



Comparison Between Hearing Outcome of Medial Versus Lateral Grafting of Tympanic Membrane to Handle of Malleus After Tympanoplasty

Nishikanta Pradhan¹, Dr. Swatee Dash¹, Dr. Sandesh Karki², Dr. Arnav Bharatendu Kapoor², Dr Ananya Patra², Shubham Agrawal², Dr Amit Pradhan³, Dr Kabikanta Samantaray⁴

1. Assistant Professor, Department of ENT, Kalinga Institute of Medical Sciences, Bhubaneswar, India.

2. Junior Resident, Department of ENT, Kalinga Institute of Medical Sciences, Bhubaneswar, India.

3. Professor, Department of Anaesthesiology, Kalinga Institute of Medical Sciences, Bhubaneswar, India.

4. Professor, Department of ENT, Kalinga Institute of Medical Sciences, Bhubaneswar, India.

*Corresponding author's E-mail: shubham.271193@gmail.com

Received: 10-05-2023; Revised: 20-07-2023; Accepted: 26-07-2023; Published on: 15-08-2023.

ABSTRACT

Introduction: A surgical procedure called tympanoplasty can be used to treat middle ear infections and enhance ear function. Repairing the perforated tympanic membrane, which is mostly caused by chronic otitis media, is a key component of tympanoplasty. Currently, underlay and overlay techniques, two traditional tympanoplasty approaches, are used. In the more popular underlay technique, the graft is positioned medial to the malleus and tympanic remnant. A few studies have compared the hearing outcome of medial or lateral position of graft with respect to handle of malleus.

Aims/ objective: To evaluate and compare hearing outcome of medial versus lateral grafting of tympanic membrane to handle of malleus after tympanoplasty.

Materials and Method: Type 1 underlay tympanoplasty was performed on the enrolled patients through post-aural approach under local anaesthesia with the help of temporalis fascia graft. Then, grafting was done medial to handle of malleus in 34 patients of group M and lateral to handle of malleus in 33 patients of group L. Detailed history of presenting complains and past history, otoscopic and microscopic examinations were collected from the patients. The patients were followed up at 4th week, 6th week and 12th week after surgery for evaluation of graft uptake. Hearing outcome was assessed at 6th week and 12th week after surgery with the help of pure tone audiometry.

Results: Air bone gap decreased significantly in both groups ($p < 0.0001$). Patients in which graft was placed medial to handle of malleus had significantly better outcome with respect to audiometry as compared to patients with lateral placement of grafts ($p < 0.05$). 94.12% of patients with grafts placed medially with respect to handle of malleus had successful graft uptake as compared with 87.88% of patients with lateral placement of graft. Most of the patients were having perforation of medium size in posterior quadrant.

Conclusion: Both the techniques of tympanoplasty were found to be effective with respect to improvement in audiometry and symptoms. 9 out of 10 patients achieved successful graft uptake. Audiometry outcomes and graft uptake were slightly better in patients who had medial grafting of tympanic membrane with respect to handle of malleus after tympanoplasty.

Keywords: Tympanoplasty, Medial Grafting, Lateral Grafting, Handle of Malleus, Hearing Outcome, Audiometry, Graft Uptake.

INTRODUCTION

A surgical procedure called tympanoplasty can be used to treat middle ear infections and enhance ear function. Repairing the perforated tympanic membrane, which is mostly caused by chronic otitis media, is a key component of tympanoplasty. The tympanic membrane may have traumatic or malignant abnormalities as additional aetiologies.¹ The most frequent postoperative reason for perforation of tympanic membrane is known to be the placement of a ventilation tube.²⁻⁴

There are about 120 million patients with chronic otitis media worldwide, and the overall incidence of chronic otitis media varies between 0.5 and 30% depending on the geographical location. Surgery is the mainstay of treatment of chronic otitis media since it helps to cure the condition, reduce recurrence, and keep or enhance hearing.⁵

