

Evaluation Of Results Of Endoscopic Type-I Interlay Tympanoplasty

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Abstract:

Background: The tympanic membrane is a thin, semi-transparent structure that separates the external auditory canal from the middle ear. A perforation of the tympanic membrane occurs when the eardrum ruptures, creating an opening between the external and middle ear. Type I tympanoplasty is the most commonly performed ear surgery after myringotomy. To enhance surgical outcomes, otologists have developed various tympanoplasty techniques, including the underlay, overlay, and interlay methods. Among these methods, the interlay approach has demonstrated promising success rates exceeding 90%. Hence, the present study was designed to study the outcome of graft uptake after endoscopic type I interlay tympanoplasty and to assess the hearing status of patients before and after the surgery.

Materials and Methods: In this hospital-based cohort study, patients with pure conductive hearing loss and dry central perforation, belonging to age group of 18 years or more were evaluated from May 2023 to April 2025. Sociodemographic profile, pre-operative and post-operative details were recorded as per the pre-validated proforma. Statistical analysis was done using IBM-SPSS version 23 for Windows (IBM Corp. 1995, 2012). A p-value of <0.05 was considered significant.

Results: Thirty-Two (32) patients with mean age of 41.93 ± 10.71 years were included in our study. The pre-operative Pure Tone Audiometry (PTA) threshold of 45.93 ± 2.68 dB, improved to 27.15 ± 4.84 dB at 6-weeks post-operatively, further decreasing to 24.93 ± 5.52 dB at 3-months, and reaching 22.81 ± 5.78 dB at the 6-month follow-up. The p-value for each follow-up interval was less than 0.001. The pre-operative Air-Bone Gap (ABG) was 31.28 ± 2.51 , which decreased to 10.87 ± 4.24 at 6-weeks, 9.21 ± 3.81 at 3-months, and 7.65 ± 3.01 at 6-months post-operatively. The p-value was less than 0.05. Graft uptake rate was seen in 31 out of 32 patients (96.9%).

Conclusion: Interlay Type I tympanoplasty stands out as a highly effective and reliable surgical technique for tympanic membrane repair. It not only demonstrates a high graft acceptance rate but also significantly improves auditory function by reducing the air-bone gap and enhancing pure tone average gain. It proves to be a valuable approach for achieving long-term auditory rehabilitation.

Key Word: Interlay Type I tympanoplasty, Pure Tone Audiometry, Air-Bone Gap, Tympanic Membrane Perforation, Mucoasal Chornic Otitis Media

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I. Introduction

The tympanic membrane is a thin, semi-transparent structure that separates the external auditory canal from the middle ear.¹ It is essential for sound transmission, as it vibrates in response to sound waves, which are then transferred to the ossicular chain in the middle ear.² A perforation of the tympanic membrane occurs when the eardrum ruptures, creating an opening between the external and middle ear. Type I tympanoplasty is the most commonly performed ear surgery after myringotomy.³ This surgical technique repairs tympanic membrane perforations when no other middle ear lesions are present. To enhance surgical outcomes, otologists have developed various tympanoplasty techniques, including the underlay, overlay, and interlay methods. Each method has its own benefits and limitations, primarily based on graft placement in the tympanic membrane remnant. Among these methods, the interlay approach has demonstrated promising success rates exceeding 90%. Interlay method also allows for easier and faster graft placement, preserves the middle ear space, provides a larger graft bed, and facilitates faster healing. Additionally, it reduces the risks of graft medialization or lateralization, anterior meatal recess blunting, and residual epithelium.⁴ Hence, the present study was designed

to study the outcome of graft uptake after endoscopic type 1 interlay tympanoplasty and to assess the hearing status of patients before and after the surgery.

II. Material And Methods

This was a hospital-based cohort study carried out at Department of General Medicine at Regional Institute of Medical Sciences (RIMS), Imphal, Manipur from May 2023 to April 2025. A total 32 patients with tympanic membrane perforation irrespective of the causes of perforation and genders, who were aged ≥ 18 , years were evaluated in this study. Patients who had Marginal perforation, ossicular dysfunction and patients having complications of CSOM and active local and focal infection were excluded from the study.

