

## ENDOSCOPIC CARTILAGE TYMPANOPLASTY. OUR TECHNIQUE AND EXPERIENCE OF 157 CASES

Muhammad Atif Najam, Urwa Sarwar, Maqbool Raza\*, Khalid Azam Khan\*\*, Humaira Saleem, Najm u Saqib Niazi, Muhammad Rashid, Naem Riaz\*\*\*

Combined Military Hospital Kharian/National University of Medical Sciences (NUMS) Pakistan, \*Combined Military Hospital Multan/National University of Medical Sciences (NUMS) Pakistan, \*\*Combined Military Hospital Lahore/National University of Medical Sciences (NUMS) Pakistan, \*\*\*Pakistan Naval Ship Hafeez, Islamabad Pakistan

### ABSTRACT

**Objective:** To assess the graft take rate and hearing gain in trans-canal endoscopic tympanoplasty

**Study Design:** Descriptive study.

**Place and Duration of Study:** Pakistan Naval Ship Hafeez, Islamabad Pakistan, form Dec 2015 to Jun 2018

**Methodology:** All patients with dry central perforations of >3 months history were included in the study. All Patients with perforations of pars tensa were booked for endoscopic cartilage tympanoplasty. All perforations were divided into four types small, medium, large and subtotal or total based on size of the tympanic membrane perforations. Small perforations involving <25% area of Pars Tensa. Medium perforation are Perforations involving 25-50% of Tympanic membrane. Large perforations include Perforations involving 50-75% of pars tensa. Subtotal or total perforations are defined as perforations with >75% perforation of the tympanic membranes. Wet Ears and perforations involving the Pars Flacida were excluded from the study. Preoperative Audiogram was carried out for all patients and A-B Gap were noted for all groups separately so as the demographic data including age and gender. Success was defined as complete closure of Tympanic membrane perforation at 3 months. All patients were operated with 0 Degree 3mm, 14cm rigid endoscope under general anesthesia.

**Results:** Mean age of patients was. 37 years and standard deviation was 12.34 (range 12-58 years). Out of total 157 cases 81 patients male were males (51%) and 76 patients were females (49). Out of 157 ears operated 146 Perforations healed completely an overall success rate of 92%. Patients with small perforations had 100 percent success rate whereas near total or total perforations had 86% Success rate. Average preoperative A-B gap was 35 db and Average Postoperative A-B Gap was 15db. Ossicular discontinuity was noted in 34 (21.6%) cases and occlusion of ventilation including obstruction of eustachian-tube opening was noted in 61 (38%) cases. Average Operative was 67 minutes. Incision scar was visible only in 2 patients 3 months after surgery.

**Conclusion:** Endoscopic trans canal cartilage tympanoplasty is scarless safe effective procedure with demonstrable tympanic membrane perforation closure rates and hearing gains in all patients with minimum complications. The Technique is single handed and has steep learning curve.

**Keywords:** Endoscopic ear surgery, Hearing loss, Pars tensa, Tragal cartilage, Tympanic membrane perforation.

**How to Cite This Article** Najam MA, Sarwar U, Raza M, Khan KA, Saleem U, Niazi N, Rashid M, Riaz N. Endoscopic Cartilage Tympanoplasty. Our Technique and Experience of 157 Cases. Pak Armed Forces Med J 2021; 71 (Suppl-3): S440-444. Doi: <https://doi.org/10.51253/pafmj.v1i1.7935>

