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Technical note

Endoscopic transcanal myringoplasty for anterior tympanic membrane perforation

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ABSTRACT

Anterior tympanic membrane perforations constitute a surgical challenge because of the anatomy of the anterior wall of the external auditory canal and the specific physical properties of the anterior tympanic membrane. The author reports an endoscopic transcanal myringoplasty technique with anterior fixation of the graft onto the anterior wall of the external auditory canal, avoiding canaloplasty in the majority of cases, detachment of the annulus in the anterior angle and medialization of the graft in the middle ear.

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1. Introduction

Myringoplasty for anterior tympanic membrane perforation (ATMP) constitutes a surgical challenge because of the anatomical situation of the anterior tympanic membrane (TM), often associated with anterior prolapse of the external auditory canal (EAC).

Endoscopic transcanal myringoplasty with anterior fixation of the graft to treat ATMP allows complete exposure of the TM in the majority of cases and promotes stabilization of the graft.

2. Surgical technique

The operation is performed under general anaesthesia, using a rigid 0° endoscope, 14 cm long and 3 mm in diameter. Intraoperative bleeding is limited by the conventional patient positioning, maintenance of low blood pressure, infiltration of the external auditory canal with ropivacaine (2 mg/mL) – adrenaline (0.25 mg/mL) solution and the use of packs impregnated with adrenaline (0.25 mg/mL) placed on the TM.

The temporal fascia is used for the graft and is harvested via a small incision just above the ear, then crushed and dried after resection of all muscle and adipose tissue.

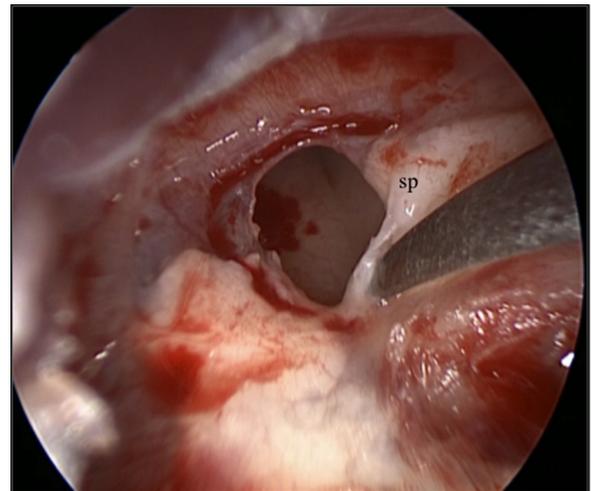


Fig. 1. The edges of the TMP are de-epithelialized (section of a strip of sclerosis). sp: strip of myringosclerosis.

2.1. Step 1

Complete exposure of the tympanic membrane perforation (TMP) and the anterior annulus despite anterior tympanic prolapse (Fig. 1). When necessary, canaloplasty is performed with a 0° transcanal endoscope using an electric saw or piezosurgery. The edges of the perforation are de-epithelialized. A strip of myringosclerosis lining the perforation can be sectioned or totally removed.

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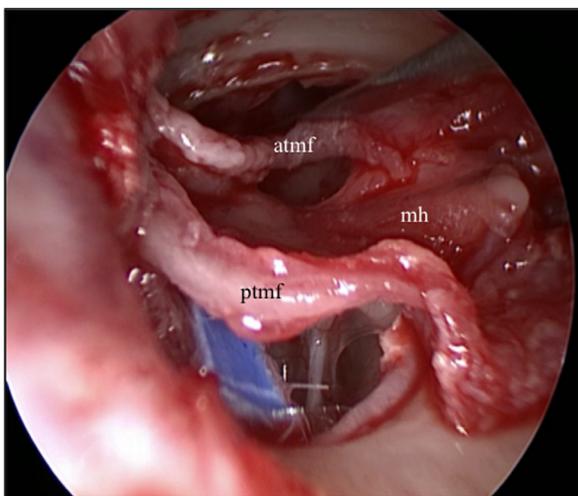


Fig. 2. An anterior and posterior tympanomeatal flap is harvested by preserving the anterior angle. atmf: anterior tympanomeatal flap; mh: handle of malleus; ptmf: posterior tympanomeatal flap.

