

Cartilaginous myringoplasty: the endoscopic transcanal procedure

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Abstract The objectives of the study are to evaluate the feasibility, results and complications of the endoscopic transcanal cartilaginous myringoplasty. Thirty patients with a tympanic membrane perforation underwent a transcanal endoscopic cartilaginous myringoplasty, between June 2008 and January 2010. Three patients had a residual perforation at 2 months after surgery. At 1 year, the perforation was closed for 29 patients (96 %). There was no case of blunting, lateralization of the tympanic membrane or ossicular injury. Two patients had an iatrogenic superficial cholesteatoma in the tympanic membrane. There was no significant postoperative worsening of sensorineural hearing loss. The preoperative Air Bone Gap (ABG) was not correlated with the size or site of TMP. The evolution of ABG postoperatively was not significant. The statistical analysis was performed by the Student's *t* test. The endoscopic transcanal cartilaginous myringoplasty is a minimally invasive, effective and reliable procedure in the management of the tympanic membrane perforations.

Keywords Cartilage · Endoscopy · Myringoplasty · Perforation · Tympanic membrane

Introduction

Myringoplasty is the best treatment for tympanic membrane perforations (TMP). The objective is a total and definitive closure and in some cases hearing improvement.

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Temporal aponeurosis, perichondrium and cartilage are the most common grafts. The retroauricular approach is favoured by most otologists enabling a good exposure of the anterior quadrants. However, a canalplasty is often necessary [1–3]. The endaural approach enables a faster exposure. The transcanal approach is less invasive for posterior perforations. Drilling of the anterior part of external auditory canal (EAC) is usually imperative for anterior perforations [4].

All these surgical approaches are microscope assisted. The value of the endoscopes for cholesteatoma has been well established [5–10]. From a complementary device, the endoscopy has been developed as an exclusive transcanal surgical technique. On the basis of our experience of transcanal endoscopy in cholesteatoma and TM retraction pockets surgery, we have developed this technique for cartilaginous myringoplasty. The current article presents the results of 30 consecutive endoscopic transcanal cartilaginous myringoplasties (type I tympanoplasty) for TMP.

Patients and methods

The study included patients of more than 6 years old, with TMP caused by mesotympanic chronic otitis media. Patients with marginal perforation or retraction pocket were excluded. A local antibiotic and steroid treatment was performed in case of preoperative inflammation of the tympanic cavity.

The preoperative microscope and endoscope-assisted otoscopy (Karl Storz rigid endoscope 0°, 4 mm diameter, 6 cm length) determined the features of the perforation:

- localization (anterosuperior, anteroinferior, posterosuperior, posteroinferior)

- size,
- side (left or right),
- myringosclerosis on the edges,
- exposure (total, partial or hidden),
- contralateral ear (normal, perforation, serous otitis media, retraction pocket, cholesteatoma)

The average on four frequencies (0.5, 1, 2 and 3 kHz) of hearing thresholds in air and bone conduction and the Air Bone Gap (ABG) have been evaluated 8 days before surgery and 1 year after.

All the surgical procedures were performed by the same surgeon under general anaesthesia. A transmeatal endoscope-assisted approach was systematically performed. Before undergoing surgery, patients were informed of the possibility of a retroauricular approach. The endoscope was held in one hand (left hand for a right-handed surgeon), the instruments and the suction cannula alternatively in the other hand (Fig. 1). A canalplasty was discussed in case of major overhang of the EAC. Margins of the perforation were debrided. A tympanomeatal flap and the annulus were

