

## Original Research Article

# Merits and demerits of endoscopic tympanoplasty

**Kirti P. Ambani\***, Bhavya B. M., Sanket D. Vakharia, Ankur Khanna, Ashish U. Katarkar

Department of ENT, GMERS Medical College, Gandhinagar, Gujarat, India

**Received:** 28 February 2017

**Accepted:** 06 March 2017

**\*Correspondence:**

Dr. Kirti P. Ambani,

E-mail: [kirtipallav1469@yahoo.co.in](mailto:kirtipallav1469@yahoo.co.in)

**Copyright:** © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

### ABSTRACT

**Background:** Aim of the study was to evaluate the merits and demerits of endoscopic tympanoplasty compared to conventional microscopic tympanoplasty.

**Methods:** This prospective comparative study was carried out between October 2015 to September 2016 in our otolaryngology department, for a period of 12 months. Total of 40 patients who fit into inclusion criteria, underwent endoscopic tympanoplasty under local anaesthesia with sedation. All laboratory preoperative testing was done; hearing evaluation was done with audiometry. Postoperative follow up was done at 2<sup>nd</sup> and 3<sup>rd</sup> month's period, graft status and hearing evaluation with PTA for all four frequencies 500, 1000, 2000 and 4000 Hz with air conduction and bone conduction thresholds were recorded.

**Results:** Out of 40 patients, 16 (40%) were males, and 24 (60%) were females, there were 21 (52.5%) cases had moderate perforation, 15 (37.5%) cases had large perforation and 4 (10%) cases had subtotal perforation. Average time taken was of around 1hour and 30minutes, range was (70-140min.). All patients were evaluated for graft status, hearing gain and cosmetic results. Out of 40 patients, 35 (87.5%) patients had successful graft uptake, 2 (5%) patients had graft infection and 3 (7.5%) patients had residual perforation seen postoperatively.

**Conclusions:** Use of endoscope not only serves as a great teaching tool, but also helps to visualize the middle ear anatomy and pathology intraoperatively with minimal soft tissue manipulation better cosmesis and reduced postoperative morbidity. In our study, we found that endoscopic tympanoplasty had better graft uptake rate.

**Keywords:** Rigid Endoscope, Tympanoplasty, Chronic suppurative otitis media, Pure tone audiometry

### INTRODUCTION

Myringoplasty is a surgical procedure which is confined to the drum head without manipulation of the ossicles or middle ear. Tympanoplasty is the surgical procedure which includes the manipulation of tympanic membrane and eradication of disease from the middle ear if present, if it is done in conjunction with manipulation of the ossicles it is known as tympanoossiculoplasty. Surgery that includes manipulation of mastoid along with tympanoplasty is known as tympanomastoidectomy. The development of tympanoplasty techniques led by incidental and inspirational contribution from surgeons all over the world. Specialized instruments like the ocular magnifying loops and the operating microscope opened

up a new dimension to otology surgery. The newest technique of performing tympanoplasty is the endoscopic tympanoplasty. Initially endoscopes were used for diagnostic and teaching purpose of tympanic membrane and ear canal. Mer and colleagues introduced middle ear endoscopy in 1967.<sup>1</sup> From then, endoscopes are increasingly used for various middle ear surgeries. In recent years, many surgeons have adopted it for middle ear surgery as opposed to microscope assisted ear surgery. Transcanal endoscopic approaches of middle ear provide wide angled view for inspecting the anatomy of the middle ear and redefining of the ossicles, which allows a better understanding of the ligaments and folds of the middle ear and help to understand the physiology of different spaces.<sup>2</sup> The aim of otology surgeons at

present is to provide maximum hearing to the patients along with eradication of disease with least morbidity. Tympanoplasty is commonly performed surgery. Aim of this study was to determine merits and demerits of endoscopic tympanoplasty over microscopic tympanoplasty and compare results in terms of graft uptake, postoperative morbidity and hearing gain.

## METHODS

This prospective comparative study was carried out between October 2015 to September 2016, for a period of 12 months, at our otorhinolaryngology department. The study was approved by the ethical committee of our institution.

### Inclusion criteria

Chronic suppurative otitis media (CSOM) tubotympanic type (TT) with central perforation –moderate, large or subtotal in size, no history of ear discharge for last 4 weeks, age group between 15 to 60 years, patients with pure conductive hearing loss with air bone gap (ABG) <40 dB.

### Exclusion criteria

Patients with suspected ossicular discontinuity as appeared in otologic examinations or with pure tone audiometry (PTA) results showing >40dB air bone gap, patients with cholesteatoma and marginal perforations, patients with revision surgery.