This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

### INTRODUCTION

Tympanoplasty is defined as removing the disease from the middle ear and reconstructing the tympanic membrane with or without ossiculoplasty.<sup>1</sup> Microscopes are being used for tympanoplasty since the early 1900.<sup>2</sup> The introduction of endoscopes in otological practice has revolutionized middle ear surgery by virtue of not only better visualization but also being able to surgically improve middle ear ventilation pathways that are usually cause of chronic middle ear infections leading to Tympanic membrane perforations.<sup>3</sup> Wullstein divided tympanoplasty into five,<sup>2</sup> types where type I is repair of tympanic membrane perforation only. Type II includes ossicular discontinuity tympanic

membrane grafted over the incus. In Type III Graft is placed directly over the stapes head. Type IV tympanoplasty includes placing the graft over foot plate of stapes. Type V includes repair of tympanic membrane with fixed foot plate of stapes. Various Grafts have been used for repairing the tympanic membrane of which temporalis fascia and tragal cartilage,<sup>4</sup> are the most popular due to easy availability at the site of surgery along with low metabolic rate.<sup>5</sup> Two techniques have popularly been used in tympanoplasty namely on lay and underlay with equal success rates.<sup>6</sup> Traditionally microscopes have been used for tympanoplasty and because of limited field of view and bony canal variations more invasive post aural exposures were used to repair anterior perforations.<sup>7</sup> Muaz *et al* created a working group of endoscopic ear surgery

**Correspondence:** Dr Muhammad Atif Najam, ENT Department, Combined Military Hospital Kharian Pakistan

1999 started using endoscopes as a single tool for treating middle ear diseases.<sup>8</sup> Endoscopes have the advantage of wider field of view, superior exposure, evaluation and management of complex middle ear anatomy. Endoscopes have an added advantage of addressing the ventilation pathways during tympanoplasty which are difficult to visualize assess and treat with a limited field of view offered by microscopes.<sup>3</sup> We share our experience of 157 endoscopic cartilage tympanoplasty by far largest series on the subject from Pakistan. We present our technique, success rate, hearing results and ossicular and ventilation abnormalities encountered during surgery. Tragal cartilage was preferred graft because of its availability in adequate quantity from the operative field, natural concavity for reconstructing the tympanic membrane and incision on medial unexposed site of tragus.

## METHODOLOGY

This Descriptive study was carried out at Pakistan Naval Ship Hafeez Islamabad, from December 2015 to June 2018. A total of 157 cases of endoscopic cartilage tympanoplasty were included in the study.

**Inclusion Criteria:** Patients of both genders over 12 years fit for general anaesthesia were included in the study. All cases with dry perforation in the pars tensa were included in the study. The patients were categorized into 4 groups based on size of perforation. Group A included patients with small sized perforation involving upto 25 percent of pars tensa. Patients in group B had medium sized perforation involving 25-50% pars tensa. Group C had 50-75 perforation in the pars tensa and group D had near total perforation with only rim of pars tensa intact. Preoperative Audiogram was done for all cases and A-B Gap noted.

**Exclusion Criteria:** All cases with active discharge, involvement of pars flacida were excluded from the study. Endoscopic tympanoplasty was performed using a 0 Degree 3mm 14 cm rigid endoscope with 3chip Camera and medical grade monitor. Tragal cartilage was harvested using a 2-3 cm incision on the medial side of tragus. Skin elevated on both sides of the cartilage. Adequate sized cartilage was harvested sparing a superior rim of cartilage to prevent cosmetic deformity at the tragus. Cartilage was harvested with perichondrium on both sides. Perichondrium on the lateral side was stripped of and prepared as a separate graft. Incision was closed with 5/0 prolene sutures. 1% Lignocaine with adrenaline Local anaesthesia was infiltrated at 6° clock and 12° clock position at the junction of cartilaginous and bony canal with and insulin syringe

