tympanomeatal flap (MMES_1, Figs. 581–586) is most often used in the retroauricular approach, but can also be used in the endaural approach. The elevation of a tympanomeatal flap is suitable for underlay palisade technique, because the inferoposterior bony annulus is visualized, facilitating placement of the palisades either onto or close to the bony annulus.

Swing-Door Technique

The most popular method is the swing-door technique with a superior and an inferior skin flap providing a good visibility to the tympanic cavity.

Epithelium around the edges of the perforation is removed carefully. A tympanomeatal flap is raised after a medial circumferential incision of the posterior ear canal skin. A medial radial incision divides the flap into a superior and inferior flap (**Fig. 4.1a**). The skin flaps, together with the fibrous annulus and the eardrum remnant, are elevated together with epithelium surrounding the chorda tympani and continuing into the posterior tympanum as a remnant of a retraction. To provide sufficient visibility over the tympanic sinuses, it is often necessary to drill the posterosuperior bony annulus (**Fig. 4.1b**).

The first palisade is placed in the superoinferior direction, slightly posterior to the malleus handle. The second palisade is placed superiorly onto the edge of the bony annulus and onto the chorda tympani (**Fig. 4.1c**). The saved and replaced epithelial flaps will adhere to the palisades (**Fig. 4.1d**) and it is often not necessary to support the palisades with Gelfoam.

Another option is placement of the palisades at a slightly deeper level. The superior ends of the two palisades just touch the superior bony annulus and the anterior palisade is placed at the level of the malleus handle, but not on it (**Fig. 4.1e**). The palisades rest mainly on the chorda tympani and the long process of the incus (**Fig. 4.1f**). Inferior ends of the palisades are supported with Gelfoam balls. After replacement of the flaps the palisades will usually remain stable (**Fig. 4.1g**) because the epithelium sticks to the palisades. It is therefore always advantageous to save all epithelial flaps.

Large Tympanomeatal Flap Technique

This incision provides a good view to the entire posterior tympanum and even to the anterior tympanum when tilting the patient forward. After the edges of the perforation are cleaned, a large posterior tympanotomy incision is performed (**Fig. 4.2a**); the tympanomeatal flap is elevated, and pushed together with the eardrum remnants anterior to the malleus handle (**Fig. 4.2b**). The posterior part of the malleus handle is cleaned of epithelium to provide good contact to the cartilage palisade. The first palisade is placed close to the posterior edge of the malleus handle. Inferiorly, all palisades are placed onto the bony annulus; superiorly, the palisades just touch the superior bony annulus (**Fig. 4.2c**). After replacement of the tympanomeatal flap, good contact with the palisades is established (**Fig. 4.2d**).

Thus, in posterior perforation there are two options in placement of palisades in relation to the bony annulus: either close to or onto the bony annulus, but we do not know which option is better.

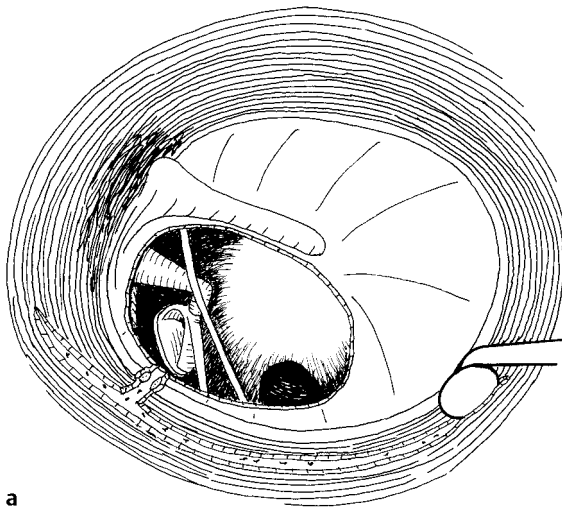
Instead of placing the inferior ends of the palisades onto the bony annulus they can be placed at the level of the bony annulus (**Fig. 4.2e**). Avoiding placement of the palisades onto the bony annulus may increase the vibratility of the palisades.