Procedure methodology:

The study was carried out after getting clearance from the research ethics board. Informed written consent was taken from all the consenting patients. Data was collected by using a proforma. All the patients underwent routine ENT evaluation in addition to general medical examinations, ear findings were noted with emphasis on size, site and margin of perforation, state of drum, remnants, state of middle ear mucosa, presence or absence of ear discharge and tuning fork tests and pure tone audiogram (PTA). After the surgery the patients were follow up at 1 week for stitch removal, at 2 weeks for inner pack removal, at 6 weeks for pure tone audiogram (PTA) and otoscopic examination, at 3 months for pure tone audiogram (PTA) and otoscopic examination, again at 6 months patients were called to check hearing improvement and the condition of the graft.

Statistical analysis:

Data was checked for consistency and completeness and then entered in IBM SPSS version 23 for Windows (IBM Corp. 1995, 2012). The data was analyzed and summarized using descriptive statistics like percentages, mean and standard deviation. Paired t-test was used to test the association of pre and post operative PTA and ABG. A probability value of <0.05 was considered as significant.

III. Result

In this study, thirty-two (32) patients with pure conductive hearing loss and dry central perforation who fulfilled the inclusion and exclusion criteria were evaluated. The age of the respondents ranged from 26 years to 62 years, with mean age of 41.93 ± 10.71 years. Almost one third (31.3%) were in the age group of 31 to 40 years of age, followed by 41-50 and >50 years age group, age group of 20-30 years constituted 18.8% of the participants (Figure 1). Both genders, i.e males and females were equally distributed, i.e 50% each for both genders (Figure 2).

The degree of hearing loss reduced gradually from pre-operative Pure Tone Audiometry (PTA) threshold 45.93 ± 2.68 dB to 27.15 ± 4.84 at 6 weeks post-operative, 24.93 ± 5.52 at 3 months post-operative and 22.81 ± 5.78 at 6 months post-operative follow-up. The p-value for each follow-up interval was less than 0.001, indicating a statistically significant improvement in hearing over time (Table 1). The Air Bone Gap (ABG) at 6 weeks, 3 months and 6 months post-operative period reduced from 31.28 ± 2.51 pre-operatively to 10.87 ± 4.24 at 6 weeks post-operatively, 9.21 ± 3.81 at 3 months post-operatively and 7.65 ± 3.01 at 6 months post-operatively. The p-value was less than 0.05 at each follow-up interval, indicating a statistically significant improvement in auditory function over time (Table 2). The graft uptake rate was 96.9% implying thereby that successful uptake was observed in 31 out of the 32 patients, with graft uptake failure being present in only 1 patient (3.1%) (Figure 3).

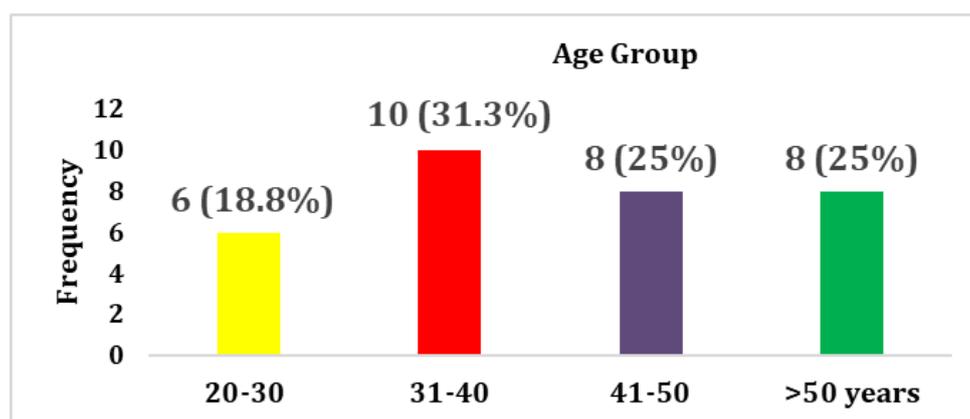


Figure 1. Distribution of participants according to Age Group (N=32)

