Clinics in Surgery

Research Article
Published: 10 Apr, 2020

Endoscopic Tympanoplasty in Patients with Tympanic Membrane Perforation

Yueqi Wang, Yao Qin, Zhe Chen, Caifeng Xia, Yi Zhang and Yuhe Liu*

Department of Otolaryngology, Head & Neck Surgery, Peking University First Hospital, China

Abstract

Repairing the perforations of the tympanic membrane, devising a simple and effective technique for performing the repair is crucial. The present study is to evaluate the efficacy of endoscopic transcanal myringoplasty for repairing perforations of the tympanic membrane. The medical record review included 43 patients who underwent endoscopic transcanal myringoplasty from March 2018 to November 2019 at Peking University First Hospital (Beijing, China). Patients with ossicular chain disease and cholesteatoma or inadequate follow-up were excluded. Patients were followed up for 1 month, and final follow-up was completed on January 2020. The main outcome was the rate of overall graft success after endoscopic transcanal myringoplasty. Secondary outcomes included hearing results and prognostic factors.

The study sample included the medical records of 43 cases (25 males [59%]; 18 females [41%]; mean [SD] age, 43.2 [7.8] years) who underwent endoscopic transcanal myringoplasty. Overall, 42 patients (98%) had a successful graft at 1 postoperative month. Moreover, the mean preoperative and postoperative air-bone gaps were 16.9 (9.3) and 5.6 (6.6) dB, respectively, revealing a significant improvement of 11.6 dB (Cohen d, 1.27; 95% CI, 90-1.63; P<0.001, paired t test) in the air-bone gap. Twenty patients (46%) had preoperative air-bone gaps of less than 20 dB, whereas 42 patients (98%) had postoperative air-bone gaps of less than 20 dB.

Keywords: Endoscope; Tympanic membrane perforation; Tympanoplasty

Introduction

Tympanic membrane can be damaged by trauma, such as a slap to the head, or by fluid resulting from infection in the middle ear (called acute otitis media) bursting its way out through the member (effusion). These factors can cause holes or perforation of the eardrum, which reduce the amount of sound energy that is captured by the ear thereby causing hearing loss. The eardrum can become scarred as a result of repeated infection. This scarring referred to as tympanosclerosis, increase the stiffness of the member, reducing its efficiency as a sound transmitter.

Since the 1950s, microscopic tympanoplasty has become the standard treatment of a perforated tympanic membrane [1]. The operation can be performed using 2 classic techniques, including underlay and overlay graft tympanoplasty [2,3]. In the underlay technique, the graft is placed medial to the remaining tympanic membrane and malleus. In the overlay technique, the graft is placed lateral to the anulus and remaining fibrous middle layer.

Transcanal Endoscopic Ear Surgery (TEES) is becoming popular in the field of otology with the advancement of optical and medical engineering techniques. In the past, an endoscope was used as an adjunct to an operating microscope, but recently it is increasingly being employed exclusively in otologic surgery. The Asians' external auditory meatus are more bending, so the anterior perforations exposure is much more difficult. As a result, tympanoplasty for closing anterior perforations of the tympanic membrane is considered challenging. The reasons for poor surgical outcomes include a reduced vascular supply, limited anterior margin, poor visualization, and inadequate graft stabilization [4-6]. In addition to microscopic tympanoplasty, TEES has been performed increasingly since the 1990s [7-20]. Compared with microscopy, endoscopy provides a wider surgical view, which can avoid postauricular incision and canalplasty for treating tympanic perforations through the narrow bending external auditory canal [21-23]. Although TEES must be performed one-handed, it can provide a wider surgical view compared to a conventional microscope. The wide surgical view enables the surgeon to observe hidden areas closely with less interference by the curvature of the external auditory canal. TEES is thus useful in patients with unfavorably shaped

OPEN ACCESS

Correspondence:
Yueqi Wang, Department of Otolaryngology, Head & Neck Surgery, Peking University First Hospital, 8# Xishiku Str. Western District, Beijing, 100034, China,
E-mail: williamwang1991@126.com

Received Date: *30 Mar 2020*
Accepted Date: *08 Apr 2020*
Published Date: *10 Apr 2020*

Citation:
Wang Y, Qin Y, Chen Z, Xia C, Zhang Y, Liu Y. Endoscopic Tympanoplasty in Patients with Tympanic Membrane Perforation. Clin Surg. 2020; 5: 2799.

external auditory canals who would have required a postauricular approach [24]. Despite the fact that the endoscope allows close observation of the ossicles, as well as various tympanic recesses in the middle ear, there are few studies on TEES for tympanic membrane perforation [25]. So the aim of this study is to estimate the efficiency of TEES for tympanic membrane perforation.