A total of 40 patients were selected who fulfill the inclusion criteria. All patients were informed about the surgical technique before operation and written and informed consent was obtained. Preoperative records of all patients regarding age, gender, address, diseased side and detailed clinical history regarding disease were maintained. Otoscopy as well otoendoscopic examinations were done and perforation size was measured. Perforation involving 25-50% of TM, 50-75% of TM and 75-90% of TM were labelled as moderate, large and subtotal perforations respectively. Small perforations were operated by fat graft, so we did not include. Otoendoscopy with 30° 4mm scope was done in all patients to inspect ossicular integrity and mobility, middle ear mucosa, Eustachian tube (ET) area and also to inspect hidden areas to rule out adhesion, granulation tissue or retraction. X-ray mastoid (bilateral Schuller's view) was done in all patients to know mastoid air cells status. Any associated symptoms like allergies, tonsillitis or sino-nasal problems were treated adequately prior to surgery. Hearing evaluation was done with tuning fork tests – 256,512 and 1024Hz, full Audiometric and Eustachian tube function testing. All laboratory preoperative investigations were done. Postoperative graft status checked and PTA was done at 2<sup>nd</sup> and 3<sup>rd</sup> month's period. Air conduction and bone conduction thresholds were recorded at all four frequencies 500,

1000, 2000 and 4000 Hz and compared with preoperative PTA records in both groups.

### Endoscopic tympanoplasty technique

Endoscopic tympanoplasty was done by permeal route. Maxer rigid endoscope of 4mm in diameter, 18cm in length and with 0,30,70 degree angles with 3-chip video camera and high definition monitor was used during surgery. All procedures were performed directly off the monitor and recorded. Standard microscopic ear surgery instruments were needed.



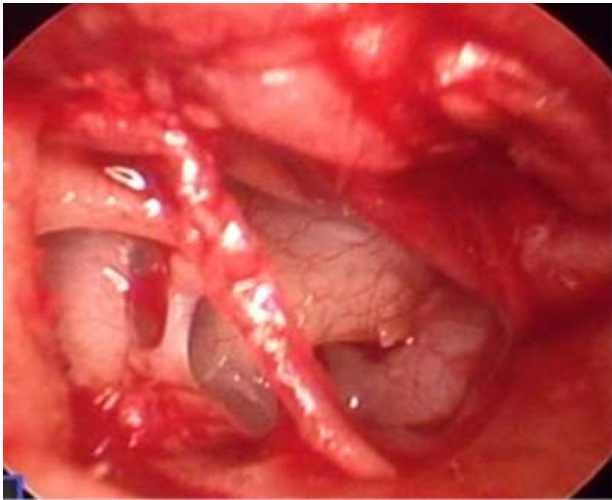
Figure 1: Showing endoscopy system.



Figure 2: Showing instruments trolley for endoscopic tympanoplasty.

All 40 patients underwent endoscopic tympanoplasty under local anaesthesia with sedation. 2% xylocaine sensitivity test was performed in all cases. Premedication was given half an hour prior to surgery in form of inj. Glycopyrolate (0.2mg), inj. Pentazocine (30mg) and inj. Promethazine (25mg) intramuscular given. Temporalis fascia (tf) graft was taken in all patients with 3cm postaural incision just below hair line, adequate size graft harvested and prepared. With the rigid endoscope 0°4mm diameter, external auditory canal (EAC) and perforation site, size and middle ear inspected. Perforation margin was freshened with a sickle knife and a curved pick used to remove mucosal layer of the undersurface of perforation to prevent mucosal pearl formation. Tympanomeatal flap raised as in conventional underlay

technique from 6 o' clock to 12 o' clock. Patients with large and subtotal perforations up to 270<sup>o</sup>– 6 o' clock to 3 o' clock tympanomeatal flap were raised. Then middle ear was inspected using 0, 30 and 70 degree 4mm scopes. Following areas inspected in all patients. Sinus tympani, anterior epitympanic area, supratubal recess, medial attic, hypotympanum, tubal area, facial recess, oval window and round window.