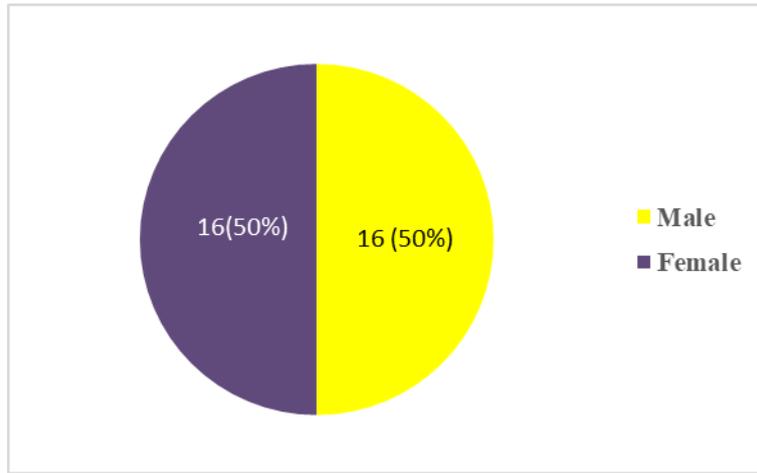


Figure 2. Distribution of participants according to Gender (N=32)

Table 1. Table showing mean difference of PTA pre-operatively and at 6 weeks, 3 months and 6 months post operative follow up (N=32)

PTA (dB)	Mean±SD	P-Value*
Pre-operative	45.93±2.68	
6 weeks post-operative follow up	27.15±4.84	<0.001
3 months post-operative follow up	24.93±5.52	<0.001
6 months post-operative follow up	22.81±5.78	<0.001

*Paired t-test

Table 2. Table showing mean difference of ABG pre-operatively and at 6 weeks, 3 months and 6 months post operative follow up (N=32)

ABG (dB)	Mean±SD	P Value
Pre-operative	31.28±2.51	
6 weeks post-operative follow up	10.87±4.24	<0.05
3 months post-operative follow up	9.21±3.81	<0.05
6 months post-operative follow up	7.65±3.01	<0.05

*Paired t-test

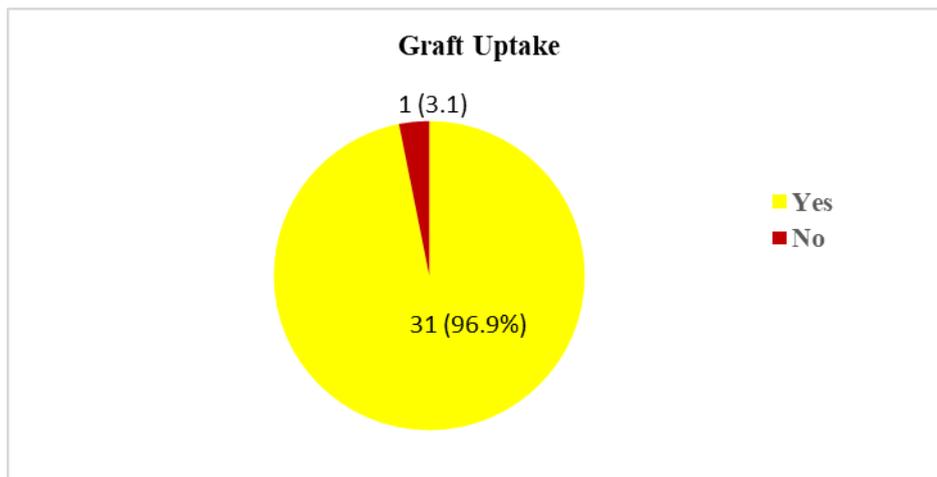


Figure 3. Distribution of participants according to Graft uptake (N=32)

IV. Discussion

The present study was designed to study the outcome of graft uptake after endoscopic type 1 interlay tympanoplasty and to assess the hearing status of patients before and after the surgery.

This study evaluated 32 patients with pure conductive hearing loss and dry central perforation in the Department of Otorhinolaryngology at the Regional Institute of Medical Sciences, Imphal, who met the inclusion and exclusion criteria. The participants' ages ranged from 26 to 62 years, with a mean age of 41.93 ± 10.71 years. The largest proportion (31.3%) belonged to the 31-40 years age group, followed by those in the 41-50 and above 50 years categories. Participants aged 20-30 years made up 18.8% of the study population. Consistent with our findings, Jain et al,⁵ reported that the majority of their patients were in the 21-30 years age group (37.2%), followed by the 31-40 years group (29.4%). Similarly, Suvaries PM et al,⁶ found that most of their participants (58.3%) belonged to the 31-45 years age group. The age group between 20-40 years is particularly vulnerable to tympanic membrane perforation due to a combination of infections, exposure to trauma, occupational and recreational risks like exposure to loud noises, invasive ear cleaning practices etc.