Inferior Perforation

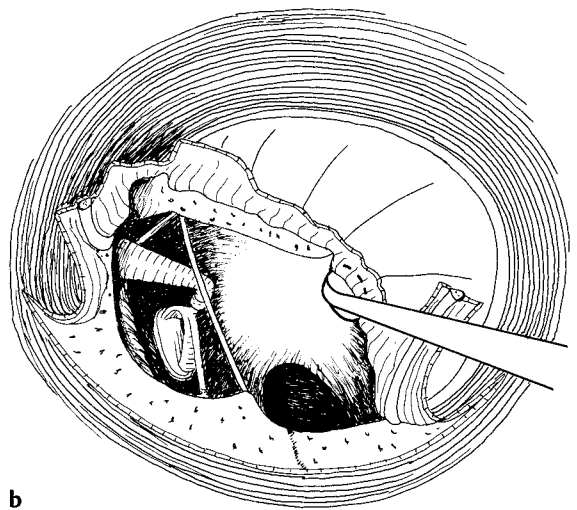
Application of cartilage palisades in underlay technique in inferior perforation is less common than in posterior or total perforation. However, in reoperation, poor function of the eustachian tube, retraction, and previous cholesteatoma, or in adhesive otitis media, underlay palisade technique can be a good solution. Swing-door technique or large tympanomeatal flap technique can be employed, but even the simple technique without tympanomeatal flaps can be used.

Technique without Tympanomeatal Flap

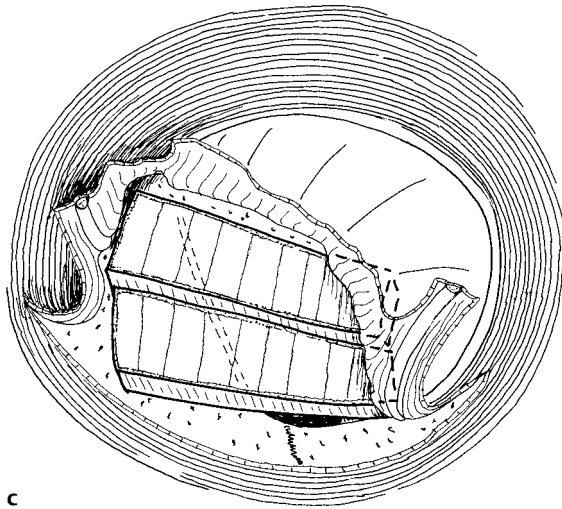
In this technique the removal of the epithelium around the perforation and scarification of the mucosa under the edges of the perforation are important. This can be achieved with a sickle knife, round knife, curved cup forces, or curved small elevator (**Fig. 4.3a**). Gelfoam balls