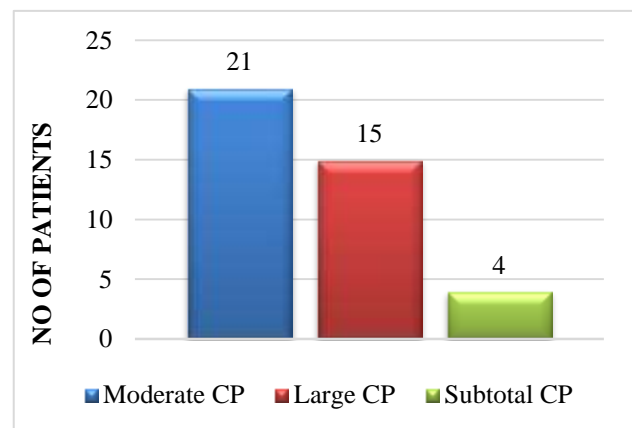
**Figure 3: Intraoperative picture showing anatomy and relations.**

Ossicular continuity checked by eliciting round window reflex. Graft was kept under the handle of malleus and resting on posterior canal wall. Anteriorly graft was tucked in eustachian tube area. Gelfoam soaked in antibiotic solution kept above and below the graft to support. Small wick soaked with antibiotic cream kept in eac, postaural wound closed in single layer and small dressing given. All patients were monitored for postoperative pain and morbidity. All patients had uneventful postoperative period and discharged on the same day evening on oral antibiotics and decongestants. All patients were advised to avoid forceful blowing of nose, vigorous coughing –sneezing and straining. Patients were followed up on 5<sup>th</sup> day; sutures removed and eac wick removed. Thereafter, patients were called every 15 days for a month and then monthly for next 3 months. At the end of 3<sup>rd</sup> month graft uptake, wound healing and hearing assessment with PTA test was done. Patients with complete graft uptake were considered as successful, while patients with residual perforation or graft failure were included in failure group.

## RESULTS

Out of 40 patients, 16 (40%) were males, and 24 (60%) were females. In our study females were more than males. In this study patients with age group between 15 to 60 years of age were included. There were 2(5%) out of 40 patients with <20 years of age, 30 (75%) out of 40 were between 20-40 years of age, majority of the patients

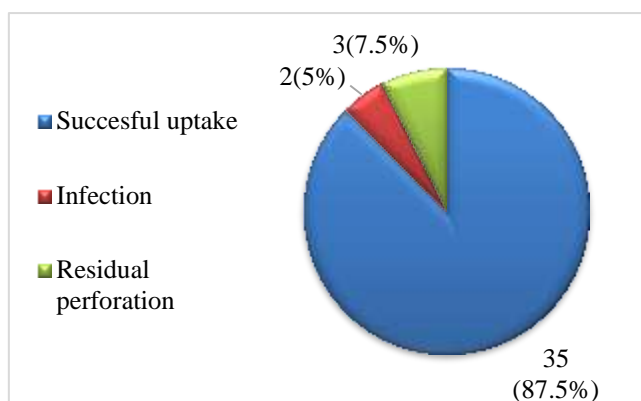
were between 20-40 years age group and 8 (20%) patients were between 40-60 years of age group. In our study 15 (37.5%) patients had bilateral CSOM, 12 (30%) patients had left CSOM and 13 (32.5%) patients had right CSOM. Characteristic of EAC was noted in all cases. Significant anterior canal wall bulge was seen in 3 (7.5%) cases, posterior canal wall bulge was seen in 3 (7.5%) cases, while 4 (10%) cases had narrow EAC. We found that endoscopic tympanoplasty was comparatively easy to perform in cases with canal wall bulge. Rest 30 (75%) patients had wide EAC. In our study, we have measured the size of perforation preoperatively and labeled according to involvement of TM. There were 21 (52.5%) cases had moderate perforation, 15 (37.5%) cases had large perforation and 4 (10%) cases had subtotal perforation.



**Figure 4: Relation of TM perforation size and no of patients.**

In our study, average preoperative air conduction was noted. 1(2.5%) patient had 10-20 dB loss, 13 (32.5%) patients had 20-30dB loss, and 24 (60%) patients had 30-40 dB loss, while 2 (5%) patients had 40-50 dB air conduction hearing loss. In endoscopic tympanoplasty, none of the patients required canaloplasty to visualize the tympanic membrane remnant completely, although EAC was narrow in 4 (10%) patients and canal wall bulge was seen in total 6 (15%) patients. In all patients, middle ear structures like promontory, round window, ET, facial nerve, hypotympanum, epitympanum, IS joint, malleus, ossicular chain mobility and round window reflexes were inspected with 0<sup>o</sup>, 30<sup>o</sup> and 70<sup>o</sup> 4mm endoscopes. So there was clear observation of middle ear cavity, which was helpful for eradication of pathologic process in the middle ear such as granulation tissue or adhesion as well as cholesteatoma and so unnecessary drilling of mastoid antrum and attic was prevented. Average time taken was of around 1 hour and 30 minutes, range was (70-140min). All patients were evaluated for graft status, hearing gain and cosmetic results. Out of 40 patients, 35 (87.5%) patients had successful graft uptake, 2 (5%) patients had graft failure and 3 (7.5%) patients had residual perforation seen postoperatively.