under endoscopic vision. Margins of perforation freshened with sharp curved needle. Canal incision was made 5mm from the bony annulus from 6-12° clock position. Tympanomeatal flap was elevated with help of rosen knife. Fibrous annulus and chorda tympani identified and middle ear mucosa incised using curved needle. Tympanomeatal flap lifted of the handle of malleus and flap reflected superiorly. Four quadrant middle ear examination done with 0 and 30 degree endoscopes. Opening of eustachian tube, processus cochleariformis, anterior and posterior ventilation pathways, sinus tympani and ossicles examined. Ossicular status and mobility noted. Middle ear bed was prepared with gelfoam and full thickness tragal cartilage cut to appropriate size with sculptured groove for handle of malleus placed via underlay technique the side of cartilage denuded of perichondrium facing laterally. Perichondrium graft placed over the cartilage. Tympanomeatal flap repositioned and external auditory canal filled with gelfoam and packed with small bismuthis examined. Fat from ear lobule was harvested from a small posterior incision for sealing the stapedotomy and wound was closed with 5/0 prolene sutures. Transcanal approach was used for all cases. Canal incisions were made at 12-6° clock and tympanomeatal flap was elevated chorda tympani was identified middle ear entry was made. Posterior bone removal was done with a curette or micro drill. Pyramidal process, Stapedius tendon, facial nerve stapes supra structure and foot plate was exposed. Stapedius tendon was divided with micro scissors (Figure-1). Incudo-stapedial joint was divided with joint knife. Crurotomy and stapedotomy was done with 0.7mm diamond burr using a stapes drill (Figure-2). Footplate distance from the incus was measured and appropriate size Teflon piston 0.6mm diameter was placed in the stapedotomy (Figure-3). Piston position and mobility was confirmed with bending sign (Figure-4) and round window reflex. Fat graft was placed around the piston to seal stapedotomy (Figure-5). Tympanomeatal flap was repositioned and spongoston was filled in the external auditory canal. Operative time was noted from start of transcanal incision's to repositioning of tympanomeatal flap. and Postoperative facial nerve function and nystagmus was documented. Post operative follow up was done after 2, 4 and 12 weeks. Postoperative audiogram was carried out at 12 weeks along with confirmation of graft take and rejection. Ossicular and middle ear ventilation pathway abnormalities noted along with total operative time. Ossiculoplasty was done in all patients with ossicular discontinuity. Remenant incus or teflon

## Endoscopic Cartilage Tympanoplasty

prosthesis were used for ossiculoplasty. Presence of visible scar with naked eye at 3 months was also noted. All data was entered in SPSS and mean was calculated for Age, Gender, A-B Gap, operative time, success of graft uptake middle ear abnormalities and visible scar was calculated.



Figure-1: TM perforation with 6-12° clock incision marked.



Figure-2: Malleus denuded and ossicular integrity checked.

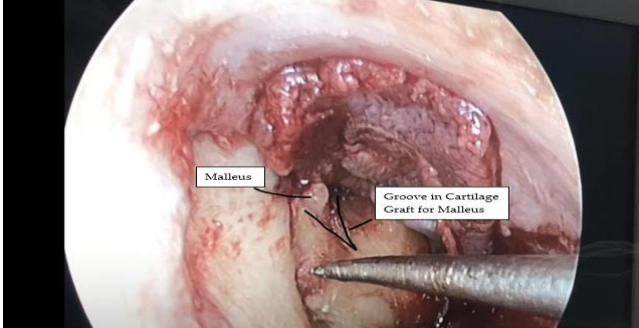


Figure-3: Cartilage graft placed with slit for malleus.

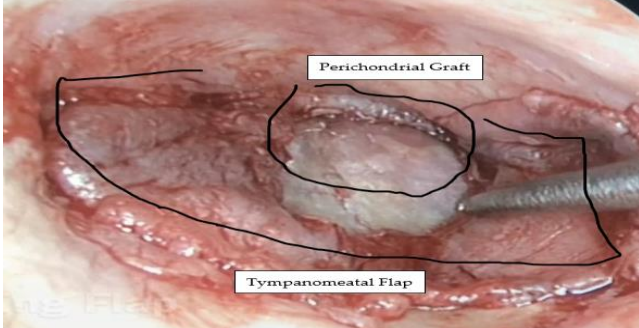


Figure-4: Perichondrium graft placed and tympanomeatal flap repositioned.