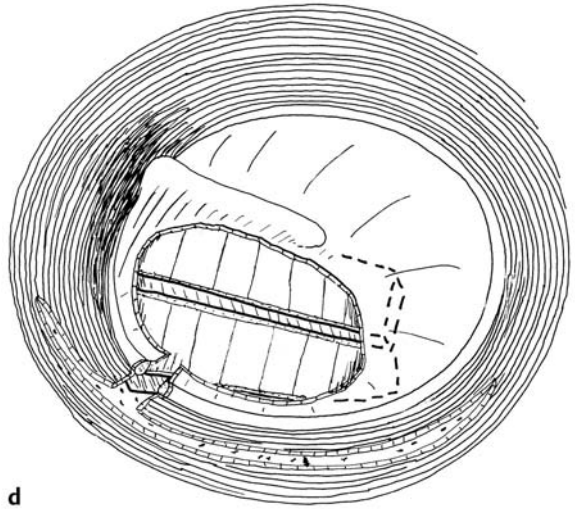
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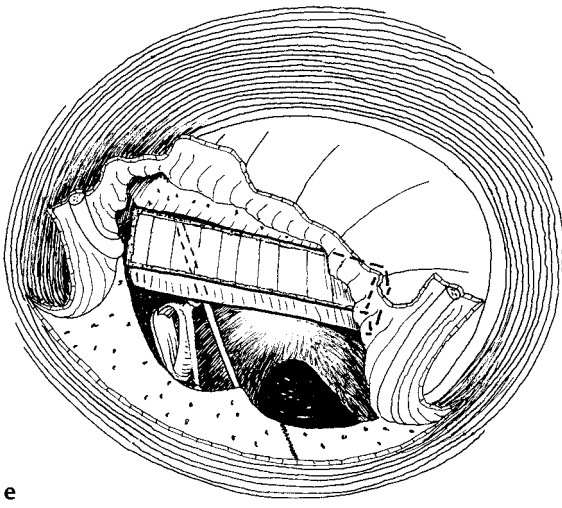
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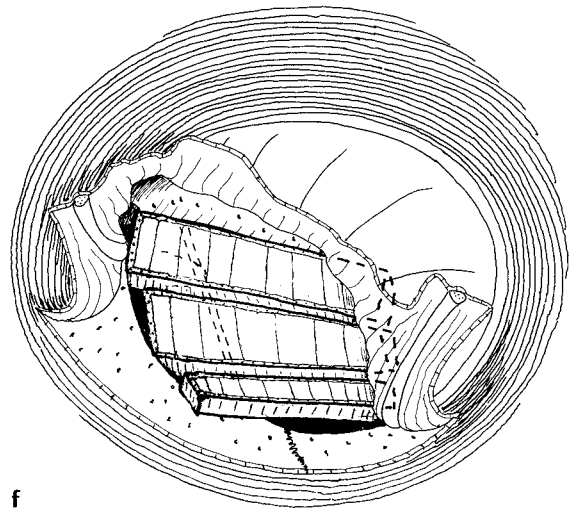
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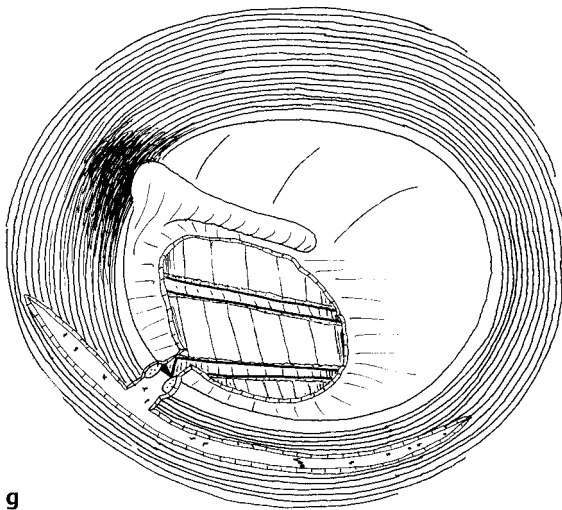
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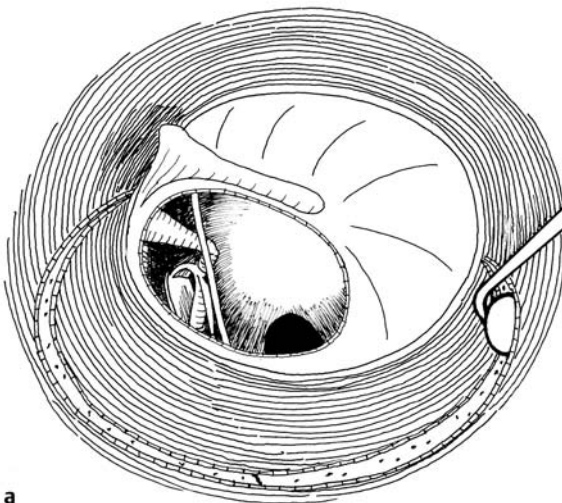
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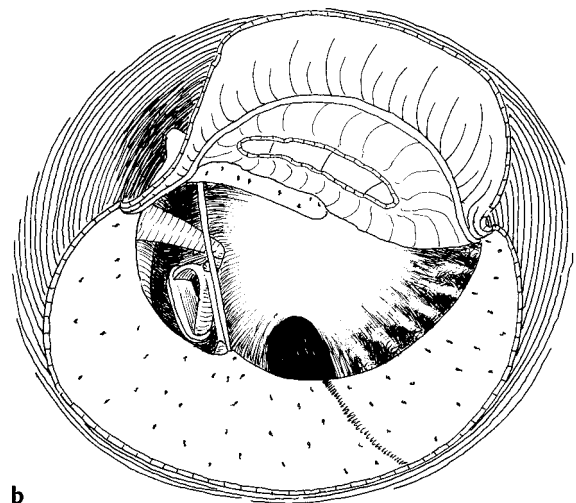
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Fig. 4.1a–g Underlay swing-door cartilage palisade technique in a posterior perforation with intact ossicular chain.

