Endoscopic Management of Chronic Otitis Media and Tympanoplasty

Muaaz Tarabichi, MD[a,*], Stéphane Ayache, MD[b], João Flávio Nogueira, MD[c], Munahi Al Qahtani, MD[d], David D. Pothier, MBChB, MSc, FRCS(ORL-HNS)[e]

KEYWORDS

• Tympanoplasty • Endoscope • Tympanic perforations • Chronic otitis media

KEY POINTS

- The endoscope allows for better inspection for cholesteatoma in cases with chronic otitis media.
- The endoscope increases the odds of preoperative detection of ossicular chain disruption associated with perforations.
- The endoscope allows better access to selective epitympanic poor ventilation and secondary selective chronic otitis media.
- The endoscope allows for better visualization of anterior poor ventilation of the mesotympanum and reestablishes adequate ventilation to the mesotympanum.
- The endoscope allows better visualization and reconstruction of anterior tympanic membrane perforations.
- The endoscope allows use of Sheehy's lateral graft tympanoplasty through a transcanal approach.

Videos of endoscopic detection of stapedial reflexes; endoscopic medial graft tympanoplasty with ossicular reconstruction; two for endoscopic medial graft tympanoplasty; endoscopic butterfly button tympanoplasty; endoscopic lateral graft tympanoplasty; and interlay tympanoplasty techniques accompany this article at http://www.oto.theclinics.com/

Disclosures: No disclosures.

[a] Center for Ear Endoscopy, Kenosha, WI, USA; [b] Department of Otolaryngology, ORPAC, Clinique du Palais, Grasse, France; [c] Department of Otolaryngology, Hospital Geral de Fortaleza, Fortaleza, Brazil; [d] Department of Otolaryngology, Riyadh Military Hospital, Riyadh, Saudi Arabia; [e] Department of Otolaryngology Head and Neck Surgery, Toronto General Hospital, University Health Network and University of Toronto, Ontario, Canada
* Corresponding author.
E-mail address: tarabichi@yahoo.com

Otolaryngol Clin N Am 46 (2013) 155–163
http://dx.doi.org/10.1016/j.otc.2012.12.002 **oto.theclinics.com**
0030-6665/13/$ – see front matter

INTRODUCTION

As discussed in the article elsewhere in this issue by Tarabachi, Marchioni, Presutti, and Nogueira, Endoscopic Transcanal Ear Anatomy and Dissection, the endoscope allows greater access to the tympanic cavity[1] and therefore offers a fresh outlook on conditions that affect this space and offers distinct advantages in the understanding of this condition and the management of its sequela.

ASSESSING STATUS OF MIDDLE EAR VENTILATION

Although the cause of chronic otitis media without chlolesteatoma is poorly understood, poor ventilation of the different air spaces within the temporal bone is believed to be at the center of this disease process. Combined tympanomastoidectomy with exenteration of air cells is considered the treatment of choice. Failure to exenterate tegmental cells from disease is a common cause of failure.[2] The endoscope allows for expanded access to the attic, especially anteriorly, and this allows for removal of any granulation tissue in that area.[1] Beyond any Eustachian tube dysfunction, there are multiple opportunities for obstruction within the narrow ventilation pathways of the tympanic cavity, which result in selective poor ventilation of the areas proximal to these sites. The 2 main areas lie anteriorly within the anterior mesotympanum and posteriorly and superiorly within the epitympanic diaphragm, 2 areas that are more accessible with the endoscope.[1] Classic surgical approaches to the attic with microscopic transmastoid technique results in poor access to the anterior attic and extensive removal of much of the associated anatomy to access these areas. In contrast, the endoscope offers clear glimpses of the anatomy and disease without undue disruption of the anatomy, making it easier to understand both the underlying anatomy and any disease process within this area.[1–6] This situation is particularly true when considering the tensor fold. Because of the location and orientation of this fold, it is a structure that cannot be seen through traditional microscopic transcanal and transmastoid approaches to the anterior attic.[7] The only exception to this situation is a widely opened facial recess, and only after removal of the incus. It is often helpful to push the handle of malleus laterally for a more open view. This observation of the tensor fold is usually made more difficult while operating on diseased ears because of the existing medialization of the handle of malleus and the fact that blood tends to pool in this area because of the position of the head in traditional mastoid surgery. The endoscope allows for inspection of this fold in healthy ears by using a 30° endoscope and looking through the isthmus (**Fig. 1**). In diseased ears, the isthmus is obstructed and narrow because of medialization of the handle of malleus, and the tensor fold can be visualized endoscopically either by looking superiorly and posteriorly with an angled scope that is positioned anterior to the handle of malleus (**Fig. 2**) or by looking forward with an angled scope after removal of the incus and ahead of malleus (**Fig. 3**).