Middle ear exposure is caused by a tympanic membrane abnormality known as perforation of tympanic membrane. The most frequent cause of it is chronic otitis media. Other reasons include surgery such the installation of a ventilation tube, trauma, and active inflammation of middle ear. A persistent malformation of the pars tensa or flaccida, probably brought on by a previous episode of acute otitis media, low middle ear pressure, or effusion associated with otitis media, is referred to as chronic otitis media. It is thought that childhood acute otitis media or otitis media with effusion serve as the catalyst for the onset of chronic otitis media. The tympanic membrane may undergo long-term alterations as a consequence of either of above.⁶

Since Zollner and Wullstein's introduction of the modern tympanoplasty in the 1950s, various procedures have been developed to repair the tympanic membrane.^{1,7-9} The first medial placement for grafting tissue to the malleus and



tympanic membrane residue was invented by Tabb and Shea.^{7,10-12}

Tympanoplasty can be performed in a number of ways: transcanally, postauricularly, and endaurally. The ear canal dimensions, the place and extent of the perforations, and the expertise of the surgeon all affect their method of surgery. In circumstances where the ear canal is spacious, little posterior perforations can be treated through transcanal technique. Large perforations should be treated by a postauricular technique, especially if the ear canal is narrow.¹³

A perfect tympanoplasty reconstructs the oval window's sound pressure transformation process and provides sound protection of the round window via constructing an enclosed air-containing middle ear. Poor medical condition, cancers of the outer part of middle ear, infection like malignant otitis externa, and adverse consequences of chronic ear illness including meningitis or cerebral abscess are definitive contraindications for tympanoplasty surgery.¹³ In order to prevent the possibility of permanent sensorineural hearing loss, this surgery is not recommended in the patients with only one functioning ear. Before performing tympanoplasty, any acute episodes of active chronic otitis media or infection of outer ear should also be under control. A dysfunctional eustachian tube is an apparent contraindication to tympanoplasty surgery.¹³

Currently, underlay and overlay techniques, two traditional tympanoplasty approaches, are used. In the more popular underlay technique, the graft is positioned medial to the malleus and tympanic remnant. In the overlay approach, the graft is placed lateral to the annulus and fibrotic layer of tympanic membrane remnant after the squamous tissue has been elevated. In general, the underlay method is preferred for posterior perforation of tympanic membrane. Even if performed by a less skilled surgeon, underlay technique has a higher tolerable success rate and reduced risk of graft rejection.¹⁴

Following tympanoplasty, graft acceptance and hearing results are influenced by a variety of circumstances. Eustachian tube disorders, prior tympanoplasty malfunction, tobacco use, and the existence of cholesteatoma are a few of the bad factors for prognosis. In spite of this, more than 90% of grafts are successfully implanted.

This study was done to evaluate and compare hearing outcome of medial versus lateral grafting of tympanic membrane to handle of malleus after tympanoplasty in tertiary care hospital of eastern India.

MATERIALS AND METHODS

This was an observational and prospective study conducted in the Department of ENT of tertiary care hospital of eastern India on patients who had been planned for type 1 underlay tympanoplasty from January 2022 to June 2023. The study was approved from

Institutional Ethics Committee and was conducted according to principles of Good Clinical Practice and Declaration of Helsinki. Participant Information sheet was provided and explained to all eligible patients to be enrolled and written informed consent was taken from them.

Consecutive sampling method was used and each odd numbered patient fulfilling our eligibility criteria was enrolled in group M in which graft was placed medial to handle of malleus and each even numbered patients fulfilling our eligibility criteria enrolled in group L where graft was placed lateral to the handle of malleus.