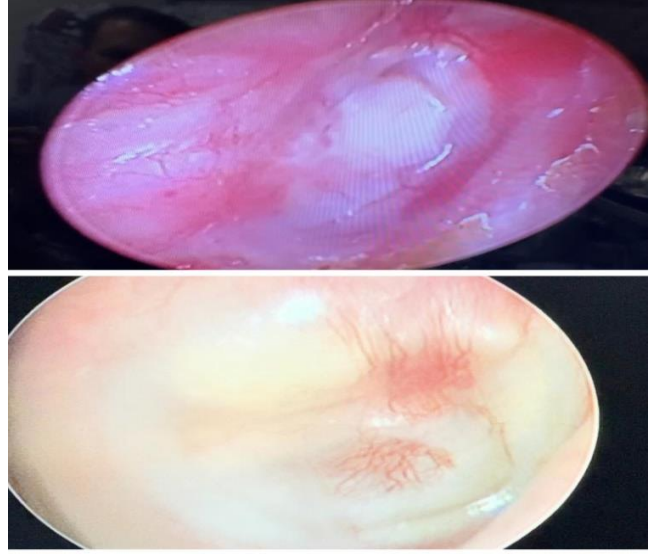


Figure-5: Healed Tympanic membranes in three of our patients.

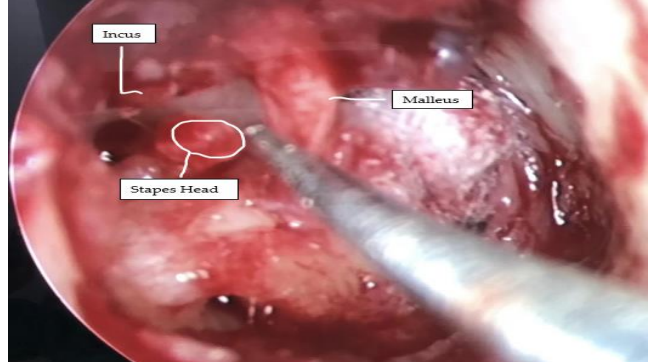


Figure-6: Intraoperative incudo-stapedial discontinuity.

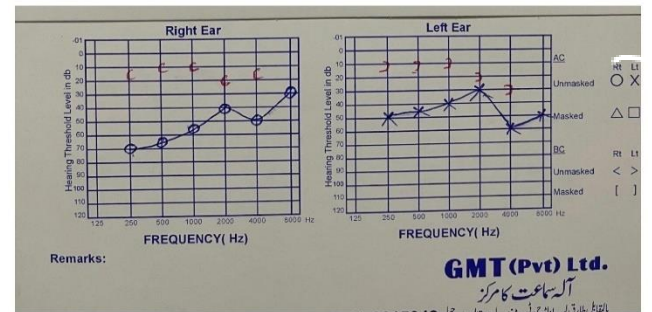


Figure-7: Preoperative and postoperative audiogram in a patient with ossicular reconstruction.

## RESULTS

Total 157 patients were included in the study. Mean age of patients was 37 years and standard deviation was 12.34 (range 12-58 years). Out of 81 were males and 76 females. Among the 157 patients operated 17 (10.82%) had small, 42 (26.75%) medium, 69 (43.9%) large and 29 (18.4%) had subtotal or near total tympanic membrane perforation. Preoperative Average Air bone gap was 35db. Tympanic membrane closure rate was 17 (100%) for small, 40 (95%) for medium, 64 (92%) for large and 25 (86%) for near total and total perforations. Over all 146 (93%) patients had complete tympanic membrane closure seen in our series. Out of 39 (24.8%) patients had ossicular discontinuity out of which 23 (14.64%) patients had necrosis of long process of incus, 10 (6.3%) patients had necrosis of supra-structure of stapes and 6 (3.8%) patients had necrosis of handle of malleus. Four (2.57%) patients had sclerosis involving the stapes suprastructure, incus and foot plate. A total of 49 (31%) patients had blockage in the ventilation pathways. The Ventilation pathway pathologies included granulations in the anterior and posterior isthmuses and fibrous bands obstructing the eustachian tube opening. Postoperative average A-B gap was 13db. Of 72% patients had >20 db of A-B Gap reduction, 18% patients had 12-15 db of A-B Gap closure where as 10% patients had <10 db of A-B Gap reduc-