Methods

Patients

The Institutional Review Peking University First Hospital (Beijing, China) approved this study and waived the need for obtaining informed consent from participants due to the use of anonymized patient data. We reviewed the medical records of 47 patients who underwent endoscopic transcanal myringoplasty. Of these patients, 4 were excluded because of an inadequate follow-up period of less than 1 month, and the remaining 25 men [59%]; 18 women [41%]; mean (SD) age, 43.2 [7.8] years, were included in the analysis. We retrospectively analyzed 43 patients with tympanic membrane perforation, who underwent primary surgery using ear endoscope from March 2018 to November 2019. All surgeries were performed by a single surgeon. All patients underwent high-resolution computed tomography of the temporal bone and hearing test before surgery. Patients with tympanic membrane perforation in combination with an inner ear anomaly, other middle ear disease such as cholesteatoma, and those with revision surgery were excluded.

Surgical techniques

All patients underwent general anesthesia. For endoscopic surgery, exploratory tympanotomy was conducted *via* the transcanal approach using 0-degree rigid endoscopes (outer diameter, 4 mm and length, 14 cm) (Karl Storz, Tuttlingen, Germany). The periaural area and external ear canal were infiltrated with 2% lidocaine hydrochloride and 1:100,000 epinephrine. Transcanal injections were administered in all 4 quadrants using a 26-gauge needle under direct endoscopic visualization. Meanwhile, blanching of the canal skin was observed, and hemorrhagic bulbs were prevented by slowly and carefully injecting local anesthesia. We used the tragal cartilage with perichondrium as graft material. For harvesting of the tragal perichondrial graft, a 1 cm incision was made 2 mm to 3 mm medial to the free border of the tragal cartilage by cutting through the skin and cartilage to avoid the exposition of the incision. The 1 mm margin cartilage was preserved to maintain the shape of the tragal. The incision was sutured with absorbable material. Using the concave shape of tragal cartilage with perichondrium on one side, the cartilage is trimmed into suitable size surrounding with over 1 mm to 2 mm perichondrium (Figure 1).

Endoscopic type I tympanoplasty: When we performed endoscopic type I tympanoplasty with elevation of the tympanomeatal flap. First, the perforation margin and anulus were visualized through endoscopy. The perforation margin was circumferentially freshened with a pick or a sickle knife (Figure 2).

An incision was made 6 mm to 8 mm away from the tympanic anulus posteriorly and extended from the 12-o'clock to the 7-o'clock positions nearby the tubal orifice. The tympanomeatal flap was subsequently elevated to the level of the fibrous anulus. In particular, the anteroinferior drum ring is completely separated and the drum groove is fully exposed. Cottonoid pledgets soaked with epinephrine were applied to reduce bleeding from the cut edges of the flap. The malleus handle was fully dissociated from tympanic membrane down

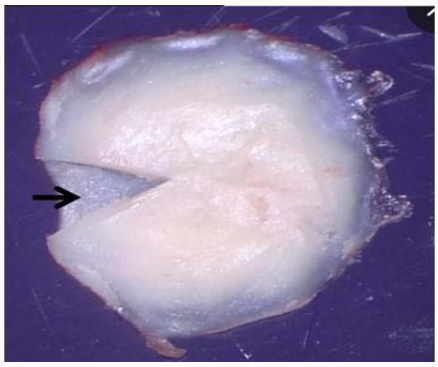

Figure 1: The tragal cartilage with perichondrium on one side, and the cartilage is trimed into suitable size. Over 2 mm perichondrium was retained. → A wedge-shape was made to shape the malleus handle.

