



## COMPARISON OF THE EFFICACY OF ENDOSCOPIC TYMPANOPLASTY WITH MICROSCOPIC TYMPANOPLASTY

**Dr. Anjana Tigga\***

Assistant Professor, Department of Otolaryngology and Head and Neck Surgery, ESI-PGIMSR, ESI Medical College and Hospital, Joka, Kolkata, India. \*Corresponding Author

**Dr. Shruti Dhingra**

Assistant Professor, Department of Otolaryngology and Head and Neck Surgery, Maulana Azad Medical College, Bahadur Shah Zafar Marg, New Delhi, India.

### ABSTRACT

**Introduction:** Otological surgery has progressed rapidly over the past century. With the recent introduction of the 3-chip camera system and high definition video systems, endoscopes now provide ultra high resolution images of the middle ear that were never seen previously. We conducted this study to compare the efficacy of endoscopic tympanoplasty over microscopic tympanoplasty in terms of preoperative ease of surgery including visualisation of ossicles and eustachian tube and intraoperative bleeding, graft uptake, hearing improvement, post-operative pain score, post-auricular hypoesthesia, duration of hospital stay etc.

**Methods:** The present study is prospective observational study, conducted in a Tertiary Health Care Centre.

**Results:** Endoscopic tympanoplasty has many advantages over microscopic tympanoplasty and can be a better alternative or adjunct to microscopic tympanoplasty.

**Conclusion:** Endoscopic ear surgery provides a better magnification, wide field view, and the ability to look around corners. Further more transcanal endoscopic ear surgery (TESS) approaches transform external auditory canal into a minimally invasive surgical portal to access middle ear disease. The ease of surgery improves with time and has a gradual learning curve. The graft uptake rate is comparable with both approaches. The overall satisfaction score in terms of reduced pain and hypoesthesia with decreased hospital stay is higher in endoscopic approach.

**KEYWORDS :** Endoscopic, tympanoplasty, TESS, microscopic

### INTRODUCTION

The term tympanoplasty was introduced in 1953 by Wullstein to describe surgical Techniques for reconstruction of the middle ear hearing mechanism that had been impaired or destroyed by chronic ear disease.(1) Zollner reported surgical techniques for improving the sound conduction mechanism of the middle ear following surgery for chronic ear disease.(2) Another major contribution by Wullstein and Zollner was the introduction of operating microscope in performing otologic surgery. The introduction of endoscopy into the middle ear has opened up new opportunities for minimally invasive temporal bone surgery.

Endoscopic imaging provides dramatic vistas to the otologists. The operating microscope provides magnified images in a straight line extending from the objective lens. Many deep recesses within the temporal bone cannot be directly seen without the surgeon taking measures to expand the operative exposure endoscopes have an immediate advantage with an inherently wide field of view that extends from the tip of the instrument's lens. Additional angulation of view is accomplished by placing prism into the tip.(3)

The "working space" in endoscopic surgery is cone shaped, and above the apex of the cone "the ear canal" needs only to be wide enough to admit the endoscope and surgical instruments. In contrast, microscopic surgery requires an upside-down conical "working space" that requires much more bone removal superficially to obtain access and to prevent the surgeon from "digging his/her self into a hole. In endoscopic surgery, the surgeon gets a bird's-eye view of the field beyond the shaft of the instrument. When using the microscope, it is important to bring the structures almost to a right angle to the axis of the microscope. In contrast, the endoscope can visualise structures that lie in the same plane as the endoscope. Changing the magnification with the endoscope is simply achieved by moving it closer to the structure. There is no need for refocusing when changing position. (4)

Endoscopes, therefore, offer the surgeon the capability of wide fields of view with Minimal exposure, looking behind the obstructions or overhangs, and peering into recesses with much less requirement for surgical exposure than in microscopic surgery. Surgical morbidity and operating time can be substantially reduced.(3) The first published description of imaging of the middle ear by endoscopy was by Mer and colleagues in 1967.(5) Endoscopy of the middle ear itself may be done through a myringotomy. Nomura introduced the concept of middle ear exploration by passing a rigid endoscope through a myringotomy in an otherwise intact tympanic membrane.(6)