Examination of the tympanic cavity in the clinic through perforations is helpful in assessing the status of the middle ear mucosa beyond the perforation and the presence of inflammatory webs in the anterior epitympanum as well as any obstruction of the isthmus, which can result in recurrent episodes of drainage or poor response to local treatment.[3] The endoscope allows for better surgical access to the tensor fold and the anterior epitympanic space to establish ventilation without disrupting the ossicular chain.[1]

ASSESSING THE STATUS OF THE OSSICULAR CHAIN

The incudostapedial joint and the stapes suprastructure are almost universally accessible for inspection endoscopically through a perforation or a thin retracted

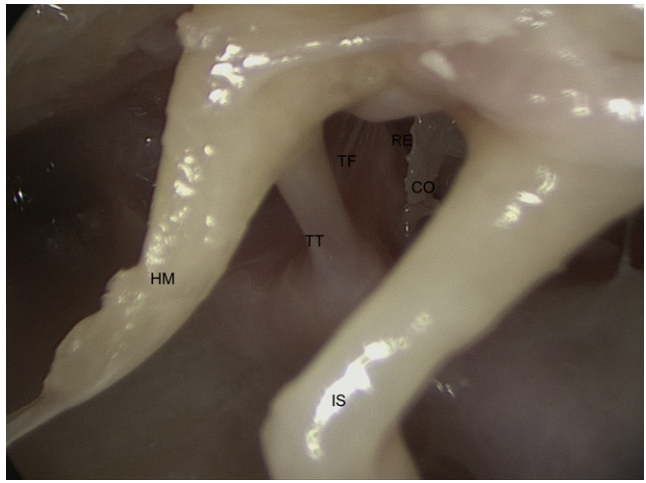

Fig. 1. Right ear: peaking through the isthmus with a 30° endoscope. CO, COG; HM, handle of malleus; IS, incudostapedial joint; RE, the recess formed through the insertion of the fold anterior to the COG; TF, tensor fold; TT, tendon of the tensor tympani.

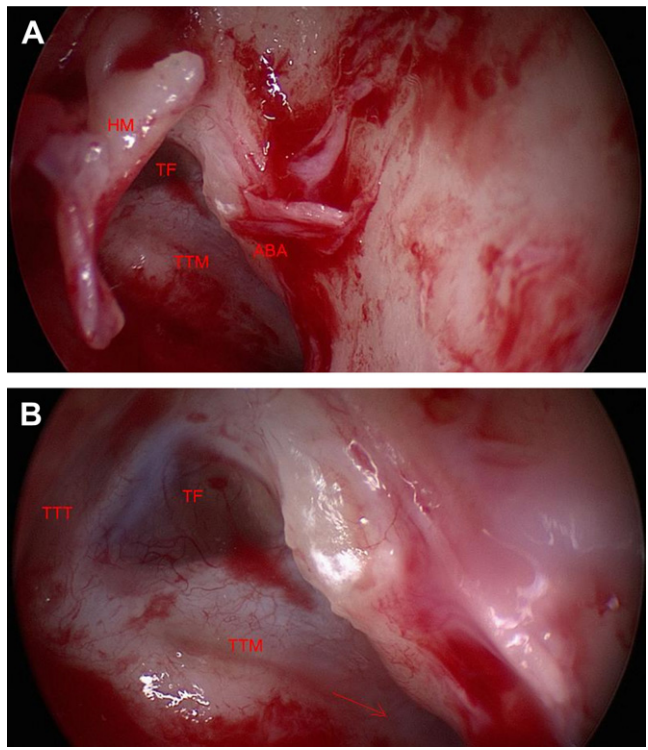

Fig. 2. Right ear intraoperative view of the tensor fold, which has an almost-horizontal orientation without any formation of supratubal recess. (*A*) General view; (B) close-up view. ABA, anterior bony annulus; *arrow*, Eustachian tube; HM, handle of malleus; TF, horizontal tensor fold; TTM, tensor tympani muscle canal; TTT, tendon of the tensor tympani.