tion. Mean operative time was 62 minutes. Middle ear cleft in form of polyp, granulation tissue or inflamed hypertrophic middle ear mucosa. It's now considered paramount to address these ventilation pathways for a successful tympanoplasty. These ventilation pathways were poorly visualized because of operating microscopes but endoscopic ear surgery has made it possible to not only treat the structural defects of middle ear but also address physiologic disorders owing to better field of view excellent anatomic details.

**Table: Perforation closure and hearing gain.**

Size of Perforation	Total Cases	Males	Females	Complete Closure	Average Pre-operative A-B Gap	Average Post Operative A-B Gap
Small	17	11	6	17(100%)	10 db	08 db
Medium	42	22	20	40(95%)	15 db	10 db
Large	69	35	34	64(92%)	25 db	10db
Total/Near Total	29	13	16	25(86%)	30db	15db

tion. Mean operative time was 62 minutes.

## DISCUSSION

Traditionally tympanoplasties have been performed with microscopes.<sup>2</sup> Endoscopes is the latest tool for surgical management of middle ear pathologies. Endoscopic tympanoplasty has rapidly gained popularity among ENT surgeons because of better visualizations of middle ear anatomy, completely trans-canal approach, no need for canaloplasty in most cases and avoidance of endaural and post-aural incisions. Tragal cartilage is a robust graft for middle ear reconstruction. Initially was reserved for total perforations and revision surgeries but currently its being used for primary tympanoplasties for its better take rates and hearing gains.<sup>9</sup> Tragal cartilage is a favored graft for endosco-

pic ear surgeons for the reason its easy to handle with a single hand technique and readily available in operative site along with better cosmetic result. Success rate of endoscopic tympanoplasty has been reported between 90-98% depending on the size and site of perforations.<sup>10</sup> Our study has reported an overall success rate of 92% with 100% success rate for small perforations and 86% for total perforations. Our results are similar to quoted by choi *et al*,<sup>11</sup> and Nausheen *et al*, in their studies.<sup>12</sup> The mean operative time for endoscopic ear surgery has been reported between 50-65 minutes.<sup>13-14</sup> Operative time in our study was 62 minutes. Tragal cartilage is associated with good hearing results. Many studies have quoted significant hearing gains with full thickness tragal cartilage owing to its natural curvature for use in middle ear and average 5mm thickness.<sup>15</sup> Our study also has shown 90% patients having more than 12db A-B gap closure suggesting a perceptible hearing gain. Vershney *et al*<sup>16</sup> reported 7.7% incidence of ossicular injury in mucosal type of chronic suppurative otitis media. In our study 24.8% patients had ossicular discontinuity of which commonest was necrosis of long process of incus similar to reported by vershney *et al*.<sup>16</sup> Middle ear ventilation has been described in detail by tarabichi and marchioni,<sup>17-18</sup> and addressing the ventilation pathways is mandatory for a successful middle ear surgery. In 31% of our patients we noticed an obstruction in the ventilation pathways of the

## LIMITATION OF STUDY

The study is first local publication on endoscopic tympanoplasty and has no local references for comparison.

## CONCLUSION

Endoscopic tympanoplasty is a minimally invasive procedure that provides excellent graft take rates and comparable hearing results with additional benefit of short operative

time minimal scar. Endoscopic ear surgery has evolved as future of otological surgical practice.