In this study, we observed a significant reduction in the degree of hearing loss following surgery. The pre-operative Pure Tone Audiometry (PTA) threshold, which was initially 45.93 ± 2.68 dB, improved to 27.15 ± 4.84 dB at six weeks post-operatively, further decreasing to 24.93 ± 5.52 dB at three months, and reaching 22.81 ± 5.78 dB at the six-month follow-up. The p-value for each follow-up interval was less than 0.001, indicating a statistically significant improvement in hearing over time. These findings were similar to studies done by an Indian study,⁷ where they also reported the pre-operative average hearing threshold to be 36.90 ± 6.92 dB and post-operative average hearing threshold at 3 and 6 months to be 28.33 ± 6.58 dB and 25.49 ± 8.69 dB, respectively. Cicek MM et al,⁸ also reported hearing threshold at pre-operative and post-operative was obtained as 34.3 ± 13.31 and 26.2 ± 14 dB, respectively.

In our study the pre-operative ABG was 31.28 ± 2.51 , which decreased to 10.87 ± 4.24 at six weeks, 9.21 ± 3.81 at three months, and 7.65 ± 3.01 at six months post-operatively. The p-value was less than 0.05 at each follow-up interval, indicating a statistically significant improvement in auditory function over time.

Our findings align with previous studies that have reported significant improvements in the Air-Bone Gap (ABG) following tympanoplasty. Patil BC et al,⁴ observed a pre-operative ABG of 36.42 ± 12.01 dB, which showed a marked reduction to 9.7 ± 6.71 dB at the final post-operative follow-up, demonstrating the effectiveness of surgical intervention. Similarly, a study conducted by Kumar G et al,⁹ reported a pre-operative ABG of 27.50 ± 5.53 dB, which improved to 13.67 ± 5.56 dB after surgery, indicating a substantial auditory gain. Additionally, Jain S et al,⁵ also documented a notable decrease in ABG, where the pre-operative value of 26.08 ± 8.32 dB reduced significantly to 10.12 ± 5.84 dB post-operatively. The reduction in the Air-Bone Gap (ABG) observed with the Interlay technique can be attributed to its enhanced conductive efficiency. Since the graft is positioned between two interlaying layers, it helps regulate frequency loss, resulting in improved sound conduction and a more significant reduction in ABG.

In this study, the graft uptake rate was 96.9% implying thereby that successful uptake was observed in 31 out of the 32 patients, with graft uptake failure being present in only 1 patient (3.1%). Our finding is in concordance with studies done by various authors. Kumanthem G et al,⁷ in their study of 34 patients who underwent composite cartilage tympanoplasty, reported that 33 i.e 97.1% patients had graft uptake, while only 1 (2.9%) had failure. Tyagi BS et al,¹⁰ also reported that where out of 55 cases, graft uptake was found in 52 (96.36%) and failure in 3 (3.64%) cases. In the study conducted by Chhapola S et al,¹¹ at 6 months after surgery, out of 61 patients, graft uptake was seen in 60 (98.36%) and failure in 1 (1.63%).

These findings collectively highlight the effectiveness of tympanoplasty in improving auditory function by substantially minimizing conductive hearing loss. The significant reduction in the Air-Bone Gap (ABG) observed across multiple studies demonstrates the procedure's ability to restore proper sound transmission through the middle ear.

Like any clinical study, this research has certain limitations. One major constraint is that all patients were selected from a single center, making it difficult to eliminate selection bias. Additionally, the sample size was relatively small, which may limit the generalizability of the findings. Another challenge was patient follow-up, as some participants did not return for post-operative evaluations. To draw more definitive conclusions, future studies should involve a larger, more diverse population with extended follow-up periods to ensure a more comprehensive assessment of surgical outcomes.

V. Conclusion

In conclusion, Interlay Type I tympanoplasty stands out as a highly effective and reliable surgical technique for tympanic membrane repair. It not only demonstrates a high graft acceptance rate but also significantly improves auditory function by reducing the air-bone gap and enhancing pure tone average gain. A key advantage of this technique is its ability to prevent graft displacement, as it remains well-supported between the fibro-squamous layer laterally and the mucosal layer medially. This stable anatomical positioning promotes

optimal graft integration, ensuring a more successful healing process and superior post-operative hearing outcomes. Given these benefits, Interlay tympanoplasty proves to be a valuable approach for achieving long-term auditory rehabilitation.

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