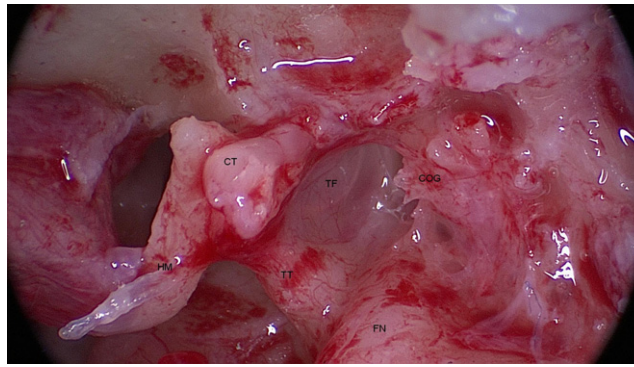

Fig. 3. Left ear intraoperative view. The incus and the head of malleus is removed and looking forward with a 30° scope toward the anterior attic at a tensor fold with almost-vertical orientation. COG, COG; CT, transected corda tympani; FN, horizontal segment of the facial nerve; HM, handle of malleus; TF, tensor fold; TT, tensor tympani tendon.

membrane.[8] Even with the use of a 0° endoscope, the endoscopic view allows for a better inspection of the ossicles (**Fig. 4**). The lack of stapedial reflexes in the presence of an intact tympanic membrane and good bone thresholds had been a useful way of detecting fixation of stapes and other ossicles. The presence of tymphanic membrane

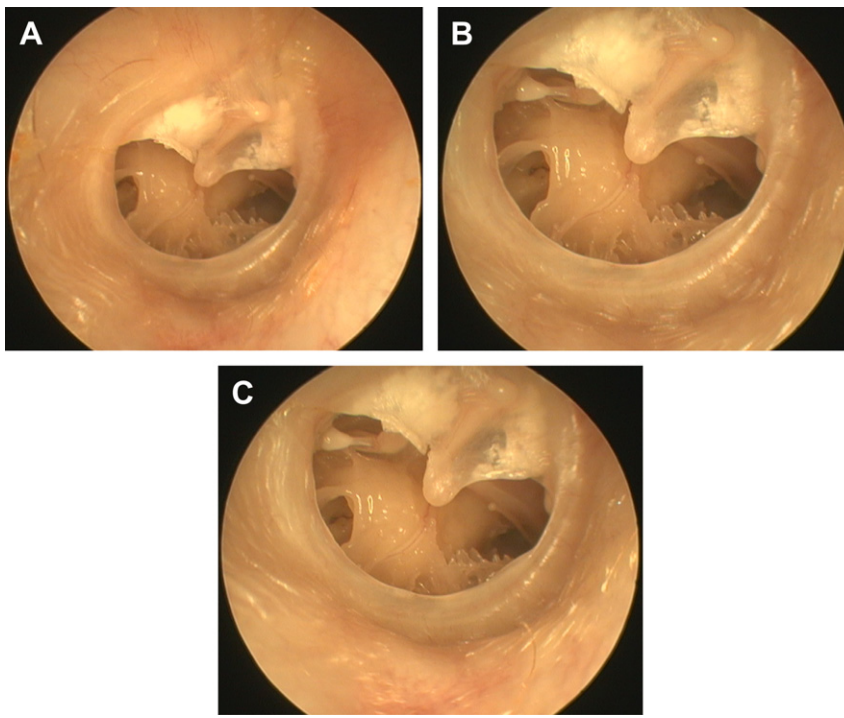

Fig. 4. (*A*) Overall endoscopic picture of perforation that is without the visualization of ossicular chain, probably similar to what is visible with microscope. (*B*) Close-up endoscopic view with visualization of the stapes. (*C*) Further close-up view showing the incudostapedial joint; all with 0° endoscopes.

perforation precludes this useful test. Endoscopic detection of stapedial reflexes through perforations allows for the identification of stapes fixation.[9] It also tests the integrity of an eroded, visually connected incudostapedial joint (Video 1).