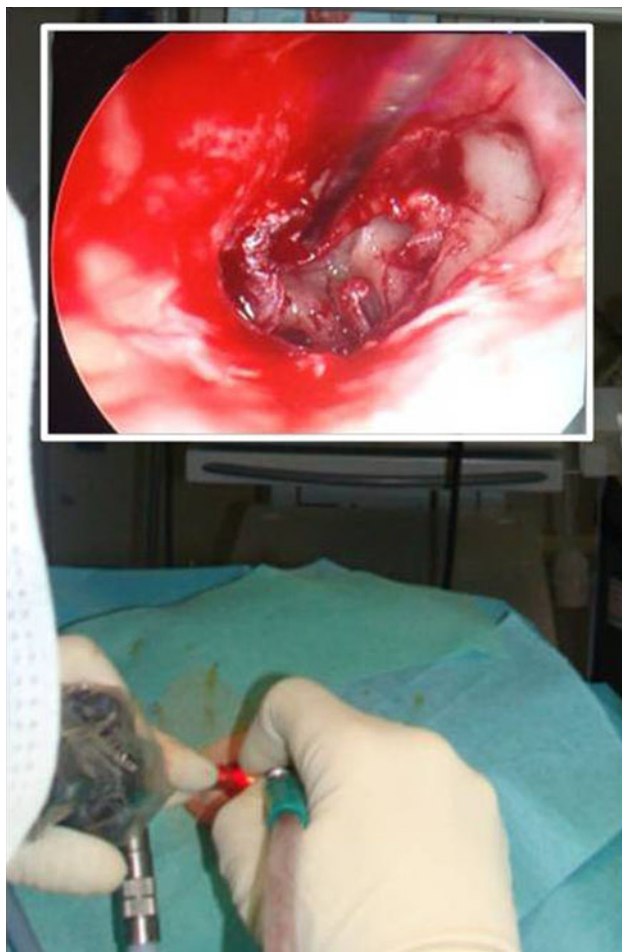


Fig. 1 Per-operative installation

raised. The marks are identified as hours on a clock (Fig. 2):

- from 1 to 7 o'clock for a posterior perforation (Fig. 2a)
- from 1 to 10 o'clock for an anteroinferior or central perforation (Fig. 2b)
- from 1 to 12 o'clock for an anterosuperior or total perforation (Fig. 2c)

A tragal perichondrium-cartilage graft was prepared by thinning of the cartilage and removing of the perichondrium at the medial part. The drum remnant was removed from the handle of malleus. The mobility of the ossicular chain was checked. The graft was shaped to the size of the perforation. For posterior perforation, the graft was placed in underlay technique, medial to the handle of malleus, tympanic membrane and annulus. For central, anterior and subtotal perforation, the graft was placed in over-underlay technique, lateral to the handle of malleus and medial to the tympanic membrane and annulus. The tympanometal flap was pulled down and the annulus meticulously inserted in the sulcus (Fig. 3a–d). The EAC was packed with a silastic roll and gelfoam, removed 8 days later. Patients were discharged 1 day after surgery and examined 8 days, 2 months, 6 months and 1 year after surgery.

The objectives were to study:

- the feasibility of a transcanal endoscope-assisted cartilaginous myringoplasty,
- the success rate,
- the complications: blunting, lateralization of the TM, iatrogenic cholesteatoma, ossicular injury,
- the hearing results,
- the benefits comparing to the microscope-assisted procedure.