Inclusion Criteria

Patients with diagnosis of inactive chronic otitis media or tubo-tympanic disease, patients of age between 18 years to 60 years, patients with pure conductive hearing loss in audiometry, patients with bone and air conduction less than 20 dB

Exclusion Criteria

Patients in which ossiculoplasty was planned, patients having history previous ear surgery, patients with diagnosis of active chronic otitis media or attico-antral disease, patients with diagnosis of mixed hearing loss, patients with compromised immune status or auto-immune disease.

Total 67 patients met our eligibility criteria during the study period and 34 patients were enrolled in group M and 33 patients in group L.

Information regarding baseline demographic and clinical characteristics, detailed history of presenting complains and past history, otoscopic and microscopic examinations were collected from the patients. Type and degree of hearing loss was evaluated using pure tone audiometry with the help of Madsen Astera 2 audiometer.

Type 1 underlay tympanoplasty was performed on the enrolled patients through post-aural approach under local anaesthesia with the help of temporalis fascia graft. Then, grafting was done medial to handle of malleus in patients of group M and lateral to handle of malleus in group L.

The patients were followed up at 4th week, 6th week and 12th week after surgery for evaluation of graft uptake. Hearing outcome was assessed at 6th week and 12th week after surgery with the help of pure tone audiometry.

Statistical analysis

Data collected from patients in group M and L were presented in tubular form in separate sheets of Microsoft Excels. Incidence and frequency of baseline parameters and outcomes were represented as number and percentage and statistical significance of difference between group M and L was evaluated using chi-square or fisher's exact test. Air bone gap was represented as mean \pm standard deviation (SD) and unpaired t-test was used to evaluate statistical significance of difference between



group M and L with p-value less than 0.05 denoting statistical significance.

RESULTS

A total of 67 patients underwent type 1 underlay tympanoplasty. Out of these, the graft was placed medial to handle of malleus in 34 patients and lateral to head of malleus in 33 patients. Baseline demographic and clinical characteristics of these patients in group M & L is given in table 1.

Table 1: Comparison of baseline demographic and clinical characteristics of patients in group M & L

| Parameters | Group M n = 34 | Group L n = 33 | P-Value |
|--|-------------------|-------------------|---------|
| Age in Years (mean ± SD) | 26.87 ± 7.35 | 26.32 ± 6.89 | 0.75* |
| Sex, n (%) | | | |
| Male | 18 (52.94) | 16 (48.48) | 0.81** |
| Female | 16 (47.06) | 17 (51.52) | |
| Size of perforation, n (%) | | | |
| Large | 12 (35.29) | 10 (30.3) | 0.82*** |
| Medium | 17 (50) | 19 (57.58) | |
| Small | 5 (14.71) | 4 (12.12) | |
| Quadrant Involved, n (%) | | | |
| Anterior | 7 (20.59) | 9 (27.27) | 0.75*** |
| Posterior | 15 (44.12) | 12 (36.36) | |
| Both | 12 (35.29) | 12 (36.36) | |
| Complain of Decreased Hearing, n (%) | | | |
| Yes | 27 (79.41) | 28 (84.85) | 0.75** |
| No | 7 (20.59) | 5 (15.15) | |
| * Unpaired t test **Fisher’s exact test ***Chi-square test | | | |

There was no statistically significance difference between group M and L with respect to age, gender, size and quadrant of perforation and symptoms (p>0.05). Most of the patients were of age group 21-30 years. Male and female were almost equal in proportion in both groups. Most of the patients were having perforation of medium size in posterior quadrant. All the 67 patients included in our study reported with complain of ear discharge and nearly 80% of patients had complain of decreased hearing.

Air bone gap decreased significantly in both groups (p<0.0001). Patients in which graph was placed medial to handle of malleus had significantly better outcome with respect to audiometry as compared to patients with lateral placement of grafts (p<0.05).