Figure 2: The perforation margin was circumferentially freshened with a pick or a sickle knife.

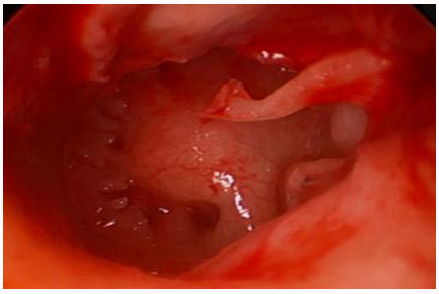

Figure 3: As the middle ear cavity was exposed, we examined the integrity and mobility of the ossicular chain and the liquidity of auditory.

to the short process of the malleus and the epithelial tissue on the malleus handle was cleaned. After the middle ear cavity was exposed, not only the integrity and mobility of the ossicular chain but also the Eustachian orifice were examined (Figure 3).

A cartilage graft reserved one side of the perichondrium was trimmed to an appropriate size, thin around the cartilage. And a wedge-shaped groove was prepared on the circular side, leaving the perichondrium intact, as shown in Figure 1. Then the graft was placed lateral to the malleus handle, with a wedge shaped slot on the malleus handle to prevent internal displacement of the graft. The margin of the graft was placed on the sulcus tympanicus. Absorbable gelatin sponges were packed in the middle ear cavity to support the graft from medialization. The tympanomeatal flap was subsequently replaced to its original position (Figure 4).

The external auditory canal was packed with absorbable gelatin sponge pledgets to the level of the isthmus. The tragal incision was packed with a cottonoid ball placed in the orifice of the external auditory canal. No mastoid dressing was required. The patients were

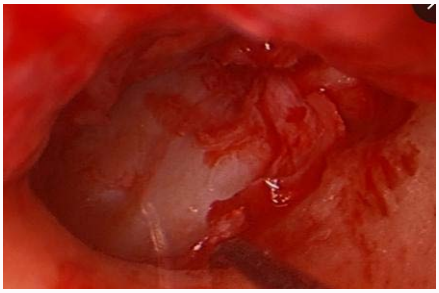

Figure 4: The trimed graft was placed on the tympanic sulcus and the cuniform crack of graft was placed surfacel to the malleus handle to prevent graft medialization.

discharged on the day of the surgery. The packing and stitches were removed 2 weeks postoperatively. Hearing tests were performed at 2 weeks postoperatively.

Statistical analysis

Statistical analysis was performed using SPSS software (version 16 for Windows; SPSS Inc/IBM). The study results were expressed as mean (SD) for continuous variables and as percentages for categorical variables. We compared the study data using the paired t, χ^2, and univariate logistic regression tests. Effect sizes were reported as Cohen d and Odds Ratios (ORs) with 95% CIs. The differences between groups were considered significant at $P<0.05$.

Results

Patient characteristics

Overall graft success was determined at 1 postoperative month in 42 of 43 patients (98%). Moreover, the mean preoperative and postoperative air-bone gaps were 16.9 (9.3) and 5.6 (6.6) dB, respectively, revealing a significant improvement of 11.6 dB (Cohen d, 1.27; 95% CI, 0.90-1.63; P <0.001, paired t test) in the air-bone gap.

Complications

The medialized graft was found in one case and resulted in the failed repair. The residual cleft was in the anteroinferior eardrum. The patient underwent later revision procedures that repaired the previous perforations. No patients reported sensorineural hearing loss.

Discussion

The major difference between microscopy and endoscopy is the surgical view. Tarabichi et al. [18,19] reported that the view during microscopic surgery is defined and limited by the narrowest segment of the ear canal. By contrast, transcanal endoscopy bypasses the narrow segment of the ear canal and provides a wide view, even when a 0° endoscope is used. Furukawa et al. [14], Lade et al. [22], and Harugop et al. [21] conducted studies to compare the microscopic and endoscopic views in tympanoplasty. They reported that in the microscopy groups, the tympanic anulus was not completely visualized in 17% to 20% of patients, thus requiring canalplasty. However, in the endoscopy groups, the tympanic anulus was completely visualized; hence, no patient required canalplasty. Ayache [13] reported an even higher rate of 73% of patients in whom perforations of the tympanic membrane were poorly visualized. Our study showed complete visualization of the perforation margin through otoscopy in 43 patients; none of them required canalplasty. All of these reports reveal that endoscopy provides a wider surgical view than microscopy, particularly in the cases of bony overhangs of the external auditory canal and perforations of the tympanic membrane.