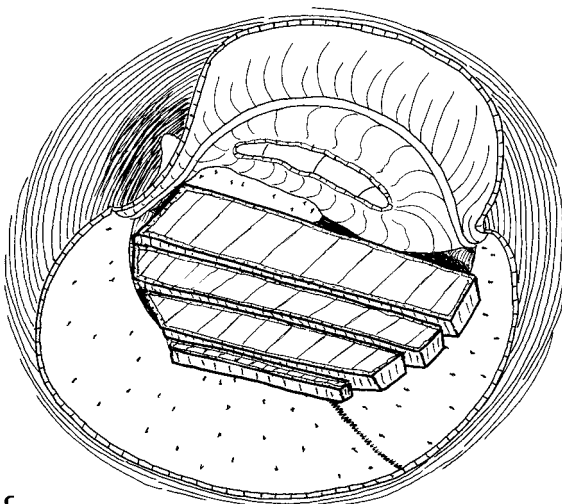
- The edges of the perforation are deepithelialized. A posterior circumferential medial incision and a radial incision at the 9-o'clock position are made.
- A superior and an inferior skin flap and all epithelial flaps around the perforation are elevated. Using a round knife, the mucous membrane of the underside of the eardrum is removed around the perforation to facilitate a better attachment of the palisade to the eardrum.
- Two large palisades are placed close to the malleus handle and superiorly onto the bony annulus. Inferiorly, the palisades are most often placed just under the eardrum remnant with the contact to the denuded mucosa.
- All flaps are replaced, but superiorly and anteriorly only small flaps cover the palisades.
- An alternative placement of the palisades in a slightly deeper level in a posterior perforation.** The first palisade is placed closed to and parallel to the malleus handle, resting on the chorda tympani. The palisade is thus placed slightly deeper.
- The following two palisades are also placed onto the chorda tympani. The palisades may also touch the long process of the incus.
- The epithelial flaps are replaced.



a



b



c

Fig. 4.2a–e Underlay cartilage palisade technique with large tympanomeatal flaps in posterior perforation and intact ossicular chain.

- The edge of the perforation with the keratinized epithelium is excised. The skin incision is placed relatively laterally in the ear canal.
- A large tympanomeatal flap is elevated together with the fibrous annulus and the remnants of the posterior half of the eardrum and the epithelium covering the posterior half of the malleus handle.
- The palisades are placed onto the inferoposterior bony annulus. The first palisade is placed on the posterior edge of the malleus handle. Superiorly, the palisades are placed close, but not onto, the bony annulus.