**Figure 5: Showing graft uptake rate at 3<sup>rd</sup> month postoperative period.**

**Table 1: Average preoperative and postoperative air bone gap calculated from average air conduction (AC) and bone conduction (BC) thresholds at frequencies 500, 1000, 2000 and 4000Hz.**

Air bone gap	Preoperative	Postoperative
<10db	1 (2.5%)	12 (30%)
10-20db	13 (32.5%)	24 (60%)
20-30db	24 (60%)	2 (5%)
30-40db	2 (5%)	2 (5%)
>40db	0 (0%)	0 (0%)

Postaural wound infection, canal wall stenosis, asymmetry of pinna and hypoesthesia of helix were not reported in any case. Cosmetic results were excellent in endoscopic tympanoplasty as invisible scar.

## DISCUSSION

The objective of the study was to determine merits and demerits of endoscope in tympanoplasty surgery as well as to compare the results of endoscopic tympanoplasty. From our study, we have concluded that endoscope has many advantages in performing ear surgeries. It allows surgeon a clear view of middle ear cavity with high definition camera gives magnified view. Endoscope overcomes the demerits of microscope and visualizing hidden area is possible. Karchuketo TS studied that endoscope assisted myringoplasty is reliable and simple procedure with the benefit of minimal trauma to the healthy tissue.<sup>3</sup> In endoscopic tympanoplasty, none of the patients required canaloplasty to see tympanic membrane remnant completely, although EAC was narrow in 4 (10%) patients and canal wall bulge was seen in total 6 (15%) patients. With endoscope, requirement for canaloplasty was overcome in tortuous and narrow EAC as remnant of drum visibility increases with wide angle scope, while with microscope tortuous EAC hampers visualization and requires canaloplasty as well as frequent manipulation of patient's head and which also increases operative time. Similar observation made by Tarabichi and Usami, Iijima et al.<sup>4</sup> Lade et al. compared microscopic vs. endoscopic tympanoplasty in 30 patients

each group. They conducted canaloplasty in 5 patients and EAC curettage in 4 patients in patients who underwent microscopic tympanoplasty, while none of the endoscopic group patients require such intervention and ossicular chain status could be assessed easily. With endoscope, visualization of middle ear cavity that is promontory, ET, protympanum, retrotympanum, IS joint, round window, facial nerve is possible. Hidden areas like facial recess, sinus tympani, retro-incudal space and epitympanum is also possible with angled endoscope. These are the key areas where granulation tissue, adhesion or cholesteatoma can be missed. So, with excellent visualization of these hidden areas help surgeon for better operative management and prevent unnecessary drilling and soft tissue work, which saves operative time and improves postoperative morbidity. Authors Raj A, Meher R reported similar observations in their study.<sup>5</sup> Success rate of graft uptake is 87.5% in our study with endoscopic approach, Herman, and Tang achieved graft uptake success rate of 95.3% and Mathai achieved graft uptake rate of 95% using microscopic approach.<sup>6,7</sup> Postoperative hearing gain is an important indicator to assess surgery outcome. In our study, closure rate of ABG within 10dB was found in 12(30%) cases which is comparable to Singh et.al (63%), Herman and Tang (75%) and Dabholkar et.al (76%), Strahan et.al (82%) and Gupta and Mishra (92%).<sup>8-12</sup> ABG closure between 11-20dB was found in 24 (60%) cases.

The duration of operation is an important factor to reduce morbidity. In a study of Ghaffar et.al, the mean duration was 62.65 min among 34 patients who underwent endoscopic tympanoplasty. In 24 of these patients, the operative duration was less than 60 min. In our study, average time taken was around 1hour 30min with range of 70-140min. Endoscopic approach allowed us to do close inspection and photo documentation of the tympanic membrane, perforation, middle ear cavity and hidden areas without elevation of tympanomeatal flap.

However endoscopic ear surgery has several demerits. Endoscopic instruments can cause direct injuries and thermal damage to EAC and middle ear structures. It is a one hand surgery so in a situation of massive bleeding the endoscopic view is difficult and time consuming, as tip of endoscope has to be cleaned frequently, where as in microscopic technique both hands are free to operate. Similar observation made in studies of Tarabichi M and Kashuketo TS, Ilomaki JH, Puhakka HJ.<sup>13,14</sup> So far endoscopic tympanoplasty meticulous hemostasis is must. Due to heat generation from light source of endoscope, Kozin ED et al recommended using submaximal light intensity and frequent repositioning the endoscope.<sup>15</sup> In our study, we assume that there was no inner ear damage by light source because bone conduction in postoperative patients were not significantly changed. Endoscope provides monocular vision, which lead to loss of depth perception so one has to be careful while close to vital structures and position of the graft which can be overcome by experience.