### AIMS AND OBJECTIVES

1. To evaluate the perioperative considerations of endoscopic ear surgery and
2. compare it's efficacy over the microscope in terms of operative time, need for postauricular incision and need for mastoidectomy.
3. To evaluate the surgical outcomes of endoscopic ear surgery in terms of graft uptake, hearing improvement, complications and need for reoperation.
4. To evaluate postoperative patient outcomes after endoscopic ear surgery in terms of pain score, surgical site morbidity (wound dehiscence, hematoma and infection) and postauricular numbness and hypoesthesia.
5. To evaluate the cases in which preoperative findings are different when viewed with the endoscope and surgery has to be completed with microscopic assistance (in cases where cholesteatoma is seen and mastoidectomy is required).

### MATERIALS AND METHODS

The present study is a prospective observational study, was conducted in ENT department of ESIC Medical College and Hospital, Faridabad. A total of 100 patients were included in the study. Surgical approach was divided into four classes. Class 0, which included use of microscope only, Class 1, which included use of endoscope for inspection only, Class 2, which included use of both endoscope and microscope for the surgery and Class 3, which included use of endoscope only for

the surgery.

Various perioperative parameters like operative time, need for postauricular incision and need of mastoidectomy were noted. Intraoperative findings like character of ear canal, whether drilling was required for any anterior canal bulge, size and shape of perforation, type of graft used and type of tympanoplasty, amount of bleeding during surgery was noted, visualisation of incudostapedial joint and eustachian tube with zero degree and 30 degree endoscope and microscope were noted. Ossiculoplasty and mastoidectomy, atticotomy, stapedectomy, excision of retraction pocket if done were also noted and compared with each class.

Postoperative pain scoring was done for each patient according to Wong-Baker Faces Pain Rating Scale for 2 days, and whether patient required any medication for pain were noted and compared. Patients were followed up for a mean of 3 months. And following points such as wound gaping infection and hematoma, post auricular hypoesthesia were noted and compared with each class after first week of follow up. Surgical outcome was noted and compared after 3 months of follow up in view of graft uptake A-B closure, whether there was need for reoperation and any complication if present were noted like worsening of bone conduction, blunting anterior angle, tympanic membrane cholesteatoma pearl or iatrogenic cholesteatoma.

Patients aged 10-50 years, both sexes, with conductive hearing loss, and small to large sized perforation of tympanic membrane were selected for the study. And those patients with pure sensorineural hearing loss, active discharge at the time of admission, attico-antral disease and any medical reasons like uncontrolled hypertension or deranged blood coagulation profile were excluded from the study. Patients were randomly selected for endoscopic and microscopic tympanoplasty.

Tuning fork test 256, 512, 1024 Hz tuning fork and PTA was done to determine the Type and degree of hearing loss. A-B gap at frequencies 500, 1, 2 Khz was noted and taking the average of three, the hearing loss was calculated. Of total 100 patients, 50 patients underwent microscopic (class 0) tympanoplasty, 49 patients underwent endoscopic (class 4) tympanoplasty, and in 1 patient both endoscope and microscope (class 2) was used for the surgical procedure. All microscopic tympanoplasty were done by post-auricular William Wildes incision.