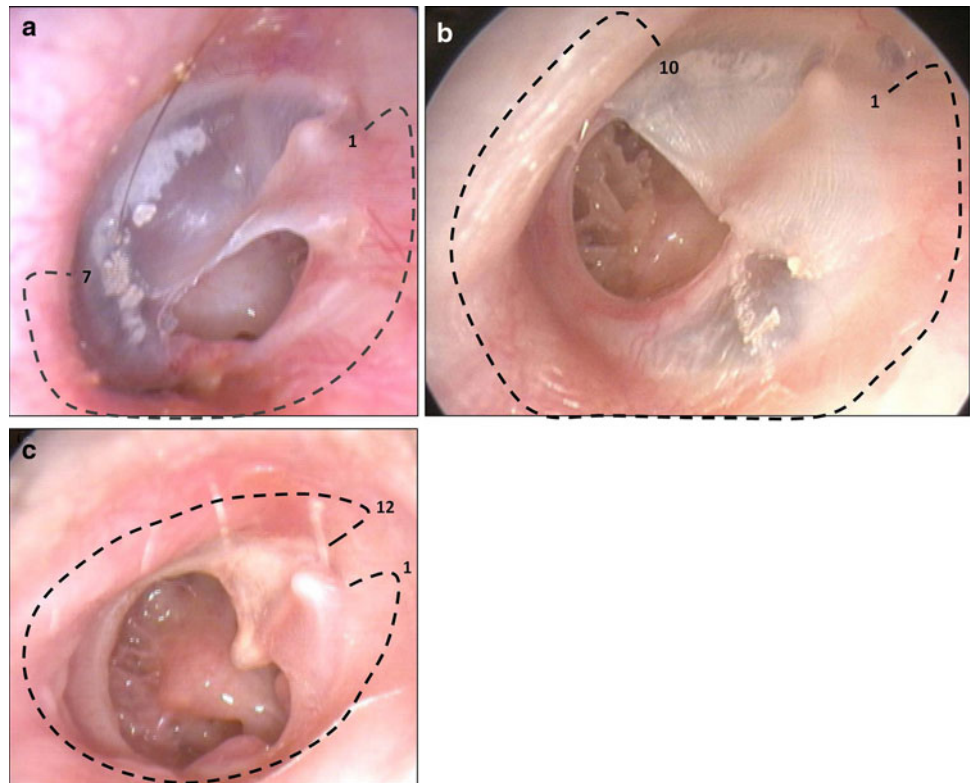
Results were statistically analyzed using the Student's *t* test. Statistical significance was accepted as $p < 0.01$.

Results

A total of 30 patients underwent endoscopic myringoplasty between June 2008 and January 2010 (6 on right side and 24 on left side). The mean age of patients was 53 years with a range of 11–87 years. Eight patients had history of myringoplasty in the affected ear, using temporal aponeurosis graft. The contralateral TM was normal in 20 cases (67 %). Ten patients had a contralateral seromucous otitis or retraction pocket (33 %). No retraction of the malleus was noticed on the side with the TMP.

The perforations were in 1, 2 or 3 quadrants in, respectively, 2, 22 and 6 cases (Table 1). Two patients had two perforations in the TM. An anterior quadrant (inferior or superior) was concerned in 26 cases (87 %).

Fig. 2 Tympanomeatal flaps for different localizations of the perforation.
a posterior perforation.
b anteroinferior perforation.
c subtotal perforation



The microscope-assisted exposure of the TM was partial in 22 cases, because of an overhang of the anterior part of the EEC (Table 2). The exposure was total in 28 cases with the 0°, 4 mm endoscope and in 2 cases with the 0°, 3 mm diameter endoscope. No canalplasty was performed.

Sclerosis was identified in 10 ears (33 %), in the posterior, anterior or superior edge in, respectively, 2, 4 and 2 cases and mostly all over the perforation in 2 ears.

The myringoplasty was performed with the over-underlay technique in 26 patients (87 %). The underlay technique was used for four patients (13 %) with a posterior TMP.

The perforation was closed for 27 patients (90 %) at 2 months and 29 patients (96 %) at 1 year after surgery. One failure occurred in the posterosuperior quadrant and closed spontaneously within 4 months. One patient underwent a re-perforation in the anterosuperior quadrant at sixth month, spontaneously closed at 1 year. The myringoplasty failed in the anterosuperior quadrant at 1 year after surgery (Fig. 4).

Bleeding occurred at the time of the elevation of the tympanomeatal flap, but also in four cases in the tympanic cavity, because of inflammatory mucosa, despite the preoperative local treatment, increasing the operative time. It never led to give up the endoscopic approach. Myringosclerosis was difficult to remove on the edges of the perforation, leading to enlarge the perforation in 10 cases.

The annulus was elevated in the anterior angle in 26 cases (87 %). No postoperative blunting occurred. In two cases, the annulus moved spontaneously from the sulcus, in the plane of the drum, without blunting (Fig. 5). The remnant was elevated from the handle of the malleus in 26 cases (87 %). No postoperative lateralization of the TM occurred.