Table 1: Preoperative to postoperative air-bone gaps.

Air-Bone Gaps, dB	No. (%) of Patients	
	Preoperative	Postoperative
<10	7 (16)	34 (79)
Oct-20	13 (30)	8 (19)
>20	23 (53)	1 (2)

Table 1 displays the changes from preoperative to postoperative air-bone gaps. Twenty patients (46%) had preoperative air-bone gaps of less than 20 dB, whereas 42 patients (98%) had postoperative air-bone gaps of less than 20 dB.

Comparing the success rates of microscopic and endoscopic tympanoplasty is often the main concern. Success rates of 90% to 95% for microscopic myringoplasty have been reported [2,3]. Similar success rates of 80% to 100% have also been reported for endoscopic myringoplasty [7,10,11]. Harugop et al. [21] and Lade et al. [22] compared the success rates of microscopic and endoscopic myringoplasty and reported no difference. For perforations of the tympanic membrane, the rates of graft success for microscopic overlay and modified underlay tympanoplasty ranged from 88% to 98% [5,6,26-28]. Our results reveal a rate of graft success of 98%. Our air-bone gap closure rates were also comparable with those previously reported [5,6,26-28]. However, our technique is less invasive because postauricular incision, canalplasty, and general anesthesia were not required. Moreover, the operative time was reduced to approximately 1 h, and all patients were discharged on the day after surgery.

Endoscopy has several disadvantages in ear surgery compared with microscopy. First, the endoscope must be held in one hand, and only the other hand is free to operate; this procedure is particularly cumbersome when bleeding obscures the view of the operating field. In addition, endoscopy provides a monocular view, which causes the loss of depth perception compared with the binocular view provided through microscopy. Moreover, endoscopic myringoplasty still requires more training experience [10,18,19].

The present study has 2 limitations. First, this study included a relatively small sample size, resulting in a lack of generalizability of the findings. Second, this study was a retrospective medical record review, and the patients who were lost to or unavailable for follow-up might have caused recall and selection bias. A prospective study with a larger patient sample is recommended.

Conclusion

Our study revealed that wider endoscopic visualization can neglect the factor of partial visualization of the perforation margin through otoscopy, which increases the rate of graft success in perforations of the tympanic membrane. Therefore, the rate of graft success and hearing results are comparable with those of microscopic myringoplasty for repairing perforations of the tympanic membrane. However, our technique is simpler because no incision was performed. Thus, endoscopic transcanal myringoplasty should be considered for repairing perforations of the tympanic membrane.

References

1. Zollner F. The principles of plastic surgery of the sound-conducting apparatus. J Laryngol Otol. 1955;69(10):637-52.

2. Sheehy JL, Anderson RG. Myringoplasty. A review of 472 cases. Ann Otol Rhinol Laryngol. 1980;89(4 Pt 1):331-4.

3. Rizer FM. Overlay *vs.* underlay tympanoplasty. Part II: The study. Laryngoscope. 1997;107(12 Pt 2):26-36.

4. Applebaum EL, Deutsch EC. An endoscopic method of tympanic membrane fluorescein angiography. Ann Otol Rhinol Laryngol. 1986;95(5 Pt 1):439-43.

5. Schraff S, Dash N, Strasnick B. "Window shade" tympanoplasty for anterior marginal perforations. Laryngoscope. 2005;115(9):1655-9.

6. Peng R, Lalwani AK. Efficacy of "hammock" tympanoplasty in the treatment of anterior perforations. Laryngoscope. 2013;123(5):1236-40.

7. el-Guindy A. Endoscopic transcanal myringoplasty. J Laryngol Otol. 1992;106(6):493-5.