#### TECHNIQUE

For endoscopic surgery 16cm length, 4mm diameter, 0 degree, 30 degree Hopkins rod lens endoscope with 3 chip CCD camera system was used. All surgeries were done under local anaesthesia. Proper trimming of ear canal hair was confirmed preoperatively. For hemostasis- 1:30,000 lignocaine: epinephrine, with 27 gauge needle was used for infiltrating external auditory canal at 3 o'clock, 6 o'clock, 9 o'clock and 12 o'clock at the bony-cartilaginous junction. The patient was premedicated with intramuscular injections of 1 ampule Fortwin and 1 ampule Phenergan. Temporalis fascia or the conchal cartilage were used as the graft material. All tympanoplasty were done by the underlay technique. All endoscopic assisted tympanoplasty were done through permeal route. In endoscopic tympanoplasty temporalis fascia was harvested through 1.5 cm supraauricular incision just above the helix. Character of EAC was noted in every procedure. Size and shape of perforation was noted. Margins of the perforation was freshened using horizontal pick. Posterior tympanomeatal flap was elevated. The middle ear was inspected and following findings were noted and compared for each case: status of ossicular chain, visualization of eustachian tube opening, oval and round

window. Middle ear was packed with dry gelfoam, and graft was placed by underlay technique in each case, and anteriorly tucked. Flap then repositioned.

Antibiotic soaked gelfoam was used to pack the EAC. Mastoid antiseptic dressing was done. Among the 100 patients, ossiculoplasty was done in 2 cases. Incus was refashioned and used in one case and in the other a small piece of conchal cartilage was used. And only in 1 patient cortical mastoidectomy was done along with tympanoplasty, which required the use of both endoscope and microscope for the procedure (class 3).

All the patients were kept for 2 days irrespective of endoscopic or microscopic tympanoplasty, and pain scoring was done for these 2 days of hospital stay. And discharged after 2 days with oral medications. All the patients were kept under weekly follow up for the first month and then followed twice for next 2 months. The suture was removed on the 7<sup>th</sup> postoperative day. During follow up all patients were examined for wound gaping, infection, hematoma, post-auricular hypoesthesia. Final assessment of surgical outcome regarding graft uptake was done at 3 months and hearing was assessed by postoperative PTA, where post op A-B gap was calculated by taking average at 500 Hz, 1 kHz, 2 kHz.

#### OBSERVATION AND RESULT

In our study a total of 100 patients were included, 50 in each microscopic and endoscopic ear surgery, 25 were males, 25 females. All age groups from 10 years to 50 years were selected. There were total 50 who were operated with microscope only, 49 patients operated using endoscope only and 1 patient who operated using both endoscope and microscope, it was shifted to microscope for doing cortical mastoidectomy as it was a case of revision surgery. With endoscope of all sizes of perforation from small to subtotal perforation was done successfully, 70% were medium size perforation, 18% large, 5% small and 2% subtotal.

While with microscope 70 % were small, 28% large and 2% medium size perforation. The temporalis fascia graft was placed via underlay technique in both endoscopic and microscopic surgery. In one case of endoscopic surgery cartilage shield tympanoplasty was done as it was a case of revision ear surgery, conchal cartilage was used. With endoscope the perforation location encountered was central (84%), anterior inferior quadrant (7%), and subtotal (1%), all were repaired successfully. Moderate amount of bleeding was seen in 38% cases of endoscopic surgery, however it was controlled using adrenaline soaked cotton patties. Minimal bleeding seen in 98% cases of microscopic surgery. Incudostapedial joint was seen in 49 cases of endoscopic surgery, and 45 cases of microscopic surgery. Eustachian tube was seen in 45 cases and 9 cases in endoscopic and microscopic surgery respectively. In microscopic surgery none of the cases of ossiculoplasty was encountered, while in endoscopic surgery 2 patients required ossiculoplasty, in one case incus was removed and was refashioned and was used, while in the other a small piece of conchal cartilage was used. External ear canal encountered during endoscopic surgery was narrow (68%), wide (28%), and tortuous in 4%, while using microscope it was wide (84%), narrow (16%) and none were tortuous.