Two patients had a superficial iatrogenic cholesteatoma on the umbo, 6 and 7 months after surgery. The cholesteatoma was totally removed at the office. No recurrence occurred at 1 year (Fig. 6a, b).

No postoperative facial nerve or ossicular chain related complications occurred. One patient woke up on the table, moving his head. The endoscope has been removed immediately, without ossicular injury.

The bone conduction deteriorated in five patients (p NS) (Table 3).

The mean ABG decreased from 17.7 dB to 7.9 dB (mean reduction 55 %, limits 29–81 %) (p NS). There was no significant correlation between the preoperative ABG and the size of the TMP. The mean air conduction level increased in four cases (5.6–7.5 dB) for patients with small posterior perforation (<1 quadrant). The explanation could be the position of the cartilaginous part of the graft, overflowing on the posterior ear canal. No correlation between the preoperative ABG and the localization of the perforation was identified.

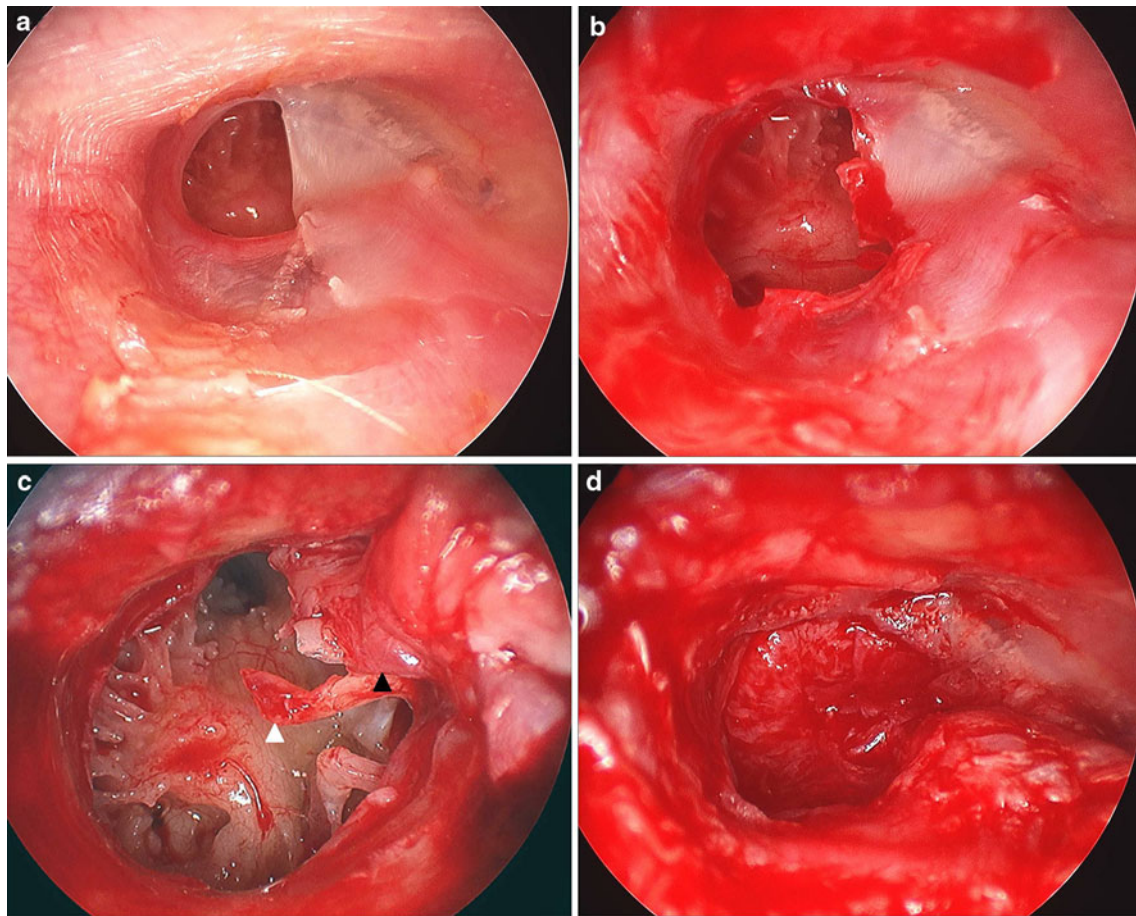


Fig. 3 **a** Surgical procedure. Anteroinferior perforation (*left ear*). **b** Surgical procedure. Removal of the edges of the perforation. **c** Surgical procedure. The tympanomeatal flap is attached on the

upper part of the malleus (*black arrow*), the umbo is free (*white arrow*). **d** Surgical procedure. Myringoplasty with the cartilage-perichondrium graft

Table 1 Localizations of the perforations

<i>n</i> = 30	Anterosuperior quadrant	Anteroinferior quadrant	Posterosuperior quadrant	Posteroinferior quadrant
2		+		
18		+		+
4			+	+
4		+	+	+
2	+	+		+

Table 2 Preoperative microscope-assisted exposure of the TM

Hidden	0		
Total	8 (27%)		
Partial	22 (73%)		
	Anterior perforation	Posterior perforation	Inferior perforation
	22	0	0