ENDOSCOPIC MEDIAL GRAFT TYMPANOPLASTY

Medial graft tympanoplasty is a common and relatively successful procedure; central to its success is adequate and relatively free exposure to the whole tympanic perforation. Unfavorable ear canal anatomy (overhanging anterior wall or a small canal) or anterior perforations make for a technically challenging transcanal procedure, which is reflected as a high rate of failure. Experience surgeons are usually more willing to consider a postauricular approach in these limiting situations to provide adequate microscopic exposure.[10]

OPERATIVE TECHNIQUE FOR ENDOSCOPIC MEDIAL GRAFT TYMPANOPLASTY

- The ear canal and the graft donor site are infiltrated with xylocaine 2% with 1 in 100,000 epinephrine (Videos 2, 3 and 4).
- A fascial graft is obtained from either the temporalis muscle fascia or tragal perichondrium.
- The edges of the perforation are debrided and the undersurface of the tympanic membrane is abraded.
- A wide tympanomeatal flap is elevated.
- The ossicular chain is inspected either through the perforation or directly after elevation of the tympanomeatal flap.
- Appropriate ossicular reconstruction is performed.
- The graft is positioned just medial to the anterior rim of the perforation as it is visualized through the tympanomeatal flap.
- If the anterior rim is not visible through the elevated flap, then a 30° endoscope is used to perform that step and to pack Gelfoam (Pfizer Canada Inc., Quebec, Canada) in the middle ear deep to the graft.
- The tympanomeatal flap is repositioned and the ear canal is packed with Gelfoam.

The impact of the endoscope on tympanoplasty surgery needs to be considered based on the surgical task contemplated and the importance of the advantages and disadvantages in specific situations, such as:

1. Elevation of tympanomeatal flap: this is performed under direct vision with the endoscope without the need for the continuous repositioning in microscopic surgery. It is difficult to tear a flap because the angle of view includes both surfaces of the whole flap. It is easy to identify and cauterize bleeding points along the incised edge of the skin of the ear canal.
2. Inspection of the middle ear space: the endoscope is the better instrument here for the reasons discussed earlier. This inspection includes operative evaluation and treatment of disease within the facial recess, sinus tympani, hypotympanum, attic, and the anterior part of the tympanic cavity.
3. Positioning of the graft: this task is easier with the endoscope, given its wide angle of view, which includes the tympanic ring along with the whole perforation and graft without the need for repositioning.
4. Positioning of a prosthesis: the unavailability of 2 hands (eg, to lift malleus) and the lack of depth perception (assessing length of prosthesis needed) makes this task more difficult with the endoscope.

5. Butterfly button tympanoplasty with an anterior perforation is a particularly manageable technique with the endoscope (Video 5).

It is difficult to use the endoscope and microscope to perform different tasks in the same procedure, and different surgeons choose their instrument of choice based on their comfort level.

The first report of endoscopic medial graft tympanoplasty in 1998 showed a high success rate in 64 ears.[11] The main point to be emphasized is how endoscopic techniques reduced the rate of postauricular approach from 42% (before the use of the endoscope) to 0%, without reducing the overall success rate and without increasing the complication rate. The first author of this article has not performed any postauricular or endaural incisions for tympanic perforations since that report.

Despite the safety of endoscopic ossicular chain reconstruction, there are no compelling reasons for performing ossicular work with the endoscope.

ENDOSCOPIC LATERAL GRAFT TYMPANOPLASTY

A wide and complete view of the tympanic ring is an essential element in Sheehy's lateral graft tympanoplasty.[12] This view is usually accomplished by enlarging the ear canal and through postauricular exposure. The endoscope offers a comparable wide view of the operative field through a transcanal approach.

OPERATIVE TECHNIQUE FOR ENDOSCOPIC LATERAL GRAFT TYMPANOPLASTY

- The ear canal and the graft donor site are infiltrated with xylocaine 2% with 1 in 100,000 epinephrine (Video 6).
- A fascial graft is obtained from either the temporalis muscle fascia or tragal perichondrium.
- The skin of the ear canal is removed along with the epithelial layer of the tympanic membrane remnant. The vascular strip is preserved.
- Overhanging bony ear canal is curetted out to obtain full endoscopic exposure to the anterior sulcus.
- The ossicular chain is inspected either through the perforation or directly after elevation of annulus if there is strong suspicion of disease based on preoperative audiogram.
- Appropriate ossicular reconstruction is performed, the middle ear cavity is packed with Gelfoam, and the facial graft and the skin are repositioned. The ear canal is packed with Gelfoam.