Table 2: Comparison of audiometry at before and after 3 months of surgery between two groups

| | Group M n = 34 | Group L n = 33 | P-Value* (Between Groups) |
|--|-------------------|-------------------|------------------------------|
| Air-bone gap in dB before surgery (mean ± SD) | 24.33 ± 3.95 | 24.91 ± 4.03 | 0.55 |
| Air-bone gap in dB after 3 months of surgery (mean ± SD) | 8.32 ± 1.86 | 10.04 ± 2.12 | 0.0008 |
| P- Value** (Before and after surgery) | <0.0001 | <0.0001 | |
| *Unpaired t test **Paired t test | | | |

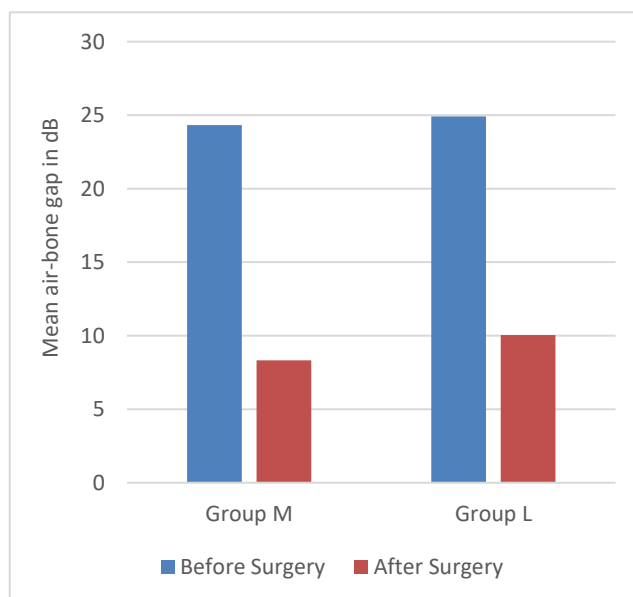


Figure 1: Comparison of Air-Bone Gap between Two Groups

Table 3: Comparison of graft uptake between group M and L

| | Group M n = 34 | Group L n = 33 | P-Value (Fisher’s Exact Test) |
|--------------------------------|-------------------|-------------------|----------------------------------|
| Successful graft uptake, n (%) | 32 (94.12) | 29 (87.88) | 0.43 |
| Residual perforation, n (%) | 2 (5.88) | 4 (12.12) | |

94.12% of patients with grafts placed medially with respect to handle of malleus had successful graft uptake as compared with 87.88% of patients with lateral placement of graft.



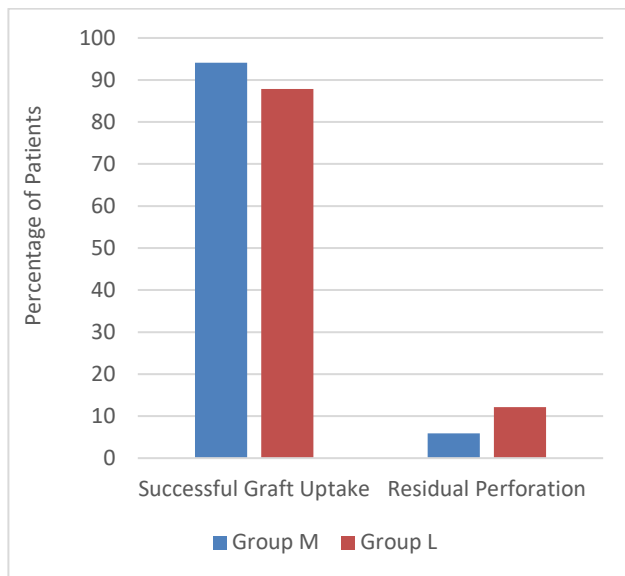


Figure 2: Comparison of Graft Uptake between Two Groups

DISCUSSION

Tympanoplasty procedures have been used in a variety of contexts and research, with varying degrees of effectiveness. The fact that rate of successful graft uptake among various research vary and that subsequent follow-up periods range from three to twenty-one months is responsible for this.