Higher preoperative ABGs were noticed with anterior perforations. The more important reductions of ABG (beyond 69 %) concerned patients with these perforations, but results were not statistically significant.

Discussion

The endoscopic approach of the middle ear is well known in the surgical management of cholesteatoma. Endoscopes

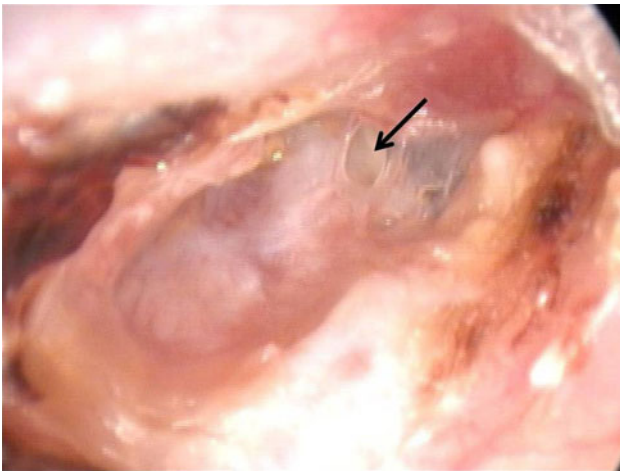


Fig. 4 Residual perforation (*black arrow*)

are used as complementary devices to the microscope or for an exclusive transcanal approach [5–12]. Publications have previously reported the value of the endoscope-assisted myringoplasty. Patients were adults, perforations were central and smaller than 5 mm diameter [13], grafts were temporal aponeurosis [13–15] or fat [16].

Surgical management of anterior perforations needs a total exposure of the anterior angle. The microscope overlooked the anterior edge of 22 perforations (73 %). The exposure was total with 0° endoscope in all cases. In some cases, the perforation can be totally hidden to the microscope, under an overhang of the anterior part of the EEC (Fig. 7). Most of the time, the transcanal endoscopy avoids canaplasty.

Microscopic ear surgery is performed with two hands, enabling a continuous suction. Endoscopic surgery is a one-hand technique. Bleeding is often considered as a limit, because one hand holds the endoscope. Many solutions can help to prevent the bleeding: preoperative steroid

local preparation, low and stable preoperative blood pressure, local adrenalin, instruments coupled with suction. Bleeding occurred at the time of elevation of tympanomeatal flap. This never led to give up the endoscope. Bleeding stopped most of the time in the tympanic cavity and was less and less problematic with experience. On the other hand, the use of an arm to keep one hand free for the suction cannula must be avoided. The technique must remain dynamic, especially if the patient moves the head.