The usefulness of the endoscope in lateral graft tympanoplasty must be considered based on the surgical task contemplated and the importance of the advantages and disadvantages in specific situations:

1. Removal of canal skin: the use of the endoscope allows canal skin to be removed under direct vision without the usual need for continuous manipulation of the microscope. It is difficult to tear the skin because the angle of view includes both surfaces. It is easy to identify and cauterize bleeding points at the edges of the incised skin as well as any anterior sulcus perforator vessels, which usually produce significant bleeding.
2. Drilling and removal of overhanging bony canal: the ability to visualize past the shaft of the drill into the surgical field makes the endoscope a useful instrument. The wide angle of view of the endoscope might lead the surgeon to underestimate the depth

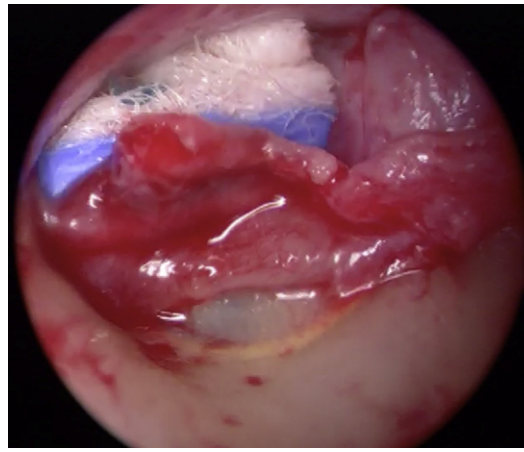

Fig. 5. Interlay tympanoplasty of left ear: the squamous layer is elevated off the fibrous layer of the tympanic membrane, leaving the fibrous layer in situ.

of the anterior sulcus, which could lead to inadequate removal of overhanging bony canal, which results in blunting of the anterior sulcus.

3. Inspection of the middle ear space: the endoscope is the better instrument here for the enhanced visualization described earlier.
4. Positioning of the graft: this task is easier with the endoscope, given its wide angle of view, which includes the whole tympanic ring.

The first report of endoscopic lateral graft tympanoplasty in 1998 showed a high success rate in 32 ears, with 3 patients having blunting of the anterior sulcus and 1 patient having a cholesteatoma pearl within the tympanic membrane at 1 year postoperatively.[11] The primary investigator of that study has since relied more on this technique to improve success rate in tympanoplasty surgery.

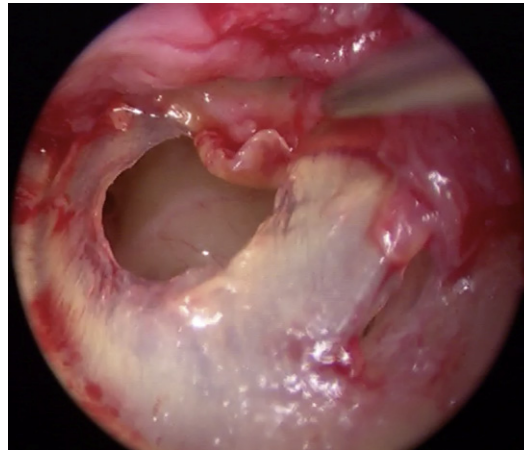

Fig. 6. The squamous layer has been elevated beyond the margins of the perforation.

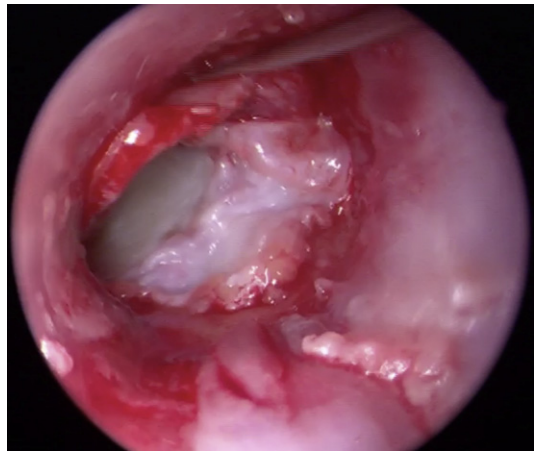

Fig. 7. A graft is inserted between the squamous layer and the fibrous layer and the flap replaced.

INTERLAY TYMPANOPLASTY

Most perforations of the tympanic membrane that are not associated with ossicular abnormalities or the ingress of keratin into the middle ear are closed with an underlay graft or a lateral graft tympanoplasty. The former is easier to perform, but the graft lacks the support of the fibrous layer of the tympanic membrane remnant; the latter provides a more robust support for the graft, but comes at the price of a substantial amount of trauma to the skin of the ear canal that is explanted and replaced as part of this procedure. This situation can cause blunting of the anterior recess of the external ear canal and may cause problems with the transfer of sound energy.