Anterior canal wall drilling was not required in any of the surgeries done using endoscope and in 1 case of microscopic surgery anterior canal wall drilling was done as anterior margin of the perforation was not seen. The graft uptake after 3 months of regular follow up, surgeries done with endoscope had 47 successful graft uptake and 3 cases had graft failure. The post operative AB gap closure after 3 months was less than 10 db in 49 cases and 47 cases of endoscopic and microscopic surgery respectively. The pain score was done on

day 1 and day 2 of the post-operative period using Wong Baker Pain Rating Scale. 43 patients of the endoscopic group didn't require any analgesic while 47 patients of the microscopic group required pain medication. On day 1 of post operative period there were 9 patients with pain score 0, 36 patients with pain score 1 and 5 patients with pain score 2 with endoscopic surgery, On day 2 of post operative period there were 37 patients with pain score 0, 11 patients with pain score 1 and 2 patients with pain score 2 with endoscopic surgery, now on day 1 of post operative period there were 2 patients with pain score 0, 11 patients with pain score 1, and 37 patients with pain score 2 with microscopic surgery. On day 2 of post operative period there were 3 patients with pain score 0, 40 patients with pain score 1 and 7 patients with pain score 2 with microscopic surgery. Various complications like recurrent cholesteatoma, blunting of anterior angle, and surgical site morbidity like wound gaping, infection and hematoma formation was not encountered in any of the cases either microscopic or endoscopic ear surgery. However post auricular hypoesthesia was complained by every patient who underwent microscopic surgery. The maximum operative time with endoscopic was 50 min and minimum was 40 min. And with microscopic ear surgery the maximum operative was 60 min and minimum was 45 min.

**Table-1 Sex Distribution Among Two Groups (n= 100)**

Sex	Endoscopic (%) n=50	Microscopic (%) n=50	p-value
Male	16 (64)	09 (36)	0.048
Female	09 (36)	16 (64)	

**Table-2 Age Distribution Among Two Groups (n= 100)**

Age	Endoscopic (%) n=50	Microscopic (%) n=50	p-value
10-20	03 (12)	04 (16)	0.464
20-30	14 (56)	09 (36)	
30-40	04 (16)	04 (16)	
40-50	04 (16)	08 (32)	

**Table-3 Classification**

Classification	Frequency	Percentage (%)
CLASS 0 (MICROSCOPE ONLY)	50	50
CLASS 1 (ENDOSCOPE FOR INSPECTION ONLY)	0	0
CLASS 2 (ENDOSCOPE + MICROSCOPE)	1	1
CLASS 3 (SURGERY WITH ENDOSCOPE ONLY)	49	49

**Table-4 Size Of Perforation**

Size of perforation	Endoscopic (%) n=50	Microscopic (%) n=50
Small	5(10)	35(70)
Medium	35(70)	1(2)
Large	9(18)	14(28)
Subtotal	1(2)	0(0)

**Table-5 Type Of Surgery**

Type of Surgery	Endoscopic (%) n=50	Microscopic (%) n=50
UNDERLAY	48 (96)	50(100)
CARTILAGE	1(2)	0(0)
CORTICAL	1(2)	0(0)

**Table-6 Perforation Location**

Perforation Location	Endoscopic (%) n=50	Microscopic (%) n=50
ASQ	0(0)	2(4)
AIQ	7(14)	28(56)
PSQ	0(0)	1(2)
PIQ	0(0)	1(2)

CENTRAL	42(84)	18(36)
SUBTOTAL	1(2)	0(0)

**Table-7 Bleeding During Surgery**

Bleeding during surgery	Endoscopic (%) n=50	Microscopic (%) n=50
MINIMAL	11(22)	49(98)
MODERATE	38(76)	1(2)
EXCESSIVE	1(2)	0(0)

**Table-8 I.S. Joint Visualized**

I.S. Joint Visualized	Endoscopic (%) n=50	Microscopic (%) n=50	p-value
Yes	49	45	0.204
No	1	5	

**Table-9 Eustachian Tube Visualized**

I.S. Joint Visualized	Endoscopic (%) n=50	Microscopic (%) n=50	p-value
Yes	45	9	0.0001
No	5	41	

**Table-10 Ossiculoplasty**

Ossiculoplasty done	Endoscopic (%) n=50	Microscopic (%) n=50
Yes	2(4)	0(0)
No	48(96)	50(100)