The perforation was closed in 27 patients (90 %) at 2 months and 29 patients (96 %) at 1 year after surgery. The average success rate of microscope-assisted myringoplasty ranges between 90 and 95 % [17]. The published rates of endoscope-assisted myringoplasty range between 80 and 91.7 % [13, 15, 16]. The comparison between the surgical techniques is difficult. Surgical approaches are different. Usually the endoscopic procedure is performed by introducing a graft through small perforations. Grafts are different (aponeurosis, fat, cartilage). In the current study, the elevation of the tympanomeatal flap and the annulus enables the comparison with the microscope-assisted technique. All perforations were included, whatever their diameter was.

Publications have reported the value of microscope-assisted cartilaginous myringoplasties [18–21]. The reconstruction of the scutum and the TM is routinely performed with tragal cartilage in the cholesteatoma endoscopic surgery [5–12]. A residual perforation remained 1 year after surgery, in the anterosuperior quadrant. A technical mistake occurred. The perichondrium was not correctly arranged on the ear canal and the cartilage fell in the tympanic cavity.

Complications of myringoplasty are rarely published.

The Blunting can occur after elevation of the annulus in the anterior angle. Vartiainen analyzed failures in 417 myringoplasties. Blunting of the anterior angle occurred in seven ears [22]. The dissection of the annulus in the anterior angle must be meticulous. The total exposure imposes

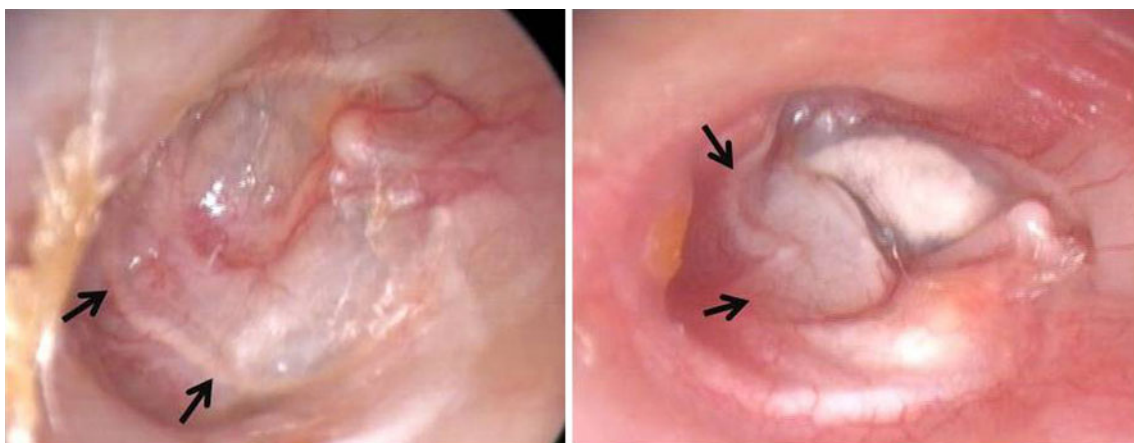


Fig. 5 Moving of the annulus from the sulcus (*black arrow*)