Fig. 4.2d, e ▷

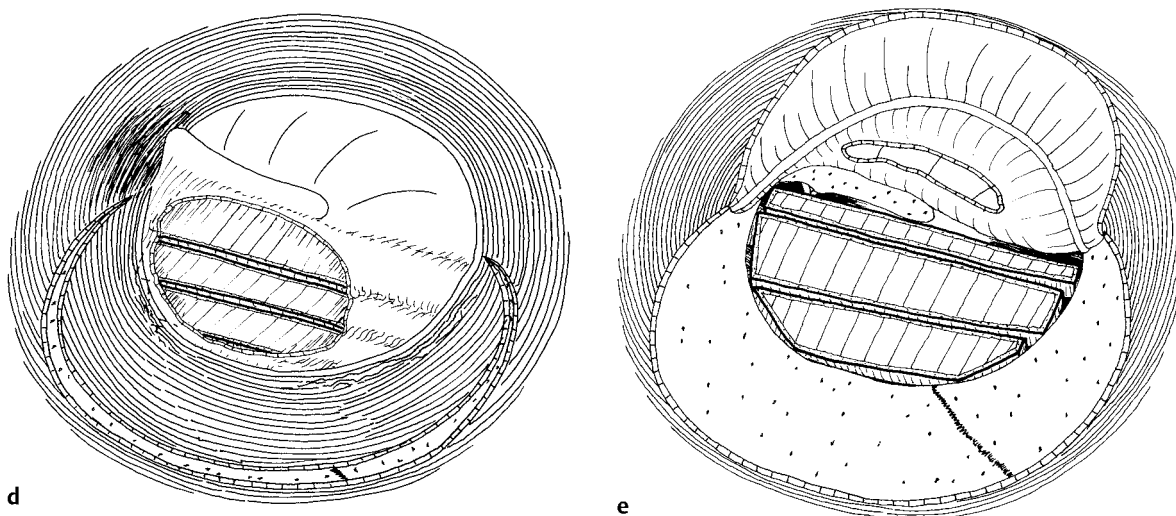


Fig. 4.2d-e

- d The tympanomeatal flap with the fibrous annulus and the remnants of the eardrum are replaced.
- e Alternative placement of the palisades under the eardrum remnant close to the bony annulus.

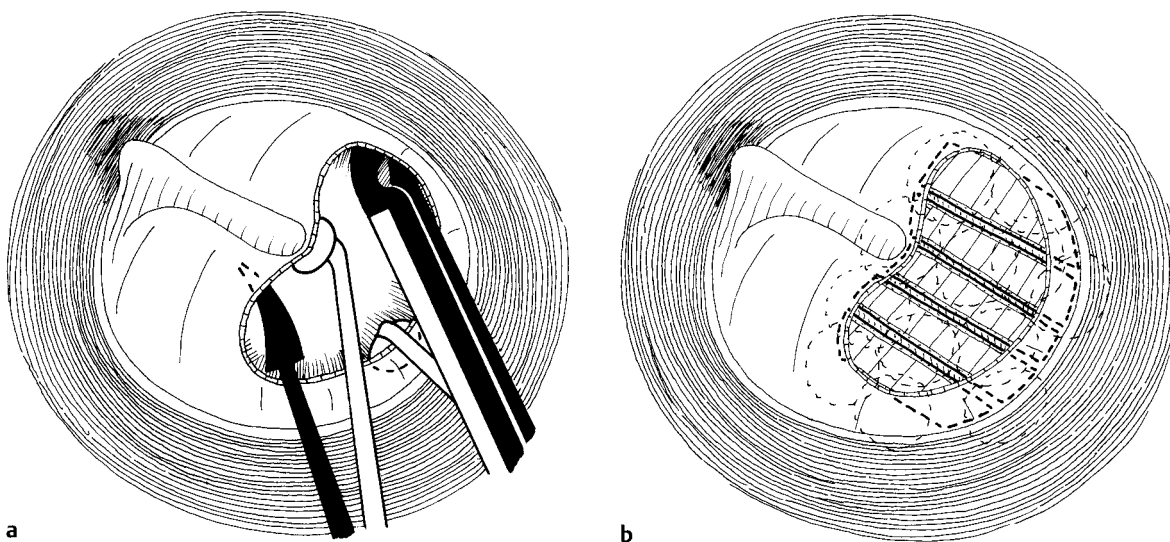
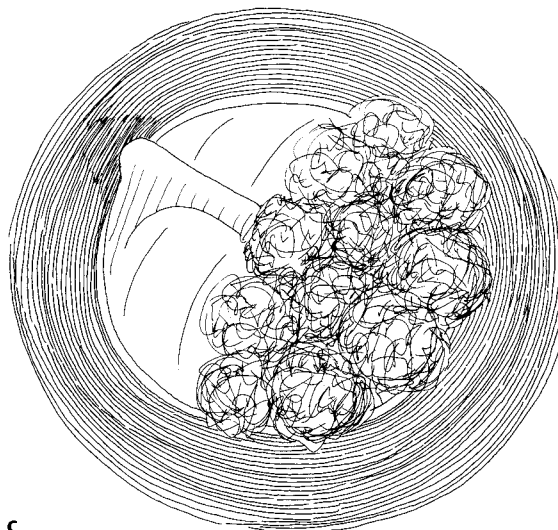