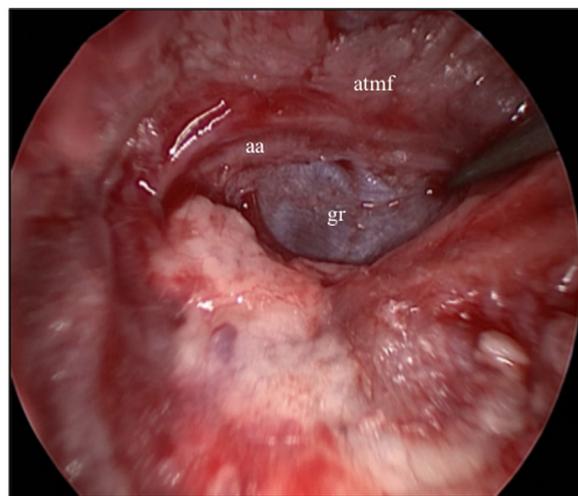


Fig. 4. Results at the end of the procedure. atmf: anterior tympanomeatal flap; aa: anterior annulus; gr: graft.

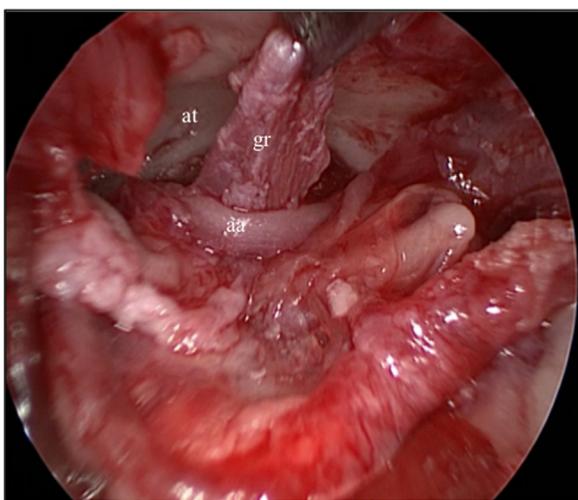


Fig. 3. The graft is introduced underneath the anterior tympanomeatal flap and placed on the anterior tympanic membrane. at: anterior tympanic membrane; gr: graft; aa: anterior annulus.

2.2. Step 2

Creation of anterior and posterior tympanomeatal flaps (Fig. 2). The annulus is not dissected in the anterior angle and remains inserted in the anterior and inferior part of the sulcus. The TM is totally detached from the umbo to the lateral process of the malleus when the perforation involves the handle of the malleus and/or the umbo.

2.3. Step 3

Introduction of the temporal aponeurosis by an underlay technique (Fig. 3):

- anteriorly, underneath the anterior tympanomeatal flap and the annulus, resting on absorbable gelatin sponge ensuring anterior fixation of the graft;
- posteriorly, beyond the posterior margin of the perforation, underneath or over the handle of the malleus.

2.4. Step 4

The anterior and posterior tympanomeatal flaps are repositioned, carefully replacing the annulus in the sulcus (Fig. 4).

Several absorbable gelatin sponges are placed over the TM. A silicone roll and then a Priest Otowick® are introduced into the external auditory canal and removed on postoperative day 10.

The operation is performed as an outpatient procedure in every case, except when surgery is performed late in the day.

Otoscopy assessment is performed before the operation, and then 2 months, 6 months and 12 months after surgery, by microscope otoscopy and a 0° endoscope, together with pure-tone audiometry with air and bone conduction at 0.5, 1, 2 and 4 kHz frequencies, as well as speech audiometry.

3. Discussion

Myringoplasty for TMP secondary to chronic otitis is the most commonly performed otological procedure and is designed to restore an intact TM and improve hearing [1,2].

ATMP constitutes a surgical challenge because of the specific characteristics of the anterior quadrants of the TM.