So even though endoscopic tympanoplasty is one handed technique, it can be successfully performed by experienced surgeon. Even in large subtotal perforation and with narrow and tortuous EAC, endoscopic tympanoplasty can be done and successful graft uptake was achieved. In all patients with endoscopic tympanoplasty hidden areas were inspected and pathology like granulation tissue or adhesion cannot be missed which gives better success rate. Unnecessary drilling and soft tissue work can be overcome with endoscopic tympanoplasty. Endoscopic tympanoplasty has better cosmesis, less morbidity and early postoperative wound healing. It is a best tool for trainee to learn ear anatomy and pathology as well as relation of vital structures.

## CONCLUSIONS

Even though use of endoscope limits the surgeon to a one hand technique. In our study, we found that endoscopic tympanoplasty was comparatively easy to perform in cases with canal wall bulge reducing the need for canaloplasty and gives better visualization of middle ear structures, hidden areas of the middle ear, prevents unnecessary drilling and soft tissue manipulation. Graft uptake rate was found to be better than microscopic technique with reduced postoperative morbidity, better healing and almost negligible surgical scar. And also, endoscope serves as a great teaching tool for trainees to learn the middle ear anatomy and pathology.

Informed consent: written informed consent was obtained from patients or patients' parents who participated in this study.

*Funding: No funding sources*

*Conflict of interest: None declared*

*Ethical approval: The study was approved by the Institutional Ethics Committee*

## REFERENCES

1. El-Guindy A. Endoscopic transcanalmyringoplasty. J Laryngol Otol. 1992;106:493-5.
2. Tarabichi M. Endoscopic transcanal middle ear surgery. Indian J Otolaryngol Head Neck Surg. 2010;62(1):6-24.
3. Kashuketo TS, Ilomaki JH, Puhakka HJ. Tympanoscope assisted myringoplasty. ORL J Otorhinolaryngol Relat Spec. 2001;63(6):353-8.
4. Usami S, Iijima N, Fujita S, Takumi Y. Endoscopic-Assisted myringoplasty. ORL J Otorhinolaryngol Relat Spec. 2001;63(5):287-90.
5. Raj A, Meher R. Endoscopic transcanalmyringoplasty- A study. Indian J Otolaryngol Head Neck Surg. 2001;53:47-9.
6. Herman MK. Tang: The perforated ear-drum: To repair or not? Hong Kong J Online. 1989;11:124-5.
7. Mathai J. Myringoplasty with temporalis fascia: Analysis of 200 cases. Indian J Otolaryngol Head Neck Surg. 1999;51:9-13.
8. Singh BJ, Sengupta A, Das SK, Ghosh D, Basak B. A comparative study of different graft materials used in myringoplasty. Indian J Otolaryngol Head Neck Surg. 2009;61:131-4.
9. Tang Herman MK: The perforated ear-drum: To repair or not? Hong Kong J Online. 1989;11:124-5.
10. DabholkarJP, Vora K, Sikdar A. Comparative study of underlaytympanoplasty with temporalis fascia and tragal perichondrium. Indian J Otolaryngol Head Neck Surg. 2007;59:116-9.
11. Strahan RW, Acquarelli M, Ward PH, Jafek B. Tympanic membrane grafting. Analysis of materials and techniques. Ann Otol Rhinol Laryngol. 1971;80:854-60.
12. Gupta N, Mishra RK. Tympanoplasty in children. Indian J Otolaryngol Head Neck Surg. 2002;54:271-3.
13. Tarabichi M. Endoscopic Middle Ear Surgery. Annals of Otolaryngology, Rhinology and Laryngology 1999;108:39-46.
14. Kashuketo TS, Ilomaki JH, Puhakka HJ. Tympanoscope-Assisted Myringoplasty. Otorhinolaryngology. 2001;63:353-8.
15. Kozin ED, Lehmann A, Carter M, Hight E, Cohen M, Nakajima HH, et al. Thermal effects of endoscopy in a human temporal bone model: implications for endoscopic ear surgery. Laryngoscope. 2014;124(8):332-9.

**Cite this article as:** Ambani KP, Bhavya BM, Vakharia SD, Khanna A, Katarkar AU. Merits and demerits of endoscopic tympanoplasty. Int J Otorhinolaryngol Head Neck Surg 2017;3:395-9.