Fig. 4.3a-c A variation of placement the palisades close to the bony annulus instead of onto the bony annulus.

- a The edge of the perforation is cleaned of the epithelium. Mucosa under the eardrum remnant is removed and scarified using the cup forceps, sickle knife, round knife, or a curved elevator.
- b After placement of Gelfoam balls, the palisades are placed close to the inferior bony annulus. Superiorly, the palisades are placed onto the Gelfoam balls. The palisades are positioned under the eardrum remnant and will stick to the eardrum remnant.
- c Gelfoam balls cover the lower part of the eardrum stabilizing the palisades.



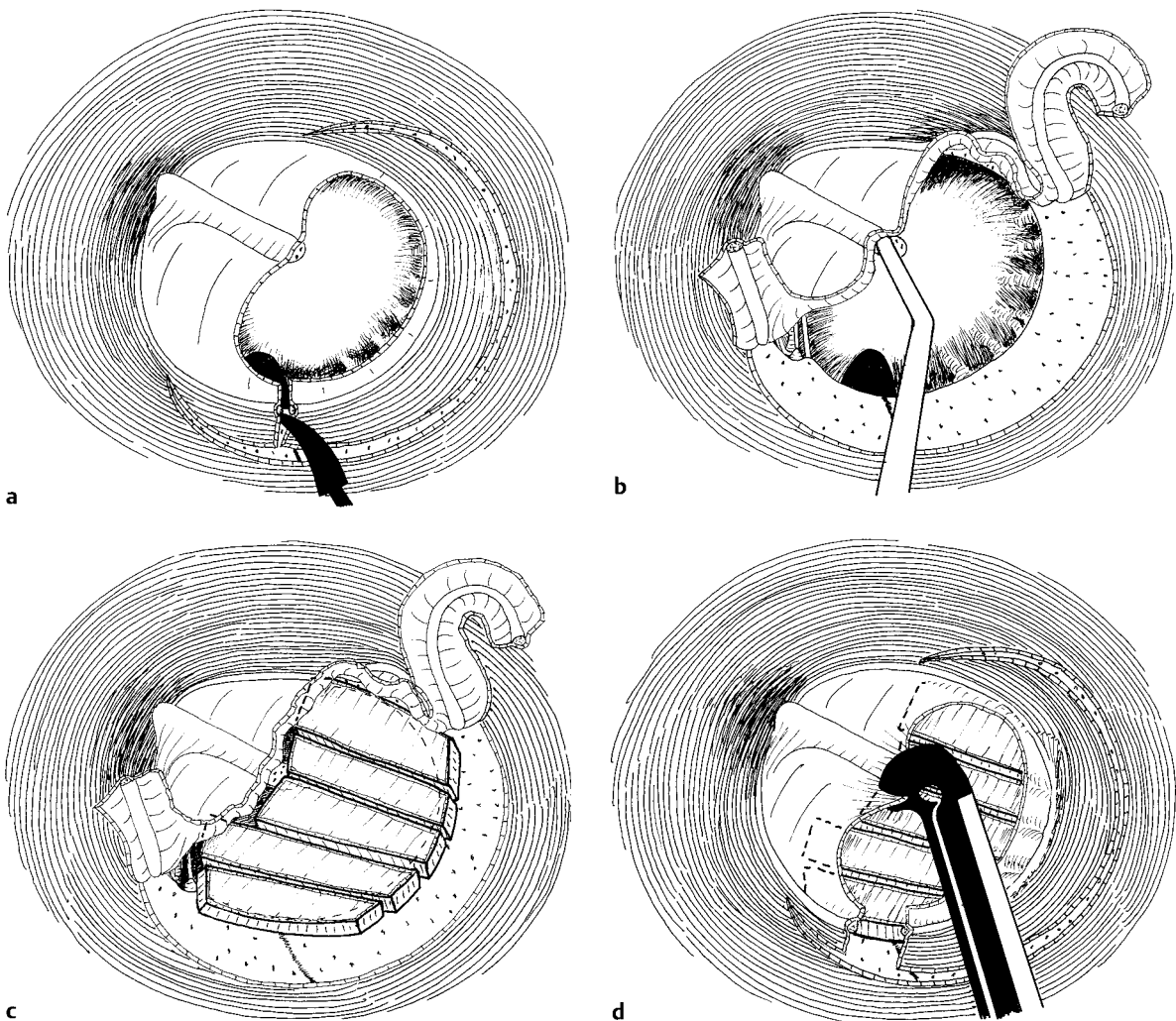


Fig. 4.4a–g Underlay swing-door cartilage palisade technique in a large inferior perforation with intact ossicular chain.

- a** Epithelium is removed from the borders of the perforation. A circumferential incision and a radial incision are made.
- b** The superior and inferior flaps are elevated. At the anterior border of the perforation, the fibrous annulus is elevated, exposing the bony annulus. Epithelium from the umbo is elevated and a small epithelial flap is elevated.