In the more popular underlay approach, the graft is placed medial to the malleus and remnant of tympanic membrane. This observational and prospective study compared the two grafting techniques of tympanic membrane by grafting medially or laterally to the handle of malleus. The graft edge was positioned medial to the annulus and tympanic membrane residues in both techniques. These can be considered in fact two types of underlay techniques.

In this study, there were no significant differences between the success rates of the two groups. Overall, there were 91.04% successful graft uptake. The medially grafted group had a success rate of 94.12% (with two perforations), while the lateral grafted group had a success rate of 87.88% (with four perforations).

Air-bone gap improvement was 16.01 in the group receiving medial to handle of malleus grafting and 14.87 in the group receiving lateral to handle of malleus grafting. Patients in which graph was placed medial to handle of malleus had significantly better outcome with respect to audiometry as compared to patients with lateral placement of grafts ($p < 0.05$).

Tympanoplasty was performed on 104 patients in retrospective research in Turkey, using the underlay approach in 46 cases and the over-under method in 58 cases. The average number of monitoring was eleven months. The rate of successful graft uptake was 91.5% in the first category of patients using the underlay approach

(the graft was positioned medial to the residual drum and the manubrium). The rate of successful graft uptake was 94.9% in the second group using the over-under approach (the graft was positioned under the remainder of the tympanic membrane and above the malleus). The air-bone gap reduced to 16.55 db in the individuals who underwent the underlay procedure. In cases operated using the over-under technique, the reduction was 16.96 db.¹⁵

A different study at the Michigan Ear Institute used the over-under tympanoplasty procedure, which involves inserting the graft above the malleus beneath the annulus. With 120 patients, every graft was effective. The grafted tympanic membrane did not laterally expand. Twelve patients experienced late perforations, and 17 patients had delayed atelectasis. Almost every one of these side effects were discovered more than twelve months after procedure and were ascribed to ongoing infections or failure of the Eustachian tube. All audiometry outcome of all patients enhanced averagely by 5.3 dB, while their verbal reception thresholds enhanced on average by 5.9 db.¹⁴

Fiorino conducted 78 umbus-anchored over-under myringoplasties for different research in Italy. The two tongues were placed to encircle the umbus area and crossover beneath a non-perforated section of the tympanic membrane. They employed a big graft with a circumferential slit stretched under the tympanic membrane and annulus. In 91 percent of the instances, successful graft uptake was achieved, and the auditory outcome revealed a mean air-bone gap of 6.7 dB after surgery.¹⁶

Ryan's research involving 147 patients found that the overlay graft approach had a 98.75% successful graft uptake for tympanoplasty, despite challenging instances.¹⁷

According to Jung's research, a big anterior or subtotal perforation of tympanic membrane can be repaired using a medial graft tympanoplasty, whereas a substantial anterior perforation can be repaired using a medio-lateral graft technique.¹⁸

Based on the results of our investigation, all procedures had satisfactory short-term results, however patients who had grafts put medial to the handle of malleus had superior outcomes. The effectiveness of surgery appears to depend more on the surgeon's ability to execute any procedure well than it does on the specific technique used. It's also important to note that none of these procedures have any firm indicators.

In our investigation, confounding variables included the size and position of the perforation of tympanic membrane, as well as the condition of the Eustachian tube. Although this study only looked at short-term consequences of two tympanoplasty techniques, extensive follow-up is required to determine any lasting consequences or problems, such as atelectasis, retraction pockets, or residual perforations. Extended follow-up and

more precise localization of the perforated site in future research may indicate certain preferences for each approach.

CONCLUSION

Both the techniques of tympanoplasty were found to be effective with respect to improvement in audiometry and symptoms. 9 out of 10 patients achieved successful graft uptake. Audiometry outcomes and graft uptake were slightly better in patients who had medial grafting of tympanic membrane with respect to handle of malleus after tympanoplasty. There are no definitive recommendations for any of these procedures, but the surgeon's use of the approach is a key role in the successful graft uptake. Extended follow-up and more accurate localization of the perforation site in future research may indicate certain preferences for each approach.