**Conflict of Interest:** None.

### Authors' Contribution

MAN: Operating surgeon, data collection, US: Data collection, data entry, discussion writing, MR: Data collection, KAK: Data collection and results, US: Data collection, data entry, discussion writing, NN: Results compilation, MR: Data collection, data entry and discussion writing, NR: Discussion and results compilation.

### REFERENCES

1. Sarkar S. A review on the history of tympanoplasty. *Ind J Otolaryngol Head Neck Surg* 2013; 65(Suppl-3): 455-460.
2. Wullstein H. The restoration of the function of the middle ear, in chronic otitis media. *Ann Otol Rhinol Laryngol* 1956; 65(4): 1021-1041.
3. Pollak N. Endoscopic and minimally-invasive ear surgery: A path to better outcomes. *World J Otorhinolaryngol Head Neck Surg* 2017; 3(3): 129-135.
4. Yamamoto E, Iwanaga M, Fukumoto M. *Otolaryngol Head Neck Surg* 1988; 98(6): 546-551.
5. Hamed M, Samir M, El Bigermy M. *Auris Nasus Larynx* 1999; 26(3): 257-262.
6. SHEA JJ. A comparison of endoscopic and microscopic techniques for the repair of tympanic membrane perforations. *Laryngol Otol* 1960; 74(1): 358-362.
7. Ahmed LA, Raza SS. Tympanoplasty type-1. Endaural or postaural approach. Should the patient decide? *Saudi Med J* 2006; 27(12): 1847-1849.
8. Tarabichi M. Endoscopic middle ear surgery. *Ann Otol Rhinol Laryngol* 1999; 108(1): 39-46.
9. El-Sheikh MM. Evaluation of hearing outcome of tympanoplasty using cartilage graft versus temporalis fascia graft. *Egypt J Otolaryngol* 2019; 35(2):1-5.
10. Özdemir D, Özgür A, Akgül G, Çelebi M, Mehel DM, Yemiş T. Outcomes of endoscopic transcanal type 1 cartilage tympanoplasty. *Eur Arch Otorhinolaryngol* 2019; 276(12): 3295-3299.
11. Choi N, Noh Y, Park W. Comparison of endoscopic tympanoplasty to microscopic tympanoplasty. *Clin Exp Otorhinolaryngol* 2017; 10(1): 44-49.
12. Qureshi N, Baig M, Parvez M, Masood S, Afzal M. Comparison of endoscopic tympanoplasty with microscopic tympanoplasty. *J Rawalpindi Med Coll* 2020; 24(4): 400-405.
13. Kuo CH. Comparison of endoscopic and microscopic tympanoplasty. *Eur Arch Otorhinolaryngol* 2017; 274(7): 2727-2732.
14. Lade H, Choudhary SR, Vashishth A. Endoscopic vs microscopic myringoplasty: a different perspective. *Eur Arch Otorhinolaryngol* 2014; 271(7): 1897-1902.
15. Kaya I, Turhal G, Ozturk A, Gode S, Bilgen C, Kirazli T. Results of endoscopic cartilage tympanoplasty procedure with limited tympanomeatal flap incision. *Acta Otolaryngol* 2017; 137(11): 1174-1177.
16. Varshney S, Nangia A, Bist SS, Singh RK, Gupta N, Bhagat S. Ossicular chain status in chronic suppurative otitis media in adults. *Ind J Otolaryngol Head Neck Surg* 2010; 62(4): 421-426.
17. Marchioni D, Rubini A, Soloperto D. Endoscopic ear surgery: re-defining middle ear anatomy and physiology. *Otolaryngo I Clin North Am* 2021; 54(1): 25-43.
18. Tarabichi M, Ayache S, Nogueira JF, Al Qahtani M, Pothier DD. Endoscopic management of chronic otitis media and tympanoplasty. *Otolaryngol Clin North Am* 2013; 46(2): 155-163.