- c** The anterior palisade is placed onto the anterior and inferior bony annulus. The second palisade is placed onto the anterior edge of the umbo. The third palisade is placed onto the posterior edge of the umbo. Inferior ends of the palisades are placed onto the inferior bony annulus.
- d** The tympanomeatal flaps are replaced.

Fig. 4.4e–g ▷

are placed into the tympanic cavity to support the palisades positioned under the denuded eardrum (**Fig. 4.3b**). Finally, the edges of the perforation are covered with Gelfoam balls for three weeks to fix the palisades (**Fig. 4.3c**).

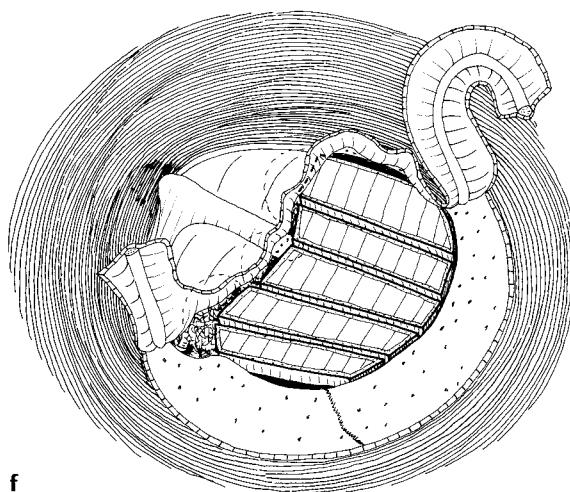
Swing-Door Technique

The edges of the perforation are cleaned of epithelium. A circumferential incision between the 10-o'clock and 3-o'clock positions and a radial incision at the 9-o'clock positions are made (**Fig. 4.4a**). Two flaps are elevated. Anteriorly, the annulus fibrosis is elevated together with