REFERENCES

1. Merchant SN, Rosowski JJ, Shelton C. Reconstruction of the middle ear. In: Snow JB, Wackym PA, Ballenger JJ, editors. Ballenger's otorhinolaryngology head and neck surgery. United States: People's Medical Publishing House; 2009. pp. 239–45.
2. Hydén D. Ear drum perforations in children after ventilation tube treatment. *Int J Pediatr Otorhinolaryngol.* 1994;29:93–100.
3. Pribitkin EA, Handler SD, Tom LW, Potsic WP, Wetmore RF. Ventilation tube removal. Indications for paper patch myringoplasty. *Arch Otolaryngol Head Neck Surg.* 1992;118:495–7.
4. Te GO, Rizer FM, Schuring AG. Pediatric tympanoplasty of iatrogenic perforations from ventilation tube therapy. *Am J Otol.* 1998;19:301–5.
5. Merchant SN. Ossiculoplasty and tympanoplasty in chronic otitis media. In: Nadol JB, McKenna MJ, editors. *Surgery of the Ear and Temporal Bone.* 2nd ed. USA: Lippincott Williams and Wilkins; 2005. pp. 306–25.
6. Schilder AG. Assessment of complications of the condition and of the treatment of otitis media with effusion. *Int J Pediatr Otorhinolaryngol* 1999;49 Suppl 1:S247-51.
7. Spiros M. Closure of tympanic membrane perforation. In: Glasscock MA, Gulya AJ, editors. *Glasscock-Shambough surgery of the ear.* Ontario: BC Decker Incorporation; 2003. pp. 400–22.
8. Zollner F. Panel of myringoplasty. Second workshop on reconstructive middle ear surgery. *Arch Otol.* 1963;78:301.
9. Heermann H. Tympanic membrane plastic with temporal fascia. *Hals-Nasen-Ohrenh.* 1960;9:136.
10. Shea JJ, Jr. Vein graft closure of eardrum perforations. *J Laryngol Otol.* 1960;74:358–62.
11. Tabb HG. Closure of perforations of the tympanic membrane by vein grafts. A preliminary report of twenty cases. *Laryngoscope.* 1960;70:271–86.
12. Tabb HG. Experience with transcanal and postauricular myringoplasty. *Trans Pac Coast Otoophthalmol Soc Annu Meet.* 1968;52:121–5.
13. Glasscock ME 3rd. Symposium: Contraindications to tympanoplasty. II. An exercise in clinical judgment. *Laryngoscope* 1976;86:70-6.
14. Kartush JM, Michaelides EM, Becvarovski Z, LaRouere MJ. Over-under tympanoplasty. *Laryngoscope.* 2002;112:802–7.
15. Yigit O, Alkan S, Topuz E, Uslu B, Unsal O, Dadas B. Short-term evaluation of over-under myringoplasty technique. *Eur Arch Otorhinolaryngol.* 2005;262:400–3.
16. Fiorino F, Barbieri F. 'Over-under' myringoplasty with umbus-anchored graft. *J Laryngol Otol.* 2008;122:854–7.
17. Ryan JE, Briggs RJ. Outcomes of the overlay graft technique in tympanoplasty. *ANZ J Surg.* 2010;80:624–9.
18. Jung T, Kim YH, Kim YH, Park SK, Martin D. Medial or medio-lateral graft tympanoplasty for repair of tympanic membrane perforation. *Int J Pediatr Otorhinolaryngol.* 2009;73:941–3.

Source of Support: The author(s) received no financial support for the research, authorship, and/or publication of this article.

Conflict of Interest: The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

For any questions related to this article, please reach us at: globalresearchonline@rediffmail.com

New manuscripts for publication can be submitted at: submit@globalresearchonline.net and submit_ijpsrr@rediffmail.com