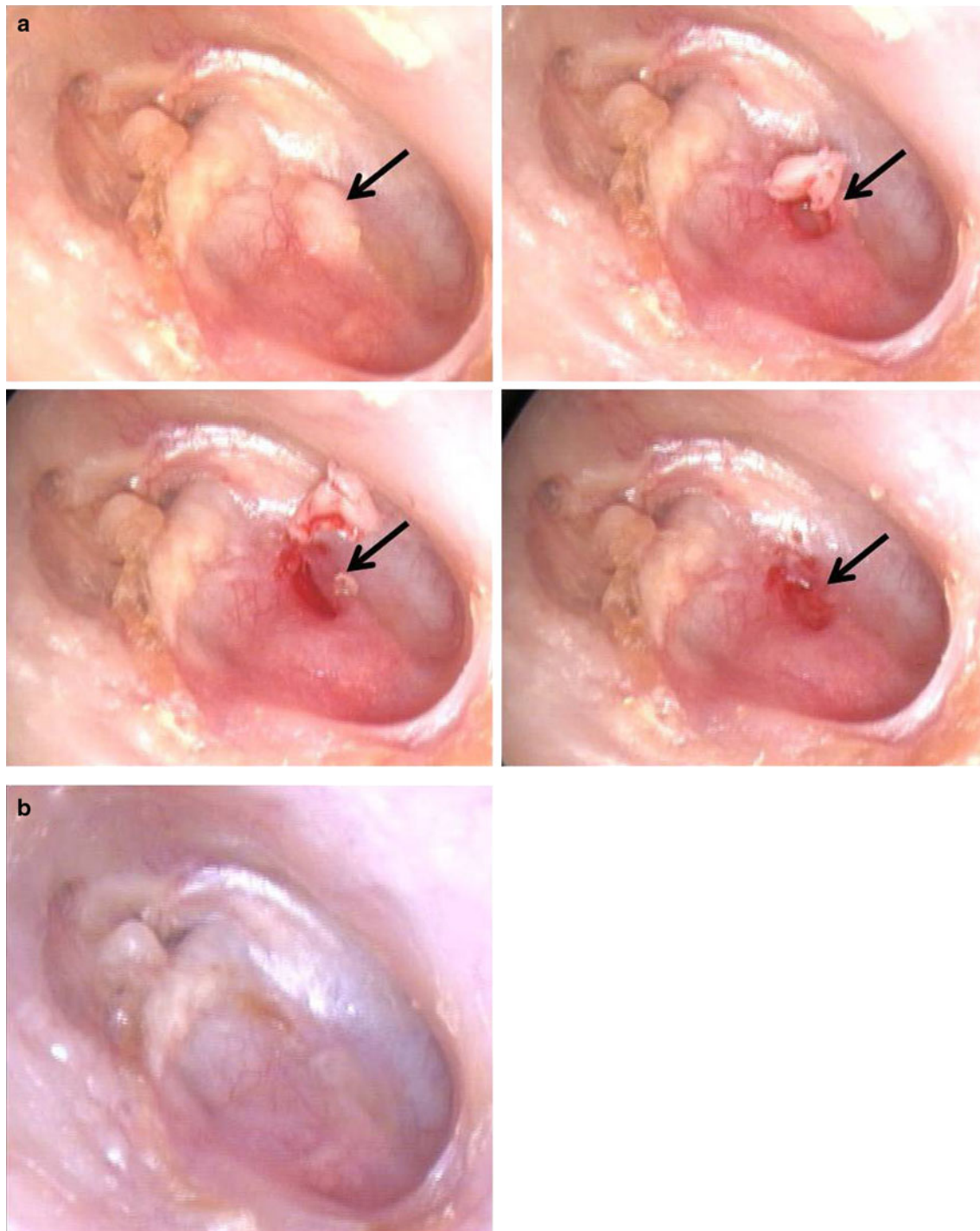


Fig. 6 **a** Removal of iatrogenic cholesteatoma (*black arrow*). **b** Result at 6 months after removal of iatrogenic cholesteatoma

usually a transcanal drilling of the anterior part of the EEC often with a retroauricular approach. Endoscope provides this exposure without any drilling, except wide overhang of the EEC, mostly up to the handle of the malleus.