Using an endoscopic approach, it is possible to perform a hybrid technique that has not been easy to perform with the microscope, because of the difficulty with access to

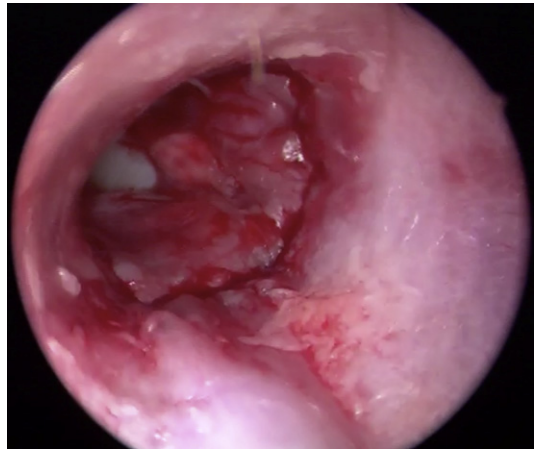

Fig. 8. The graft is now sandwiched between the fibrous and the squamous layer, which provides a robust support for the graft.

the anterior region of the tympanic membrane. The hybrid interlay technique involves the raising of an extended tympanomeatal flap to the level of the fibrous annulus of the tympanic membrane. At this point, rather than raising the flap along with the annulus and the tympanic membrane, the squamous layer is elevated off the fibrous layer of the tympanic membrane, leaving the fibrous layer in situ (**Fig. 5**). After the squamous layer has been elevated beyond the margins of the perforation (**Fig. 6**), a graft is inserted between the squamous layer and the fibrous layer and the flap replaced (**Fig. 7**). The graft material can be temporalis fascia, perichondrium, or a composite graft.

The graft is now sandwiched between the fibrous and the squamous layer, which provides a robust support for the graft (**Fig. 8**). This technique preserves the integrity of the fibrous annulus and leaves the skin of the ear canal in position in the anterior recess and still provides a stable bed for the graft. A potential drawback is the difficulty in raising the squamous layer from the fibrous layer, but this is easier to perform with wide access to the flap and the accurate and highly magnified view of the interface of these layers afforded by the endoscopic view (Video 7).

SUPPLEMENTARY DATA

Supplementary data related to this article can be found online at http://dx.doi.org/10.1016/j.otc.2012.12.002.

REFERENCES

1. Tarabichi M. Transcanal endoscopic management of cholesteatoma. Otol Neurotol 2010;31:580–8.
2. Nadol JB. Causes of failure of mastoidectomy for chronic otitis media. Laryngoscope 1985;95:410–3.
3. Mansour S, Nicolas K, Naim A, et al. Inflammatory chronic otitis media and the anterior epitympanic recess. J Otolaryngol 2005;34(3):149–59.
4. Tarabichi M. Endoscopic management of acquired cholesteatoma. Am J Otol 1997;18:544–9.
5. Tarabichi M. Endoscopic management of cholesteatoma: long-term results. Otolaryngol Head Neck Surg 2000;122:874–81.
6. Tarabichi M. Endoscopic management of limited attic cholesteatoma. Laryngoscope 2004;114:1157–62.
7. Marchioni D, Alicandri-Ciufelli M, Molteni M. Selective dysventilation syndrome. Laryngoscope 2010;120:1028–33.
8. Karhuketo TS, Puhakka HJ, Laippala PJ. Tympanoscopy to increase the accuracy of diagnosis in conductive hearing loss. J Laryngol Otol 1998;112(2):154–7.
9. Al-Qahtani MM, Hagr AA. A preliminary study of endoscopic acoustic stapedial reflex in chronic otitis media. Saudi Med J 2010;31(8):900–3.
10. Doyle PJ, Schleuning AJ, Echevarria J. Tympanoplasty: should grafts be placed medial or lateral to the tympanic membrane? Laryngoscope 1972;82:1425–30.
11. Tarabichi M. Endoscopic middle ear surgery. Ann Otol Rhinol Laryngol 1999;108:39–46.
12. Sheehy JL. Surgery of chronic otitis media. In: English GM, editor. Otolaryngology. New York: Harper and Row; 1977.