3.1. Due to the anatomy of the external auditory canal

When the anterior wall of the EAC masks the anterior TM, the anterior edge of the perforation cannot be adequately de-epithelialized and, consequently, the graft cannot be correctly placed on the anterior part of the canal, possibly resulting in medialization in the middle ear or blunting of the anterior angle. A “pull-through” myringoplasty technique has been described in these cases [3], but the narrow incision of the lateral part of the annulus requires good exposure of this region.

A microscopic transcanal approach can also be limited by EAC stenosis in children, requiring a posterior incision with canaloplasty.

3.2. Due to the physical properties of the anterior TM

The blood supply of the anterior TM is reduced, resulting in a risk of graft necrosis that can lead to persistence of a dehiscence between the graft and the edge of the TMP [10].

The success of myringoplasty performed to correct ATMP depends on 3 essential points:

- the TMP must be fully exposed to de-epithelialize the edges of the perforation. The 0° endoscope provides complete exposure of the TMP in the majority of cases, avoiding the need for canaloplasty. Strips of myringosclerosis lining the edges of the TMP can be sectioned separately;
- the graft must be placed over the anterior tympanic membrane. The anterior annulus is detached from the sulcus except in the antero-inferior angle of the EAC. The graft is pulled underneath the anterior annulus with excellent endoscopic exposure of the anterior edge of the perforation, avoiding medialization of the graft in the middle ear. Some authors have stressed the importance of anterior support using an underlay technique [4,5];
- the graft must be placed beyond the edges of the perforation.

At the posterior edge of the perforation, the graft must be systematically placed over the handle of the malleus and the umbo and underneath the residual TM when the perforation involves the malleus to avoid postoperative dehiscence between the graft and the malleus. In other cases, the graft is placed underneath the malleus. As reported by Peng and Lalwani [6], the graft is not always placed on the posterior tympanic membrane, but on absorbable gelatin sponge to prevent loss of the graft in the middle ear.

At the superior edge of the perforation, when the perforation extends beyond the lateral process of the malleus, anterior and superior fixation of the graft ensures greater stability, as reported by D'Eredita in a study using the operating microscope to treat ATMP [4].

At the anterior edge of the perforation, the anterior angle constitutes the anatomical limit of the technique and can lead to blunting. Excessive fibrous tissue can fill the anterior angle when the annulus is identified in this space [6], contributing to conductive hearing loss. The anterior fixation technique is adapted in the presence of residual TM in the anterior angle; the graft is then placed by an underlay technique without elevating the annulus. Preservation of the anterior angle also constitutes a key determinant of the postoperative hearing results.

The graft is usually placed as an underlay. The overlay technique is more difficult to perform with a one-handed endoscopic surgical procedure and can result in delayed healing, prolonged granular myringitis, cholesteatoma or blunting [6].

Bleeding usually occurs during elevation of the tympanomeatal flap and may lead to conversion from an endoscopic approach to the microscope, particularly for inexperienced surgeons. Adrenaline infiltration, the use of adrenaline-impregnated sponges and surgical training are the best ways to reduce bleeding. The presence of fog on the endoscope can usually be well controlled by the use of soapy solutions.

The surgeon must rigorously follow the procedure on the screen to avoid any risk of damage to the anatomical structures of the

middle ear by the endoscope or microsurgery instruments. Dissection of the ossicular chain must be performed by slow and very cautious movements, avoiding the use of hooks early during the experience with this technique.

Endoscopic transcanal surgery is a one-handed technique. Like all new techniques, training on temporal bone dissections is essential to accelerate the learning curve.

Other endoscopic myringoplasty procedures to treat ATMP have been described in the literature, but they are unable to control the state of the ossicular chain:

- anterior pull-through tympanoplasty [3];
- tympanoplasty by adipose graft for small perforations [7];
- push-through technique for small perforations situated away from the malleus and anterior malleolar ligament [8];
- butterfly myringoplasty [9].

4. Conclusion

Endoscopic transcanal surgery to treat ATMP with anterior fixation of the graft is an excellent alternative myringoplasty technique. It meets the conditions of a reference technique in our surgical practice.

Disclosure of interest

The authors declare that they have no competing interest.

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