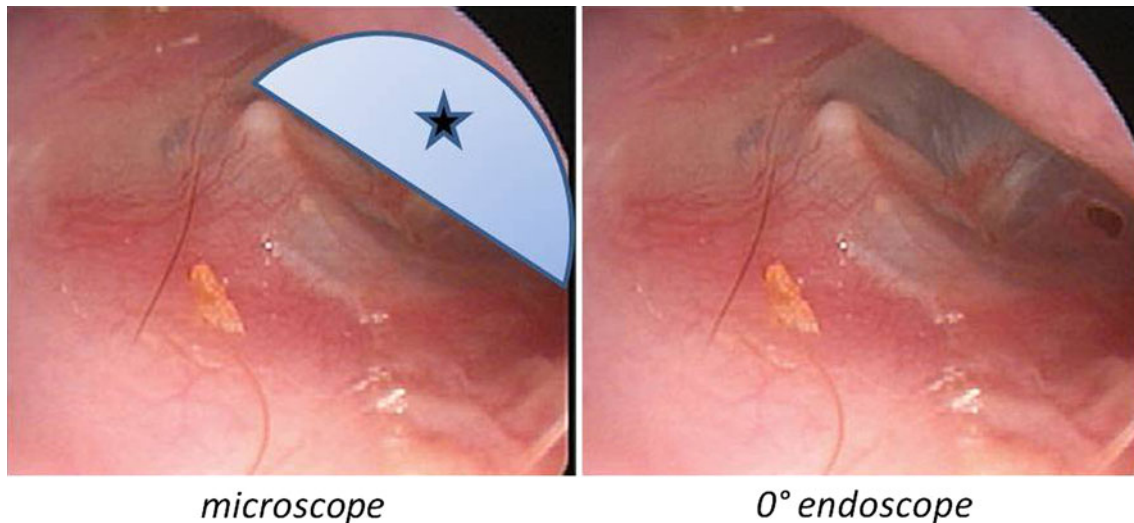
Most of the myringoplasties were performed with over-underlay technique in our series. The cartilaginous graft placed lateral to the handle of the malleus contributes to

prevent medialization of the graft [23], but exposes to lateralization. No case was identified. The handle was introduced in a notch in the cartilage and covered by perichondrium arranged under tympanic membrane remnant.

Two patients had iatrogenic cholesteatoma in the TM. Such complication is rarely reported in literature and occurred usually on the umbo [24] due to squamous

Table 3 Pre and postoperative hearing results

	Preoperative results		Preoperative ABG	Postoperative results		Postoperative ABG
	Air conduction	Bone conduction		Air conduction	Bone conduction	
Limits	10.7–81.3	5–66	5–36.3	13.8–72.5	6–70	3–13.2
Mean	45.5	27.7	17.7	35.3	28.1	7.9

**Fig. 7** Microscope-assisted otoscopy. Anterior hidden space (*black star*)

epithelium attached to the handle of the malleus. The dissection of the tympanic remnants must be very careful. A High Definition camera will be helpful. No recurrence occurred in both cases after removal at the office 1 year later and no other case was identified. This complication underlines the value of a long-term follow-up.

No postoperative facial nerve or ossicular chain complication occurred. One patient woke up on the table, moving his head. The endoscope has been removed immediately, without ossicular injury. One-hand video-assisted surgery is not usual for ear surgeons. The experience of sinus surgery can reduce the learning curve. An arm holding the endoscope would create dramatic damages if the patient moves the head. The surgeon must be ready to remove quickly the endoscope from the ear.

No patient had significant worsening of sensorineural hearing loss. There was no significant correlation between the size of TMP and preoperative hearing results. Previous publications have reported that ABG increases with perforation size [25, 26]. In the series, the ABG increased postoperatively for small posterior perforations (less than 1 quadrant) with preoperative very low ABG. The higher preoperative ABGs were identified for anterior perforations. This result is not statistically significant. Anterior and posterior perforations showed no significant difference in ABG in a previous study [25].

All patients were discharged the day after surgery. Endoscopic transcanal myringoplasty is a minimally invasive technique in surgical approach, postoperative bleeding and pain. This endoscopic procedure could be performed in ambulatory surgery.

Conclusion

The endoscopic transcanal cartilaginous myringoplasty is feasible and reliable. Endoscopes provide good exposure of the TM, usually without canalplasty. Postoperative cares are easy as the technique is minimally invasive in surgical approach, scar, bleeding and pain.

This technique should be learned, surgical experience of endoscopic surgeons should be shared. This is the objective of the IWGEES (International Working Group on Endoscopic Ear Surgery).

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