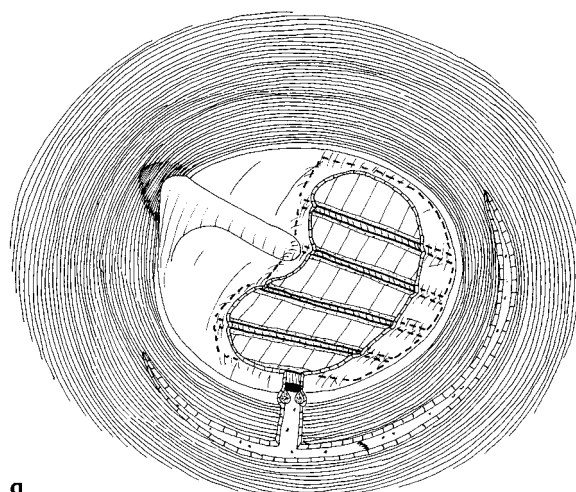
the eardrum remnant. Epithelium from the umbo is elevated and a small epithelial flap is created (**Fig. 4.4b**). Gelfoam balls are placed in the central part of the tympanic cavity to support the superior ends of the palisades. The anterior palisade is placed onto the anterior bony annulus. Two palisades have contact with the umbo. Inferiorly, the palisades lie on the inferior bony annulus (**Fig. 4.4c**). The superior ends of the palisades may be supported by Gelfoam, especially in the umbo region. The tympanomeatal flap and the remnant of the eardrum are replaced (**Fig. 4.4d**). The epithelial flap of the umbo is replaced. The eardrum is covered with several Gelfoam balls (**Fig. 4.4e**).



e



f



g

Fig. 4.4e–g

- e The eardrum is covered with Gelfoam balls.
 f Placement of the palisades at the level of the bony annulus. The palisades touch the bony annulus, but they are not placed onto it. The palisades are supported by Gelfoam balls.
 g The epithelial flaps are replaced and the eardrum remnant is in good contact with the palisades.

The alternative of placing the inferior and posterior ends of the palisades close to and at the level of the bony annulus (Fig. 4.4f) requires extensive scarification of the eardrum remnant to promote gluing of the palisades to the undersurface of the denuded eardrum (Fig. 4.4g)

Large Tympanomeatal Flap Technique

After removal of the epithelium from the edges of the perforation, an inferior circumferential incision is made (Fig. 4.5a). A large tympanomeatal flap is elevated and the umbo is cleaned of epithelium (Fig. 4.5b). Gelfoam balls are placed into the tympanic cavity to support the superior ends of the palisades. In this example the most anterior palisade is placed under the bony annulus, but it could be placed onto the bony annulus (Fig. 4.5c, d). The short palisade is placed under the umbo, but it can be placed onto the umbo as well. The tympanomeatal flap is replaced (Fig. 4.5e) and the eardrum covered with Gelfoam (Fig. 4.5f, g).

In inferior perforation, the inferior ends of the palisades are placed onto the bony annulus, but they could be placed close to the bony annulus or even under it. In such cases a support of Gelfoam balls should be applied (Fig. 4.5h). After replacement of the tympanomeatal flap the palisades will come into contact with the eardrum remnant (Fig. 4.5e, f) and be stabilized.

Total Perforation

Reconstruction of the eardrum with cartilage palisades or cartilage strips is often indicated in total perforation, in particular with signs of previous retraction. Cartilage tympanoplasty is also indicated in cases of previously unsuccessful surgery of a total perforation. In cases with a dry total perforation with negative preoperative Valsalva maneuver, cartilage tympanoplasty is absolutely indicated. Cartilage palisades can also be employed in slightly moist ears with some thickness of the mucosa.