**Table-11 Type Of Ear Canal**

Type of Ear Canal	Endoscopic (%) n=50	Microscopic (%) n=50
WIDE	14(28)	42(84)
NARROW	34(68)	8(16)
TORTUOUS	2(4)	0(0)

**Table-12 Anterior Canal Bulge Drilling Required**

ANTERIOR CANAL BULGE DRILLING REQUIRED	Endoscopic (%) n=50	Microscopic (%) n=50
Yes	0(0)	1(2)
No	50 (100)	49(98)

**Table-13 Graft Take Up**

Graft Take up	Endoscopic (%) n=50	Microscopic (%) n=50	p-value
Yes	47	47	1.000
No	3	3	

**Table-14 Post OP AB Gap (less than 10Db)**

Post OP AB Gap	Endoscopic (%) n=50	Microscopic (%) n=50	p-value
Yes	49	47	0.617
No	1	3	

**Table-15 Analgesic Required**

ANALGESIC REQUIRED	Endoscopic (%) n=50	Microscopic (%) n=50	p-value
Yes	7	47	0.0001
No	43	3	

**DISCUSSION**

The basic aim of our study was to compare the efficacy of endoscopic ear surgery over the microscope in terms of factors like operative time, surgical outcome, pain score, surgical site morbidity. Endoscopes can be used for all sizes of perforation, small to large and subtotal. In our study 7 (14%) of the perforation was located in the anterior inferior quadrant encountered during endoscopic surgery and the graft was placed successfully. In case of severe bleeding during endoscopic surgery it becomes difficult to operate and moreover blood soils the tip of endoscope and requires regular cleaning and hence prolongs the operative time. In

our study minimal amount of bleeding was encountered during endoscopic surgery and was controlled using adrenaline soaked cotton patties.

In case of narrow and tortuous ear canal, canalplasty is done to see the structures in microscopic ear surgery. It requires manipulation of head of the patient in narrow canal and to refocus every time the position is changed. However with endoscope to adjust the magnification it just requires to move the endoscope closer to the structure.

Moreover with angled endoscopes it is possible to visualise structures like round window niche, sinus tympani, anterior epitympanum, eustachian tube area, facial recess, which are difficult to visualise with microscope. Other authors like Raj A, Mehar R et al (7), Tarabichi M (8) and Usami S, Iijima M et al (9) reported similar observation in their studies.

The graft uptake was seen in 47 cases and graft rejection was seen in 3 cases of both endoscopic and microscopic surgery. A B gap closure of less than 10 was achieved in 49 cases of endoscopic and 47 cases of microscopic ear surgery. Surgical site morbidity like wound gaping, infection, hematoma formation was not encountered in any of the patients. However postauricular hypoesthesia was seen in all the patients who under went microscopic ear surgery. 43 patients in endoscopic group required no pain medication, while 47 patients in microscopic surgery required analgesic. In microscopic ear surgery the graft was harvested via the William Wilde's incision requiring more tissue dissection and more of post operative pain, delayed wound healing. Similar results seen in terms of graft acceptance and hearing improvement in both endoscopic and microscopic surgery and hence endoscopic tympanoplasty can be an alternative over microscopic tympanoplasty with minimum post operative pain, no post auricular hypoesthesia.

## CONCLUSION

Endoscopes have been proven advantages over the microscopes, including wider angle of view, better visualisation of structures that are parallel to the axis of the microscope, visualisation of deep recesses and hidden structures (i.e, around corners), and the ability to visualise beyond the shaft of the surgical instrument.

On the other hand, the disadvantages of endoscopes include loss of depth of perception and binocular vision, the inevitable one-handed surgical technique necessitated, the need for a strictly bloodless field (hence meticulous attention to hemostasis is essential), fogging and smearing of the tip of the endoscope.(1)

## Conflict Of Interest:

The authors declare that they have no conflict of interest.

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