8. Raj A, Meher R. Endoscopic transcanal myringoplasty - A study. Indian J Otolaryngol Head Neck Surg. 2001;53(1):47-9.

9. Usami S, Iijima N, Fujita S, Takumi Y. Endoscopic-assisted myringoplasty. ORL J Otorhinolaryngol Relat Spec. 2001;63(5):287-90.

10. Karhuketo TS, Ilomäki JH, Puhakka HJ. Tympanoscope-assisted myringoplasty. ORL J Otorhinolaryngol Relat Spec. 2001;63(6):353-7.

11. Yadav SP, Aggarwal N, Julaha M, Goel A. Endoscope-assisted myringoplasty. Singapore Med J. 2009;50(5):510-2.

12. Mohindra S, Panda NK. Ear surgery without microscope; is it possible. Indian J Otolaryngol Head Neck Surg. 2010;62(2):138-41.

13. Ayache S. Cartilaginous myringoplasty: The endoscopic transcanal procedure. Eur Arch Otorhinolaryngol. 2013;270(3):853-60.

14. Furukawa T, Watanabe T, Ito T, Kubota T, Kakehata S. Feasibility and advantages of transcanal endoscopic myringoplasty. Otol Neurotol. 2014;35(4):e140-5.

15. Dündar R, Kulduk E, Soy FK, Aslan M, Hanci D, Muluk NB, et al. Endoscopic *vs.* microscopic approach to type 1 tympanoplasty in children. Int J Pediatr Otorhinolaryngol. 2014;78(7):1084-9.

16. Migirov L, Wolf M. Transcanal microscope-assisted endoscopic myringoplasty in children. BMC Pediatr. 2015;15:32.

17. Awad OG, Hamid KA. Endoscopic type 1 tympanoplasty in pediatric patients using tragal cartilage. JAMA Otolaryngol Head Neck Surg. 2015;141(6):532-8.

18. Tarabichi M. Endoscopic middle ear surgery. Ann Otol Rhinol Laryngol. 1999;108(1):39-46.

19. Panetti G, Cavaliere M, Panetti M, Marino A, Iemma M. Endoscopic tympanoplasty in the treatment of chronic otitis media: Our experience. Acta Otolaryngol. 2017;137(3):225-8.

20. Eren SB, Tugrul S, Ozucer B, Veyseller B, Aksoy F, Ozturan O. Endoscopic transcanal inlay myringoplasty: Alternative approach for anterior perforations. Otolaryngol Head Neck Surg. 2015;153(5):891-3.

21. Harugop AS, Mudhol RS, Godhi RA. A comparative study of endoscope assisted myringoplasty and micrsoscope assisted myringoplasty. Indian J Otolaryngol Head Neck Surg. 2008;60(4):298-302.

22. Lade H, Choudhary SR, Vashishth A. Endoscopic *vs.* microscopic myringoplasty: A different perspective. Eur Arch Otorhinolaryngol. 2014;271(7):1897-902.

23. Pinar E, Sadullahoglu K, Calli C, Oncel S. Evaluation of prognostic factors and middle ear risk index in tympanoplasty. Otolaryngol Head Neck Surg. 2008;139(3):386-90.

24. Salviz M, Bayram O, Bayram AA, Balikci HH, Chatzi T, Paltura C. Prognostic factors in type I tympanoplasty. Auris Nasus Larynx. 2015;42(1):20-3.

25. Nardone M, Sommerville R, Bowman J, Danesi G. Myringoplasty in simple chronic otitis media: Critical analysis of long-term results in a 1,000-adult patient series. Otol Neurotol. 2012;33(1):48-53.

26. Jung TT, Park SK. Mediolateral graft tympanoplasty for anterior or subtotal tympanic membrane perforation. Otolaryngol Head Neck Surg. 2005;132(4):532-6.

27. Seidman MD. Anterior transcanal tympanoplasty: A novel technique to repair anterior perforations. Otolaryngol Head Neck Surg. 2008;138(2):242-5.

28. Lee HY, Auo HJ, Kang JM. Loop overlay tympanoplasty for anterior or subtotal perforations. Auris Nasus Larynx. 2010;37(2):162-6.